

BUREAU OF EDUCATION, INDIA

SCIENTIFIC MAN-POWER COMMITTEE

INTERIM REPORT

**Programme for the Immediate Improvement and
Expansion of Facilities for Scientific and Technical
Education, Research & Training.**



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PERSONNEL AND TERMS OF REFERENCE

The Scientific Man-power Committee was set up by the Government of India in April 1947 under the Chairmanship of the late Sir Shafaat Ahmed Khan as notified in a press communiqué issued on April 19, 1947. The present composition of the Committee is as shown below:

- Sir Shanti Swarup Bhatnagar, F.R.S.,
Director, Council of Scientific
and Industrial Research, Delhi. (Chairman).
- Dr. Homi Bhabha, F.R.S.,
Director, Tata Institute of Fundamental Research,
Peddar Road, Bombay.
- Dr. K. A. Hamed,
c/o CIPLA, Manufacturers of Chemical & Pharmaceutical Products,
289, Belassis Road, Byculla, Bombay.
- Mian Afzal Husain,
Member, Punjab & N. W. F. P., Joint Public Service Commission,
Lahore.
- Prof. Humayun Kabir,
Member, Railway Enquiry Committee,
Railway Board, New Delhi.
- Rai Bahadur A. N. Khosla, I.S.E.,
Chairman, Central Waterways, Irrigation and Navigation Commission,
New Delhi.
- Sir K. S. Krishnan, F.R.S.,
Director, National Physical Laboratories,
University Buildings, Delhi.
- Mr. G. L. Mehta,
7, Wellesley Place, Calcutta.
- Mrs. Hansa Mehta,
16, Altamont Road, Camballa Hill, Bombay.
- Major B. N. Mitra,
Defence Department, New Delhi.
- Professor J. N. Mukherji,
Director, Indian Agricultural Research Institute, Delhi.
- Dr. M. Qureshi,
Director, Board of Scientific & Industrial Research, Hyderabad
(Deccan).
- Rao Bahadur Dr. K. C. K. E. Raja,
Officer on Special Duty, Ministry of Health, New Delhi.
- Dr. Birbal Sahni, F.R.S.,
Professor of Botany & Dean of the Faculty of Science,
Lucknow University, Lucknow.
- Wing Commander H. Singh,
Technical Branch, Air Headquarters, New Delhi.
- Mr. D. N. Wadia,
Mineral Adviser to the Government of India,
Ministry of Works, Mines and Power, New Delhi.
- Dr. S. R. Sen Gupta,
Deputy Educational Adviser (Technical),
Ministry of Education, New Delhi (Secretary).

The following are the terms of reference of the Committee:—

(1) To assess the requirements for different grades of scientific and technical manpower, taking a comprehensive view over a period of the next ten years, of the needs of Government (Civil and Defence), of teaching and research and of industry, agriculture, transport, medicine and other fields dependent on the use of scientific and technical manpower;

(2) To make recommendations regarding action to be taken during the next five years to meet these requirements, in particular with reference to:—

(a) the immediate improvement and expansion of facilities for scientific and technical training in Indian universities and special institutions,

(b) training overseas in scientific and technical subjects;

(c) the promotion and development of scientific and technical research,

(d) the utilisation of scientific and technical manpower, and

(e) the maintenance of a register of scientific and technical personnel to facilitate their utilisation to the best advantage.

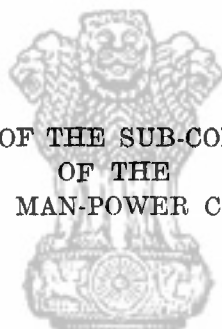
At its third meeting held on the 22nd and 23rd August, 1947, the Scientific Man-power Committee adopted the following report prepared by its sub-committee adumbrating measures for the immediate improvement and expansion of facilities for scientific and technical education, research and training.



सत्यमेव जयते

S. R. SEN GUPTA,
Secretary.
Scientific Man-Power Committee.

REPORT OF THE SUB-COMMITTEE
OF THE
SCIENTIFIC MAN-POWER COMMITTEE



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INTRODUCTION

At its explanatory meeting held on the 12th and 13th May 1947, the Scientific Man-power Committee came to the conclusion that the available data on which to base the Committee's work were inadequate and that a considerable amount of information, both qualitative and quantitative, required to be collected before the Committee could begin its work. They thought that the collection, sifting and collection of such data could be made speedily only if the Government placed at the disposal of the Committee 15 officers on special duty. The Government have been good enough to sanction ten posts but owing to certain administrative difficulties, arising mainly out of the present constitutional changes, it has not been possible to fill these posts, excepting one and that also only a few days back. Meanwhile, the health of the Chairman, the late Sir Shafaat Ahmed Khan, had deteriorated greatly and at his request, Sir Shanti Swarup Bhatnagar consented to act as the Chairman of the Committee.

Sir Shanti Swarup Bhatnagar has since been appointed Chairman in place of the late Sir Shafaat Ahmed Khan with effect from the 23rd July 1947.

On the 7th July, 1947, the acting Chairman was requested by the Government to let them have by the 5th of August, at the latest, an 'Interim Report' based on available information, however inadequate, recommending measures which should be given the highest priority and initiated within six months in order to meet, to some extent at least, the shortage of scientific and technical personnel—a shortage which is admitted on all hands.

In view of the urgency of the situation, Sir Shanti Swarup Bhatnagar agreed to undertake this work. A Sub-Committee consisting mainly of the local members of the Main Committee was constituted at the instance of the Government. The purpose of the Sub-Committee was to formulate certain interim recommendations, prompt action on which on the part of the Government could pave the way to meeting partially the scientific and technical manpower shortage. The Sub-Committee consisted of:—

Sir S. S. Bhatnagar, F.R.S. (Chairman).

Rai Bahadur A. N. Khosla.

Dr. J. N. Mukherjee.

Rao Bahadur Dr. K. C. K. E. Raja.

Dr. J. N. Ray.

Wing Comdr. H. Singh.

Mr. D. N. Wadia.

Dr. S. R. Sen Gupta. (Secretary).

and had before it the following terms of reference:—

To advise the Government of India on measures which should be given the highest priority and initiative within the next six months in respect of—

(a) the immediate improvement and expansion of facilities for scientific and technical training in Indian universities and in special institutions; and

(b) the promotion and development of scientific and technical research.

The Sub-Committee held its first meeting on the 16th July, 1947, and came to the conclusion that the best method of tackling the task before it would be for each member of the Committee to prepare a note on the subject or subjects with which he was concerned, suggesting what programme of training could be initiated within the next six months, taking due note of the existing facilities for education, training and research, with a view to improving and developing them and using them to their fullest extent. Thereafter, the Sub-Committee as a whole could consider the facts thus presented and formulate

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recommendations. The members accordingly prepared the following notes, which are given in Part II of the Report:—

Sir S. S. Bhatnagar—Training of personnel for scientific and industrial research and for industry.

Raj Bahadur A. N. Khosla—Programme for provision of facilities for education, training and research for engineering personnel which can be initiated within the next six months.

Dr. J. N. Mukherjee—Measures which can be implemented in the next six months for speeding up education, training and research in agriculture and allied subjects.

Rao Bahadur Dr. K. C. K. E. Raja—Training of health personnel.

Dr. J. N. Ray—Requirements of technical and scientific personnel for industrial development and their training programme.

Wing Comdr. H. Singh—R. I. A. F. training, research and development in collaboration with civil institutions.

Mr. D. N. Wadia—Programme for provision of facilities for education, training and research in Geology and Mining which can be initiated within the next six months.

Dr. S. R. Sen Gupta—Programme for the improvement and development of higher technical education.

These notes were considered by the Sub-Committee on July 25, 26, 28 and August 3, 1947, and the Sub-Committee's findings and recommendations are given in Chapter I. A brief summary of the Sub-Committee's recommendations is given in Chapter II.



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CHAPTER I

PROGRAMME FOR THE IMMEDIATE IMPROVEMENT AND EXPANSION OF FACILITIES FOR SCIENTIFIC AND TECHNICAL EDUCATION, RESEARCH AND TRAINING.

1. In order to maintain the closest possible relation between the terms of reference before us and our findings and recommendations, we have found it convenient to report under distinct main headings, *viz.*, Education, Research and Industrial Training. It should, however, be mentioned that the subjects are so interlinked and have such close bearing on each other that any hard and fast demarcation can neither be made nor is desirable. We also mention that owing to the limited amount of information available to us as well as our cognisance of the present scarcity of capital goods, building materials, etc. we have exercised considerable caution and restraint in formulating our recommendations.

SECTION I—EDUCATION

2. Although we did not have up-to-date statistics concerning the annual output of scientific and technical personnel from institutions, we had before us a certain amount of information, which is necessarily slightly out-of-date. We reproduce below the figures concerning the whole of British India for the year 1940.

Students passing the various examinations

Matriculation or its equivalent	92,552
Intermediate Arts	19,000
Intermediate Science	5,453
B.Sc. (Pass)	2,199
B.Sc. (Honours School)	359
M.Sc.	428
Medical Degree	875
Agricultural Degree	293
Engineering (Civil, Mechanical & Electrical, Mining and Metallurgy) Degrees	638
Doctorate (Arts, Science, Medicine) Degrees	38

These figures reveal the inadequacy of the 1940 output. We have no reason to suppose that conditions have changed to any great extent.

3. **Basic scientific education.**—A substantial increase in the facilities for education in general science up to Intermediate Science and B.Sc. standards is clearly an immediate necessity so that the output from these courses may be adequate, in quantity as well as in quality, to feed the professional and post-graduate institutions, which it will be necessary to improve, expand and multiply to meet India's immediate and future needs for scientists, technologists, engineers and medical men.

4. **Double Shift.**—We have considered in this connection, as an interim measure, the possibility of running double shifts in Colleges. While the double shift system would certainly help us to tide over the present difficulty of providing additional teaching accommodation and perhaps additional equipment, we cannot whole-heartedly support its adoption. We are given to understand that during the war the double shift system was given a trial in some places but was not altogether a success. Teaching should have sufficient leisure not only to prepare lectures, correct home work and laboratory record books, etc. but also to keep themselves up-to-date by reading current literature and latest

text books. Although educationally unsound, we, in view of the present emergency, recommend, only as an interim measure, the introduction of double shifts in such institutions where there is a certain amount of spare equipment, provided a completely new set of staff is engaged for lecture and laboratory work in the second shift. The Government should, wherever the introduction of the double shift system is considered feasible, come to the aid of the institutions if necessary by—

(a) bearing a share of the expenses on staff salaries and contingencies, and

(b) assisting the institutions in the procurement of equipment and building materials.

5. We note with regret that not much progress has been made in the establishment of Technical High Schools. We strongly urge the Provincial Governments, etc. to convert without delay some of their existing ordinary High Schools to Technical High Schools, and to simultaneously proceed with the early establishment of new Technical High Schools. We attach considerable importance to the establishment of a large number of institutions of this type. For, the products of these institutions are likely to be better fitted to take to scientific and technical occupations. As the establishment of such schools will reduce the total schooling period as preparation for professional courses by one year, it will also lead to an increase in the available material for admission to the professional and scientific institutions.

Higher Scientific Education.—While we are pleased to note that the Central Universities, *viz.*, Aligarh, Benares and Delhi, are being developed to provide wider facilities for higher scientific education, we feel at the same time that there is need for developing also the scientific departments of other universities, especially their post-graduate departments, so that an adequate number of scientific personnel with Honours and M.Sc. qualifications may be forthcoming for teaching posts, for service as specialists, for research and training in the National Laboratories and in industry; for example, each of the proposed Higher Technical Institutions is likely to require over 600 teachers and the National Laboratories would require more than 600 men with specialised qualifications. There is also the need for a large number of scientists to provide the expanded facilities for education in universities and other institutions. We, therefore, recommend that the Central Government should come to the aid of all universities by giving them suitable financial and other assistance to expand their post-graduate departments.

7. **Geological Education.**—In particular, we strongly support the recommendations of the Geological Education Committee and urge the Government to give effect to these recommendations immediately, so that trained geologists, adequate in number, say about 80 per year, for the teaching of geology and for the survey and development of the mineral resources of India, may become available; for example, the Geological Survey of India alone will require within the next two or three years 150 geologists.

8. In regard to the training of geologists, there is one special aspect which cannot be passed over. The education of a working geologist is different from that of any other scientist. A systematic field training forms an essential part of a geologist's education. This kind of instruction could hardly be provided by universities and colleges. We understand that the Geological Survey of India will soon have adequate staff to help educational institutions by opening field training camps to supplement the education of our geology-graduates. We recommend that the Geological Survey should increase the number of their field training camps in order to train at least 50 geologists annually for field work (For details see Mr. Wadia's Note).

9. **Engineering and Technological Education.**—In view of the uncertainty of the extent of development of Indian industries during the next few years and as

a consequence of the inadequacy of information available to us, we are unable to assess with reasonable exactitude the requirements for technical personnel during the next four or five years. In the absence of other data, the only way in which an approximate assessment can be made of our immediate requirements is to analyse the new capital flotation allowed by the Government and to infer from that India's requirements for technicians. The table below gives the position of new capital issues for some of the various industries since January, 1946. In the last column is shown the number of additional technical personnel that would be required for the successful running of these industries. The technical personnel have been divided into three categories:—

'A' = Experts.

'B' = Technicians with superior qualifications.

'C' = Lower grade technicians including mechanics.

Industries	New Capital issue allowed in 1946 (in lakhs)	Estimated requirement (Number in Grades)		
		'A'	'B'	'C'
	Rs.			
1. Glass and Ceramics	213	10	30	200
2. Chemicals & Drugs	570	20	100	250
3. Soap and oil (excluding edible= oils and Vanas-pati)	110	8	10	100
4. Rayon and Art silk	402	6	30	200
5. Paper, Board, etc.	281	10	50	150
6. Plastics	50	10	40	200
7. Leather	85	5	13	35
8. Cement	463	10	20	80
9. Woollen	137	10	36	100
10. Rubber	117	70	94	188
11. Engineering	1,242	25	150	1,000
12. Electrical	910	25	150	300
13. Non-Ferrous Metals	98	6	45	250
14. Machine= tools	122	100	400	1,000

10. It is worth noting that the new capital issue allowed since 1946 is about Rs. 47 crores whereas the total capital invested in organised industry up to the year 1937 has been estimated to be about Rs. 80 crores. It is, therefore, clear that since 1946 the capital issue for industry has increased by about 60%. We are informed that since the last Budget Session of the Central Legislature there has been a considerable falling off of application from industry to start new lines of manufacture and it is, therefore, not possible to foresee what would be the requirements of industry for technical personnel unless the precise industrial policy of the Central Government is definitely known. There is, however, every reason to believe that the tempo of capital investment in industry is likely to be faster in the near future provided the Government adopt a benevolent policy to foster the growth of industry.

11. The present (1946) output of graduates in engineering and technology is estimated to be as follows:—

Aeronautical Engineering	15
Architecture and Building construction	20
Civil and Municipal Engineering	467
Chemical Engineering and Chemical Technology	244
Electrical Engineering	285
Mechanical Engineering	258
Metallurgy	27
Mining	27
Total	1,343

12. From a comparative study of the figures for the present output with those for the immediate requirements of industry alone, leaving aside the requirements of Governments for their contemplated large-scale public works—we have come to the conclusion that we have to plan for at least a four-fold increase in the output of all categories of personnel, if we are to meet our needs for the next four or five years.

13. We have dealt with the question of training of 'A' grade technicians, i.e., experts, in subsequent sections dealing with Research and Training. In the matters of education in engineering and technology, we, therefore, recommend a short-term and a long-term programme both of which require to be initiated within six months.

14. **Short-term programme.**—Under the short-term programme, we recommend the adoption of the following five measures:—

I. Introduction of an intensive twelve month training programme in co-operation with industry.

II. Introduction of three-year degree course in engineering.

III. Introduction of double-shift system in engineering colleges.

IV. Use of science departments of university colleges for the instruction of engineering students in science subjects.

V. Employment of experts to assist in teaching.

VI. Improvement of salaries of teachers.

15. (I) We recommend the introduction of an intensive 12-month training programme for M.Sc.'s and graduates in chemical technology to be run on co-operative basis, between different universities and relevant industries. We feel that some of the existing institutions, if assisted with suitable grants, capital and recurring, should be able to impart short-term courses to the technological graduates, who can then be placed in appropriate factories for practical training for a further period of six months. For example, an ordinary M.Sc. graduate in applied chemistry can be trained in educational institutions in such subjects as oils and fats, paints and varnishes, etc., for a short period, say six months, to supplement his basic scientific training. This training programme can be shared by two or three institutions depending on the subject and the specialisation required; this academic training to be followed by practical training in a suitable factory for a period of six months or so. We consider that the following institutions are capable of organising such courses and recommend the grants noted against each:—

	Capital grant (in Rs. lakhs)	Recurring grant (in Rs. lakhs)
(1) Harcourt Butler Technological Institute, Cawnpore	5	1
(2) College of Technology, Hindu University, Benares	5	2
(3) Department of Applied Chemistry, Calcutta University	7	2
(4) Laxminarayan Technological Institute, Nagpur	3	0.8
(5) University College, Andhra University	3	0.5
(6) Indian Institute of Science, Bangalore	..	2
(7) Bengal Tanning Institute, Calcutta	1	0.5
(8) Institute of Leather Technology, Madras	1	0.5
(9) Engineering College, Guindy, Madras	2	0.75
(10) Department of Engineering and Technology, Annamalai University	1	0.5
(11) Department of Chemical Technology, Bombay University	1	0.5

	Central grant (in Rs. lakhs)	Recurring grant (in Rs. lakhs)
(12) Forest Research Institute, Dehra Dun	2	0.75
(13) College of Engineering and Technology, Jadav- pur	2	1
(14) Victoria Jubilee Technical Institute, Bombay	1	0.5
Total	34	13.3

This recommendation on being given effect to will help to a great extent in making good the present shortage of chemical technologists of grade B.

16. (II) At present, the courses in engineering extend over a period varying from three to four years. We have every reason to presume that with judicious selection for admission to engineering colleges, it should be possible to reduce the period of training to three years. We understand that the All-India Council for Technical Education have prepared a draft curriculum and syllabuses of studies which it should be possible to cover in three academic sessions of 1400 hours each as against the commonly prevailing four academic sessions of less than 1000 hours each. We, therefore, recommend that the universities should consider the introduction of three-year-degree courses in engineering. This would shorten the training period, and also largely help in the increase of the number of engineers.

17. (III) We have also considered the feasibility of introduction of double shifts in some of the colleges. We are given to understand that it was run with some success in the Thomason Engineering College, Roorkee during the war years. Elsewhere, in paragraph 4, we have stated the reasons for our reluctance to recommend the general introduction of double shift system. With the provisos stipulated therein we recommend that the universities may consider the introduction of double shift system, if conditions permit.

18. (IV) Wherever possible use should be made of the teaching facilities of the science departments of suitable colleges to assist in the education in basic sciences for engineering students.

19. (V) As an interim measure we recommend that engineers in Government service should be encouraged, where necessary, to assist in the instruction in engineering colleges. This would relieve the strain on college professors and will save them some of their time for training additional students, who too will derive more benefit from the latest ideas and knowledge and appreciation of the latest developments in the various engineering activities.

20. (VI) We understand that there is an acute shortage of teachers in most of the engineering colleges and this is mainly due to the inadequate salaries offered for teaching posts. We are definitely of the opinion that the pay and prospects of a teacher should correspond to those that would be open to him had he joined a technical department under the Government.

21. **Long-term programme.**—As long-term measures which have to be initiated right now if they are to bear fruit within the next four or five years, we recommend the following:—

I. Establishment of Regional Committees of the, All-India Council for Technical Education.

II. Improvement and expansion of the existing colleges of engineering and technology.

III. Expansion of the Delhi Polytechnic, especially its departments of Architecture and Engineering.

IV. Equipping of all institutions of engineering and technology, adequately.

V. Arranging for the early operation of the Power Engineering Department of the Indian Institute of Science.

VI. Expediting the establishment of the Regional (Eastern & Western) Higher Technical Institutions.

VII. Expansion of the Indian School of Mines, Dhanbad.

22. (I) We understand that in order to enable the All-India Council for Technical Education to tender judicious advice to the Government for the provision of facilities for technical education in every part of the country, adequate in relation to the possible industrial development of each region, the Council have decided to establish regional committees and that the formation of these committees has been delayed owing to the present constitutional changes. We strongly recommend that for ensuring co-ordinated development of technical education and generally to raise its standard, it is essential to establish the regional committees immediately.

23. (II) For the improvement of the standard of education as well as the expansion of some of the institutions of engineering and technology, so that the present facilities may be utilised to the fullest extent, the Government of India should immediately make grants to such institutions as are recommended by the All-India Council for Technical Education. We understand that the All-India Council for Technical Education will shortly submit specific recommendations for the improvement and expansion of the following institutions on the basis of reports of Expert Committees set up by them for this purpose.

(i) College of Engineering and Technology, Jadavpur.

(ii) Department of Applied Chemistry, University College of Science and Technology, Calcutta.

(iii) Department of Applied Physics, University College of Science and Technology, Calcutta.

(iv) Engineering College, Benares Hindu University.

(v) College of Mining and Metallurgy, Benares Hindu University.

(vi) College of Technology, Benares Hindu University.

(vii) Engineering College, Dayalbagh.

(viii) Engineering College, Muslim University, Aligarh.

(ix) N. E. D. Engineering College, Karachi.

(x) Victoria Jubilee Technical Institute, Bombay.

(xi) Department of Chemical Technology, Forman Christian College Lahore.

(xii) Department of Chemical Technology, Bombay University.

(xiii) Laxmi Narayan Institute of Technology, Nagpur University.

(xiv) Department of Technology, Andhra University.

(xv) Department of Chemical Technology, Madras University.

(xvi) Engineering College, Annamalai University.

With suitable financial assistance the output from these institutions can be increased by more than 50 per cent. within the next three or four years. The total capital grant required for the purpose would be in the neighbourhood of about rupees two crores spread over five years and the recurring grant about rupees 31 lakhs. We strongly recommend that adequate funds should be made available and steps initiated by October, 1947, for the improvement of these institutions. This measure would raise the standard of education in these institutions and in most cases also increase their training capacity and thereby lead to a gradual increase in the annual output of graduates.

24. (III) We understand that some building construction is contemplated for the Delhi Polytechnic to enable it to increase the annual intake to the Architecture Classes. The matter requires immediate attention as there are less than 300 qualified architects in the whole of India and facilities for architectural education are almost non-existent in the country. With the expenditure of about a lakh of rupees, the Government would be providing facilities for the education of 30 or more architects every year.

25. We should have been happier if the progress of the Delhi Polytechnic had been more satisfactory. We understand that the lack of progress has been mainly due to the utterly inadequate salaries which are being offered to the teaching posts in the Delhi Polytechnic. We consider it essential that the Government should forthwith improve the prevailing scales of pay for teachers in the Delhi Polytechnic and also take steps to shift the institution from its present premises to a more commodious site. The Government should also consider the desirability of setting up a small technical committee to advise the Governing Body on technical matters and also affiliate certain departments of the Polytechnic to the Delhi University.

26. (IV) At present most of the educational institutions are suffering from lack of equipment. We consider the matter worthy of special attention, and have dealt with it in a later section. Here, we should urge the Government to remove immediately all restrictions on the import of scientific and technological equipment and also introduce measures affording relief from import duty by allowing rebate on such imports to educational institutions.

27. (V) We note that the Indian Institute of Science is being developed further and that a High Voltage Laboratory and a Power Engineering Department for the post-graduate training in power engineering are being established. We would urge the Indian Institute of Science authorities to expedite the operation of the Power Engineering Department so that a number of engineers adequately qualified to tackle power development especially hydro-electric, may be available in the very near future.

28. (VI) We note that on the recommendation of the Sarkar Committee the Government have decided to establish within the quinquennium commencing from 1946-47, two regional institutions, namely, the Eastern and the Western Institutions, each with a capacity for the training of about 2000 under-graduates and 1000 post-graduate and research students. Each of these institutions is to have wide facilities for post-graduate study and research. For example, the Eastern Institutions is expected to provide facilities for post-graduate study and research in the following subjects:—

Fuel Technology.

Pharmaceutics and Fine Chemicals.

Regional Planning.

Paper Technology.

Glass and Ceramics.

Plastics.

Paints and Pigments.

Hydraulic and River Research.

Transportation (including Railway Engineering).

Structural Engineering (including High Dams).

Design of Electrical Machinery.

Refrigeration and Air conditioning.

Automobile Engineering.

Machine-Tools.

Design of Machinery and Instruments.

Light Alloys.

Industrial Physics.

Electronics (including Radio Engineering).

Economic Botany.

Geophysics, Geology, Mineralogy.

Meteorology.

Food Technology.

29. We strongly recommend that within the next six months the Government should complete the purchase of the sites and appoint the planning staff and, if possible, arrange to hire temporary buildings to start the institutions. We attach the greatest importance to the early establishment of these institutions, for the sooner they are established the sooner will India be free from the necessity of sending overseas a large number of scholars for advanced training in different branches of technology. We are also of the opinion that in order to expedite construction of buildings for these institutions, it would be desirable to authorise the department concerned to use private agencies instead of the Central Public Works Department.

30. (VII) We understand that a Reorganisation Committee has recommended comprehensive measures for the improvement and expansion (doubling its present output of mining engineers and applied geologists)—of the Indian School of Mines, Dhanbad. We urge that these recommendations be acted upon without delay.

31. **Education and Training of 'C' Grade Technicians.**—We cannot close this sub-section without making some reference to the matter of education and training of the 'C' grade technicians including mechanics. We understand that the Labour Department of the Government of India have under consideration a comprehensive scheme for the training and apprenticeship of craftsmen for industry. We are of the opinion that the implementation of this scheme should not be delayed any longer and that it should be initiated, wherever possible, within the next six months.

32. For this purpose and for the training of foremen and overseer type of personnel, the Government should take over some of the private engineering schools and develop them. We are not able to make any estimate of the financial implications of such a step, but we are convinced that the step recommended by us is the only possible way under the present conditions for quickly developing engineering schools for the training of overseer type of personnel and also for increasing the outturn of the number of craftsmen. Later on, in Section III dealing with "Industrial Training" we have made further suggestions.

33. Before we close this sub-section, we should also like to refer to the special needs of Footwear and Leather Industries. The available training facilities for both the superior as well as the craftsmen type of personnel are inadequate. The development and promotion of scientific and technical research in leather industries would be stimulated by introducing leather chemistry as one of the subjects for the M.Sc. Industrial Chemistry and encouraging the students qualified in leather technology to do research in leather chemistry for the doctorate degrees. We also consider that the existing training institutions should be made more efficient and useful by adding to their equipment, and by enabling them to employ better paid staff.

34. Practical Training of Engineers.—One aspect of engineering education deserves special attention, *viz.*, facilities for their post-collegiate practical training. We have later, under the section 'Industrial Training' also dealt with certain aspects of this question. Past experience has shown the necessity of some positive steps to ensure that fresh graduates receive an adequate amount of such training. Employers, including Indian mines, metallurgical works, oil companies as well as Government departments should appreciate that engineering colleges cannot provide them with finished products for ready employment in responsible posts and that it would be to their interest to take in fresh graduates and train them properly. Unless employers are willing to face this responsibility and readily undertake to provide facilities for the practical training of fresh graduates, it may be necessary to introduce legislation making it obligatory on the part of organised industry to do so.

35. Education of Agricultural personnel.—It is understood that on the whole the standard of teaching in Agricultural colleges in the country is rather indifferent. Certain suggestions, which have been put forward in Dr. Mukherjee's note (Part II, Chapter III) for the improvement of the standard of education deserve serious consideration. It is essential to ensure co-ordinated development of agricultural education, for which purpose the Government should consider the desirability of establishing an Advisory Council for Agricultural Education on an All-India basis. This is specially necessary in view of the large number of agricultural personnel that would be required. For example, according to the findings of the Agricultural Education Committee of the Central Advisory Board of Education, the Agriculture Departments alone would require during the next 10 or 15 years:—

- 800 Gazetted Officers.
- 15,000 Graduate Assistants.
- 30,000 Non-gazetted field assistants for agricultural work, and 550 Gazetted Officers.
- 4,000 Non-gazetted Inspectors, and 20,000 Stock-men for animal-husbandry work.

36. Considering the output figures for the year 1940, *i.e.*, about 299 graduates and 290 licentiates, it is apparent that steps must be initiated without delay to implement all schemes for large scale expansion of facilities for agricultural education. Here again we have to recommend only as an interim measure the introduction of a double shift subject to the provisos stipulated in paragraph 4 above. In our final report, we hope to be able to make specific proposals on this point in respect of some of the existing institutions.

37. Since agricultural colleges like other professional colleges receive their intake from the general science colleges, it may be pertinent to observe that in so far as agricultural education is concerned, entry qualifications of candidates require improvement in certain ways, some of which have been referred to in Dr. Mukherjee's note.

38. In view of the urgent need for gazetted staff of the Departments of the Central, Provincial and State Governments, we also urge that the training programme of the Central Institutions be speeded up in all possible ways. We would specially recommend that necessary measures be taken to increase the output from the Indian Agricultural Research Institute, the Indian Veterinary Research Institute, the Indian Dairy Research Institute, etc.

39. We note that the Central Agricultural College has just started functioning and will be producing about 40 graduates in three years time and later on 60 every year. We recommend that the institutions be advised to increase the scope of the training programme so as to be able to train double the present number. The various central plans for agricultural education have been outlined in the annexure to Dr. Mukherjee's note.

For purposes of education, research and their applications, it is desirable to promote ecological studies which have been neglected in the past. Soil surveys on a coordinated all-India basis and establishment of a large number of experimental stations in each region distinguished by climatic and soil conditions is an immediate necessity.

A greater degree of diversification and also flexibility is necessary in the curricula of studies of universities in order that facilities for training and research in a large number of scientific subjects, especially in agriculture, can be provided for. The American unit system is a model which may be adopted with suitable modifications. For example, many chemists should have the option of training in bacteriology or in plant physiology. Similarly, plant physiologists should be able to take supplementary courses in chemistry. Besides, in view of the importance of agriculture, more universities should be encouraged to open faculties of agriculture. Where the resources of any one university may not be sufficient, two or more of them may combine to establish agricultural colleges if geographical and other considerations make it feasible. The resources of universities and colleges for training in the primary sciences may be utilised to a greater extent for developing technical and agricultural education.

40. Education for Health Personnel.—From Dr. Raja's note (Part II, Chapter IV) it will be seen that 20 medical colleges (new and converted medical schools together) are being established for undergraduate medical education. While the number of existing colleges is thus being doubled the total output of medical graduates in the country as a whole after five years is likely to be about 1800, an increase of only 80 per cent.

41. If India is to be provided with reasonable medical facilities it is clearly necessary to initiate immediately, measures for stepping up the output of doctors. As a short term measure, we have examined the possibility of introduction of double shift system in medical colleges. We understand that the Calcutta Medical College authorities are prepared to try out the system and it is expected to cost Rs. 1.30 lakhs recurring and Rs. 0.10 lakhs capital expenditure. Subject to the provisos set out in paragraph 4 above we recommend its introduction in the Calcutta Medical College to begin with. The possibility of introducing this system in the G. S. Medical College, Bombay, where the authorities seem hopeful of doing so if adequate help could be given should also be investigated.

42. As a long-term measure to be initiated right now, we support the recommendations of the Bhoré committee in the matter of improvement and expansion of the existing colleges. This would lead not only to an improvement of the standard of education but also to an increase in the output by about 53 per cent. over the present level in the country as a whole. We recommend that the Central Government should make available to Provincial Governments a substantial proportion of the capital and recurring grants required.

	Existing College in	
	India (in lakhs of Rs.)	Pakistan. (in lakhs of Rs.)
Capital expenditure	432.0	54.0
Recurring expenditure	115.0	16.5

43. We also recommend that Departments of Preventive Medicine and Public Health should be opened in the Madras Medical College, the Grant Medical College, Bombay, and the Calcutta Medical College. The total expenditure is likely to be—

Capital—Rs. 6 lakhs.
Recurring—Rs. 6.75 lakhs.

44. The development of existing postgraduate training facilities in special branches of medicine in a manner designed to serve the needs of the whole of India, is an urgent need and we recommend the immediate formation of a small committee of experts to inspect centres and report on steps that should be taken to encourage postgraduate and research studies. Fifty scholarships of Rs. 100 per month should be provided each year with immediate effect to encourage such studies. The recurring cost involved is likely to be 0.825 lakhs.

45. We have considered certain proposals for further utilising the present facilities of the All-India Institute of Hygiene and Public Health. The details of this scheme will be found in Dr. Raja's note. Briefly, it involves maximum utilisation of the present facilities, the setting up of a Department of Food Technology and the training of certain types of public health personnel. The expenditure involved is, capital Rs. 2.80 lakhs and recurring Rs. 2.66 lakhs.

46. Facilities for dental education are utterly inadequate at present and we recommend a capital grant of Rs. 1.69 lakhs and a recurring grant of Rs. 1.49 lakhs in each case for the improvement and expansion of the Calcutta Dental College and of the Nair Dental College, Bombay.

47. The training of nurses should receive the highest priority. The Nursing College in New Delhi is the only one of its kind in India and is intended to train public health nurses, a type so far unknown in this country, as well as to provide administrators and teachers in the field of nursing. Future expansion of training in this subject and the development of provincial nursing services will be greatly assisted by increasing the intake of the Nursing College. The details of the recommendations put forward in this connection will be found in Dr. Raja's note. We strongly recommend that the additional staff, equipment and accommodation which are required should be made available without delay. A capital grant of Rs. 1 lakh and a recurring grant of Rs. 1.5 lakhs will be required over and above the present expenditure.

48. The need for increasing the rate of production of health visitors is equally great. The proposal for expanding training facilities at the Lady Reading Health School in Dr. Raja's note has our full support. The proposed annual expenditure of Rs. 71,000 should, we recommend, be sanctioned and the additional accommodation and staff required should be provided.

49. We also warmly commend the training schemes for certain types of non-medical personnel such as health inspectors, health visitors, mid-wives and vaccinators which have been put forward by provincial authorities and suggest that expenditure to the extent of Rs. 11,000 (non-recurring) and of Rs. 2.05 lakhs (recurring) should be sanctioned for a period of three years, at the end of which the position should be reviewed.

50. We also recommend the institution of twelve scholarships for training in medical social work at the Tata Institute of Social Sciences at an annual recurring cost of 0.60 lakhs.

51. A start should also be made during the next six months, with the establishment of a college of pharmacy in Calcutta at an estimated cost of—

Recurring—Rs. 182.8 lakhs.

Capital—Rs. 446.8 lakhs.

SECTION II.—TRAINING OF PERSONNEL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

52. The highest type of scientific and technical personnel required falls into two distinct categories: (a) research workers of the highest type and (b) technical workers with a basic knowledge of the sciences and technologies along with experience of industry. The former category of personnel is drawn from university postgraduates, who have shown a definite flair or disposition for research. The second category of men, who are responsible for the manning of industries is

built of graduates and diploma holders in technological subjects and the question of "conditioning" them for employment will be dealt with in the next Section.

53. The inadequacy of facilities for research, higher study and training in our universities and research institutions has been chiefly responsible for the present rather unsatisfactory state of development of both research and industry. To aggravate matters, many of our universities have not yet established well-equipped (both by way of staff and equipment) post-graduate research departments in the several fundamental and applied sciences. The only way in which we may improve the situation immediately and give impetus to an increase in the outturn of trained scientific workers is to tap the existing universities and research institutions by enabling them to expand their training facilities. We are also of the opinion that the rigidity of the system of training prevalent in certain universities and institutions should be removed and the system made more flexible and diversified so that a wider sphere of activity might be covered. For instance, universities which are well-equipped for research in organic chemistry should expand their activity to include bio-chemistry, fermentation chemistry and other allied subjects, and those having a well-equipped research school in physics should also take up geophysics. Similarly, technical institutions which impart graduate and post-graduate training in mechanical and electrical engineering should be able to take up, for example, communication engineering, chemical engineering, and other allied branches also.

54. A good proportion of the available scientific man-power in the country has not been made use of in a fruitful way in as much as owing to the existing conditions of recruitment to services and other factors many qualified men have not had suitable opportunities of contributing all they could in the sphere of scientific and industrial activity. The prevention of this kind of wastage or drift of scientific talent should engage our immediate attention. As a quick and effective way of assessing the availability of such wasted talent and usefully employing it, we recommend that the necessary information about all trained men who are not profitably engaged at present be collected through advertisement and an attempt made to fit them into their proper places. This measure will help to a better utilisation of the existing resources and will also inspire confidence in the men undergoing training that the State will look after their interests.

55. We consider that the existing centres of research are capable of being better utilised than at present for the training of personnel for scientific and industrial research. Such training should be of two general types, viz. (a) higher research and to some extent advanced technological training in special institutions; and (b) post-graduate education with research also leading to a post-graduate degree in Indian universities.

To take the former into consideration first, there are 30 special institutions, as mentioned in appendix 'A' of Sir S. S. Bhatnagar's note (Part II, Chapter I) catering for a wide range of subjects both in the fundamental and applied sciences. We find that a large number of these are fairly well-equipped and well-established research centres; and some like the Government Test House, Geological Survey of India, Ordinance Laboratories, etc., are scientific departments of the Government. Although these latter institutions carry out mostly routine scientific work, as distinct from research they could become no less important as training centres. For scientific workers trained in these places would be useful not only for certain types of research in specialised fields but also if needed in the manning of the departments concerned.

56. Almost all the special institutions mentioned in the Appendix 'A' referred to above have training facilities which may be stretched to train more men than at present. Since the inadequacy of research scholarships has been mainly responsible for the limited use of this facility, the best way of attaining the objective in view is to provide research scholarships on a generous scale.

57. According to appendix 'A' mentioned above, altogether about 300 additional workers may be trained in these special institutions. Eighty of these could be placed for training in non-Government organisations and the rest in the scientific departments of the Government.

As an urgent measure we recommend that eighty research scholarships, each of the value of Rs. 100 per month, be instituted in the following non-government research institutions:

Institution	Number of scholarships
(1) Indian Institute of Science, Bangalore	28
(2) Bose Research Institute, Calcutta	11
(3) Tata Institute of Fundamental Research, Bombay	4
(4) Nutrition Research Institute, Coonoor	8
(5) Cotton Technological Laboratory, Bombay	5
(6) Indian Association for the Cultivation of Sciences, Calcutta	8
(7) Lao Research Institute, Ranchi	5
(8) Jute Research Institute, Calcutta	5
(9) Laboratory of the Indian Academy of Sciences, Bangalore	3
	(for the present)
(10) Palaeo Botanical Research Institute, Lucknow University	3

The subject-wise distribution of scholarships proposed above may be decided in consultation with the institute concerned.

58. In addition to the institution of scholarships, we would also recommend that institutes 1, 2, 3, 6, 9. & 10 be each given a capital grant of Rs. 2 lakhs for the immediate purchase of much needed equipment, books, journals, etc., and institutes 4, 5, 7 and 8 each a capital grant of Rs. 50,000 for the same purpose. We would also recommend that the above institutes be each given a recurring grant of Rs. 25,000 for their expanded activities.

59. We have already referred to the 20 scientific departments of the Government, which are in a position to provide training facilities for 200 additional workers. Generally due to various administrative reasons these departments are not at present admitting trainees, and have thereby shut off very useful training centres. We feel that the present situation calls for an early examination of the question so that facilities available in these places may be fully utilised to bring about a quick increase in the supply of trained scientific workers. We feel that the various departments should be able to train additional men as indicated below:

Department	No. of additional men.
Forest Research Institute, Dehra-Dun	12
Haffkine Institute, Bombay	10
Biochemical Standardisation Laboratory, Calcutta	5
Geological Survey of India	12
Ordnance Laboratories	20
Directorate General of Observatories	25
All-India Radio	10
Government Test House, Alipore, Calcutta	15
Metallurgical Inspectorate	5
Inspectorate of Military Explosives	4
Survey of India	10
Mathematical Instruments Office, Calcutta	5
Civil Aviation Directorate	10
Posts & Telegraphs Department Workshops and Laboratories	20
Zoological Survey of India	5
Botanical Survey of India	6
Central Waterways, Irrigation and Navigation Commission and Waterways Experimental Stations	12
Central Public Works Department	15
Imperial Dairy Institute	8
Provincial Industrial Research Laboratories	5

We recommend that all the above institutions be asked to submit detailed proposals in respect of scientific training, preferably on the same lines proposed for non-government organisations, and the Government give immediate effect to such proposals.

60. We have examined with interest a scheme of Railway Scientific Research described in Sir S. S. Bhatnagar's Note (Part II, Chapter I) and commend it to the Government. Our railways and their workshops and laboratories constitute ideal training centres for scientific and technical workers in all problems relating to railway and we should not fail to utilise these facilities. There are at present six laboratories and 10 workshops attached to the State Railways where facilities for research in chemical, metallurgical and other allied fields exist. The scheme put forth proposes to mobilise these facilities for the organisation of an efficient Railway Scientific Research Section, where about 200 research workers may be trained. We recommend that the scheme be approved, a recurring grant of Rs. 3.42 lakhs made and a Director of Railway Scientific Research be appointed to work out the details of the scheme.

61. We have also noted that the existing laboratories of the Council of Scientific and Industrial Research can provide for the training of about 20 additional research workers in various branches of Chemistry, Physics, Glass and Ceramics and Fuel, and recommend that the Council be asked to organise immediately such training. We further recommend that the Council be given such grants as are necessary for the purpose. It is likely that this training programme would entail a recurring grant of Rs. 35,000 for 20 research scholarships each of Rs. 100 p.m. and Rs. 10,000 towards miscellaneous or contingent expenses.

62. Next to special institutions, the universities and other educational institutions constitute the most important centres for the training of personnel in scientific and industrial research. In Appendix B of Sir S. S. Bhatnagar's note is given a comprehensive statement of the facilities available in various Indian Universities, and the urgent measures which should be given effect to, in order to increase the outturn of research workers and also the probable number of additional men each University will be in a position to admit in the immediate future. From these data we find that only the universities of Calcutta, Bombay, Andhra, Benares, Lucknow, Allahabad, Aligarh, Dacca and Punjab have fairly well-equipped post-graduate research departments and the universities of Madras, Nagpur, Delhi, Patna, Annamalai and Agra are not so good in this respect. The Sind University has just been established and it will be some time before this university could come into its own. From the information presented, it is obvious that our approach to the problem of research training in universities should be two-fold, *viz.* an immediate all-round strengthening of the existing post-graduate departments in all Indian Universities both by way of equipment and research scholarships and the creation of post-graduate research departments for certain important subjects in such of the universities as do not have them at present. We would, therefore, recommend to the Government that: (a) the post-graduate research departments of the following universities be given the grant noted against them:

University	Grants	
	Capital	Recurring
	Rs.	
(1) Calcutta . . .	2 lakhs . . .	25 scholarships each of the value of Rs. 100 p. m. and Rs. 50,000 as contingencies.
(2) Bombay . . .	2 lakhs . . .	15 scholarships of the value of Rs. 100 p. m. and Rs. 50,000 as contingencies.

University		Grants	
	Capital Rs.		Recurring
(3) Andhra . . .	2 lakhs . . .	10	scholarships each of the value of Rs. 100 p. m. and Rs. 30,000 as contingencies.
(4) Benares . . .	2 lakhs . . .	20	scholarships each of the value of Rs. 100 p. m. and Rs. 40,000 as contingencies.
(5) Lucknow . . .	2 lakhs . . .	6	scholarships each of the value of Rs. 100 p. m. and Rs. 20,000 for contingencies.
(6) Allahabad . . .	2 lakhs . . .	6	scholarships each of the value of Rs. 100 p. m. and Rs. 20,000 for contingencies.
(7) Aligarh . . .	2 lakhs . . .	10	scholarships each of the value of Rs. 100 p. m. and Rs. 40,000 for contingencies.
(8) Punjab . . .	2 lakhs . . .	10	scholarships each of the value of Rs. 100 p. m. and Rs. 30,000 for contingencies.
(9) Dacca . . .	2 lakhs . . .	8	scholarships each of the value of Rs. 100 p. m. and Rs. 20,000 for contingencies.

and (b) the following universities be given the grants noted against them for expanding their post-graduate departments and also to start new post-graduate research departments in the subjects in which they can do so immediately (the grants recommended include expenditure for the creation of professorships, readerships and other tutorial staff):

University		Grants	
	Capital Rs.		Recurring
(1) Madras . . .	5 lakhs . . .	8	scholarships each of Rs. 100 p. m. and Rs. 1.75 lakhs towards teaching staff and contingencies.
(2) Nagpur . . .	5 lakhs . . .	5	scholarships each of Rs. 100 p.m. and Rs. 1.05 lakhs towards teaching staff and contingencies.
(3) Delhi . . .	5 lakhs . . .	4	scholarships each of Rs. 100 p. m. and Rs. 1.05 lakhs towards teaching staff and contingencies.
(4) Agra . . .	5 lakhs . . .	2	scholarships each of Rs. 100 p. m. and Rs. 1.05 lakhs towards teaching staff and contingencies.
(5) Patna . . .	5 lakhs . . .	5	scholarships each of Rs. 100 p. m. and Rs. 1.05 lakhs towards teaching staff and contingencies.
(6) Annamalai . . .	5 lakhs . . .	4	scholarships each of Rs. 100 p. m. and Rs. 1.05 lakhs towards teaching staff and contingencies.

In addition to above firms there is a large number of industrial concerns as for example, the Ordnance factories, Explosive factories, the Mint, printing of the Government. These have good training facilities.

Institutions		Grants—Recurring	
(1) Bengal Tanning Institute . . .		5	scholarships each of Rs. 100 p. m. and Rs. 15,000 for contingencies.
(2) Leather Trades Institute, Madras . . .		5	scholarships each of Rs. 100 p. m. and 12,000 for contingencies.

Institutions	Grants—Recurring
(3) Harcourt Butler Technological Institute	4 scholarships each of Rs. 100 p. m. and Rs. 12,000 for contingencies.
(4) Kerala Soap Institute, Calicut	3 scholarships each of Rs. 100 p. m. and Rs. 12,000 for contingencies.
(5) Imperial Institute of Sugar Technology, Cawnpore.	4 scholarships each of Rs. 100 p. m. and Rs. 12,000 for contingencies.
(6) Indian School of Mines, Dhanbad	5 scholarships each of Rs. 100 p. m. and Rs. 12,000 for contingencies.

The total grant, which we have recommended above for the expansion of research facilities in special institutions and universities will be:

Capital	Rs. 62 lakhs.
Recurring	Rs. 19.948 lakhs.

63. Special measures to be initiated within the next six months.— The question of providing expanded facilities for the training of personnel in scientific and industrial research is closely linked up with the general question of organisation and development of scientific research in the country. The recommendations which we have made in the preceding sections are merely in the nature of interim measures for bringing about an immediate increase in the outturn of scientific manpower in the country, and do not fulfil all our requirements in respect of development of scientific research. Long term measures will, therefore, have to be formulated. Since these are equally urgent and important, we have examined the general question in the light of recommendations, made at various times, especially the recommendations of the Industrial Research Planning Committee. Of the various recommendations of the Research Planning Committee the following are of far reaching importance not merely for research development but also in the present context of research training: (i) Levy of a statutory cess (1/16 of 1 per cent.) on industry on the basis of industrial production or as a small surcharge on income-tax so as to realise at least Rs. 1 crore for supplementing the grant from the Government for research; (ii) Block grant of Rs. 6 crores from the Government (spread over a period of 5 years) for establishment of various National Laboratories and for providing funds to universities and special institutions for research in all the sciences and technologies; (iii) Annual recurring grant of Rs. 1 crore from the Government for ensuring the continuity of research activities on a progressive scale.

We are of the opinion that inasmuch as the above recommendations relate not only to the organisation and development of scientific research in the country but also to the outturn of scientific manpower, they should be given effect to immediately. The principle of levying cess on industry has been accepted by the Government in the late Planning and Development Department but has not yet been translated into action. We, therefore, strongly urge that immediate action on the recommendations of the Industrial Research Planning Committee, especially in regard to the levy of cess on industry for research purposes be initiated.

SECTION III.—INDUSTRIAL TRAINING

64. In this Section we propose to deal with advanced and foremanship training in industrial concerns. Many major industrial concerns in the country, especially those in the fields of iron and steel metallurgy, engineering, heavy chemicals, pharmaceuticals and drugs, soaps, oils and fats, paints and varnishes, cement, sugar and alcohol, mineral oils and mining, have good facilities for both advanced and foremanship training of technical personnel. But a majority of these firms are at present rather luke warm in the matter of admitting trainees in numbers larger than required for their own purpose. This

situation has contributed in no small measure to a denial of opportunities to suitably qualified students, seeking necessary training in industry. We sincerely hope that industry will come to appreciate that it would be in their own interest to take a more enlightened view in the matter. As we have stated earlier in this chapter, it may perhaps become necessary for the Government to introduce suitable legislative measures so that it becomes incumbent on every established industrial concern to provide facilities for technical training to qualified young men in all the grades notwithstanding whether the personnel thus trained would be required by the concern or not. We also recommend that in every contract entered into by the Government for the purchase of industrial machinery, plant and equipment from foreign and Indian firms there should be provision in the terms of purchase for the training of a suitable number of Indians in the workshops of the firms.

65. Training in industrial concerns may be brought under two general categories: (i) advanced practical training of graduates and to some extent research; (ii) semi-advanced or foremanship training. At present we have not been able to obtain correct information regarding the various industrial concerns in the country which are willing to admit additional men for training in the immediate future and the number of men who could be thus admitted into the various categories of training. In appendix 'C' of Sir S. S. Bhatnagar's note, however, is presented whatever information is available in this respect. A summary of these particulars is given below to indicate the total number of major concerns in the country in each important industry and the probable number of additional men who may be trained.

Industry	Additional Number of workers to be trained
(1) Iron & Steel—12 concerns	20
(2) Refractories—6 concerns	5
(3) Associated Industries—4 firms	Not definitely known.
(4) Non-ferrous metallurgical industries—10 firms	5
(5) Engineering Industries—24 firms	50
(6) Electrical Industries—23 firms	50
(7) Ship-building & Marine Engineering—8 firms	15
(8) Air craft (Assembly & maintenance)—1 firm	20
(9) Scientific stores—11 firms	8
(10) Coking & Carbonisation Industries—6 firms	5
(11) Heavy Chemicals and Chemical Industries—29 firms	15
(12) Soaps & Cosmetics—10 firms	15
(13) Textiles (over 50 groups of Mills)	100
(14) Tanning, Leather & Leather Products (over 10 firms)	25
(15) Paints, Varnishes & Associated Industries (16 firms)	35
(16) Paper (over 7 firms)	10
(17) Sugar and alcohol (over 25 firms)	50
(18) Glass & Ceramics (22 firms)	20 (not definite).
(19) Cement (over 15 firms)	20
(20) Rubber (7 firms)	5
(21) Oil Companies and Petroleum Refineries (2 firms)	Not definitely known.
(22) Manganese Mining (3 firms)	Do.
(23) Copper Mining (1 firm)	Do.

In addition to above firms there is a large number of industrial concerns as for example, the Ordnance factories, Explosive factories, the Mint, printing presses, Railway workshops, etc., under the direct administration and control of the Government. These have good training facilities.

66. From the foregoing it is obvious that an immediate increase in the output of trained technical personnel may be brought about if the facilities available in all industrial concerns including Government establishments in

the country are fully mobilised. We attach considerable importance to this and recommend that arrangements be made for the practical training of graduates and for the foremanship training of about 500 men in the immediate future. We also recommend the following tentative distribution of the trainees among the various industries :

	Advanced	Foreman
Iron and Steel Metallurgy	20	45
Refractories	5	8
Associated Industries	3	5
Non-ferrous Industries	5	8
Engineering Industries	30	50
Electrical Industries	20	35
Ship-building and Marine Eng.	10	15
Air-craft	5	8
Scientific stores	5	8
Coking and Carbonisation	5	8
Heavy Chemicals and Pharmaceuticals and Drugs	30	50
Soaps, fats and oils	10	15
Textiles	25	40
Leather	10	15
Paints and varnishes	10	15
Paper	1	15
Sugar and alcohol	20	35
Glass and Ceramics	15	24
Rubber	5	8
Cement	10	15
Defence Industries	20	35
Railway Engineering	12	20
Mint	5	8
Printing	10	15

We should, however, like to see a larger proportion of foremen trained.

Training in industrial concerns may be best provided by selecting suitably qualified men and assigning them to various factories. The selected men should be given attractive stipends—at least Rs. 100 per month for advanced training and Rs. 75 per month for foremanship training; and should be placed under the top technical executives of the concerns so that they may receive the best of attention. Advanced industrial training should, as far as practicable, include training in design and research also. Provision should also be made for the proper supervision of the trainees. We recommend that a total recurring grant of Rs. 8.2 lakhs be sanctioned by the Government for this industrial training scheme. Further we also recommend that the Government may provide whatever additional facilities the factories concerned might require by way of housing accommodation for the trainees, additional laboratory equipment for research, etc.

67. 'A' grade technicians are experts and specialists in the subject and in most cases it is difficult to provide for their satisfactory training in India. The Overseas Scholarship Scheme was, therefore, introduced by the Government to meet this situation. But at present great difficulties are being experienced in finding admission for these students in institutions abroad. We, therefore, suggest as an urgent measure that a certain number of 'A' grade technicians be trained in India. A tentative priority list of subjects in which training can be imparted in India has been indicated in Dr. Ray's note (Part II, Chapter V). We hope to be in a position to formulate detailed proposals in this matter later.

68. We have already referred in brief to the question of training of 'C' grade technicians, although this matter does not come strictly within our purview. We, however, recommend further that a fund of Rs. 5 lakhs should be provided for instituting a system of scholarships to make it possible for 'C' grade technicians already engaged in Industry to undergo a short refresher and supplementary course in suitable institutions or industrial concerns. This refresher course should be arranged in co-operation with the railway workshops, ordnance factories and the various engineering firms.

Section IV.—Technical Training for Defence Services

69. Owing to various reasons Defence Services have so far remained an excluded field and consequently, we are unable to assess the requirements of scientific and technical personnel for the various branches of the services. Working as we are under these handicaps, we are unable to formulate any specific proposals for the immediate filling in of the existing lacunae if any. However, in view of the imminent constitutional changes in the country with the consequent changes in the organisational set up of the services both on the operational side and on the technical side, we have felt it necessary to examine at this stage the subject of Defence in its general technical aspects, so as to be able to suggest certain essential and immediate measures that might be a sort of 'path-finder' for a future comprehensive plan. For this purpose we have had the note prepared by Wing Commander Singh (Part II, Chapter VI) as a basis although it refers chiefly to the Air Forces.

70. It has been brought to our notice that certain recommendations of the Pay Commission are likely to affect adversely the efficiency of the Technical Arms of the Defence Services. We wish to bring it to the notice of the Government that unless the status of technical and scientific men in the services as in other services is improved the efficiency of Defence Services will greatly suffer. Since, however, this question is closely linked up with the larger general question of status of scientists and technical men we defer making any definite recommendations in the matter here.

71. Although during the war, a certain amount of co-operative research was carried out between the Defence Department and certain civilian research organisation, we regret to have to say that the Defence Organisation of the country has not become research conscious and consequently there has been poor development of defence research. The chief contributory factor to this state of affairs has been that the Defence Forces in India have so far been staffed and manned by British Officers, who depended on British resources for scientific developments. Now that the power of administration and defence of the country is going to pass into our hands it is imperative that we should build up a strong defence organisation on up-to-date and scientific lines. For this, we need to organise defence research on an extensive scale with strong scientific sections to deal with the training and utilisation of resources available in the country for forward advance in the manufacture of defence materials. Our considered recommendation in this respect, therefore, is that the Defence Department should be asked to formulate a project which should include research, design and engineering construction for the several branches of the Defence Forces viz. Army, Navy and Air Forces; and the project should be examined by a commission of experts.

Since Defence research cannot make any progress without the co-operation of civil research, we also recommend that effective liaison between the Civil and the Defence Organisations be established immediately. We understand

that a scientific adviser appointed by the Government has made certain recommendations for the development of the scientific and technical side of the Defence Services. We urge that the report of this expert be made available to Scientific Man-power Committee.

72. In the matter of technical training for Defence Services we have already referred to the inadequacy of information. It is, therefore, essential that the necessary information should be collected by the Defence Department and examined immediately. Meanwhile, on the basis of information presented in Wing Commander Singh's note relating to Air Force requirements we propose the following urgent measures for adoption:

(a) The existing scheme of technical training in Civil Aviation be correlated with that in the Royal Indian Air Force. This measure will not only quicken the pace in the training of mechanics but will also enable us to create a common pool of trained men for sharing it between the two organisations.

(b) The Civil Aviation Training Centre at Saharanpur should be utilised for the training of both the Air Force and the Civil Aviation personnel.

(c) Ground engineers in Civil Aviation with A, B, C, D & X licenses should be employed by the Air Force; and the Air Force should be fully represented on the examination boards and the certificates endorsed as 'Acceptable to the Defence Services.'

(d) For the development of radio research the Indian Institute of Science, Bangalore, the Universities of Calcutta and Allahabad and the National Physical Laboratory should be enabled to expand their facilities so that a large number of research workers may be admitted.

Section V.—Shortage of Equipment and other Related Questions

73. Elsewhere we had occasion to refer to the shortage of essential laboratory equipment in our educational research institutions. We feel, however, that the matter is so important that it deserves special consideration. During the war years most of our educational and research institutions have greatly suffered in the matter of scientific instruments and apparatus, due to various disabilities as for instance lack of funds, import control restrictions, etc. These handicaps continue in a large measure even now; and unless they are removed immediately, it will be almost impossible for the institutions to expand their training facilities and increase the outturn of scientific manpower in the country. The situation calls for quick action and we strongly urge the Government to give top priority to the import of scientific equipment for educational and research institutions. We also urge that the Government should remove all restrictions on import of scientific equipment and endeavour to secure from abroad through the supply missions or other official channels whatever equipment the institutions concerned fail to obtain themselves. The Government should also encourage Indian concerns to manufacture scientific and technical equipment. If the government allows a rebate on the import duty of scientific equipment it would be giving considerable help to the institutions. We commend this for the earnest consideration of the government.

74. On the cessation of the war a considerable amount of scientific stores and equipment of educational value was rendered surplus and these are now being released for civilian use. But due to the existing disposals policy of the Government a large part of the valuable materials of educational value is passing into the hands of private dealers and the hard-pressed educational institutions are

being deprived of much needed equipment. We take a serious view of the matter and desire that the present disposals policy should be reviewed. We have projected in this report a plan of scientific and technical training in various institutions in the immediate future which entails a supply of a fair amount of scientific apparatus and equipment to the institutions. Unless the necessary equipment is provided to the institutions we are afraid the plan may very well fail to produce the desired result. Under the existing circumstances, it is difficult to obtain all the needed equipment from abroad even if there is enough money for it. Recourse will, therefore, have to be had to our own resources in the country of which the surplus war goods form a valuable part. We strongly urge the government to reconsider its disposal policy in the light of these circumstances and take such measures as are necessary to ensure that surplus war goods of scientific value are made easily available to educational and research institutions and as far as possible without cost.

75. Housing.—The next important question is the housing accommodation for additional men who will have to undergo the proposed training in universities, special institutions and industry. There is already acute shortage of hostel or suitable housing accommodation in every educational institution in the country. Industrial concerns are also hard pressed in this respect and many of them, although willing to take apprentices in large numbers have been compelled to greatly restrict admissions on this ground. This is a serious situation and needs looking into soon. For otherwise, it will become worse and no institution or factory will be able to take in additional men under our proposed training programme. The government should immediately evolve a suitable machinery for expediting building construction especially at various training centres and also provide necessary funds for the purpose. We suggest the following concrete steps:—

- (a) construction of additional wings to the existing hostels in universities, research and technical institutions where the additional men are intended to be trained and the cost of such construction to be borne partially or entirely by the Government.
- (b) construction of residential buildings in factories, where training is to be provided on the basis of 50 per cent of the cost as interest free loan to the industrial concerns, the loan to be repaid to the government in instalments and the buildings constructed to become the property of the concerns after a certain period when the loan has been repaid. It is hoped that the concerns will welcome this proposal.

Section VI.—Steps to Expedite Government Projects

76. Before we close this chapter, we feel it necessary to mention that we have been told that great difficulties are being experienced in implementing most of the Governmental schemes for the improvement and expansion of research and training facilities. Even though the subject does not come strictly within our terms of reference, we feel it incumbent on us to make a reference to some of the difficulties which have been brought to our notice, and to suggest steps that the Government may take to overcome them.

We are informed that:

- (I) It is difficult to secure suitably trained men, especially in the higher cadres owing to
- (a) the lack of proper appreciation of the services which scientists can render and consequent relegation of scientists to a status subordinate to administrators;

(b) the prevailing system of recruitment through the Federal Public Service Commission; (scientists of good standing do not normally respond to advertisements and can be secured only through negotiation);

(c) the generally low salaries attached to scientific posts;

(d) the lack of funds and the machinery whereby teaching and research institutions can benefit by sending their experienced men to visit the well-known world centres of training and research;

(e) the inadequacy of the number of scholarships available for research and post-graduate training.

(II) Most of the institutions are hopelessly out of date in the matter of equipment and what they possess require complete overhauling.

(III) A great deal of time is wasted in getting buildings planned and executed through the Government agencies.

(IV) A great deal of time is wasted owing to the necessity of getting the administrative department's sanction on major as well as minor issues relating to staff, equipment, etc.

77. In our opinion the above difficulties can be overcome if the Government agree to

(I) Leave it to the administrative department to decide as to how any particular scientific or technical post should be filled. The normal procedure of recruitment through the Federal Public Service Commission may be followed generally but in special cases at the discretion of the administrative department, posts may be filled by negotiation with prospective candidates through the medium of a selection committee, with which, if necessary, it may be possible to associate the Federal Public Service Commission.

(II) Create a Scientific Service equal in status and emoluments to administrative services, similar to that created in Great Britain.

(III) Improve the salary scales of teachers especially those engaged in technical education.

(IV) Provide funds to enable the institution to send their experienced staff overseas to visit important centres of scientific and technical education and research.

(V) Institute a large number of scholarships for post-graduate and research training in institutions in India.

(VI) Assist institutions to bring their equipment up-to-date.

(VII) Afford the fullest scope to Indian agencies to manufacture and wherever necessary import scientific and technical equipment.

(VIII) Authorise the administrative department to set up a Building Committee on which representatives of the Central Public Works Department and the Finance Department may sit together with departmental representatives and wherever necessary, to entrust the department at its discretion to have their buildings planned and executed through private agencies.

(IX) Delegate a greater amount of power than at present to heads of educational and research institutions.

(X) Place at the disposal of institutions funds in the form of block grants to implement programmes approved by the Government. The procedure for extending these grants should be simplified so as to give the greatest amount of freedom to the head of the institution, consistent with due safeguards, to enable the programme to be put into execution speedily and effectively.

(XI) Decisions on technical matters should be arrived at in full consultation with scientific and technical men of the department concerned at all stages. Any change, in technical proposals including policy should be effected only after giving technical men the fullest opportunity to represent their view point.

78. The Sub-committee desires to place on record its high appreciation of the valuable services rendered by Dr. S. R. Sen Gupta and Mr. L. S. Chandra Kant in the preparation of this report.

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A. N. Khosla,
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NEW DELHI,
August 3, 1947.



CHAPTER II

Summary of Recommendations

The Sub-committee of the Scientific Manpower Committee makes the following recommendations to the Government of India for immediate implementation:

I. For an immediate improvement in the out-turn of scientific man-power the Government should utilise the existing sources, *viz.*, universities special institutions and the industrial concerns by helping to create in these places adequate facilities for higher education, research and practical training. Such help as is to be given should largely be in the form of grants for (a) the creation of scholarships on a generous scale, (b) the purchase of equipment, (c) the opening of post-graduate research departments in the universities, which do not have any at the moment. In addition to above, the several educational development plans, which have been prepared by the Departments of Education etc., should be pushed through, immediately.

For the objectives generally set forth above the sub-committee makes the following detailed recommendations under various heads.

II. Education:

(a) *Basic scientific education*

A substantial increase in the facilities for education in general science up to the Intermediate Science and B.Sc. standards should be aimed at so that the output from these courses may be adequate to feed the post-graduate institutions: (Para 3, Chapter I).

As an interim measure to meet present emergency double shifts should be introduced in such institutions where there is some spare teaching accommodation and equipment but a completely new set of staff should be engaged for the second shift. The Government should, wherever the introduction of double shift is concerned feasible, come to the aid of the institution by bearing a share of the expenses on staff salary and contingencies; and by assisting the institution in securing a certain amount of equipment and building materials. (Para 4, Chapter I).

The Provincial Governments should be requested to convert without delay some of their existing ordinary High Schools into Technical High Schools. (Para 5, Chapter I).

(b) *Higher Scientific Education*

The Government of India should come to the aid of all universities by giving them suitable financial assistance to expand their post-graduate departments so that the output of post-graduate science students may be increased. (Para 6, Chapter I).

The recommendations of the Geological Education Committee should be acted on immediately so that trained geologists adequate in number may be available for the survey and development of India's mineral resources. The Geological Survey of India should increase the number of their present training camps so as to be able to train annually at least 50 geologists in field work. (Para. 7 & 8, Chapter I).

(c) *Engineering and Technological Education*

In the matter of education in engineering and technology a short term and a long term programme should be initiated within the next six months:

Short-term programme:

Introduction of an intensive 12 month ~~training programme~~ ^{programme} of M.Sc.'s and graduates in Chemical Technology to be run on a co-operative basis between (14 different technical institutions and corresponding industries) at a cost of Rs. 34 lakhs in capital and Rs. 13.3 lakhs in recurring. (Para 15, Chapter I).

The universities should introduce 3-year degree course in engineering as proposed by the All-India Council for Technical Education. (Para 16, Chapter I).

Double shift system should be introduced in engineering colleges, if conditions justify. (Para 17, Chapter I).

Wherever possible use should be made of the teaching facilities of the science departments of general colleges to assist in the education in basic sciences for engineering students. (Para 18, Chapter I).

As an interim measure, engineers in Government service should be encouraged to assist in the instruction in engineering colleges. (Para 19, Chapter I).

Long-term Programme:

For ensuring co-ordinated development of technical education and generally to raise its standard, the Regional Committees, recommended by the All-India Council for Technical Education be established immediately. (Para 22, Chapter I).

For the improvement of the standard of education as well as the expansion of some of the institutions of engineering and technology, so that the present facilities may be fully utilised the Government of India should immediately make grants to such institutions as are recommended by the All-India Council for Technical Education. The grants required will be about Rs. 2 crores capital spread over 5 years and Rs. 31 lakhs recurring. (Para 23, Chapter I).

Building construction at present contemplated to increase the annual intake of architecture and engineering classes of the Delhi Polytechnic should be expedited. The existing unsatisfactory conditions in the Delhi Polytechnic, especially in the matter of salaries to teachers, accommodation etc. should be removed and certain departments of the institution should be affiliated to the Delhi University. The government should also consider the desirability of setting up a small technical committee to advise the governing body of the Polytechnic. (Paras 24, 25 Chapter I).

The Indian Institute of Science should be urged to expedite the opening of the Power Engineering Department so that the out-turn of engineers, adequately qualified to handle hydroelectric power development projects etc. may be available soon. (Para 27, Chapter I).

Within the next six months the Government should complete the purchase of the sites and appoint the planning staff and if possible arrange to hire temporary buildings for starting work on the Eastern and the Western Higher Technical Institutions. (Para 29, Chapter I).

The Government should give immediate effect to the recommendations of the Indian School of Mines Reorganisation Committee for

the improvement and expansion of facilities for mining and applied geological education. (Para 30, Chapter I).

The scheme of training of 'C' grade technicians prepared by the Department of Labour should be put into operation as far as possible within the next six months. For this purpose and for the training of craftsmen or overseers, the Government should take over some of the private engineering schools and develop them. (Paras 31, 32, Chapter I).

For the special needs of leather and foot-wear industries leather chemistry should be introduced as one of the subjects in the M.Sc. Industrial Chemistry course and the existing training institutions in leather technology should be made more efficient and useful by adding to their equipment and by enabling them to have better paid staff. (Para 33, Chapter I).

(d) *Agricultural Education:*

(i) For the co-ordinated development of agricultural education, the Government should constitute on an all-India basis an Advisory Council for Agricultural Education. (Para 35, Chapter I).

(ii) In order to bring about an improvement in the flow of trained personnel the system of double shift should be introduced wherever possible, as an interim measure. (Para 36, Chapter I).

The programme of development of training and research facilities of the Indian Agricultural Research Institute, Central Agricultural College and other Central Research Institutes dealing with different aspects of agriculture forestry, and fisheries should be implemented and all facilities given to increase the scope of the training programme so as to be able to train double the present number.

(iv) The Indian universities should be encouraged by financial grants and otherwise to establish and/or develop their facilities of agriculture and diversify the scope of their training.

(e) *Medical Education*

For an immediate increase in the outturn of medical personnel, the double shift system should be tried as an interim experimental measure, in the Calcutta Medical College and a grant of Rs. 1.8 lakhs in recurring and Rs. 0.10 lakhs in Capital be made for the purpose. The possibility of introducing this system in the G.S. Medical College, Bombay, should also be investigated. (Para 41, Chapter I).

As a long term measure the following grants should be sanctioned for the general improvement and expansion of training facilities in the existing medical colleges and certain other purposes.

(a) Existing Colleges in.

	India (in lakhs of rupees)	Pakistan (in lakhs of rupees)
Capital expenditure	432.0	54.0
Recurring expenditure	115.5	16.5

(b) Rs. 6 lakhs capital and Rs. 6.75 lakhs recurring for starting departments of Preventive Medicine and Public Health in the Medical Colleges of Bombay and Calcutta.

(c) Rs. 0.825 lakhs for instituting 50 medical research scholarships at various centres in India.

(d) Rs. 2.8 lakhs capital and Rs. 2.66 lakhs recurring for expanding the existing training facilities of the All-India Institute of Public Health and Hygiene.

(e) Rs. 3.38 lakhs capital and Rs. 2.98 lakhs recurring for the improvement and expansion of the Calcutta Dental College and the Dental College in Bombay.

(f) A capital grant of Rs. 1 lakh and a recurring grant of Rs. 1.5 lakhs to the Nursing College over and above present expenditure.

(g) A recurring grant of Rs. 71,000 to the Lady Reading Health School, Delhi, for the next three years.

(h) Rs. 2.05 lakhs recurring and Rs. 11,000 capital for schemes for training of certain types of non-medical personnel such as midwives, health inspectors, health visitors and vaccinators in the provinces.

(i) Rs. 0.60 lakhs recurring for instituting 12 research scholarships in medical and social welfare work at the Tata Institute of Social Sciences, Bombay.

(j) Rs. 446.3 lakhs capital and Rs. 132.8 lakhs recurring for a college of Pharmacy in Calcutta, a start being made within the next six months. (Paras 42 to 51, Chapter I).

III. Scientific Research Training

The rigidity of the system of training obtaining in certain universities, and research institutions should be removed and the system made more flexible and diversified so that a wider field of activity could be covered. (Para. 53, Chapter I).

The drift or wastage of scientific talent now going on should be prevented; and such available talent should be assessed and properly made use of. (Para 54, Chapter I).

For an immediate improvement in the research training facilities in universities and special institutions the following measures should be given effect to:

(a) the institution of 250 scholarships in Indian universities and non-government research institutions at an estimated expenditure of Rs. 3 lakhs in recurring.

(b) Creation of 20 professorships, 20 readerships and 40 lectureships in certain universities.

(c) The Universities of Madras, Nagpur, Delhi, Agra, Patna and Annamalai be asked to start postgraduate research departments in certain important subjects and a total grant of Rs. 30 lakhs in capital and Rs. 7.0 lakhs in recurring [which includes (b) above] be sanctioned.

(d) The Universities of Calcutta, Bombay, Andhra, Benares, Lucknow, Allahabad, Aligarh, Punjab and Dacca be asked to expand their research training facilities by way of equipment, library, etc. to take in additional workers and that a total grant of Rs. 18 lakhs in capital and Rs. 3 lakhs in recurring be sanctioned.

(e) The Indian Institute of Science, Bose Research Institute, Tata Institute of Fundamental Research, Nutrition Research Laboratory, Cotton Technological Laboratory, Indian Association for the Cultivation of Science, Lac Research Institute, Jute Research Institute and the Laboratories of the Indian Academy of Sciences and the Palaeo Botanical Research Institute be asked to expand their research facilities to accommodate more workers and that a grant of Rs. 14 lakhs in capital and Rs. 2.50 lakhs in recurring be sanctioned for the purpose.

(f) The Council of Scientific and Industrial Research be asked to admit at least 20 research workers for training in their present laboratories and that a grant of Rs. 35,000 in recurring be sanctioned for the purpose.

(g) The Bengal Tanning Institute, Leather Trades Institute, Madras, Harcourt Butler Technological Institute, Kerala Soap Institute, Imperial Institute of Sugar Technology and the Indian School of Mines, be asked to expand their research facilities to take in more men and that a grant of Rs. 0.75 lakhs in recurring be sanctioned for the purpose.

(h) The various scientific departments of the Government which are about 20 in number be asked to formulate immediately proposals for the training of as many men as possible, not less than 200 in any case for all the departments and the Government take appropriate action of the proposals.

(i) A scheme of Railway Scientific Research for the training of about 200 workers be instituted immediately, and a grant of Rs. 3.42 lakhs in recurring be sanctioned for the purpose.

(j) For the organisation and development of scientific and industrial research in the country the government should implement the recommendations of the Industrial Research Planning Committee especially in regard to the levy of statutory cess on industry for research purposes. (Paras 55 to 63, Chapter I).

IV. Industrial Training

All the established industrial concerns in the country should be approached to provide facilities for advanced and lower grades of training in their factories for more men. In case the response from the concerns is poor the government should introduce suitable legislative measure whereby it should become incumbent on industrial concerns to provide technical training for qualified students notwithstanding whether the personnel thus trained would be required by the particular concerns or not. (Para. 64, Chapter I).

In all contracts entered into by the Government for the purchase of industrial machinery, plant and equipment from foreign and Indian firms there should be a provision in the terms of purchase for the training of a suitable number of Indians in the workshops of the firms. (Para. 64, Chapter I).

The following immediate programme of training of men in industry should be implemented:—

(1) Advanced training of 300 men in 24 major industries at an estimated cost of Rs. 3.6 lakhs recurring.

(2) Foremanship Training of 500 men in 24 major industries at an estimated cost of Rs. 4.6 lakhs recurring. (Paras 65 and 66, Chapter I).

V. Technical Training in Institutions

A certain number of 'A' grade technicians (experts) should be trained in India possibly in accordance with the tentative list of priority subjects drawn up by the Sub-committee. (Para. 67, Chapter I).

A scheme of imparting an immediate intensive shortcourse training to 'B' grade technicians as mentioned in II(C) should be implemented forthwith.

A grant of Rs. 5 lakhs be made for instituting a system of scholarships to make it possible for 'C' grade technicians already engaged in industry to undergo a short refresher and supplementary course in suitable institutions or industrial concerns. (Para 68, Chapter I).

VI. Defence

The Defence Organisation of the country should be developed on up-to-date scientific lines partly by organising defence research on an extensive scale, through a strong scientific section dealing with the training and utilisation of

resources available in the country for forward advance in the manufacture of defence materials. For this purpose the Defence Department should be asked to formulate a scientific project which should include research, design and engineering construction for the several branches of the Defence Forces viz. Army, Navy and Air Forces and the project examined by a Commission of Experts. (Chapter I, para. 71).

Since Defence Research cannot progress without the co-operation of 'Civil' research effective liaison should be established immediately between the 'Civil' and 'Defence' organisations. (Para 71, Chapter I).

Adequate information relating to the requirements of the Defence Organisation in respect of scientific and technical man-power being not available at this stage, the necessary details should be collected from the Defence Department immediately and examined. (Para 72, Chapter I)

With reference to the Air Forces the following measures should be adopted as far as practicable:—

- (a) The existing scheme of technical training in civil aviation be correlated with that in the R.I.A.F. This measure will not only quicken the pace in the training of mechanics but will also enable us to create a common pool of trained personnel between the two organisations.
- (b) The Civil Aviation Training Centre at Saharanpur should be utilised for the training of both the Air Force and the Civil Aviation personnel.
- (c) Ground Engineers in Civil Aviation with A, B, C, D & X licences should be employed by the Air Forces; and the Air Force should be fully represented on the examination boards and the certificates endorsed as "Acceptable to the Defence Services". (Para 72, Chapter I).

VII. General recommendations

For the successful expansion of research and training facilities in universities and special institutions, especially in regard to the various programmes recommended above the Government should immediately adopt the following special measures:—

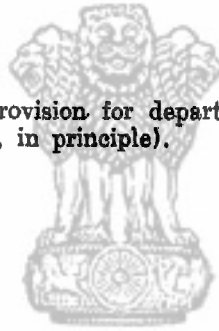
- (a) The existing handicaps in the matter of import of scientific equipment and apparatus for educational institutions should be removed and top priority given for such imports. The Government should also endeavour to secure from abroad through the official trade agencies whatever equipment the institutions concerned fail to obtain themselves. The Government should as far as possible also allow rebate on the import duty on scientific equipment.
- (b) In order to augment the existing equipment resources for scientific institutions the Government should reconsider its present policy of disposal of surplus war materials of scientific value and adopt necessary measures to prevent the passing of such materials into the hands of private dealers and ensure that the materials are made available to educational and research institutions easily and as far as possible free of cost.
- (c) In order to facilitate the training of additional workers in institutions and industrial concerns the Government should immediately evolve a suitable machinery for expediting building construction, especially at various training centres, and also provide necessary funds for the purpose. The following concrete steps may be favourably considered by the Government:—

- (i) Construction of additional wings to the existing hostels in universities, research and technical institutions where the additional men are intended to be trained and the cost of such construction to be entirely borne by the Government.
- (ii) Construction of residential buildings in factories where training is to be provided on the basis of 50 per cent. of the cost as interest free loan to the industrial concerns, the loan to be repaid to the Government in instalments and the buildings constructed to become the property of the concerns after a certain period. (Paras 73 to 75, Chapter I).

In order to overcome the great difficulties experienced by the Government in implementing most of their schemes for the improvement and expansion of research and training facilities, the Government should:—

- (a) Leave it to the administrative department to decide as to how any particular scientific or technical post should be filled. The normal procedure of recruitment through the Federal Public Service Commission can be followed generally but in special cases at the discretion of the Administrative department, posts may be filled through negotiations with prospective candidates through the medium of a selection committee, with which it may be possible to associate the Federal Public Service Commission.
- (b) Create Scientific Service at par in status and emoluments with administrative services, similar to that created in Great Britain.
- (c) Improve the salary scales of teachers especially those engaged in technical education.
- (d) Provide funds to enable the institution to send their experienced staff overseas to visit important centres of scientific and technical education and research.
- (e) Institute a large number of scholarships for post-graduate and research training in institutions in India.
- (f) Ask the administrative department to set up a Building Committee on which representatives of the C.P.W.D. and the Finance Department may sit together with departmental representatives and wherever necessary to entrust the department at its discretion to have their building planned and executed through the private agencies.
- (g) Delegate a greater amount of power than at present to heads of educational and research institutions.
- (h) Place at the disposal of the institutions the funds in the form of block grants to implement programmes approved by the Government. Normally, the head of the institution should have the authority as a matter of course, once the scheme has been approved and funds allotted, to take the action he considers most appropriate to achieve the desired result without delay.
- (i) Decisions on technical matters should be arrived at in fullest consultation with the scientific and technical men at all stages. For any changes in technical proposals including policy, technical men of the department should be given an opportunity to represent their view point. (Para 77, Chapter I).

(The above includes the provision for departmental schemes, which have been accepted by Government, in principle).



सत्यमेव जयते

PART II.

NOTES BY :—

Sir S. S. Bhatnagar.

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Dr. J. N. Mukherjee.

Dr. K. C. K. E. Raja.

Dr. J. N. Ray.

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Dr. D. N. Wadia.

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सत्यमेव जयते

CHAPTER I.

Training of Personnel for Scientific and Industrial Research and for Industry

By

S. S. Bhatnagar

It is proposed to deal in the following with the measures that need to be given the highest priority for the training of personnel for scientific and industrial research and for the Industry. The kind of training contemplated may be brought under four general categories viz. (i) Higher research and to some extent advanced technological training in special institutions; (ii) research and perhaps education also leading to a post-graduate degree in Indian Universities; (iii) advanced training after the graduation stage and to some extent research also in industrial concerns; (iv) semi-advanced or foremanship training in industrial concerns after the diploma or a higher stage.

Training in special institutions.—The existing research institutions, which may be enabled to take up immediately the training of scientific workers are given in Appendix 'A' together with the subjects in which the institutions can impart training and the probable number of men, who may be trained in addition to the present strength. Since the type of training contemplated in these institutions is entirely different from that provided in regular educational institutions the best way of attaining the objective in view would be to provide research scholarships on a generous scale in these institutions. This measure will result in a large number of post-graduate students with suitable academic qualifications entering the institutions for further study and research in the **several sciences and technologies**. Incidentally, this would also give great impetus to the development of research in the country. In addition to scholarships adequate grants for the purchase of laboratory equipment, books and journals will have to be made to the institutions.

It may be mentioned here that in the immediate past, especially during the war years most of the special institutions and universities have greatly suffered in the matter of obtaining apparatus and other equipment, due to various disabilities such as for instance lack of funds, lack of priority for the import of equipment etc. These disabilities should be removed immediately if the institutions are to be enabled to increase their outturn of trained personnel. The import of equipment for any training institution should be given top priority and the government should endeavour to secure from abroad whatever equipment the institutions concerned fail to obtain by themselves.

The National Laboratories of the Council of Scientific and Industrial Research although belonging to the category of special institutions are different from those mentioned in Appendix 'A' in that the laboratories will soon constitute the single largest employer of scientific talent and hence provision will be made for the immediate training of such personnel as is required for the execution of the research programme of the laboratories. Besides, the work of the National Laboratories is highly diversified and cover a wide range of specialised subjects, and advanced training for the senior staff can in the initial stages be provided only in specialised research centres abroad. Such deputations are obviously different from the Overseas Training Scheme, which the Government has put up. The Council has provided for the advanced training of nearly 50 members of the senior staff of the laboratories abroad. At the same time provision can also be made immediately for the training of at least 15-20 research workers in the present laboratories of the Council (Physical and Chemical Sections located at Delhi, nucleus of the Fuel Research Institute at Dhanbad and the nucleus of the Central Glass and Ceramic Research Institute at Calcutta) in the following subjects: General Chemistry, Organic Chemistry with special reference to plant products, plastics, paints and

varnishes, Oils and Fats, Physical and Chemical Survey of Coal, Glass and Ceramics, Ultra-sonics, Wood Impregnation, Carbon Products, Producer gas fuels, Electro-chemistry etc.

This immediate out-turn of trained scientific workers can be increased further if the laboratory accommodation available in Delhi is also increased, since the Council has in its possession some facilities by way of equipment etc., which could be stretched to meet this urgent need. This particular scheme should be implemented without delay so that within the next 10-12 months we can have about 20 additional men, who can be fitted either in the projected National Laboratories or in Industry. This will supplement the trained scientific personnel coming out of other special institutions and universities.

Training in Universities.—Next to the scientific institutions mentioned, the universities constitute the most important training ground for the superior types of scientific and technical manpower. Whatever facilities, which we may have to extend to our universities for an immediate increase both in the out-turn and the usefulness of the trainees will be largely influenced by the fact that some of the universities do not have post-graduate research departments and those that do, do not possess the heavier and costlier types of equipment and apparatus which are necessary to train up men, who could engage in more advanced stages of research or could directly take on responsible jobs in Industry. What, therefore, needs to be done immediately is to strengthen the existing post-graduate departments especially in respect of equipment. At the same time, we should provide for a good number of post-graduate studentships in every university in order to attract promising young-men into the post-graduate departments. These urgent measures could only be applied for immediate fruitful results to only such of the existing universities as have post-graduate departments, which include research, and will help to fill in the existing gaps in the supply of trained personnel. As regards those universities, which have now proper post-graduate departments our approach to the problem will have to be different in that, these should be enabled to take immediate steps to create post-graduate departments, keeping primarily in view research in the basic and applied sciences. For this, grants will have to be made to the universities for the institution of professorships, readerships and other guiding staff for research, for the purchase of equipment and for the creation of a suitable number of scholarships. This measure will ensure an increased supply of men required in execution of the various developmental plans.

In Appendix 'B' is given a statement showing the existing facilities in various Indian Universities and other educational institutions for post-graduate research and training, the probable number of additional men who can be accommodated, provided the existing facilities are augmented as suggested above, the universities in which post-graduate departments and new courses of higher studies will have to be set up.

Training in Industry.—One of the means by which we may augment the existing facilities available in universities and special institutions on the industrial side is to tap the existing industries themselves. Many major industrial concerns in the country especially in such fields as Iron and Steel Metallurgy, constructional engineering, heavy chemicals and chemical industries, soaps, oils and fats, paints and varnishes, cement, sugar and alcohol have very good factory facilities to offer for both advanced and foremanship training of candidates. It is, however, to be noted that only a very limited number have any worthwhile research facilities. In the immediate future, therefore, training in industrial concerns will be confined mostly to the former type rather than to industrial research.

In Appendix 'C' is given a list of important industrial subjects together with the firms, which are capable of providing training facilities. It has not been possible at this moment to ascertain definitely what firms are willing to admit trainees and in what numbers. Whatever information is available in this respect is given in the appropriate columns in the list. Since, most of the industrial concerns regularly admit apprentices from universities and technical institutions in some strength or other it may be assumed that in the present scheme of training their co-operation would be forthcoming. However, some sort of legislative measure would be necessary to ensure that every industrial concern which has the necessary facilities does take in men for training. The Government should endeavour to secure facilities for at least 300 men for advanced training and for about 500 for foremanship training.

In addition, in every contract entered into by the government for the purchase of industrial machinery, plant and equipment from foreign and Indian firms there should be provision in the terms of purchase for the training of a suitable number of Indians in the workshops of the firms. This measure will help to open up another useful line of training in Industry.

It may be mentioned here that the various concerns, such as the railway workshops and laboratories, ordnance factories and high explosive factories etc. which are under the direct administration and control of the government should be asked to take in men for training to their utmost capacity, so that these could supplement the facilities available in private industrial concerns. The Railway workshops and laboratories constitute in fact an ideal training centre for scientific workers in all problems relating to railways and we should not fail to utilise the existing facilities for such training of men, who would be required in large numbers to man the railways in the near future. There are at present six State Railway Laboratories and 10 Workshops in India where all kinds of chemical, metallurgical and allied problems are dealt with. For want of efficient technical advice and help, the scientific officers incharge of the laboratories are now kept busy mainly with routine analytical work although these men are competent to undertake research work on any railway scientific problem and also to train up others in the line. In order, therefore, to utilise fully the facilities available in our State railways, both in regard to men and materials for purposes of giving impetus to railway scientific research and the training of a scheme of Railway Scientific Research should be taken up immediately. A Chief Railway Scientific Officer or Director of Railway Scientific Research should be appointed to work out the details of the scheme and carry it out. In its essentials, however, the scheme should envisage research and training on the following problems: (1) Heat treatment of metals; (2) Corrosion and wear of metals; (3) Boiler feed metals; (4) White Metal and other non-ferrous alloys; (5) Foundry Moulding Sands; (6) Refractory Materials; (7) Oils, Paints and Varnishes; (8) Quenching Oils for tempering; (9) Reclamation of Oils; (10) Hot boxes; (11) Oil-less bearings; (12) Reclamation of Metals; (13) White Metallurgy procedure; (14) Fatigue failure of Metals; (15) Welding of rails; (16) Economy on coal consumption; (17) Coal-dust briquetting; (18) High duty cast iron; (19) Manufacture of Malleable cast iron; (20) Manufacture of Steel.

An eminent and experienced railway scientist should be selected for the post of Director for Railway Scientific Research in consultation with the Council of Scientific and Industrial Research and in addition four qualified Deputy Directors to be incharge of the following four sections: (a) Fuels; (b) Metals; (c) Boiler water; (d) Lubricants, Oils and Paints should also be appointed.

This scheme of railway research on the Indian Railways can easily take in 200 scientific workers, who would be suitably trained in different railway laboratories and workshops. No additional expenditure for buildings or for

housing the training centres would be required as these can be conveniently done by individual railways as and when required by the Director of Railway Research.

Training in industrial concerns could be best provided by selecting suitable men and assigning them to the various factories. The selected men should be given attractive stipends and should be placed under the top technical executives of the concerns—who should be well qualified and experienced in their respective fields—so that they may receive the best of attention and training. Advanced technical training should as far practicable include research training also in the factories, which have facilities for such work. After the necessary training, most of these men will fill the existing gaps in respect of technical personnel required for manning the industries, and in suitable cases for technological research in the research laboratories of the Council of Scientific and Industrial Research and the Industry.

Financial aspects of the scheme.—Both capital and recurring grants would be required to give effect to the recommendations made in the present scheme of training of scientific and technical personnel. The former would largely be in the form of studentships or scholarships for the trainees; and the latter for the purchase of additional equipment etc., especially in the post-graduate departments of universities. It may be proposed that the value of scholarships in universities and special institutions should be about Rs. 100 p.m. and in industrial concerns Rs. 100 and Rs. 75 for advanced and foremanships training, respectively. The capital grant that is to be made to the universities depends on the actual needs of the universities in the immediate future to provide training facilities for additional men and will vary from university to university since some universities have to start post-graduate departments on the requisite scale. It may, however, be proposed that the universities which have to start post-graduate departments should receive a lump sum grant of Rs. 5 lakhs and a proportionate recurring grant for the creation of professorships, readerships and other tutorial staff and to meet their expenses. As regards the universities which have already research departments, a general equipment grant of Rs. 2 lakhs for each university and a recurring grant of 20 per cent. of the university's present annual expenditure may be made. All the grants proposed will be in addition to the scholarships and studentships which the government has to institute. Since many of the industrial concerns are already in a favourable position in respect of training facilities large sums of money, it is expected, would not be required for capital or recurring expenditure in these places.

The following statement indicates an approximate estimate of the grant required during the next 12 months for this part of the training programme.

A. Recurring.

1. Scholarships for research training and advanced study in universities and special institutions (Non-Government) Total No. 250; Value Rs. 100 each	Rs. 3 lakhs.
2. Scholarships for advanced training in industrial concerns: Total No. 300; value Rs. 100 each	3.6 lakhs.
3. Scholarships for foremanship training in industrial concerns: Total No. 500; value Rs. 75 each	4.5 lakhs.
4. Creation of professorships, Readerships, etc. in universities 20 Readerships, 20 Professorships, and 40 Lecturerships	5 lakhs.
5. Recurring expenditure miscellaneous for universities and research institutions	8.00 lakhs.
6. Research Scholarships for training in the laboratories of the Council of Scientific & Industrial Research; Total No. 20; value Rs. 100 each and recurring expenditure	0.35 lakhs.
7. Scholarships for Railway Scientific Research Scheme. Total No. 200; value Rs. 100	2.4 lakhs.
8. Director of Railway Research on Rs. 2,500 p.m. & 4 Deputy Directors each on Rs. 1,500 p.m.	1.0 lakhs.
Total	27.85 lakhs.

B. Capital.

1. Capital grant to Universities for starting post-graduate departments 6 Universities Rs. 5 lakhs each	30 lakhs.
2. Capital grant to existing post-graduate departments of Universities 9 Universities, Rs. 2 lakhs each	18 lakhs.
3. Capital grant to research institutions (Non—Govt.) 7 institutions	12 lakhs.
	<hr/>
Total	60 lakhs.
	<hr/>
Capital grant	60 lakhs.
Recurring grant	27.87 lakhs.

NOTE.—(As regards hostel accommodation for the additional trainees in Universities and special institutions, and also buildings for the expansion of University post-graduate departments it has been found that this need could be met from the funds (about Rs. 75 lakhs) proposed to be spent by the Education Department in the immediate future on a general expansion and strengthening of the existing Universities and other educational institutions. The question of accommodation for trainees in industry, however, should be taken up with industrial concerns, individually and satisfactory arrangement arrived at).

Other Special Measures.—After an extensive survey of the existing facilities in the country the Industrial Research Planning Committee of the Council of Scientific and Industrial Research has made some far-reaching recommendations for the organisation of scientific and industrial research in India on the basis of a 5 year plan. Of these, the following four recommendations are of special significance in the present context of research training.

(1) Setting up of a net-work of National Research Laboratories.

(2) Block grant of Rs. 6 crores from the Central Government (spread over a period of 5 years) for the establishment of National Laboratories and for providing funds to universities and special institutions for research in all sciences and technologies.

(3) Annual recurring grant of Rs. 1 crore from the government for ensuring the continuity of research activities on a progressive scale.

(4) Levy of a statutory cess (1/16 of 1 per cent) on Industry on the basis of industrial production or as a small surcharge on income tax so as to realise at least Rs. 1 crore for supplementing the grant from the Government for research.

In-as-much as the above recommendations will give immediate impetus not only to the expansion of facilities in the country for scientific and industrial research but also to the out-turn of scientific manpower they should be given effect to. The question of levy of cess on Industry has been under the consideration of the Department of Industries and Supplies but urgent action in the matter should be initiated. The Council of Scientific and Industrial Research being the Central Organisation responsible for the development of research in the country, should be provided with the capital grant of Rs. 6 crores (spread over 5 years) and the recurring grant of Rs. 1 crore in addition to the proceeds of the cess to carry out its various plans for research development. In addition to the establishment of new laboratories and the financing of research departments of universities and other institutions these plans include some of the essential features of research training envisaged in this scheme. The present scheme in its entirety can also be adopted and carried out, expeditiously by the Council in view of the fact that the Council and its Advisory bodies constitute the best existing machinery for the implementation of the proposals of the training scheme. In the event of the decision to give effect to the recommendations of the Industrial Research Planning Committee along the above lines no separate grants (as shown in pp. 7-8) apart from those

recommended by the Industrial Research Planning Committee would be necessary.

Summary of recommendations.—(1) For an immediate increase in the supply of scientific manpower it is necessary to tap the existing universities, special institutions and industry by creating adequate facilities in these places for advanced research and training.

(2) The target of increase under the existing circumstances should be at least 250 trained men for scientific and industrial research, 500 men (advanced cadre) for the manning of the industries including the state railways and also for industrial research and 500 men (foremanship cadre) for the industry in the next 12 months.

(3) Such facilities as are to be created for the above purpose, should largely be in the form of grants to universities and special institutions for instituting post-graduate research scholarships or studentships on a generous scale, purchase of equipment, opening of post-graduate research departments in the universities, which do not have any at present, and for the creation of Professorships and Readerships in some of the universities.

(4) The government should sanction a capital grant of Rs. 60 lakhs and a recurring grant of Rs. 27.87 for this training scheme.

(5) The recommendations of the Industrial Research Planning Committee relating to a block grant of Rs. 6 crores (spread over a period of 5 years) and a recurring grant of Rs. 2 crores for the organisation of scientific research should be implemented and the grants placed at the disposal of the Council of Scientific and Industrial Research for the immediate purpose of expanding research and training facilities in the country. If this is done, no separate grant as recommended in (4) need be made since the Council of Scientific and Industrial Research would then be in a position to implement the main features of the present scheme.

(6) Some kind of legislative measure should be enforced whereby it becomes incumbent on every established industrial concern in the country to provide for technical training to qualified young men, notwithstanding whether the personnel thus trained would be required by the concern or not. Government should also arrange for expanded facilities for the industrial training in such places as Railway Workshops, Ordnance and Explosives factories, and other concerns, which are under their direct control.

(7) The import of equipment for any research or educational institution should be given the highest priority and the government should endeavour to secure from abroad whatever equipment the institutions concerned fail to obtain themselves.

(8) A scheme of railway research and training as outlined in this report should be taken up in order to provide facilities for the immediate training of at least 200 workers in the existing railway workshops and laboratories.

APPENDIX 'A'

Institution	Subjects	Additional number of workers who may be trained
1. Indian Institute of Science, Bangalore.	General and Applied Chemistry, Industrial Fermentation, Bio-chemistry, Organic Chemistry with particular reference to Pharmaceuticals and Drugs, Physics, Electronics, Chemical Engineering, Internal Combustion Engines, Communication and Electrical Engineering, Aeronautical Engineering and Metallurgy.	30
2. Bose Research Institute, Calcutta.	Nuclear Physics, X-rays and Ultrasonics, Plant and Animal Physiology, Biophysics, Biochemistry, Anthropology and Racial Biology.	13
3. Tata Institute of Fundamental Research, Bombay.	Nuclear Physics, Cosmic rays and Theoretical Physics.	4
4. Forest Research Institute, Dehra Dun.	Wood technology, Wood Chemistry, Paper and Pulp, Minor Forest Products, Botany, Biochemistry.	12
5. Imperial Dairy Research Institute, Bangalore.	Dairy and Dairy Chemistry.	8
6. Haffkine Institute, Bombay .	Sera, Vaccines, Anti-toxins, Pharmaceuticals and Drugs, Antibiotics, Biochemistry, Pharmacology, Organic Chemistry, Bacteriology.	10
7. Biochemical Standardisation Laboratory.	Biological evaluation, Biochemistry, Pharmacology.	5
8. Nutrition Research Institute, Coonoor and Shillong.	Nutrition, Biochemistry	8
9. Cotton Technological Laboratory, Matunga.	Physics and Chemistry of Cellulose and Textile fibres.	5
10. Geological Survey of India .	Geophysical prospecting Mineralogy, Mineral analysis.	12
11. Indian Association for the Cultivation of Science.	Crystallography, Magnetism, X-rays, Spectroscopy.	8
12. Provincial Industrial Research Laboratories.	Industrial Research	5
13. Lac Research Institute, Ranchi.	Lac and Lac Products	5
14. Jute Research Institute .	Jute and Jute Products	5
15. Laboratory of the Indian Academy of Sciences	Mineralogy, Spectroscopy, Crystallography	3
16. Ordnance Laboratories .	Ordnance and Military Stores, Testing and Research.	20
17. Directorate General of Observatories (at various places).	Meteorology, Physics of the Upper Atmosphere. Solar Physics and Seismology.	25
18. All-India Radio	Communication Engineering	10
19. Govt. Test House	Testing of raw materials and finished products	15
20. Sericultural Research Station, Kollegal and Government Silk Institute, Bhagalpur.	Sericulture and silk spinning, weaving and dyeing	5
21. Metallurgical Inspectorate, Tatanagar.	Metallurgical Research and Testing . .	5
22. Inspectorate of Military Explosives.	Research in plastics, Testing and Explosives and other defence chemicals.	4
23. Survey of India	Trigonometrical, magnetic and other surveys, Geodesy.	10
24. Mathematical Instruments Office.	Mathematical, and Physical Instruments and Accessories.	5
25. Civil Aviation Directorate .	Communication Engineering	10
26. Posts and Telegraphs Dept.	Tele-communication	20
Workshops and Laboratories.		
27. Zoological Survey	Marine Biology, Museum	5

1	2	3
28. Botanical Survey. . .	Botanical Museum, Botanical Gardens and Cinchona and other alkaloid-bearing plant cultivation.	6
29. Central Waterways, Irrigation and Navigation Commission and Waterways experimental Station at Poona.	Dam construction, Power Projects Irrigation, Navigation, Hydro-dynamics.	12
30. Public Works Department of Central and Provincial Governments.	Structural, Highway and Irrigation, Engineering and Design.	15



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APPENDIX 'B'

University or Institution	Subjects of post-graduate research and advanced study	Number of additional men who may be admitted	Remarks
1. Calcutta University (Univ. College of Science & Technology Presidency College).	Physics, Chemistry, Botany, Zoology, Psychology, Physiology, Bio-Chemistry, Geology, Nuclear Physics and Electronics and Applied Physics and Chemistry, Mathematics.	25	Good facilities available for taking up immediate training. Can admit a good number of workers if additional equipment and scholarships are made available.
2. Bombay University (Dept. of Applied Chemistry, Chemical Technology and Royal Inst. of Science).	Applied Chemistry, Textile, Chemistry, Chemical Engineering, Foods, Drugs and Pharmaceuticals, Dyestuffs.	15	Good facilities are available and are being expanded. Can take up a considerable number of workers if additional equipment and scholarships are made available.
3. Madras University (University Research Labs., Presidency College & College of Technology).	Organic Chemistry, Biochemistry, Botany, and Zoology, Leather Chemistry and Technology, Mathematics.	8	Facilities for diversified post-graduate research and training not available. Belong to the second category of institutions, which need encouragement for opening up proper post-graduate departments in various branches specially in technology.
4. Andhra University (Univ. College of Science and Technology).	Physics, Chemistry, Natural Sciences and Chemical Technology.	10	Special facilities available for advanced study in Chemical Technology and Research in Plant Products. Can turn out useful results if funds are made available for the strengthening of the existing departments.
5. Nagpur University (Lakshminarayan Inst. of Technology).	Chemical Engineering and Technology.	..	Facilities mostly for training post-graduate students in Industrial Chemistry and Chemical Engineering available. Need equipment and Chemical Engineering immediate work and also funds for opening post-graduate departments.
6. Benares Hindu University.	Physics, Chemistry, Mathematics, Zoology, Geology, Industrial Chemistry, Chemical Engineering, Ceramics, Glass, Pharmaceuticals, Mining and Metallurgy.	20	Facilities available for research in fundamental and applied sciences as also for advanced study. Need equipment and scholarships for increasing the output of personnel.
7. Delhi University.	Physics and Chemistry.	4	Limited facilities for post-graduate research and training but can avail of the facilities available in the C. S. I. R. laboratories. Need funds for opening proper post-graduate deptts. Some facilities for post-graduates.

University or Institution	Subjects of post-graduate research and advanced study	Number of additional men who may be admitted	Remarks
8. Lucknow University	Physics, Chemistry, Botany, Zoology, and Mathematics.	6	Some facilities for post-graduate research in fundamental sciences especially in paleobotany exist. For the strengthening of the post-graduate departments the university needs considerable sums for equipment scholarships and also for some Chairs.
9. Patna University	Physics and Chemistry.	5	Only limited facilities exist for post-graduate research. The university needs grants for opening up post-graduate departments, especially in technology since it has to meet the growing needs of Bihar.
10. Allahabad University	Physics, Chemistry, Botany & Zoology	6	The University has fairly well-established post-graduate departments in Physics and Chemistry but lack proper tutorial staff to guide in research. First requirement is in respect of staff and scholarships and also better equipment. Post-graduate departments in applied sciences will have to be opened.
11. Annamalai University	Physics, Chemistry, Botany and Zoology	4	Although the University has started post-graduate departments in some of the sciences it has few facilities to offer for advanced research and training. Hence primary requirement is in respect of equipment, scholarships and to some extent staff. The university also needs encouragement to open post-graduate departments in applied sciences.
12. Agra University (affiliated colleges)	Physics and Chemistry	2	It is only an affiliating university and has no proper post-graduate dept. Hence belongs to the category of universities which have to be encouraged to establish post-graduate departments. But the affiliated colleges can perhaps accommodate the number indicated for research.
13. Aligarh University	Physics and Chemistry, Botany, Zoology and Mathematics.	10	The University's primary requirements for advanced research and training are in respect of equipment and scholarships. It also needs considerable support for opening post-graduate departments in technological sciences.
14. Punjab University	Physics, Chemistry, Botany, Zoology and Chemical technology.	10	The University's primary requirements for advanced research and training are in respect of equipment and scholarships.
15. Dacca University	Physics, Chemistry, Mathematics and Biological Sciences. (Universities of Indian States are not included in the above list).	8	

Educational Institutions not affiliated to any University.

16. Bengal Tanning Institute.	Leather, Chemistry and Technology		
17. Leather Trades Institute, Madras.	Leather, Chemistry and Technology	5	Facilities exist for research and advanced study in Leather, Chemistry and Technology.
18. Harcourt Butler Technological Oils and fats and general Chemical Technology.		5	Facilities exist for research and study in Leather Technology.
19. Imperial Institute of Sugar Technology.	Sugar Chemistry, Sugar Technology and Sugar Engineering, Fermentation, Chemistry and Technology	4	Some facilities exist for technological research in soaps, oils, fats and applied chemistry.
		4	Facilities exist for Technological research and training in problems of sugar and fermentation industries.
20. Kerala Soap Institute.	Soaps, oils and fats and essential oils.	3	Facilities exist for training and research in the Technology of oils, fats and soaps and also cosmetics.
21. Indian School of Mines, Dhanbad.	Geology and Mining, problems connected with coal.	5	Facilities exist for research and training in problems connected with coal, especially coal washing.

APPENDIX C

Subject.	Name of Concern.	Firm willing to take in trainees.	Probable No.	Remarks.
1. <i>Metallurgy and Engineering.</i>				
(a) Iron and Steel.	(1) Tatas; (2) Indian Iron and Steel Co.; (3) SCOB; (4) Kumardhubi Works; (5) Bharatia Steel Works; (6) Mukand Steel Rolling Mills; (7) National Iron and Steel Works; (8) Ordnance Factories; (9) Railway Workshops; (10) Mysore Iron and Steel Works; (11) J. K. Steel and Iron Co; (12) Indian Rolling Mills, Negepatam.	(1), (8) & (10) and (9) if the Government allows.	20	Almost all the firms have very well equipped works and Control laboratory facilities for advanced training in Iron and Steel metallurgy. Definite information regarding willingness to admit trainees is available only in respect of firms 1 and 10. But, all are likely to provide facilities for training in which case the number will be quite considerable. The Tatas have also good facilities for metallurgical research.
(b) Refractories.	(1) Burn & Co.; (2) Reliance Firebricks; (3) Kumardhubi Works; (4) Bihar Firebricks & Pottery Co.; (5) Tatas; (6) Himalaya Potteries.	(5)	5	Firms (1), (3) and (5) have very good facilities for training and all are likely to admit trainees.
(c) Associated Industries.	(1) Tinsplate Co. of India; (2) Metal Box Co. of India; (3) Indian Wire and Steel Products; (4) Wire Nails of India.	No information	..	
(d) Non-ferrous Metals.	(1) Indian Copper Corporation; (2) Indian Standard Metal Wks.; (3) Kamani Wks.; (4) India Rolling Mills; (5) Jayant Metal Manufacturing Co. Aligarh; (6) Indian Smelting and Refining Co.; (7) Indian Aluminium Co.; (8) Aluminium Corporation of India; (9) Jeevan Lal & Co.	(1)	5	(7) and (8) are aluminium manufacturing concerns and have good facilities to offer for advanced training in electro-metallurgy.
(e) Engineering Industries.	(1) Jessops; (2) India Machinery Co.; (3) Britannia Engineering Co.; (4) Copper Engineering Co.; (5) Kirtoskar Co.; (6) Maya Engineering Co.; (7) Hind Machines.	..	..	Excepting firm (24) who have agreed, no definite information is available as regards the firms which are willing to take trainees. But since most of

(8) Investa Machine Tool Co.; (9) Jay Engineering Co.; (10) S. L. Dutta and Co.; (11) P. S. G. & Co. Coimbatore; (12) Avery & Co.; (13) Bharat Eng. & Weighing Scale Syndicate; (14) Taximaco; (15) Garlick & Co.; (16) Joyti Ltd.; (17) Feather Stone Eng. Co.; (18) Cooper, Connolly & Califford Co.; (19) Braithwaite & Co.; (20) Martin & Co.; (21) Saran Eng. Co.; (22) Ordnance Factories & Railway Workshops; (23) Ford and General Motors Co.; (Body building and assembling); (24) Birla Cycle Manufacturing Co.

(f) Electrical Industries.

(1) Bengal Lamps; (2) Mysore Lamps; (3) Bharat Lamp and Electric Wks.; (4) Bijli Products; (5) Calcutta Electric Lamp Works; (6) Electric Lamp Manufacturing Co. of India; (7) India Electric Works; (8) Greaves Cotton, Crompton & Parkinson; (9) Calcutta Electrical Mfg. Co.; (10) Kaycee Industries; (11) Government Electric Factory, Bangalore; (12) Bestolite Co.; (13) Estrella Products; (14) Standard Batteries; (15) Bharat Batteries; (16) Chloride Electrical Storage Co.; (17) Associated Elec. Mfg. Co.; (18) AMCO Ltd.; (19) Metropole Works; (20) National Insulated Cable Co. of India; (21) Indian Cable Co.; (22) Indian Conduit Industries; (23) Indian Hume Pipe Co.

(g) Ship building and Marine Engineering.

(1) Scindia Steam Navigation Co.; (2) Gordon Reach Works; (3) India Navigation and Railway Co.; (4) Port Eng. Works; (5) Hooghly Docking & Eng. Co.; (6) Alcock Ashdown Co., Bombay; (7) Ahmadia Ship-yard; (8) Martin & Co.

the concerns have good workshops facilities and since many of them admit apprentices from universities it may be assumed that they might provide facilities for advance technological training. It may also be assumed that at least 50 candidates for advance training and 100 for foremanship training may be provided for in these firms. Some of them, especially Messrs. Cooper Engineering Co., Kirloskar Co., have facilities in specialised lines like internal combustion engines, pumps, etc.

The above remarks hold good in general.

No definite information. But it may be possible to obtain facilities for the training of at least 15 candidates.

Subject.	Name of Concern.	Firm willing to take in trainees.	Probable No.	Remarks.
(b) Air-craft	(1) Hindustan Aircraft Co.	....	...	Since the firm is primarily government controlled there may not be any difficulty in admitting trainees. The factory is only for assembling, body building and repairing purposes and about 26 people may be trained in these fields.
(c) Scientific stores. . . .	(1) P. R. & Sons; (2) Lawrence and Mayo; (3) Balance Works, Benares; (4) Mathematical Instruments Office; (5) Associated Instruments Mfg. Ltd.; (6) Adair Dutt; (7) SICO; (8) Andhra Scientific Works; (9) Hargolal & Sons; (10) Raj-der-Kar; (11) Scientific and Industrial Equipment Co.	(9), (10) and (11)	6	It is likely that (3), (7), (8) and some others also may provide facilities for training. (4) is a government organisation and should be able to admit 2 workers.
2. Coking and Coal Carbonisation and wood and Coal tar Distillation.	(1) Tata Iron & Steel Co.; (2) Berar Cokes Co.; (3) Shalimar Tar Products; (4) Oriental Gas Supply Co.; (5) Mysore Iron & Steel Co.; (6) Government Coking Plants.	(1) and (5)		Since (6) is under government control, trainees may be admitted.
3. Heavy Chemicals, Chemical Industries, Pharmaceuticals & Drugs.	(1) Tata Chemicals; (2) Bengal Chemicals & Pharmaceuticals; (3) Meitner Chemicals; (4) Travancore Chemicals & Fertilisers; (5) Eastern Chemicals Co.; (6) Pioneer Magnesia Works; (7) Chemicals Corporation of India; (8) Contact Acid & Chemical Co.; (9) D. C. M. Chemical Works; (10) Cordite & High Explosives Factories; (11) CIPLA; (12) Calchemico; (13) Zandu Chemical & Pharmaceutical Works; (14) Standard Drug Co.; (15) Industrial & Testing Laboratory, Bangalore; (16) Alembic Chemicals; (17) Sarabhai Chemicals; (18) Smith Stanistreet Co.; (19) Alpha Chemicals; (20) Standard Pharmaceutical Co.; (21) Parry & Co.; (22) Mysore Chemicals & Fertilisers; (23) Phoenix Chemical Works; (24) Birla Bros; (25) Shambhu Nath & Sons; (26) Indian Iron & Steel	(1), (3), (7) and (8)	15	The other concerns also might admit trainees.

Co.; (27) D. Waldie & Co.; (28) Cawnpore Chemical Works; (29) Dharamsi & Co., Bombay.

4. Soaps & Cosmetics.

- (1) Tata Oil Mills; (2) Lever Bros.; (3) Kerala Soap Works; (4) Godrej Soap Co.; (5) Swastik Oil Mills; (6) Modif Industries; (7) D. C. M. Soap Works; (8) Bengal Chemical & Pharmaceutical Works; (9) Calchemico; (10) Mysore Soap Factory and many other concerns.

5. Textiles

- All affiliates of Indian Textile Manufacturers Association and other major textile Mills.

(1), (3), (7) and (8)

The other concerns also might admit trainees.

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Although no definite information is available regarding the firms, which are willing to provide facilities for advanced training in textile chemistry & engineering most of the Mills usually admit apprentices in considerable numbers and it may be assumed, these will agree to take in more men under the present scheme. Besides, the Indian Textile Manufacturers Association has established a research association with plans for extensive research laboratories. It may also be expected that at least about 100 additional men may be provided for in the existing Mills.

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No definite information is available, but it is likely that provision can be made in the bigger firms for advanced training in tanning and allied fields. About 25 men may be thus accommodated.

7. Paints & Varnishes, Resins and Turpentine.

6. Leather & Leather Products.
(1) Cawnpore Tanneries; (2) Chrome Leather Co.; (3) Bata Co.; (4) Flex Co.; (5) Bengal Tanneries; (6) North-West Tanneries; (7) Gordon Woodroffe Co. Madras; (8) Mysore Chrome Tanning Co.; (9) Cooper Abbas & Co.; (10) The Eastern Tanneries & many others, big and small.
(1) Shalimar; (2) Jenson & Nicholson; (3) Constituents of IPMA; (4) Good Lacs Wall; (5) Hadfields; (6) Hoyle, Robson, Barnett & Co.; (7) D. Waldie & Co.; (8) Balmer Lawrie & Co.; (9) Macfarlane & Co.; (10) Wilkinson Heywood & Clark & Co.; (11) Robert Kearley & Co.; (12) Lyall Marshall & Co.; (13) Jay Engineering Works; (14) Spence Ltd.; (15) Robert Ingham Clark; (16) Jello Resin Co.

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No definite information is available, but most of the firms have good laboratory and factory facilities to offer for advance training and can on the whole provide for at least 35 trainees.



Subject.	Name of Concern.	Firm willing to take in trainees.	Probable No.	Remarks.
8. Paper	(1) Titaghur Paper Co; (2) Shrigopal Paper Mills; (3) Mysore Paper Mills; (4) Upper India Cooper Paper Mills Co; and constituents of Indian Paper Manufacturers' Association.	(3) & (4)	8-10	The rest of the firms are likely to provide training facilities.
9. Sugar and Alcohol	Important sugar factories in the country.	....	..	No definite information is available, but it is likely that most of them will offer facilities for training to the extent of about 50 candidates on the whole.
10. Glass and Ceramics	(1) Bengal Potteries; (2) Gwalior Potteries; (3) Mysore Porcelain Factory (4) U. P. Glass Works; (5) Sodepur Glass Works; (6) Ogale Glass Works; (7) Ganga Glass Works; (8) Capital Glass Works; (9) Kaycee Glass Works; (10) Scientific Indian Glass Works; and several others big and small in U. P., Calcutta and elsewhere.	....	..	No definite information is available, but it is likely that some of them will admit trainees. It is, however, to be noted that most of the glass companies are working along obsolete lines and, therefore, can offer few facilities for advanced training in glass technology.
11. Cement	Cement Companies of Dalmia; and the constituents of Associated Cement Companies.	....	..	No definite information is available, but since most of them usually admit apprentices, can now offer facilities for advanced training for at least 20 men under this scheme.
12. Rubber	Dunlop Rubber Co.; Firestone Tyre and Rubber Co.; Bata Shoe Co.; Bengal Water-Proof Co; A. K. Sarkar and Co.; Travancore Rubber Works; Indian Rubber Manufactures.	....	..	No definite information is available but it is likely that most of the firms will admit men for training.
13. Mineral Oil & Refining	Attock Oil Co., Assam Oil Co.	....	..	The above remarks hold good.
14. Manganese & Copper Mining.	Four firms	....	..	The firms are willing to admit trainees but the number is not yet known.

CHAPTER II

Programme for provision of facilities for education, training and research for engineering personnel which can be initiated within the next six months.

BY

A. N. KHOSLA

The two main handicaps at present are lack of equipment and shortage of professors. The shortage of college and hostel accommodation is yet another handicap but of lesser significance.

2. We have to consider engineering training under three categories:

- (a) Engineering officers.
- (b) Engineering subordinates and draftsmen.
- (c) Technicians.

The number required under each of the categories (b) and (c) will be three to four times that under category (a). A balanced scheme of training must provide for training to the required extent under each category.

3. It will take some time before our long term plans can be implemented. In the interval—and this is the period of emergency—there is urgent need for increasing the output of technical personnel from colleges and schools. These needs can be met in the following ways without lowering efficiency.

(i) The course of training at the engineering colleges and schools should be reduced by curtailing vacations and introducing additional hours of teaching. This was followed with success at the Thomason Civil Engineering College, Roorkee, as a war measure.

(ii) Double shifts and evening classes should be introduced in colleges, schools and research laboratories, wherever possible. Professors should be required to put in more hours of work during this period of emergency and given additional pay for this additional work.

It may be argued that the professors, lecturers and demonstrators have already too many hours to put in during the week with the result that they have little time to devote to advanced studies, or research. It must, however, be recognised that, as conditions stand at present in India, only a very limited number of professors and lecturers care to devote time to advanced studies or to carry out research. Most of them find these spare hours hanging heavily on them which they try to fill up with "bridge" and other futile social functions. In the nation's hour of need, these superfluities must go, spare hours put to useful work and the teaching staff asked to devote more time to teaching work and train more students. Those among them who are genuinely desirous of pursuing advanced studies and research should be given full opportunity to do so. When the emergency is over more and more professors will have more and more free time for research and advanced studies.

It is pointed out that while the preparation of a lecture takes some considerable time, the delivering of the same lecture to two classes instead of one will not take more than an additional hour or so. In other words with a few additional hours of work per week on the part of each professor a large number of additional students can be trained. With the arrangement of double shifts, if adequate additional teaching staff can be made available, the same accommodation and equipment will suffice for teaching the additional number of students. In this way the out-put of students can be considerably increased if not actually doubled without much additional cost. High standards must, however, be maintained at all times and quality must not be sacrificed for quantity.

(iii) Engineers in Government and other services should be encouraged and, where necessary, required to devote some of their time to delivering specialist lectures in the engineering colleges and schools in subjects in which they have special knowledge.

The Heads of the Departments or Organisations concerned should nominate suitable officers and subordinates for the purpose, each one of whom should be given a suitable honorarium for this additional work.

For instance, officers in various engineering services, namely, irrigation, hydraulics, buildings and roads, railways, water supply, agriculture, electrical, mechanical, aeronautical, chemical, industry, etc., should be called upon to deliver a series of special lectures in these subjects, the basic ground work for which will remain the concern of the regular college professors and lecturers. This will relieve strain on the college professors and set some of their time free for training additional students or for research. To the students it will bring the benefit of latest ideas and a knowledge and appreciation of the up-to-date developments in the various fields of engineering activity.

Similar remarks would apply to the Research Officers and Research Assistants serving in the various Government and other Research Organisations, located within reasonable distance of the engineering institutions.

(iv) Government should make arrangement in the various Government Departments, Research Stations and Industrial Undertakings, for the compulsory training of students at various stages of their career in the colleges and schools for a period of one year after they qualify. The Departments and Organisations concerned should be required to give special attention to the training of these students as practical training is of the utmost importance both to the candidates and the Departments and Organisations in which they are to serve. All such trainees should be given a stipend during the period of training. Quarterly or six-monthly reports on the work of these trainees should be submitted by the training officers to the Heads of Departments of Government or other Organisations. At the end of the training period, a copy of the final training report on each trainee should be sent to the Principal of the College concerned.

(v) To save time on preliminaries in Technical Institutions, the many Arts and Science Colleges and schools may be encouraged to give a certain amount of technical and vocational bias in their scheme of education.

For instance, in the high schools the curriculum in the Senior classes may include subjects such as mensuration, drawing, elements of mechanics, surveying, etc., and some vocational training such as masonry, carpentry, smithy, etc. Similar technical and vocational work including radio science and practice should be introduced in the intermediate and degree classes.

(vi) In order to meet the greater demand of engineering subordinates a greater number of engineering schools should be opened. Rapid progress in this direction should be possible by adding engineering classes to the many Arts and Science Colleges spread all over the country. Common subjects like Mathematics, Chemistry, Physics, etc., the Engineering students could read with the Science students. For technical subjects they may have separate lectures and separate teachers should be employed for the purpose. This will very considerably reduce the number of additional teachers and the amount of additional equipment required for the purpose. Successful experiment on these lines was carried out for many years in the D.A.V. College, Lahore.

(vii) A new engineering college and at least one engineering school should be set up in East Punjab at Amritsar, Jullundur, Ludhiana or Ambala. But until such time as this can be done, the Thomason Civil Engineering College

should admit the required number of students from the Punjab. Similarly, a new engineering college should be set up in East Bengal.

(viii) The Jadavpur College at Calcutta should be expanded.

(ix) Government should take over certain private engineering schools and with suitable additional staff and improvements in equipments and accommodation arrange to train engineering subordinates on well established standards.

(x) In order to maintain uniform standards of teaching throughout the country the All-India Council of Technical Education specify the minimum equipment required for institutions of various categories. Further to make sure that the out-put of students is not increased at cost of efficiency, outside examiners should have a hand in the college final examinations.

(xii) All Engineering Institutions in the country should be open to candidates from all over India, irrespective of the province of origin of the candidate or the province of location of the Institution.

Students from India can seek admission into any of the British, American or European Universities but in India students from one province are debarred from seeking admission into the Engineering Colleges and Schools located in any other Province. This practice is against the best interest of the country, as apart from engendering provincial exclusiveness, it leads to non-uniformity of teaching standards and prevents the impact of talent from different provinces so necessary to bring out the best in our young men.

(xiii) The four regional Institutions on the model of the Massachusetts Institute of Technology should be set up with the least possible delay.

(xiv) The remuneration of professors should be given the most careful consideration and must be at par with other services in respect of pay scales and prospects. If we want to maintain high standards in teaching and aim at turning out high class students, we must have the best men as professors.

4. I am making no special recommendations for immediate improvement in research facilities, as in the Centre as well as in many Provinces and States large Engineering Research Institutions are already in the course of being set up. Because of the difficulty of obtaining adequate equipment, this work cannot be appreciably accelerated. These research stations will deal with all matters relating to hydraulics, navigation, hydro-electric power development, buildings, roads, soils, materials of construction, geology, seismology, hydrology and various other subjects.

CHAPTER III

Measures which can be implemented during the next six months for speeding up education, training and research in agriculture and allied subjects

By J. N. MUKHERJI

The Sub-Committee of the Scientific Man Power Committee has been asked to suggest measures which should be put into immediate operation with a view to achieving:—

(a) the immediate improvement and expansion of facilities for scientific and technical training in Indian Universities and special institutions, and

(b) the promotion and development of scientific and technical research.

Since scientific and technical training and research are closely linked, it has been found convenient to treat them together.

In considering what should be done, we must first have some idea as to the existing facilities and the annual output of trained men in the different branches of agricultural science and husbandry, forestry, fisheries, and the botanical and zoological survey organizations. The information available is given in Annexure II.

Unfortunately, the information is meagre and incomplete. The matter has, however, been taken up by the Main Committee. The information should be collected within the next three months so that more definite recommendations can be made within the next six months.

The Agricultural Colleges.—The standard of teaching in the agricultural colleges is very variable and on the whole, of rather low quality; this is particularly true in those cases where matriculation is the minimum qualification of admission. The acceptance of this standard for the new Central Agricultural College is regretted. In Great Britain where the standard is generally considered to be higher than in this country, it has been found by the Loveday Committee on Higher Agricultural Education in England and Wales (vide their report published in 1946, extracts given in Annexure I) that the standard requires to be raised further and they have recommended that completion of the first two years of the Honour's Course (corresponding to Part I of the Tripos) should be the minimum qualification for the Bachelor's degree in Agriculture, which itself is a two years' course.

A serious drawback in the present set-up is that crop and animal husbandry are divorced from each other. This is a mistake, especially in India where the prevailing system of farming is essentially one of mixed farming. Degree courses in Dairy Science and Veterinary Science are not available at all in India. The Indian Dairy Research Institute, however, offers a 15 month post-graduate diploma course in the former subject, and the Indian Veterinary Research Institute gives short courses in veterinary science.

A reference to the extracts from the Loveday Committee's report will show that different courses of studies are required for the training of agricultural graduates for different types of agricultural work, e.g., for agriculture, for horticulture, for practical farmers, for husbandry work which naturally deals with both crops and live-stock, for advisory work and for agricultural research. At present we have only one type of training and as stated above, with different standards. Although in some cases some alternative subjects are offered at the M.Sc. (Ag.) stage, it is neither sufficient to cover the essential range of subjects nor is the standard at all adequate. Dr. A. B. Stewart has also explained in his report to the Indian Council of Agricultural Research the reasons for starting with graduates in pure science for training in the agricultural sciences.

There is also a pressing need for the study and development of agricultural economics and agricultural engineering which are very much neglected subjects at present. Since agricultural economics is concerned with the business side of farming and farming is essentially a business, the agricultural economist should be associated with all agricultural activity. Agricultural engineering also plays an essential part in agriculture but mechanised methods and machines and implements have to be adjusted to Indian conditions.

Besides an increase in the number of courses taught there is necessary for supplementing courses open to students. For example, a soil scientist working with minor elements must have some knowledge of plant physiology, and a plant physiologist working on nutritional problems needs to possess a knowledge of soil science also. Facilities for training in many specialised branches are absent. Our present system is too rigid and there is no provision for meeting requirements of the kind just referred to. Another lacuna in the present courses in agriculture is that sufficient stress is not laid on acquaintance with actual agricultural practices of the country. Agricultural graduates should be apprenticed for one year to farms and provision should be made to enable them to get a first-hand knowledge of the life of peasants and their agricultural practices; and a certificate given to the effect that they have completed this period of apprenticeship satisfactorily. This should be made an essential qualification for appointment.

In India there is at present no provision for effective advisory work. Men who are to undertake such work require special training and the agricultural colleges should provide for this type of students also. (The basic training necessary for advisory staff has been outlined in the Loveday report).

Besides the training of those intending to serve as scientific officers and research assistants, or as advisory staff, it is necessary to consider the training of agricultural technicians and fieldmen or kamdars who constitute a large and necessary class of staff at farms and for assisting those engaged in extension work. According to the report of the Agricultural Education Committee of the Central Advisory Board of Education (1944), 20,000 kamdars will be required during the next 10—15 years for the Central and Provincial Agriculture Departments.

A regular system of training is necessary for these agricultural technicians, fieldmen or kamdars so that in addition to practical training they may have understanding of the elementary scientific principles underlying agricultural practice and so prove to be efficient workers instead of forming merely a class of inefficient labour, as many of them tend to be at present. This training should be given by the Agricultural schools and colleges.

The defects which have been pointed out may be attributed to the initial low standard of the students admitted (especially in agricultural colleges where matriculation is the requisite qualification for admission), the difficulty of study in a foreign language, the low emoluments of the teachers, lack of leisure for the teachers to do research, inadequate library and laboratory facilities, poor equipment and insufficient personal attention to students arising mostly from inadequate personnel for training. Modern agricultural science is a complex and highly developed subject, and requires adequate equipment and highly trained teachers if proper instruction is to be imparted to students.

Various estimates have been made of the number of agricultural graduates which will be required in the next few years. According to the estimates in the Kharegat Memorandum, the Indian Union comprising 177 districts will require for extension work in the Provinces, 44 Assistant Directors; 176 Superintendents, one for each district; 1,056 inspectors, one for each tehsil; 5,280 agricultural supervisors, one for each circle; and 31,400 Fieldmen, one

for each union. The Agricultural Education Committee of the Central Advisory Board of Education estimated that for the development of agricultural and animal husbandry in the whole of India during the next 10 to 15 years, 300 gazetted officers, 15,000 graduate Assistants, 10,000 non-graduate Assistants, 20,000 field assistants will be required for the agricultural departments and 550 gazetted officers, 4,000 inspectors (graduates) and 20,000 stockmen will be required on the animal husbandry side. For the extension of promising results of research to the cultivator's fields, the technical personnel required as recommended by Dr. A. B. Stewart, will be 1232 field experiment assistants (basic qualifications, graduates of agriculture) at the rate of seven for each district; 1232 soil surveyors at the same rate; and 176 statisticians at the rate of one for each district. These figures are for the Indian Dominion only. The requirement of trained personnel for the Central Institutes have been discussed later.

Compared with the annual output of graduates, which was about 270 and licentiates which was about 290 in 1939-40 (later figures not available), the numbers given in the preceding paragraphs require a very large increase in the output of agricultural graduates and of men trained for agricultural research.

The question is how an immediate increase in number can be achieved. Although it is not possible to give an estimate of actual increase in numbers, one way is to introduce a shift system so as to utilise fully the existing laboratory facilities. This will, however, mean that the number of teachers will have to be increased. To provide for this and for additional accommodation and equipment which may be necessary, the Government should make bloc grants. It should also be possible to establish a Faculty of Agriculture in many universities where this has not been done. Much of the training can be given immediately and economically and also supplementary facilities should not be difficult to arrange. In order that an estimate of the sums actually required and of what can be done immediately to secure diversification of the regular courses of studies and introduction of supplementary courses may be obtained without delay, the Scientific and Technical Manpower Committee should arrange that some of its members may visit the different centres for personal consultation with the Universities, Heads of the Colleges and Institutes concerned, and make their recommendations before the end of three months.

The action suggested above is in respect of immediate needs only, but it would, however, help the formulation of long-term plans. For securing a balanced development of agricultural training, keeping in view the considerations which have been discussed above, it is essential that a Council of Agricultural Education on which both the Centre and the Provinces are represented should be immediately established. It should not be unwieldy in size and consist of representatives of the Central Department of Agriculture, the Universities, Agricultural Colleges, Provincial Departments of Agriculture and the Central training institutes. The Council should be able to submit its report on the short-term aspects within the next six months.

Another immediate necessity is the establishment of farms with a minimum of equipment in each region, characterised by distinctive climatic and soil conditions. Some of the existing experimental stations and smaller farms may be developed for this purpose, but many will have to be located in new sites. The evolution of suitable cropping systems and correlated soil-crop management, which will improve and maintain soil fertility, give an over-all optimum yields of crops over a long time and meet local regional and national needs, should form one of the major items in our policy of agricultural research and development. In view of the many Commodity Research stations and institutes which deal only with the needs of particular crops as distinct from

a cropping system characteristic of soil and climatic regions, it is necessary to consider immediately how the Commodity stations could be fitted into the objective mentioned above. Research and Development in agriculture are intimately connected and to ensure their balanced development a conference of the Directors of Central Research Institutes, and of Commodity Stations and representatives of Provincial Departments of Agriculture in charge of research should be called to consider scientific aspects and evolve a plan of development of research, extension and advisory work.

Universities.—The universities constitute the main source of supply of science graduates and I.Sc's required for specialisation in special branches of science including the agricultural sciences; and it is to the universities that we must look for an increase in the output of such trained men. The remarks already made about the variability and low standard of teaching apply in some measure to the universities also. Besides expansion of what is being done at present in the way of training, it is necessary to effect improvement both in the variety and the standard of the subjects taught. An aspect of the development of scientific training which requires immediate attention is the desirability of introducing something like the 'unit' system prevalent in the U.S.A. This will enable a greater flexibility in the choice of subjects for degree courses as also for supplementary courses of instruction.

Many branches of science are neglected or even entirely omitted. For example, most universities teach Botany but this is done in a general way and systematic botany is not given proper attention. The science of genetics which is so important for a proper study of living things, if taken up at all, is finished in four or five lectures. Numerous such examples could be given. The result is that students who are admitted for postgraduate courses in the agricultural sciences such as plant breeding, plant pathology, agricultural entomology, etc., do not possess adequate basic knowledge necessary and teaching has to be started from the bottom with the natural result that the standard of training cannot be raised.

As in the case of the agricultural colleges, action which may be taken immediately to increase the output and improve and devise the training is to provide additional teachers and increase the grants. It is suggested that a bloc grant equivalent to the total expenditure for one year should be immediately given to each university. They should be permitted to carry over to the next year what they cannot spend within the next six months; such bloc grants will enable comprehensive schemes to be drawn up which will be considered later in detail.

The members of the Manpower and Technical Committee which it has been recommended should go round the agricultural colleges should visit the universities also and make an estimate of their possibilities of improving output as also diversification in so far as they concern agricultural subjects. The Council for Agricultural Education will have as one of its functions the development in the universities of basic sciences related to agriculture.

Central Institutes.—In Annexure III, a, b, c, are given the requirements of the existing and proposed institutes at the centre, for research and training. The summary of the requirements in respect of gazetted staff and technical non-gazetted staff is given below under the heads:—A—Agriculture, B—Animal Husbandry and Veterinary Science, and C—Administrative and Development work.

A. Staff.—Gazetted—770; Technical Non-Gazetted 8,291.

Expenditure (Non-recurring).—557.21 lakhs.

B. Staff.—Gazetted—148; Technical Non-Gazetted 605

Expenditure (Non-recurring).—579.99 lakhs.

C. Staff.—Gazetted—176; Technical Non-Gazetted 196.

Expenditure (Non-recurring).—49.55 lakhs.

Grand Total: Staff.—Gazetted 1,089; Technical Non-Gazetted 4,092.

Expenditure (Non-recurring).—1182.75 lakhs.

The estimates refer to different periods of expansion varying from 3—5 years excepting the staff required for the Indian Council of Agricultural Research which is for one year. The numbers receiving post-graduate training in the Central Institutes and the proposed increase in the annual output thereof is given in statement of Annexure II. It will be seen at a glance that it will be difficult under present conditions to supply for a long time to come quite a major portion of the staff required even of the minimum standard necessary, unless the training programme of the Central Institutes is speeded up in all possible ways.

Great difficulties are being experienced in implementing the expansion schemes of the Research and Training Institutes. These difficulties are:

(a) **Difficulties in getting suitably trained men specially in the higher cadres.**

—The main cause for this difficulty is the fact that at present scientists in this country do not receive proper recognition. In other countries scientists are included among the best paid men. In India, however, a distinction is drawn between administrative and scientific services to the disadvantage of the latter. If we are to attract the best brains for scientific work, it is essential that not only should the scientists not be at a disadvantage compared to those serving in administrative and other spheres of work in respect of emoluments, but the status of the scientists should be raised. At present scientists in India tend to have a subordinate status, and steps should be taken to rectify this position. It should be emphasised that it is not the actual amount of the salary that matters, but its comparative value as compared with the emoluments paid in other branches of Government service.

The present system of recruitment through the Federal Public Service Commission is satisfactory for administrative and non-technical services. For the scientific services, however, it is necessary to take cognisance of the fact that some of the most highly talented scientific workers do not care to apply for posts advertised under the present system and in many cases emoluments have to be settled within the scale by negotiation, and a method must be found by which services of these men can be obtained. Machinery is also needed for the expeditious filling up of temporary vacancies. This can perhaps best be done by local selection committees on which a representative of the Department and Commission will be present. The existing system, therefore, requires to be made more flexible to deal with these two points, and greater liaison should be established between the Federal Public Service Commission and departmental representatives so that decisions may be taken more quickly.

It is necessary to send abroad men who are already working in universities and official and non-official research institutes and who have the necessary training and experience to benefit by visits to important institutions abroad where they can see the latest advances in technique and equipment and make contacts with leading research workers in their respective fields. The present system of sending raw graduates abroad cannot be justified except in the case of subjects where facilities for training are not available in this country. It may also be desirable to give a larger number of scholarships to induce graduates and post-graduates to come to the existing research institutes in larger numbers than at present.

(b) The second difficulty is the lack of adequate equipment. At present facilities in regard to equipment are inadequate and out of date in most of the scientific and technical institutions. In many of them it has not been possible since 1939 even to replace what they had and very little upto-date equipment is

available. Apart from providing the finances which are required, the government can immediately assist by making dollar exchange facilities available direct to the industries and by removal of restrictions on the import of scientific equipment. It is one of the avowed objects of the UNESCO to help in the matter of procurement of books, journals, apparatus and other materials required for research. Arrangements should be made immediately with the Indian Supply Mission in America and the High Commissioner in the United Kingdom for importing the necessary equipment. Arrangements made through official agencies, however, tend to be slow and there are other disadvantages. The importance of giving full scope to Indian agencies for importing and supplying scientific equipment requires to be emphasised. Because of their business interest and dealings with manufacturers abroad they can ensure a quicker supply, fuller information and a wider choice of instruments and materials. Government should encourage Indian agencies as with experience they are likely to undertake manufacture of scientific instruments as some have already done. Government may also as a matter of policy encourage the establishment of firms undertaking the manufacture of apparatus, chemicals, and instruments required for scientific research. Every institute should be asked immediately what their requirements are in respect of dollars so that the total requirements may be estimated and early action taken to secure what is required.

(c) **Buildings.**—Under the present system a very great deal of time is wasted in the construction of buildings even though funds have been sanctioned and plans approved. Although, for example, additional accommodation urgently required at the Indian Agricultural Research Institute was sanctioned a long time ago, practically no progress has been made up-to-date. Besides many items of ordinary equipment and fittings of the laboratories for scientific work have to be made through the C.P.W.D. and it takes unduly long time to do such work. Under such conditions, the research worker may have to sit idle for lack of the necessary facilities or divert his attention to some other item of work and eventually lose incentive and interest.

(d) One outstanding cause of delay in progress is the time taken for decision on many points relating to the staff, equipment, and work of the research institutes. Quite often many schemes urgently required in connection with greater food production have got stuck up at various stages.

The remedy for this and other difficulties enumerated above lies in—

- (1) a greater delegation of power to the heads of the research institutes;
- (2) funds should be placed at their disposal in the form of a block grant to implement programmes approved by government. The head of the institute should further have the authority once a scheme has been approved and funds allotted to take action he considers most appropriate to achieve the desired results without delay.
- (3) Committees should be set up on which representatives of the Central Public Works Department and the Finance Department will sit with representatives of the Department of Agriculture and the head of the institute to expedite action.
- (4) Decisions on technical matters should be arrived at in fullest consultation with technical men at all stages. For any changes for reasons of policy technical men should be taken in full confidence.

J. N. MUKHERJEE.

LIST OF ANNEXURES

ANNEXURE I—Extracts from Loveday Committee's Report on Higher Agricultural Education in England and Wales, 1946.

ANNEXURE II—Statement showing the number of passes in Agricultural Courses of various categories:—

(A) 2-year courses in agriculture; (B) Number of passes in Agriculture Degree Examination; (C) Post-graduates in agricultural sciences at the I.A.R.I., (D) 2-year courses in Dairying (I.D.D.); (E) Post-graduates in Dairying at the Indian Dairy Institute, (R) Statement showing the institutions under the Agricultural Department, their present output of trained personnel and proposed output under expansion scheme.

ANNEXURE III—Requirement of various existing and proposed Institutes at the Centre for (A) Research and training in Agriculture, (B) Research and training in Animal Husbandry and Veterinary Science and (C) Administrative and Developmental work.

ANNEXURE IV—Estimates of the requirements of technical personnel in the provinces (A) for extension work as recommended in the Kharegat Memorandum, (B) as recommended in the Report of the Agricultural Education Committee of the Central Advisory Board of Education, 1944 and (C) for experimental and investigational work in the provinces as recommended by Dr. A. B. Stewart in his Report on Soil Fertility Investigations in India.

ANNEXURE V—Extracts from the Report on Soil Fertility Investigations in India for planning and conduct of future experiments, 1947.

ANNEXURE VI—Training of students abroad.

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ANNEXURE I

Extracts from Loveday Committee's Report on Higher Agricultural Education in England and Wales, 1946

Classes of the whole range of occupations for which the system of this agricultural education may have to provide:—

1. *The Practical Farming Class.*

Farmers (general and specialist, including managers on the large farms);
Commercial horticulturists;
Park superintendents and head gardeners.

2. *The Estate Management Class.*

Landowners; Rural estate agents; County land agents; Land Commissioners; Rural land utilization officers.

3. *The Advisory Class.*

Scientific Advisers (including bacteriologists); Agriculture; husbandry advisers; Horticultural advisers.

4. *The Teaching Class.*

Teachers of science and school gardening in secondary schools or county colleges; Farm Institute lecturers; University college lecturers in husbandry and the agricultural science.

5. *The Research Class.*

Fundamental research workers, Husbandry research workers.

6. *The Economic Class.*

Agricultural economists (engaged in research, teaching or advisory work)
Farm management experts; Marketing officers.

7. *The Engineering Class.*

Agricultural engineers; Experts on mechanised husbandry; Civil engineers and architects.

8. *The Commercial Class.*

*Agricultural and Horticultural Teaching in the University (paragraphs 17—21).—*The ordinary courses in agriculture and horticulture at present offered by the universities are 3-year courses to which the student may be admitted on matriculating or securing exemption from matriculation. The arrangement of the courses varies amongst the different universities. Teaching of pure science upto the Intermediate standard is essential. If one is devoted to it, the remaining two years are not enough for the theory and practice of agriculture or horticulture to be brought upto a satisfactory standard. It was therefore recommended that either the standard of pure science presupposed by the 3-year course should be extended to four years.

As a good grounding in the natural sciences must be the foundation of agricultural or horticultural study at the university, students in their one year or two at school should give time to the study of chemistry, biology and physics with the necessary mathematics. Universities would be justified in taking for granted in their teaching the appropriate standard of scientific knowledge without necessarily imposing any formal test. This may compel the students to stay at school till they were nineteen, which should not be discouraged.

The improved degree courses represent the highest level at which agriculture or horticulture can be taught, but they are materially below science honours degree courses. More advanced teaching in agriculture or horticulture can best be given in the form of graduate course designed to follow at least the

first part of an honours' degree course in pure science, that is to say, by two years' study of pure science at honours level.

Courses Recommended.

*Improved degree courses in Agriculture (paragraphs 22-23).—*The specific aims of a university course suitable for the practical man are:—

- (a) to give a thorough understanding of British Agriculture as an industry and to promote thought about it by providing an education on a broad scientific basis;
- (b) to impart appropriate knowledge of the sciences, of their agricultural applications and of the physical, biological and economic factors by which agricultural policy and practice are determined;
- (c) to give such knowledge of British Agricultural practice, based on principles, as is required for an understanding of the application of the sciences to agriculture and as a preparation for farming and related activities.

The existing courses for a degree in agriculture have not in the main been consciously planned in accordance with the foregoing principles. On the understanding that each university would interpret them in accordance with its own experience, judgment and academic policy, the details of the ordinary degree course in agriculture as a training for the general farmer have been set out above.

The following courses of study are contemplated. They include existing courses with or without modification.

List of the Courses.

1. Improved degree courses in Horticulture (paragraphs 71—75).
2. Two-year courses of less than the degree standard, in agriculture (paragraphs 34-35).
3. Two-year courses of less than the degree standard, in horticulture (paragraphs 76-77).
4. Two-year courses of less than the degree standard, in Estate Management (paragraph 66).

5. Graduate Courses—

- (i) Agriculture for graduates in science who intend to become husbandry advisers, husbandry teachers or practical farmers (paragraph 95).
- (ii) Agriculture for graduates in agriculture who intend to become husbandry advisers or teachers (paragraph 96).
- (iii) Agriculture for graduates in commerce who intend to become marketing officers (paragraph 132).
- (iv) Agriculture and estate management for graduates in science (law or economics) who intend to become teachers or research workers in estate management (paragraph 69).
- (v) Agriculture and agricultural economics for graduates in economics who intend to become agricultural economists (paragraph 127).
- (vi) Agriculture and farm machinery for graduates in engineering, who intend to become agricultural engineers (paragraph 142).
- (vii) Agriculture, water supply, land drainage and irrigation for civil engineers who intend to become drainage or irrigation engineers (paragraph 149).
- (viii) Agricultural sciences for graduates in science who intend to become research workers or scientific advisers in agriculture or teachers of agricultural science (paragraph 86).

- (ix) Horticultural sciences for graduates in science who intend to become research workers or scientific advisers in horticulture (paragraph 104).
- (x) Horticulture for graduates in science who intend to become advisers in or teachers of horticulture or practical horticulturists (paragraph 105).
- (xi) Horticulture for graduates in horticulture who intend to become advisers in or teachers of horticulture or practical horticulturists (paragraph 105).
- (xii) Poultry, husbandry for graduates in science who intend to become research workers or scientific advisers on poultry problems (paragraph 100).
- (xiii) Poultry husbandry for graduates in agriculture (with a variant for graduate in science) who intend to become advisers in or teachers of poultry husbandry (paragraph 101).
- (xiv) Estate managements for graduates in agriculture who intend to become rural land agents or the like (paragraph 82).
- (xv) Agricultural economics for graduates in agriculture who intend to become agricultural economists or farm management experts (paragraphs 128 and 130).
- (xvi) Engineering and farm machinery for graduates in agriculture who intend to become farm mechanization experts (paragraph 143).
- (xvii) Commerce for graduates in agriculture who intend to become marketing officers (paragraph 132).
- (xviii) Bacteriology for graduates in science who intend to become advisory bacteriologists, dairy bacteriologists, or the like (paragraph 90).

The Husbandry Adviser.—The training of the husbandry adviser presents greater difficulty. It is in this branch that the staff employed have in the past differed widely in the intellectual calibre and technical qualifications. Whereas the staffing of the specialist advisory service has been governed by the standards of the universities and colleges by which its members are directly employed, the general advisory service has been staffed more or less at random with graduates of various kinds and with holders of one or other of the university, college or national diplomas whose standards vary greatly amongst themselves. In certain specialised branches of husbandry there has been, at any rate until lately, no specific qualification higher than a national diploma: in the absence of any general standard and in face of practical objections to prolonged training, the diploma has perforce been accepted as constituting in itself a sufficient qualification, in spite of informed criticism of the shortcomings of diploma courses, especially on the scientific side. This inequality should not be allowed to persist in the National Agricultural Advisory Service, not only because of its need for staff of the highest quality but also because, if it is to attract the best men into all its branches, it must offer opportunities of a progressive career which, as the Luxmoore Committee pointed out, the old country service failed to provide. If, as we believe to be desirable and we understand to be intended, the higher posts in the National Agricultural Advisory Service, which will require administrative capacity as well as technical competence, are to be open to any member of the staff who shows the necessary talent, whatever his specialist field, it is imperative that there should be a common minimum standard of qualification throughout the service.

We therefore believe that the best candidates for husbandry advisory posts are likely to be found amongst students who have taken an initial course in

pure science. We hope that some of them will be men who, on developing the appropriate interests, turn over to agriculture at the end of a full honours course, notwithstanding the length of the complete course of training thus involved. A strong enough foundation of scientific knowledge would however, be provided by the first part of the honours degree course, that is to say by two years' study of pure science at honours level. To either course of training two years' study of agriculture and the agricultural sciences must be added. It seems to us immaterial whether this be treated as a graduate course or the second part of a four-year degree course of which pure science of honours standard form the first part. The essential point is that two years of agriculture are superimposed on a good honours standard in pure science.

We have considered whether it is desirable and practicable to provide separate courses of training in the specialized branches of farming such as crop husbandry, grassland management and dairy farming. They would obviously be useful and we see no reason why a university should not, if it so desires give a specialist bias to a graduate course such as we have recommended in the last paragraph. The amount of material provided by any one branch, however, that would be suitable for teaching at graduate level seems to us to be scanty and the number of students wishing to take a particular course at one time might be so small as to render its provision uneconomic. As a general rule, therefore, we think that the need for specialists in the different branches of husbandry can best be met by men with a general training who are later led by personal predilection to acquire special knowledge through private study and practical experience.

For the husbandry adviser, as for the scientific adviser, any graduate course must obviously be regarded as only part of a longer training that includes the whole of his probationary period. Indeed the arguments advanced in paragraph 88 apply with even greater force to the husbandry adviser, who will be in more constant contact with farmers and will need a thorough first hand knowledge of farming practice if he is to carry conviction. For this purpose the probationary period should include attachments to advisory centres and experimental farms, as well as opportunities for travel, particular investigation and private study, before the probationer takes up his first post under a district officer. Except for the scientist turned agriculturist, who must needs take a systematic course of instruction in agriculture as part of his initial training, any formal course of graduate study should not necessarily be taken at the beginning of the probationary period, but might well follow a spell of practical experience in the field. We have already suggested that arrangements for the training of advisory officers should be as elastic as possible, and we believe that for husbandry advisers in particular there is a fruitful field for experiment on the part of the Ministry for collaboration with the universities and the research institutes,

Research.—Research is the foundation of technical efficiency and progress. Advisers and teachers are in their several spheres the channels by which a knowledge bearing on agricultural problems is conveyed to those who can give effect to it in improved practice: they are dependent for that knowledge on the constant prosecution of research. Research work ranges from the pursuit of knowledge for its own sake without regard to its utility, through the investigation of specific problems that raise scientific questions of a fundamental character, to enquiries into matters closely related to every day practice. Agricultural research may for our purposes be regarded as excluding the purely "disinterested" search for knowledge and as confined to systematic investigation, whether fundamental or practical, such as may be conducted by university departments of agriculture or by research institutes under the control of the Agricultural Research Council or the Ministry of Agriculture.

Agricultural research demands the highest qualities of intellect and initiative. It offers no scope for routine workers except in subordinate posts. For the strictly scientific branches a first or good second-class honours degree in a suitable combination of natural sciences is necessary. Specialised knowledge of the particular branch of pure science appropriate to the student's prospective field of activity may be obtained either before or after graduation, but in any case it must be brought up to the highest standard. Valuable contributions to agricultural research work may be managed by scientists with no knowledge of agricultural theory or practice, but it is clearly desirable that provision should be made for training prospective research workers in the appropriate branch of applied science. The graduate courses that we have recommended for the training of the scientific adviser (paragraphs 86 and 104) would be useful for that purpose. We have referred to the desirability of providing so far as possible a common training of the research worker. Flexibility is essential and a formal course is only one way of meeting his needs at the graduate stage. In his probationary period he may profitably be attached to advisory centres or to overseas research stations, but some time must always be spent in research under the supervision of an experienced worker.

The training of research workers in agricultural economics and in agricultural engineering is discussed under those general headings in the following paragraphs.

ANNEXURE II

Statement showing the number of Passes in agricultural courses of various categories

A—2 year courses in agriculture—

	1937-38	1938-39
Lyallpur	37	31
Dhulia	16	14
Dacca	18	22
Bulandshahr	30	34
Gorakhpur	36	41

B.—Number of passes in Agricultural Degree Examination—

Name of Province	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	Total
Assam . . . . .	..	..	..	..	..	..	..	..	..	..	..
Bengal . . . . .	..	..	..	..	..	..	..	..	..	..	..
Bihar . . . . .	..	..	..	..	..	..	..	..	..	..	..
Orissa . . . . .	..	..	..	..	..	..	..	..	..	..	..
Madras	24	31	55	48	40	30	29	28	30	41	356
Bombay	67	53	..	78	54	42	42	42	48	54	480
C. P.	18	9	..	24	19	26	22	15	17	22	172
Delhi . . . . .	..	..	..	..	..	..	..	..	..	..	..
N. W. F. P. . . . .	..	..	..	..	..	..	..	2	1	2	5
U. P. . . . .	..	32	37	30	50	30	55	55	51	65	405
Sind . . . . .	..	..	..	..	..	..	..	..	..	..	..
TOTAL	109	166	126	238	228	174	163	158	205	242	1,809

Figures for 1939-40—Masters of Agriculture 24
 Bachelors of Agriculture 269
 Licentiates of Agriculture 289

C.—Number of Post-graduates in Agricultural Sciences at the I. A. R. I. —

1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	
10	10	9	12	10	17	13	13	10	12	2-year course.
4	5	5	3	3	2	4	1	9	3	1-year course for ag- ricultural students.
									4	Plant Protection.

D.—2-year courses in Dairying (I. D. D.)—

	1937-38	1938-39
Bangalore	23	...
Allahabad	..	21

E.—Post-graduates in dairying at the Indian Dairy Institute, Bangalore—

1937-38	6,1938-39	7
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N. B.—The figures, as far as available, have been incorporated above.

F.—Statement showing Institutions under the Central Government, Department of Agriculture, their present output of trained personnel and proposed output in expansion schemes.

List of Institutions	Average annual out-put	Expected output
Indian Agricultural Research Institute, New Delhi.	19 post-graduate students.	A 5 year development plan has been sanctioned for the expansion of the Institute with effect from the 1st August, 1946, and when the plan is in full swing the annual output will be 100 Agricultural post-graduate students.
Central College of Agriculture, New Delhi.	....	It is a post-war development scheme and when in fullswing the annual output will be 60 degree students per year. The classes will be started in July, 1947. The first batch will come out in 1951.
Botanical Survey of India, Calcutta.	6 officers are trained annually in systematic Botany and Taxonomy.	A re-organisation plan has been sanctioned but it will not affect the output.
Horticultural Training Class for Agricultural Graduates (under the Agriculture Department).	25 students	Nil.
Ladies Training Class in Advanced Fruit Preservation (under the Agriculture Dept.).	25-30 lady students.	Nil.
Institute of Fruit Technology, Lyallpur.	24 students	Nil.
Superior Forest College, Dehra Dun.	30 superior officers	An increase of 25 is expected in 1949 and 60 in 1950, the output will be 90 superior officers. This is due to the post-war expansion of the Institute.
Indian Forest Ranger College Dehra Dun.	26 Rangers	An increase of 65 is expected in 1949 and 95 in 1950. This will be due to improvement in the Rangers College.
Marine Fisheries Research Station, Madras.	} Short Fisheries' Training Course (20 students).	Some development plans are under consideration and their effect on the output cannot be anticipated at the moment.
Indian Fisheries Research Station, Calcutta.		

List of Institutions	Average annual out-put	Expected output
Deep Sea Fishing Station, Bombay.	....	It is not proposed to institute any regular training course at this station.
Zoological Survey of India.	4	With a view to obtaining suitable Zoologists required in connection with the future expansion of the survey an <i>ad hoc</i> scheme for training 4 candidates in the systematics of Zoology for 2 years was sanctioned in 1945. The scheme is expected to be continued for about 5 or 6 years. If the development plans for the Z.S.I. are implemented the output may increase to 6.
Indian Veterinary Research Institute.	40 post-graduate students.	In the re-organisation scheme which is still under consideration and which provides for additional buildings and staff etc. the output will be about 72 post-graduate personnel. It may, however, be mentioned that I. V. R. I. is not primarily a teaching institute. Its main object is Research in Veterinary.
Indian Dairy Research Institute.	(a) I. D. D. Course—25. (b) Post-graduate Course—12. (c) Short Courses—30.	In the re-organisation scheme of the I. D. R. I. which also is under consideration it is expected that provision would be made at the start for training out some 25 B.Sc.'s (Dairy Science) personnel annually rising to 40 in subsequent years in addition to the other courses.

ANNEXURE III

Requirements of various existing and proposed Institutes at the Centre for Research and Training

A.—Agriculture—

Indian Agricultural Research Institute (Five years).

Gazetted	56	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	205	Buildings	52.00
Annual Average	52	Equipment	8.00

Years).

Indian Fisheries Research Institute (Three

Gazetted	64	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	48	Capital	63.99
Annual Average	37		

Institute for Fruit Culture (Three Years).

Gazetted	28	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	154	Buildings	10.75
Annual Average	61	Equipment	6.00

Institute for Vegetable Culture (Three Years).

Gazetted	27	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	131	Buildings	10.18
Annual Average	53	Equipment	6.00

Institute of Agricultural Economics.

Gazetted	9		
Technical Non-Gazetted	39		

Agricultural Marketing Department (Three Years).

Gazetted	76	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	20	Buildings	5.00
Annual Average	32	Equipment.	7.00

Soil Conservation Units (Three Years).

Gazetted	30		
Technical Non-Gazetted	92		
Annual Average	41		

Ornithology in Relation to Agriculture (Three Years).

Gazetted	19	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	133		
Annual Average	51	Capital	.59

Central Commodity Committees (Three Years).

Gazetted	375	Non-recurring Expenditure in lakhs.	
Technical Non-gazetted	2,250		
Annual Average	875	Capital	360.00

Central Agricultural College (Four Years).

Gazetted	24	Non-recurring Expenditure in lakhs,	
Technical Non-Gazetted	55	Building	19.00
Annual Average	20	Equipment	10.00

Rice Research Institute (Five Years).

Gazetted	22	Non-recurring Expenditure	5.00
Technical Non-Gazetted	84		
Annual Average	21		

Zoological Survey of India.

Gazetted	40	On account of impending constitutional	
Technical Non-Gazetted	80	changes, the implementation of the scheme	
		has been held up.	

B.—Animal Husbandry and Veterinary Science.*Indian Veterinary Research Institute (Three Years).*

Gazetted	38	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	34	Buildings	32.69
Annual Average	24	Equipment	2.50

Anti-Rinderpest Organization (Four Years).

Gazetted	4	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	147	Buildings	2.8
Annual Average	38	Equipment	30

Bull-Breeding Farms (Five Years).

Gazetted	50	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	250	Buildings	200.00
Annual Average	60	Equipment	50.00

Central Breeding Farms (Three Years).

Gazetted	6	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	51	Buildings	65.50
Annual Average	19	Equipment	28.00

Experimental Livestock Breeding Farms (Five Years).

Gazetted	22	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	114	Buildings	111.20
Annual Average	27	Equipment	42.00

Central Animal Husbandry College (Four Years).

Gazetted	23	Non-recurring Expenditure in lakhs.	
Technical Non-Gazetted	9	Buildings	38.55
Annual Average	8	Equipment	6.45

C.—Administrative and Development Work.*Indian Council of Agricultural Research (One Year).*

Gazetted	45	Non-recurring Expenditure in lakhs.	
		Buildings	25.00
		Equipment	1.00

<i>Indian Council of Agricultural Research, Information Section (One Year).</i>			
Gazetted	8	Non-recurring Expenditure	
		Equipment	15.00
<i>Quarantine Stations for plants (Three Years).</i>			
Gazetted	80		
Technical Non-Gazetted	180	Non-recurring	6.30
Annual Average	80		
<i>Plant Protection Organization (Three Years).</i>			
Gazetted	31		
Technical Non-Gazetted	31	Equipment	1.00
Annual Average	21		
<i>Land Utilization Board.</i>			
Gazetted	5	Equipment	1.00
Technical Non-Gazetted	5		
<i>Indian Council of Co-operation.</i>			
Gazetted	7	Capital	.25

ANNEXURE IV.

Estimate of requirements of technical personnel in the Provinces.

A. As estimated in the Kharegat Memorandum (for extension work).

In India (Dominion) as it will be on 15th August, there will be 176 districts taking 4 districts for a Division—the number of Divisions comes to 44.

Rough approximation can be obtained by taking an average of 12,000 villages for a Division, 3,000 for a district, 5,000 for tehsil, 100 for Kanungos' circle and 20 for a union.

	Total
Kamdar (Fieldman)—1 for each union	31,400
Agricultural Supervisor for each circle	5,280
Inspector at each tehsil	1,056
Superintendent for each district	176
Assistant Director for a Division	44

B. Estimates prepared by the Agricultural Education Committee of the Central Advisory Board of Education, 1944.

It is estimated that during the next 10—15 years the personnel required by Government Departments for the development of Agriculture and Animal Husbandry will be as follows:—

Agriculture

	Total
Field Assistants (Kamdars)	20,000
Non-graduate Assistants	10,000
Graduate Assistants	1,500
Gazetted Officers (Classes I and II)	300

Animal Husbandry—

Stockmen	20,000
Inspectors (Graduates, of the rank of Veterinary Assistant Surgeons)	4,000
Gazetted Officers (Classes I and II)	550.

To enable one to consider the full implications of the above programme, so far as institutions of Agricultural Education are concerned, the nature and length of the training required, for the different grades of personnel may also be stated here.

Agriculture.—

Field Assistants.—One year's course at a Farm Institute which will be located on a model farm.

Non-graduate Assistants.—2 years' course at a special Agricultural School or the normal course at an Agricultural High School.

Graduate Assistants.—4 years' course at an Agricultural College or University.

Gazetted Officers.—A suitable post-graduate course of at least 2-3 years' duration.

Animal Husbandry—

Stockmen and Compounders.—One year's course partly at a Departmental laboratory and partly at a Farm Institute, which is equipped for training in Animal Husbandry.

Inspectors (or Veterinary Assistant Surgeons).—4 years' course at a Veterinary College.

Gazetted Officers.—A suitable post-graduate course.

It is obvious that in order to meet these demands it is necessary to bring into existence as early as possible a comprehensive and planned system of Agricultural Education.

C. *Estimates of requirement of technical personnel as recommended by Dr. A. B. Stewart in his Report on Soil Fertility Investigations in India for the Planning and Conduct of Future Experiments.*

Field Experiment Assistants—7 for each district	1,232
Statistician—1 for each district	176
Soil Surveyors—7 for each district	1,232

(These figures represent the requirements of the Indian Dominion only.)

N.B.—(The ultimate target should be one field experiment assistant for each tehsil. The number of tehsils under the Indian Union will be 1,056, so that the total number of field experiment assistants ultimately will be 1,056).

ANNEXURE V.

Extracts from the Report on Soil Fertility Investigations in India for the planning and conduct of future experiments by Dr. Alexander B. Stewart.

General requirements.—These have been discussed with particular reference to financial outlays, direction of research and extension work, staffing, and a Central Agricultural Information Bureau. The need for a vastly increased expenditure on agricultural research has been underlined, and attention has been drawn to the need for distinguishing clearly between experimentation and the question of whether a particular discovery will be profitable to agriculture. An experiment cannot be expected to pay its way. The view has been expressed that, to meet the demands of modern science as well as the demands of extension work, the time is now ripe for the appointment in each Province and major State of a scientist as a whole-time director of research, in addition to a whole-time director of extension work. It is equally important to ensure that such directors will have adequate number of well-qualified staff under them. There is, in the writer's opinion a very great need for improving the status and salaries of the staffs of agricultural departments in India. The need for whole time field experiment assistants, who could give to individual experiments the care and attention which they require, has been stressed, and the view has been expressed that in the future more attention should be given to the recruitment of graduates in pure science to the agricultural service. Reference has been made to the possibility of setting up a Central Agricultural Information Bureau, which, it is considered, could serve a very useful function in helping Indian workers to keep abreast of the latest developments in agricultural science, both in their own and in other Countries. Other points of general importance have also been summarized under the headings of soils, crops, manurial experiments and cultural practices.

Bridging the gap between knowledge and practice.—Whilst much has still to be learned, it is essential to avoid stagnation in extension work whilst further information is being acquired. The Indian cultivator and his soil are badly in need of help now, and several examples have been given of points to be borne in mind in a normal extension work programme; although each ameliorative measure by itself may make only a slight apparently negligible contribution to general improvement, their effect in aggregate may well become appreciable. A great increase in the use of manures and fertilizers is one of the most pressing needs of Indian agriculture especially in areas where the introduction of irrigation has eliminated lack of water as a limiting factor in crop growth, and the need for ensuring the return to the soil of all materials of manurial value has been emphasized. Attention has also been drawn to other outlets for the extension officers' energies, and the value of models in propaganda work has been stressed. Other suggestions have been made under the heads of (a) Dry farming, (b) Irrigation, (c) Commercial exploitation of useful discoveries, and (d) Land reclamation.

Simple experiments in cultivators' fields.—Reasons why such experiments are necessary have been given and the objectives of such work are stated as: (i) to find the average response to a particular manurial supplement or similar agricultural improvement measure in a given tract, and (ii) to study the interaction of this response with local variations within the tract, and thereby obtain information as a basis for making practical recommendation which would be applicable to specific condition. For reasons which have been discussed, it is suggested that these experiments should be based on districts as major units, with sub-division on the basis of tahsils and villages. The factors of principal importance in the planning and conduct of these experiments have been considered under the following heads: (1) Practical limitations, (2) Statistical considerations, (3) Extension of scope of crop-cutting surveys, (4) Organization of experimental work, (5) Environmental conditions and data on soils, (6) Experimental treatments and (7) Evaluation of results.

Organization of experimental work.—I have already stressed the need for whole-time field experiment assistants on the staffs of agricultural departments, and the number of assistants available will naturally determine the extent to which a scheme of experimentation, such as I have suggested, can be undertaken in any Province or State. As a prelude to obtaining the necessary recruits, the first step which should be taken by responsible authorities is to approve in principle the need for field experiment assistants. As will be seen later, field experiment assistants will also be necessary for detailed experimental work at deliberately selected centres, as distinct from assistants for simple experiments in the cultivators' fields. For the detailed experiment work, such assistants should be responsible to the research officers in charge, whilst assistants for the latter type of experiments, which as indicated really serve as a link between academic research and extension work, should, I suggest, be recruited on a district basis and be responsible to the Deputy Director of Agriculture who, in turn, should maintain close contact with the research officers. If, because of other duties, the Deputy-Director of Agriculture in a particular district is unable to assume responsibility for the conduct and supervision of the field experiment work, an officer may have to be appointed specially for the purpose. For experimental work of the simple type in cultivators' fields, I suggest further that an ultimate target of at least 1 field experiment assistant per tahsil should be set. The supervision and conduct of all field experiments on agricultural holdings within the tahsil would be the personal responsibility of the field experiment assistant who, in addition to making all the necessary arrangements for the laying down and harvesting of the experiments, should also record relevant environmental details and observations on the crop during its period of growth, in addition to undertaking for the agricultural chemist such sampling of soil and produce as may

be necessary for the attainment of objective (ii) of the scheme. It is highly desirable that the field experiment assistants should receive from the officer-in-charge brief courses of detailed instruction on all points affecting the conduct and supervision of the experiments.

In the interval until field experiment assistants are available in sufficient numbers to permit of experimentation on the extensive scale which is necessary, it is important to achieve as much as possible with existing staffs. The extent to which this is possible will vary in different parts of the country, but I suggest as a first step that each Province and major State should endeavour to carry out the scheme in at least one district. I think it well at this stage that all resources should be concentrated on obtaining accurate information for individual districts, as this is likely to yield more tangible results than would be obtained by attempting with inadequate staff to cover larger areas. The primary need for the success of the scheme on a district basis is a minimum of about 6 or 7 field experiment assistants, depending on the number of tahsils, and in each Province and State I suggest that this number of staff should be assigned to full-time work of the scheme.

Research and detailed experimental work of carefully selected centres.—The second main type of experimental work, which should be undertaken simultaneously, has been considered under the following heads: (1) Objectives, (2) Outstanding gaps in knowledge, (3) Selection of centres for experiments, (4) Sub-division of experimental areas, (5) Water and manures, (6) Crop rotations, (7) Cultural practices, (8) Other experiments, (9) Soil surveys and (10) Laboratory investigations.

Selection of centres for experiments.—Reference is made to the unsuitability of many Government farms for further manurial experiment work and to the need for many fresh experimental centres. Such centres, unlike those in 3(a) above, where random selection has been advocated, must be carefully chosen in the light of all existing knowledge of soil, climatic and agricultural conditions in the area which the centre is to represent. A few of the more important considerations affecting the choice of such sites have been outlined, and it has been suggested that the primary selection should be based on data of the type illustrated by the map (p. 18) showing the general distribution of soils in India, with further sub-division on the basis of such factors as textural variations, salt contents, prevailing cropping practices, water supply position, present fertility levels, etc., and with ultimate responsibility for the selection of the centre resting on the agricultural or soil chemist. Concerning the control of land selected for such experiments three main possibilities have been discussed: land on the holdings of co-operative and willing cultivators, land on the estates of progressive *zamindars*, and land which could be acquired, through the revenue departments, for a period of about 10 years. Unduly large acreages of land should not be necessary, as it is felt that, at this stage, more is likely to be gained from a fairly large number of relatively small units than from a smaller number of larger units.

Sub-division of experimental areas.—The suggestion has been made that from the outset, the experimental area should be sub-divided into blocks and maintained as such throughout the period of experiment. There should, for instance, be separate blocks for experiments on water and manures, crop rotations, and cultural practices, as well as a block for other work, such as Botanical investigations. Such questions as ultimate responsibility for particular experiments, methods of cultivation and general management of experiment areas, and possible experimental treatments have been discussed under the appropriate heads.

Soil surveys.—It is impossible to utilize efficiently the resources of a country unless there is available a knowledge of what the resources are and where they are distributed. A soil survey aims at providing an inventory of a country's

soil resources and reference has been made to general aspects of soil survey work in India. The suggestion is made that in the future greater attention should be given to the systematic mapping of soils by means of field studies supplemented by simple laboratory data. Results obtained in the Bombay Province are referred to as providing an example of the practical value of basing investigations on problems of crop production on the results of soil survey. For the attainment of objective (ii) in simple experiments on cultivators' fields, field and laboratory data on soils are necessary, and the suggestion has been made that consideration should be given to the possibility of carrying out soil surveys in at least a few of the districts in which these simple experiments are being conducted over a 3-year period. In view of the vast acreages involved and because of lack of staff, reconnaissance mapping on the scale of 1 inch=1 mile has been suggested. It is estimated that about 7 trained soil surveyors (with suitable labour assistance) would be needed to map a district on this scale in 3 years, and observations have been made on the selection of suitable districts, the methods which might be adopted and the type of information which could be obtained.

Soils.—Whilst there is an urgent need for concentrating on practical work, it is necessary not to lose sight of the fact that a great deal of purely scientific work is required in order to arrive at a correct knowledge of the manurial requirements and crop producing capacities of the various types of soil. Knowledge of the soils is also necessary to ensure the success of irrigation projects, to help in decisions regarding prevention of salinity, or methods to be adopted in the reclamation of saline soils, and to serve as a basis for the interpretation of the results of agricultural experiments, the sites for which should depend more on the suitability of the particular soil than on the availability or accessibility of a given centre.

Environmental conditions and data on soils.—The foregoing observations deal primarily with the attainment of what I have called objective (i) of simple experiments in cultivators' fields, *i.e.*, the measurement of average response in a district as a whole. Objective (ii) is concerned with the need for obtaining information which will be necessary before advice can be given on problems of specific or local importance resulting from variations within the tract. Such information can be obtained only if adequate data on soil and other environmental factors are available for correlation with the field experiment results.

Soil Data.—In Chapter I, I dealt at some length with the general distribution of soils in India and with the more important soil conditions affecting crop growth. It is very desirable that as much information as possible on the soils of the experimental areas should be acquired, for correlation with the field experiment data, as it is only in this way that experimental findings in one area can be of value to another, where similar soil conditions may obtain. I shall deal in greater detail with future work on soils in section 3 (b), and at this stage it will be sufficient to emphasize that it should be the responsibility of the agricultural chemist to make sure that relevant data on the soils of the experimental areas should be available for correlation with the yield data. The field examination of the profile and the sampling of the soil of an experimental area should be undertaken before the experiment is laid down, and wherever possible, this should be done by a trained soil surveyor, who could define the type in terms of an All-India grouping, such as that illustrated on the map facing page 8. Where this is impossible, the work may have to be undertaken by the field experiment assistant, who, as already indicated, should in any case have received from the agricultural chemist a brief course of detailed instruction on the field examination and sampling of soils. Each field experiment assistant could then be instructed that, before laying down an experiment, he should (a) record a field description and (b) take whatever soil

samples are necessary. The latter, together with the field description, could then be forwarded to the agricultural chemist who, after the necessary analyses had been completed, could tabulate the field and laboratory data which should form part of the experiment record.

Laboratory investigations.—Pot and laboratory methods for the characterization of the nutrient status of soils are arbitrary, and before they can be expected to furnish reliable information in the diagnosis of soil deficiencies, their results must be checked or calibrated against an adequate background of field experiment data. Particular reference has been made to the establishing of limiting values and the assessment of the relative merits of different methods against the background of the field experiments which have been proposed. Apart from laboratory estimations of manurial contents, it would appear that chief attention should be given to determinations of exchangeable cations calcium carbonate, pH value, salt contents, clay contents and moisture relationships as factors with a direct bearing on soil productivity. Attention has been drawn to the fact that in India there is a dearth of modern scientific equipment for the laboratory study of soils. There are, for instance, comparatively few photo-electric calorimeters available for the routine determination of phosphate and other soil constituents. Particular reference has been made to the value of spectrographic outfits in the study of problems of both plant and animal nutrition, and the suggestion is made that each Province and major State should endeavour to add as soon as possible a spectrographic outfit to the equipment of its chief agricultural research centre. Consideration should also be given to the possibility of using X-ray methods for the study of clay fractions at selected centres.

Staffing.—No less important than the appointment of directors of research and directors of extension work for each major area, such as a Province or a State, is the need for ensuring that these directors will have adequate numbers of well qualified staff under them. There is, in my opinion, a very great need for improving the status and salary of members of the staffs of agricultural departments in India. On tour, I did not consider that I was over-paying my personal bearer, but I found nevertheless that I was paying him more than many an agricultural graduate was receiving as a salaried member of an agricultural staff. In the absence of improvements in both salaries and status I fail to see how it will be possible in the future either to attract recruits to, or indeed hold in the service, men of the mental calibre needed to solve the many problems of agriculture. Apart from the question of improving salaries and status, there is also a need for increasing the numbers of both research and extension staffs. Without exception, the provincial or state agricultural department staffs are quite inadequate in number to permit of touching more than the fringe of the problems requiring attention. Another factor which should be borne in mind in the recruitment of staff, is the desirability of making as many as possible of the appointments permanent, after a reasonable probationary period of a few years, to ensure that the probationer is indeed qualified for and fit to undertake the work required. Short term work and temporary appointments cannot be expected to produce contented and efficient workers. As already indicated, one of the weaknesses of field experiment work in the past has undoubtedly been the fact that such work has had to be undertaken as an incidental duty by numerous individuals, who had many other duties expected of them. If a basis of sound information is to be built up in a reasonable time, one of the first essentials is realization of the need for whole-time field experiment assistants.

One of the incidental effects of scientific advance in the past two decades has been the need for corresponding changes in the curricula, training and out-

look of students qualifying for degrees either in pure science or in agriculture. A modern graduate in agriculture has of necessity to assimilate uncritically knowledge on a wide variety of subjects. Knowledge of this type is of great value and is indeed essential in many aspects of extension and general agricultural work. The University or College training of such a graduate, however, does not develop in him the critical faculty, and, except in special cases where a man may have a flair for research which no amount of training can ever give, the general graduate in agriculture is not likely to make a good research worker or experimentalist. By virtue of the more intensive training which he receives, a graduate in any of the pure sciences has his critical faculty more fully developed and is, therefore, likely to become a better research worker than the ordinary graduate in agriculture. Whereas it is extremely difficult to instil scientific principles into the latter, it is relatively simple for an able science graduate to acquire an adequate agricultural background to enable him to understand the problems of agriculture and appreciate the needs of extension work. I suggest, therefore, that in the future more attention should be given to the agricultural service of graduates in pure science.

ANNEXURE VI

Training of students abroad (Three Years .)

	1st year		2nd year.		3rd year		Total	
	A	B	A	B	A	B	A	B
Agriculture	57	37	42	37	32	...	121	74
Animal Husbandry (including dairying)	20	25	28	24	12	...	50	49
A.--Centre	171							
B.--Provinces	123							

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CHAPTER IV.

Training of health personnel.

By

K. C. K. E. RAJA.

Introduction.—This note consists of two parts. Part I presents a brief survey of existing training facilities in medical and certain allied fields as well as of proposals for the training of health personnel which are included in the five-year plans put forward by Provincial Governments. Reference is also made to the development of medical colleges in certain Indian States. In Part II are given a number of new proposals for increasing the rate of production of health personnel over and above that achieved by the measures indicated in Part I of this note. The directive given to the Scientific Manpower Subcommittee requires that the proposals incorporated in Part II should be capable of being initiated within the next six months. While this has been kept in mind, it has not been considered desirable to permit that a narrow interpretation of it should lead to the exclusion of certain proposals of importance, the implementation of which might not be started within the next six months, although certain preliminary investigations in relation to them can and should be carried out within that period.

It cannot be emphasised too strongly that the proposed development of training programmes for scientific personnel requires the simultaneous promotion of schemes for the utilisation of their services. Failure to provide such measures as are necessary to facilitate their employment after training will have disastrous results. For instance, even in 1938, in spite of the fact that there had been no determined effort to expand the training of doctors on a large scale, the Director General, Indian Medical Service, pointed out in his Indian Medical Review that "unemployment has become a serious problem among the younger members of the profession".

PART I.

It may be mentioned that part of the information given here is based on the five-year plans for health development put forward by Provincial Governments. These plans were originally framed by the Adviser Governments in the provinces and popular Ministries, after they took over, have been revising these plans partly to fit in with the new policies they are enunciating and partly as the result of the decisions reached at the Health Ministers' Conference held in October 1946. It is understood that certain provinces have appointed Special Health Reorganisation Committees which have been actively considering the previous five-year plans and it is not possible to state to what extent these plans will be modified by the Committees concerned. The figures given in this note may therefore undergo some changes but it is hoped that they will nevertheless, provide a basis for the discussions of the Scientific Manpower Committee.

Undergraduate Medical Education.—A list of medical colleges and of schools is given below. Some of the schools are in the process of conversion into colleges, e.g., those in Orissa and Sind. But conversion is not complete and these institutions are shown as schools and not as colleges. Certain Provincial Governments have, as part of their postwar development programme, planned the establishment of new medical colleges. Similar developments are taking

place in some of the Indian States also. The information available from provincial five-year plans and from other sources is summarised below:—

Province	Number of existing colleges	Number of schools	Number under conversion into colleges or proposed to be converted within five years	Number of new colleges proposed
1. Madras	4	Nil	Nil	2
2. Bombay	2	4	2	Nil
3. Bengal	2	9	2	1
4. C.P.	Nil	1	Nil	
5. Orissa	Nil	1	1	Nil
6. Bihar	1	1	1	1
7. U. P.	2	Nil	Nil	1
8. Punjab	3	2	Nil	(1 Medical School for women)
9. Sind	Nil	1	1	Nil
10. Delhi	1	Nil	Nil	
11. Assam	Nil	1	1	Nil
12. N. W. F. P.	Nil	Nil	..	1
<i>Indian States—</i>				
1. Mysore	1	1	1	Nil
2. Hyderabad	1	Nil	Nil	Nil
3. Jaipur	Nil	Nil	Nil	1
4. Gwalior	Nil	Nil	Nil	1
5. Baroda	Nil	Nil	Nil	1
6. Indore*	Nil	1	1	Nil

In addition to these, it has been proposed that medical colleges should be established at Aligarh and Benares. These will have to be financed largely by the Central Government. As regards Aligarh it is understood that a sum of about Rs. 50 lakhs has already been collected by the University authorities and the possibility of its establishment has therefore been strengthened.

The numbers passing out from existing medical colleges and schools are approximately 1,000 graduates and 800 licentiates per year. Provincial programmes provide for the establishment of six new medical colleges and of a medical school for women, the conversion of nine medical schools into colleges and various improvements to existing colleges and schools within the next five years. In addition five more colleges are likely to be functioning in Indian States during the same period. The Bhore Committee recommended for the first five years seven new colleges, the conversion of eight medical schools and improvement and extension of existing colleges so as to enable them to admit 100—120 students a year.

The number of annual admissions in the proposed new colleges will fall far short of 100, they being nearer 50 in most cases. The following are the figures available for admission in the new colleges in Indian States:—

Jaipur	50
Gwalior	35
Indore	50
Baroda	50

*This is not maintained by the State but by a Committee over which the Resident to Central India States presides. There is a proposal to convert it into a college with financial support from a number of States in Central India and Rajputana admission being reserved to the candidates nominated by each of these States. Without support from the Central Government this conversion is not, however, likely to take place.

In the case of the proposed new colleges in the provinces and of those schools which are being raised to colleges complete information regarding annual admission is not available. From such figures as are known the annual rate of admission is not likely to exceed 50 in each case. Conversion has started at varying dates in respect of individual medical schools. However, as the medical course extends over a period of five years, the contribution made by these institutions in the way of qualified medical practitioners will be negligible during that next five years. New medical colleges will also make no contribution during the same period. During the next quinquennium, taking the average annual admission to each of these new and converted colleges at 50 and the average number qualifying each year as 80 per cent. of the annual number of admissions, the 20 new or converted institutions in India (15 in British India and five in Indian States) will together provide some 800 additional medical graduates annually.

It must at the same time be remembered that the production of licentiates at the converted institutions will have ceased during this period, so that the total number of doctors passing out annually will not materially alter unless other steps for raising production can also be undertaken. The proposal of the Bhoze Committee to increase the intake of a medical college at least to 100 candidates per year will, when applied to existing and new colleges, provide for the admission of about 3,700 students and the passing out of some 3,000 medical graduates every year.

Postgraduate Medical Education.—The following quotation from chapter XIII of Volume I of the Bhoze Committee's report sums up existing facilities in the country:—

“The existing facilities for postgraduate education in the different medical colleges are few. Recently there has been a great deal of activity shown by most universities in the institution of postgraduate degrees and postgraduate diplomas without, however, providing in every case the necessary facilities for adequate instruction in the subjects concerned. Madras is, in this connection, an exception. There are two university diplomas, one in Obstetrics and Gynaecology and the other in Ophthalmology, and the training, which is in both cases for a period of one academic year, is imparted in the special hospitals concerned. Government diplomas also exist in the specialities of Tuberculosis, Radiology and Clinical Laboratory Sciences with adequate provision for the training of students in these subjects. Courses for Diplomas in Public Health and in Maternity and Child Welfare are given at the All-India Institute of Hygiene and Public Health, Calcutta, as well as shorter courses in certain branches of public health work. For the Diploma in Public Health the Institute is affiliated to the Calcutta University. The Universities of Bombay and Madras also award a similar diploma, the one granted in Madras being known as the Bachelor of Sanitary Science (B.S.Sc.). Facilities for the required training are available at the Grant Medical College, Bombay, and at the Madras Medical College. In addition, the University of Calcutta grants a Doctorate of Science in Public Health (D.Sc.) and the University of Bombay a Doctorate in Hygiene (D.Hy.) Regular postgraduate courses are also provided in the School of Tropical Medicine at Calcutta.

“In certain universities the degrees of M.D. and M.S. provide for specialisation in such subjects as Ophthalmology, Bacteriology, Anatomy and Physiology. Research degrees have also been instituted in some universities in the non-clinical subjects of Anatomy, Physiology, Pharmacology, Biochemistry, Pathology and

Bacteriology. The diplomas, that have been instituted in the different universities, include the following subjects:—

Ophthalmology,
Psychological Medicine,
Radiology,
Pediatrics.
Oto-Rhino-Laryngology,
Venereology,
Orthopædics.
Obstetrics and Gynæcology.
Dermatology,
Tuberculosis.
Anæsthesia.

“As has already been pointed out, in many cases proper instruction courses in these subjects have not been organised at the different centres where such special degrees or diplomas have been instituted by the universities concerned. When such training facilities become available, there should be wide scope in the country for specialisation on satisfactory lines.

“No organisation to co-ordinate and foster postgraduate education exists in any of the universities, except Madras where a Council of Postgraduate Medical Education has recently been formed. It is understood that a proposal for the institution of a similar organisation is under consideration in the universities of Bombay and Calcutta.”

The provision of adequate facilities for postgraduate education is vital to the development of medical education in India. The teaching staff of existing colleges are inadequate in relation to the number of students and an increase in the number of admissions to these colleges as well as the establishment of new institutions can proceed with reasonable speed only if a large number of trained teachers is made available. A satisfactory approach to the problem appears to be by the provision of an overseas postgraduate training programme and by the simultaneous development of facilities in India.

Overseas training programme.—Forty-nine candidates were selected in 1946 and have been working in different institutions in the U.K. and U.S.A. for some months. All these are for training in medical subjects. In 1947 the scope of the scholarship scheme was extended in order to include dentistry and nutrition and the following numbers have been selected:—

Medical subjects	82
Dentistry	13
Nutrition	10
	<hr/>
	105

In view of the limited number of seats which foreign countries are able or willing to place at our disposal because of their own postwar needs, the authorities in those countries have, generally speaking, agreed to give us as many seats as can be spared and they desire that the best candidates available should be selected for placement in their institutions. It is also to the advantage of India that the limited facilities thus secured should be utilised by candidates chosen through a process of careful selection and that the field of choice should be as extensive as possible. Therefore Provincial Governments, Indian States and the different Departments of the Government of India have all been brought into the scheme. Selection is carried out by a Central Selection Board appointed by the Health Department of the Government of India.

Development of postgraduate training facilities in India.—The Health Survey and Development Committee (the Bhore Committee) put forward three sets of proposals:—

- (1) the establishment of an All-India Medical Institute which will provide undergraduate and postgraduate training of a high order in medical and certain allied subjects with due emphasis on research (in the laboratory and in the field into community health problems) by every Department of that Institute;
- (2) the development of training and research facilities in particular subjects in existing centres of teaching in the provinces with a view to making these enlarged facilities available not only to the provinces concerned but also to other parts of India and
- (3) the establishment of special institutions for diseases such as leprosy, filariasis or kala-azar which have a definite geographical distribution in each case; the location of such institutes will obviously be determined by the availability of suitable clinical material in abundance.

The creation of an All-India Medical Institute has been actively under consideration by a special Committee appointed by the Government of India. It is understood that, in addition to putting forward proposals regarding the Institute, this Committee has emphasised the importance of a speedy development of training and research facilities in particular subjects at suitable medical colleges in order to make such facilities available to the country as a whole and has suggested that a special Subcommittee should be appointed to visit medical colleges and submit a report on the proposed developments. The reports on the All-India Medical Institute and on the suggested expansion of provincial medical training centres should, when they become available, prove to be of great value to the Scientific Manpower Committee.

Co-ordination of internal and external training programme.—The need for co-ordination of internal and external facilities for postgraduate medical education was stressed by the Central Selection Board in its report to the Government of India in 1946. The Board has pointed out that, as a result of its examination of the candidates it interviewed it has "come to the conclusion that there are a number of persons who, by their record of undergraduate medical training, give reasonable promise of high performance in specific fields but have not yet attained, through adequate postgraduate training and experience, that level of achievement which it considers necessary for students who are to be sent abroad." After recommending that existing centres for postgraduate training in specific subjects in different parts of the country should be improved and enlarged to admit students from all parts of the country, the Board recommended that "a scheme of scholarships should be instituted in order to assist promising young medical graduates to undergo the training offered in these institutions."

Public Health Training for Doctors and Certain Higher Type of Personnel.—The proposals of the Bhore Committee for the reorganisation of undergraduate medical teaching will, if adopted, provide a type of doctor whose training will include most of the preventive health teaching now given as part of the postgraduate course for the Diploma in Public Health (D.P.H.). The Committee says "Postgraduate training in preventive and social medicine will then have, as its objective, the provision of facilities for advanced training in such branches of the subject as malariology, maternity and child welfare, industrial hygiene, public health administration, epidemiology, public health laboratory practice and statistics. Such specialised training may be of two types. The first will be of a limited character and will have as its purpose the equipment of health workers with a reasonable measure of proficiency in these subjects. This course

of instruction may, it is suggested, ordinarily range from about three months to one year. The second will be for those who desire to attain the status of specialists in each of the abovementioned branches of preventive health work. For them we suggest that the period of training should be about three to five years."

With this background of the recommendations of the Bhole Committee existing facilities for postgraduate training of higher types in preventive health work may be examined.

All-India Institute of hygiene and public health, Calcutta.—This is the most important institution in India for the training of higher types of public health personnel. The institute consists of the following teaching sections:

- (a) Public health administration;
- (b) Epidemiology;
- (c) Microbiology;
- (d) Biochemistry, Nutrition and Physiological hygiene;
- (e) Sanitary engineering;
- (f) Maternity and child welfare and
- (g) Statistics.

Each section is under the charge of a Professor assisted by a number of gazetted and non-gazetted officers under him.

The Degrees and Diplomas for which students are trained at this institute and the special courses available in the institute are:—

- (a) Doctorate of Science in Public Health;
- (b) Diploma in Public Health;
- (c) Diploma in Public Health and Hygiene;
- (d) Diploma in Maternity and Child Welfare and
- (e) Certificate course of three months' duration in the subjects of maternity and child welfare, industrial hygiene, nutrition, laboratory technique and biometric technique

Training courses for doctors for general public health work, which are available in other parts of India, have been referred to in the latter part of para. 1 of the extract from Chapter XIII of Volume I of the Bhole Committee's Report, which is given on page 5 of this note.

The Training of Lower Types of Public Health Personnel.—Under this head three classes of workers are considered here, (1) midwives, (2) health visitors and (3) public health or sanitary inspectors.

Midwife.—The number of practising midwives in the country is estimated at 5,000 while, on the basis of about 10 million births each year in British India, the number required for providing adequate service to the people is 100,000. Provincial five-year plans do not in all cases give the number to be trained each year but, from such information as is available, it is considered that the number of newly qualified midwives each year will not exceed a few hundreds.

Health Visitor.—The health visitor is a fully trained midwife, with additional training in preventive health work which, in different institutions, varies from 9 months to a year and a half. She has normally no training in nursing. The health visitor has been mainly employed in this country in maternity and child welfare work.

The total number of health visitors available in India is estimated at about 750—800. Complete information regarding the proposed training programmes

for health visitors in the provinces is not available. Madras will train about 100 health visitors each year while an unstated number will be trained in Orissa and in the United Provinces. The annual output of health visitors in India as a whole is at present about 60. It is considered that at least one health visitor will be required to supervise the work of five midwives or the eventual requirement of the country will be about 20,000.

Public health or sanitary inspectors.—The existing output of qualified public health inspectors in India is about 200 per year. The majority of the provinces are making provision for the training of these inspectors although the number to be trained each year has not been stated in many cases. The present number under employment is probably 3,000 while British India requires a minimum of 12,000 public health inspectors.

Nursing.—The total number of qualified and practising nurses in India is estimated to be about 7,000, which gives a ratio of 1 to 43,000 of the population as against 1 to 300 in the U. K. and 1 to 357 in the U.S.A. The Bhore Committee suggested that a ratio of 1 to 500 should be attained in India by 1971, which will mean a hundredfold increase. Provincial plans do not give a clear indication of the provision made for expansion of nursing services and, in many cases, the exact number likely to become available is not readily seen. From such information as is available the total annual output is not likely to exceed four to five hundred from the fourth year of the training programme. The normal training course for a Certificate in Nursing is 3 years. There are Junior and Senior Certificates in Nursing, the type of qualification being dependent on the basic educational standard of the candidates.

The national health programme requires two types of nurses (1) the person trained principally for nursing the sick and (2) the individual who, in addition to training in sick-nursing, is equipped for preventive health work in a variety of services as school health, tuberculosis and venereal diseases. The former will be mainly employed in hospitals and other institutions for the skilled nursing of patients while the latter, who is known as the public health nurse, will be employed essentially for the development of a combined curative and preventive health service in the homes of the people. The nursing which the public health nurse will be called upon to do will not be of the same high order as that which the hospital nurse will carry out, while along with such duties she will have to perform, as has already been pointed out, various preventive duties in the homes she visits. The public health nurse does not exist in India today.

The Nursing College.—Last year the Government of India started a Nursing College in Delhi. It provides three types of courses:—

- (1) a four-year course leading to B.Sc. (Hons.) in Nursing of Delhi University;
- (2) a Nursing Administration Course lasting 8 months and
- (3) a Sister Tutor's Course covering a period of nine months.

The last two are for qualified nurses and, on passing, the candidates are given certificates issued by the Government of India.

The B.Sc. (Hons.) course lays emphasis on preventive health work and the candidates who qualify will be public health nurses. The second course is for qualified nurses and is intended to provide suitable candidates for administrative posts either in hospitals or in the nursing service of the provinces. Sister Tutor are fully trained nurses, who after undergoing the course will be able to undertake the training of pupil nurses.

Training facilities in Certain Special Fields—

(a) *Malaria*—*Malaria Institute of India.*—At this institute in normal years, two training courses, each of six weeks' duration, are held for doctors, one for malaria inspectors (who are usually qualified sanitary inspectors or those who

have done antimalaria work for some time) and for engineers in malariology. The annual numbers trained are roughly 50 medical men (graduates and licentiates), about 25 inspectors and 30 engineers.

(b) *Tuberculosis (T.D.D. course)*.—A nine months' course financed by the Government of India for special training in tuberculosis for medical graduates has been started this year under the auspices of the Delhi University. Similar courses exist at present in Madras and Mysore. The Tuberculosis Association of India has sent an appeal that other universities should also start such courses and in particular the universities of the Punjab and Bombay.

(c) *Leprosy*.—Under the auspices of the Indian Council of the British Empire Leprosy Relief Association a special training course for doctors has been held annually at the Calcutta School of Tropical Medicine. The period of training used to be two weeks but it was extended to four weeks in 1946 in order to make the course fuller. The number of doctors attending the course varied from 15 to 22 during the years 1944—46.

(d) *Nutrition*.—Reference has already been made to a three-months' training course in nutrition in the All-India Institute of Hygiene and Public Health, Calcutta. A nutrition course has also been held every year since 1937 at the Nutrition Research Laboratories at Coonoor except in 1943 and 1946 when no training was done. The normal period of the course is 10 weeks although in 1942, 1944 and 1945 it was curtailed for special reasons. Students attending the classes have in the majority of cases been employees deputed by Provincial and State Governments and those trained at Coonoor are now working as full-time Nutrition Officers in Baroda, Hyderabad (Deccan), Bihar, the Punjab and in certain other Provinces and States. In 1947, in addition to the usual 10-weeks' course, a special course of 8 weeks for nursing sisters, health visitors, teachers, labour welfare officers and others was also held. The number of candidates attending the courses varied, between 1937 and 1947, from 7 to 29.

Lake Medical College, Calcutta.—In order to enable medical licentiates with war service to acquire the degree qualification the Government of India has started a medical college in Calcutta. It is proposed to take, every six months, 150 candidates and to give them 18-24 months' training which, under the special concessions granted by the Medical Council of India, enables them to take the M.B.B.S. The scheme is now sanctioned for a period of five years.

Dental Education.—Both as regards undergraduate and postgraduate education dental training in India is far behind medical education. There is only one dental college which offers training on the university standard and it is located in Lahore. The Calcutta Dental College, which was the first to be established in the country and which came into being through voluntary effort, is housed in a rented building which requires extensive repair. Augmentation of staff and personnel is also necessary to improve the institution to a desirable level. Similarly the Nair Dental College at Bombay, which has also helped to spread dental education in India for many years, requires assistance to raise its level of efficiency. The ultimate objective should be to provide, as in the field of medical education, adequate facilities in the country for undergraduate and postgraduate dental training. In the immediate future the upgrading of the two institutions in Bombay and Calcutta should receive attention, they being raised to the university standard of teaching and affiliated to the Universities of Bombay and Calcutta respectively.

The number of qualified dentists practising in the country is estimated at 1,000. In the West a ratio of one dentist to 3,000 inhabitants is not considered sufficient. In India, as the incidence of dental caries is relatively less, a lower ratio of 1: 4,000 seems permissible as the objective to be aimed at. On this basis British India will require about 92,500 dentists for an estimated population of 370 millions in 1971.

Pharmaceutical Education.—Three types of training are available, (1) the training for compounders, (2) the chemists and druggists qualification and (3) a college education leading up to a degree in pharmacy. The preliminary qualification required for entrants into compounders' class varies, in the provinces, from the middle school to the high school standard. The period of training also varies from one to two years. A period of practical training in a chemist's or druggist's establishment or in a hospital is included.

The preliminary educational standard required for the chemists and druggists course is the Matriculation or School Leaving Certificate. The period of training lasts two and a half years.

As regards collegiate education the following extract from page 174 of Vol. I of the Bhoré Committee's report states the present position:—

"This is designed to turn out a class comparable to the graduate pharmacists or pharmaceutical chemists found in Europe and America. The Benares Hindu University was the first to inaugurate a course of this kind in 1934 and, since that time, other universities have also provided similar training facilities. The Andhra University instituted the study of 'Pharmaceutics' as a special subject in the curriculum for the B.Sc (Honours) and M.Sc. Degree in Chemical Technology. The Calcutta University has a course in Pharmaceutical Chemistry for M.Sc. students. The Bombay University has opened a new course in Pharmaceuticals in their technological Faculty. The Madras University has inaugurated a two years course, B.Sc. (Pharm.), for which students who have passed the Intermediate examination in Science are eligible. Thus graduate instruction in pharmacy is of two types, one which deals mainly with the technical side of it and the other which stresses the pharmaceutical side."

In the preceding paragraphs certain estimates of existing numbers of different types of health workers and the targets to be achieved in each case have been discussed. These estimates are those put forward by the Bhoré Committee. For the sake of convenience the information is given below in tabular form:—

	Estimate of existing number	Number considered desirable	Approximate rate of in- crease re- quired
1. Doctors	47,000	185,000	4 times.
2. Nurses	7,000	740,000	106 times.
3. Dentists	1,000	92,500	92 times.
4. Midwives	5,000	100,000	20 times.
5. Qualified Pharmacists (University stan- dard).	75	672,000	827 times.
6. Public health inspectors	3,000	12,000	4 times

PART II.

Proposals for enhancing the rate of production of health personnel.

The proposals included here are intended to supplement the production of health personnel resulting from the five-year plans of Provincial Governments and the training facilities of existing institutions, which have been briefly surveyed in Part I of this note.

Undergraduate Medical Education.—It has already been shown that some 800 medical graduates are likely to be produced annually after a period of five years, *i.e.*, the present annual output of about 1,000 graduates is likely to be increased by 80 per cent.

Two methods seem possible to enhance still further the rate of production of doctors, namely, (1) the application of the double shift system of teaching and (2) the improvement of existing colleges so as to permit of each taking 100—120 students each year.

The double shift system.—This system requires an adequate supply of teachers and an enlargement of laboratory and other teaching facilities, including an increased number of hospital patients for teaching purposes. These conditions are most likely to be satisfied in Calcutta, Bombay and Madras. Therefore a reference was made to the Surgeons Generals of these three provinces regarding the possibility of developing a double shift system of training in the medical colleges in each of these three cities. The reply from Madras was definitely against the starting of the double shift system while the Surgeon General, Bengal, has agreed to try it out in the Calcutta Medical College and thereby increase the annual intake of students by 50 per cent. of the existing rate of admission or by 55 students each year. The Surgeon General of Bombay has stated that the introduction of the double shift system is not possible in the Grant Medical College but that the position in G. S. Medical College is somewhat brighter and that the Dean and his professors think it is possible if more accommodation can be made available through the provision of a third floor to the present college building and the acquirement of the adjoining Veterinary College, which is about to be abandoned, and if beds can be provided at the ex-Military Hospital at Dharavi. The proposal requires, however, careful consideration before it can be accepted as a practical proposition.

In the circumstances stated above there seems to be little possibility of utilising the double shift system for promoting a marked rise in the rate of production of doctors, at least in the near future. Nevertheless, it seems desirable to try out this system at Calcutta and, if possible, at Bombay because the experience gained can be utilised later in other places also.

Improvement of existing Colleges.—Existing colleges are, in many cases, deficient in accommodation, equipment and staff and the Bhore Committee has recommended the improvement of these colleges and a raising of their rate of annual admission to 100—120 students per year. While a few colleges have at present this rate of admission others fall short of it. The Committee has recommended that all the existing colleges should undergo the necessary improvements within a period of 10 years (see tables on pages 380 and 381 of Volume III of the Bhore Committee's report). Of these colleges two belong to the Punjab fall in Pakistan. In British India the remaining colleges number 14. The estimated expenditure for improvement and expansion of these colleges which are in "India" and in Pakistan respectively is shown below:—

India—

14 colleges	{ Recurring	Rs. 115·5 lakhs.
	{ Non-recurring	Rs. 432·0 lakhs.

Pakistan—

2 colleges	{ Recurring	Rs. 16·5 lakhs.
	{ Non-recurring	Rs. 54·0 lakhs.

At a uniform rate of annual admission of 100 students per year in each of the 14 medical colleges the number of qualified medical graduates produced each year will be 1,120. If the admission rate can be raised to 120 the number of

qualified medical graduates will be about 1,350 per year. If the two colleges in Lahore are also included, the total number passing out each year will be 1,280 if the rate of admission be 100 and about 1,580 if it be 120.

In the case of the new colleges it is better to await the completion of their development before the question of expanding their capacity for intake is considered. At present many of the existing colleges and their associated hospitals are deficient in respect of accommodation, equipment and staff and any funds that are available would be spent more usefully on their improvement and expansion rather than on the enlargement of the colleges that are now coming into existence.

Improvement of undergraduate training in preventive medicine and public health practice.—The Bhore Committee pointed out that the development of future health services in India should lay emphasis on the preventive aspect of medical practice. The Committee has therefore suggested the creation of a Department of Preventive Medicine and Public Health in all medical colleges, the provision of facilities for training in rural and urban public health practice to the undergraduate medical student and the introduction of extensive changes in the teaching of the subject. The purpose in view is to familiarise the student, early in his career, with environmental and other factors associated with the problem of ill-health, to develop in him the preventive outlook and to provide opportunities for his active participation, even as a student in community health work. The urban and rural health organisations, which will be associated with the proposed Department of Preventive Medicine and Public Health, will also serve the purpose of enabling the different departments of the college to promote research into community health problems as well as to attempt the practical application of the fruits of research. The developments are bound to influence the student profoundly, to stimulate a spirit of observation and enquiry and to promote the growth of a scientific outlook in him. The services of trained medical social workers are required for the teaching of preventive medicine on the lines indicated above. Recently the training of such social workers has, it is understood, been started in Bombay at the Tata Institute of Social Studies and, later in this note, a proposal has been included for securing a steady supply of trained social workers in the medical field. It is proposed that the opening of this department should now be limited to (a) the Madras Medical College (b) the Grant Medical College, Bombay and (c) the Calcutta Medical College.

Postgraduate Medical Education.

Development of training facilities in special branches of medicine in existing institutions.—Reference has already been made to a proposal for the establishment of a small Committee to visit the more important medical teaching centres in the country and to report on the steps to be taken to promote the development of existing postgraduate training facilities in special branches of medicine in a manner designed to serve the needs not only of the province concerned but also of others. No time should be lost in the formation of this Committee and it should be asked to complete its task in a period of about three months. It would be desirable to employ the members of this Committee on a full-time basis during the period in order to ensure the speedy submission of its report. The report should give sufficient details regarding the financial implications of the proposals in order to enable Government to take early decisions regarding their acceptance and implementation.

Scholarships for Postgraduate Training in India.—Reference was made to the recommendation of the Central Selection Board that a scheme of scholarships should be instituted in order to assist promising young medical graduates to undergo postgraduate training in suitable centres in India. The Board considered that "a combination of provision in India for the immediate needs of the medical student after graduation and of a programme of studies abroad for candidates selected from among those who have undergone the courses available

in India would be essential to ensure the success of the health development schemes actively under consideration by the Central and Provincial Governments."

It is suggested that fifty scholarships of Rs. 100 a month per candidate plus tuition fees should be provided each year.

The All-India Institute of Hygiene and Public Health, Calcutta.—The different courses of training available at this Institute have already been indicated. Two tabular statements are attached which show what increase is possible in the number of admissions to each of the existing courses (Table A) and what new courses can be introduced (Table B) provided an adequate expansion of space, equipment and staff is made available.

In addition to the courses of training mentioned in these two tables reference should be made to certain other developments which are desirable. The prospectus of the Institute provides for the admission of research students on the payment of a fee of Rs. 250 per year. Although the Institute has been in existence for about 15 years there has hardly been any request for admission as a research student. On a discussion with the Director and the Professors of the Institute the opinion was unanimously expressed that it was essential not only to exempt research scholars from the payment of fees but also to give them a stipend. The scholarship scheme outlined in a previous paragraph should make it possible to select and place suitable candidates in the different sections of the Institute for definite periods of training, during which they can be made to participate in special investigations in the field and in the laboratory.

Another type of trainee should be the postgraduate worker who proposes to specialise in such subjects as a epidemiology, maternity and child welfare work and public health laboratory practice. As has been pointed out by the Bhore Committee (para. 84 on page 383 of Volume II of the report) that the period of training will have to be for about three to five years, the candidate participating in the teaching, research and administrative activities of the department. Persons so trained will be suitable for teaching posts in the Department of Preventive Medicine and Public Health in medical colleges and for the more responsible posts in health departments. If a man is to devote himself to such prolonged study it is essential that he should be free from financial embarrassment and that he should be sure of obtaining a suitable post after his training is completed. It is therefore desirable that suitable candidates should be selected by Governments either from their own servants or from outside and sent to the Hygiene Institute with adequate provision for financial aid during training and with the assurance of a suitable post if the programmes of study are completed satisfactorily.

It is important to remember that quality is as important as quantity and that the need for the production of an adequate number of teachers and of capable administrators is great if the development of the health programme is to proceed on sound lines.

In connection with the proposed expansion of training facilities the Director of the Institute has stressed the importance of providing increased floor space for teaching and laboratory work and of residential accommodation for students at Calcutta and for students and staff at the Singur field training centre. Provision for these are included in the estimates of cost appended to this note.

Another important advance which is necessary is the setting up of a Food Technology Section in the Institute. The Departments of Microbiology, of Biochemistry and Nutrition and of Sanitary Engineering should participate in the development of the proposed new Section. While the enforcement of Food Adulteration Acts has resulted in the development of chemical standards of purity for food, the working out of bacteriological standards suitable for Indian conditions, which are particularly important in respect of milk and milk

products, has hardly been done. Moreover, from the point of view of food transport and preservation a combined attack on the associated problems by bacteriologists, chemists, nutritionists and public health engineers is necessary. Preliminary investigations by the three Departments of the Institute mentioned above will be necessary and it is suggested that such investigations should be initiated without delay. It is difficult to give a budget for the proposed expenditure but the need for promoting co-ordinated work in the field is urgent.

Dental Education.—The immediate need is to raise the Calcutta Dental College and the Nair Dental College, Bombay to the university standard and to get them affiliated to the universities of these two cities. During a recent visit to Calcutta the authorities of the Calcutta Dental College were interviewed as well as the Planning Officer in the Office of the Surgeon General, Bengal, who has been in close touch with these authorities for investigating the possibility of raising the standard of the college. The college is housed in a rented building which requires extensive repair. Considerable expenditure on equipment will also be necessary. Two schemes have been prepared by the authorities in consultation with the office of the Surgeon General, an Interim scheme and a Permanent Scheme. The former is based on securing the existing building on a lease from the landlord and on carrying out all the necessary repairs and improvements. The Interim Scheme will permit of the annual admission of 25 students for the degree course (B. D. S.) from July 1948 if the necessary equipment and staff can be secured and repairs carried out. The present course for 25 students undergoing the L. D. S. course will continue. The Permanent Scheme provides for a Dental College built on a proper site and capable of admitting 100 students per year on the lines of the recommendations of the Bhore Committee. The site on which the college now stands is too small to permit of the development of a college capable of admitting 100 students each year. The estimates of cost are as shown below:—

	Recurring (in lakhs)	Non-recurring (in lakhs)
<i>Permanent Scheme—</i>	5.00	25.00
<i>Interim Scheme—</i>	1.48	1.69

It seems fairly certain that the larger permanent scheme is bound to take some years to materialise and, in the meantime it is highly desirable that the Interim Scheme should be proceeded with.

It is not possible to give similar estimate for the Nair Dental College at Bombay because there has not been sufficient time to visit the institution or collect the necessary information. This college at Bombay and the Calcutta Dental College have, as has already been pointed out, led the way in the development of dental education in India and have worked for years with all the handicaps of insufficient financial support. Provision on the basis of the Interim Scheme in Calcutta would seem to be justified for the Bombay institution.

The Nursing College, New Delhi.—The present strength of the different classes in this institution (1947-48) and the targets which can be attained within the next four or five years if additional space, equipment, and staff can be made available are shown below. At present, the majority of the professional posts remain unfilled in spite of constant effort at recruitment. This position should be rectified as soon as possible. The present sanctioned strength of the teaching and administrative staff and the expansion necessary

for increasing the intake of pupils are shown below. These figures have been received from the Principal of the College:—

Course of training	Present Strength (1947-48)	Target at the end of 4 to 5 years. 30 a year for each of the four years of the course = 120
(a) B. Sc. I Year	20	
II Year	8	
(b) Nursing Administration	6	15
(c) Sister Tutor	6	30
(d) Public health course for qualified nurses (2 years).	25 a year	50
(e) Supervisors for specialities such as paediatrics, orthopaedics etc. . . . .	..	10
(f) Dietetics course . . . . .	..	25
(g) Preliminary Training School Course	25	50
Total	65	300

STAFF

Teaching & Administrative—

Senior staff	6	11
Junior staff	11	24
Total	17	35

Other staff—

Librarian	1	2
Clerks	3	10
Domestic servants	40	100
Total	44	112

ESTIMATES OF EXPENDITURE

Recurring cost.

1947-48.	Rs. 1.327 lakhs.
At the end of 4-5 years.	Rs. 2.795 lakhs.

Some of the teaching at the college is now done by the university. If the College is required to employ whole-time staff for all the subjects in the curriculum, the figures given above will have to be revised.

Non-recurring expenditure.

	1947-48	At the end of 4—5 years.
Equipment	Rs. 40,000	Rs. 1 lakh
Building	At present the college is housed in war-time barracks.	A rough estimate of the cost of new buildings for the college is Rs. 75-80 lakhs.

Nursing is a subject which has been considerably neglected in the past and it is essential that early steps should be taken to expand the training, facilities at the Nursing College without waiting for the construction of a new building, which might cost as much as Rs. 75-80 lakhs. The present war-time barracks in which the college is housed have been fully occupied and an expansion of

the training programme on the lines suggested will require more accommodation. Constitution House is adjacent to the Nursing College and it is for consideration whether, as soon as the work of the Constituent Assembly is over, it cannot be made available for housing the college. The Principal considers that it would be desirable to move the college as a whole into the Constitution House instead of occupying a portion of it. Then the existing college buildings can be made available for other purposes.

The Lady Reading Health School.—This school trains at present batches of 12 pupils, who are qualified midwives, for undertaking the duties of health visitors, the period of training extending to 18 months. The entrants to the school receive their midwifery training in different institutions all over the country and a disadvantage is that the standard of education varies to some extent. It is understood that the Indian Red Cross Society, which maintains the School, has recently put forward a scheme to the Government of India for giving midwifery training also at Delhi. The number to be trained remains 12 and the average annual cost of the scheme, which is put forward for a period of three years, is Rs. 50,000. This appears to be too large an expenditure if the purpose served is only that of ensuring improved midwifery training. After discussion a revised scheme has now been prepared whereby it will be possible to admit 30 pupils for midwifery training and 25 for the course for health visitors, each of which lasts 18 months. The new scheme also provides for improved teaching in child health. The average annual expenditure required will rise to Rs. 71,000, an increase of Rs. 21,000, which would seem to be well worth while in view of the larger intake of pupils.

An obstacle to the expansion of training facilities in the past has been the inadequacy of housing accommodation for the pupils. This will have to be rectified. At present there is provision in the school building for 24 students (two batches of 12 will be under training simultaneously) and a room for the Matron. Under the proposed expansion room will be required for 110 students at a time, for two women doctors and four midwifery assistants. It is suggested that the possibility of securing W. A. C. (I) Hostels for accommodating the additional students and staff should be investigated.

College of Pharmacy, Bengal.—The establishment of a College of Pharmacy in Calcutta has been under investigation for some time. The provision of a Licentiate course in the subject of approximately two years' duration for those with Matriculation as general educational qualification and of a degree course of three years' duration for those with Intermediate in Science has been proposed. It has been suggested that it should be started on a modest basis on rented premises. The recurring expenditure is likely to be Rs. 1.25 lakhs and non-recurring (mainly for equipment) Rs. 2.0 lakhs.

The Tata Institute of Social Sciences.—The need for training medical social workers has already been stressed. The Tata Institute of Social Sciences appears to be the only place in India where such training can be given. A scheme offering twelve scholarships a year in order to provide for candidates sponsored by the Central and Provincial Governments is suggested. The course lasts a period of two and a half years and the value of the scholarships should be, the Director of the Institute suggests, Rs. 1,500 each year, including the annual tuition fee of Rs. 250.

Proposals from the Provinces for raising the output of certain types of Health Personnel above the present level.—Provincial Administrative Medical officers of the Medical and Public Health Departments were asked whether training facilities over and above existing training courses could be made available in respect of such health workers as midwives, health visitors, health inspectors etc. and, if so, they were asked to indicate the expenditure which would be necessary. It

was made clear to them that the schemes should be capable of being initiated within the next six months. The replies received are tabulated below:—

United Provinces.

Additional numbers to be trained under double shift system.

Health inspectors	30
Health visitors	20
Midwives	30
Vaccinators	30
Laboratory assistants	30

Total grant required for one year is Rs. 40,000. This does not include provision for boarding and lodging arrangements for the students or examination fees.

Bombay—

	Present provision per year	Expected provision in April 1948
Health visitors	20 (10 at Poona and 10 at Bombay Schools).	50 (20+15) at each of two new schools for Gujarat and Karnatak.
Health inspectors	125—150 (Bombay city).	325—350 (Two new centres of training are to be opened at Ahmedabad and Poona respectively)

Madras.

100 more midwives can be trained at a cost of Rs. 720 per pupil.

Bihar.

	Number that can be trained	Cost Rs.
1. Health inspectors	80	5,000
2. Vaccinators	480	27,000
3. Health visitors	12	30,000
4. Midwives	12	20,000

Assam.

	Number that can be trained	Institution giving training	Grant required /Recurring Non- recurring
1. Malaria Inspectors	24	Malaria Section of the Public Health Department. Pasteur Institute, Shillong. Government Vaccine Depot, Shillong.	Rs. 2,000 Rs. 10,000
2. Laboratory Assistants	8		
3. Laboratory Technicians (six months' course).	12-24		8,000 1,000
4. Vaccinators	60		1,000 ...

The increased out-put per year in respect of each type of worker for all the provinces together will be :—

(1) Health inspectors	260
(2) Health visitors	62
(3) Midwives	142
(4) Vaccinators	570
(5) Laboratory Assistants	36
(6) Laboratory Technicians	12—24
(7) Malaria Inspectors	24

The total expenditure will be non-recurring Rs. 11,000 and recurring Rs. 205,000.

Reorganisation of Health Administration in Delhi Province and the establishment of the All-India Medical Institute.—These are long term plans but they are mentioned here partly because of their importance and partly because

of the need for keeping in mind the necessity for initiating action on them as early as possible. Further, as will be shown later, they are, to some extent, inter-linked and their development will, it is believed, constitute a great contribution by the Centre towards promoting interest in the country in the expansion of health services and in aiding medical education.

The Bhoré Committee has recommended that the Central Government should develop Delhi Province as a demonstration area and that its plans and those put forward by other postwar reconstruction committees should be implemented simultaneously in order to make a determined effort to improve the life of the community. Making such a social experiment, methods suited to Indian conditions and to our resources will have to be developed if the purpose in view is to achieve lasting results and if the advance made in Delhi is to be reproduced in other parts of the country as well.

The All-India Medical Institute will help to demonstrate desirable standards of training in the medical and certain allied fields to the rest of India, besides producing a reasonable number of teachers, research workers and potential administrators in the field of health. This Institute will require urban and rural health organisations in which the practical training of its students can be carried out as well as research into community health problems. The reorganised health administration of Delhi Province can provide these rural and urban training facilities and thus it is of advantage to link the Institute and Delhi health organisation together.

From the point of view of securing suitable teaching personnel for the proposed All-India Medical Institute, the development of teaching and research departments in respect of specific subjects in selected medical colleges in different parts of the country must be started immediately. Delhi health re-organisation should also receive very high priority and it would be wise to remember that the establishment of the Medical Institute as early as possible would make a notable contribution to the efficiency of the Delhi health services as well as to the advancement of medical education in the country.

Estimates of Cost.—Rough estimates of the cost of many of the proposals put forward in Part II of this note are given in an appendix to this note. In certain cases no such estimates have been attempted partly because of the difficulty of making them at short notice. Further, certain measures such as the provision of rural and urban training fields in association with the Departments of Preventive Medicine and Public Health in the colleges at Calcutta, Bombay and Madras can be carried out as part of the provincial plan for expansion of health services and it has not therefore been considered necessary to make specific provision for such organisations in the attached estimates of cost.

APPENDIX

Approximate Estimates of cost for Certain Proposals.

Name of the proposal	Expenditure (In lakhs of rupees).	
	Recurring	Non-recurring
(1) Double shift system at Calcutta Medical College	1.30	0.10
(2) (a) Improvement of existing medical colleges in India	115.50	432.00
(b) Improvement of existing medical colleges in Pakistan	16.50	115.50
(3) Provision of Departments of Preventive Medicine and Public Health in 3 medical colleges at Calcutta, Bombay and Madras	6.75	0 00
(4) Scholarship scheme for post-graduate training in India {	Scholarships.	0.60
{ tuition fees.	0.15	...
{ Travelling allowance at Rs. 150 each	0.075	
(50 scholars).		0.085

(5) Expansion of training courses at the All-India Institute of Hygiene and Public Health	2.66	2.80
(6) (a) Dental Interim Scheme for Calcutta	1.49	1.69
(b) Dental Interim Scheme for Bombay	1.49	1.69
(7) Nursing Colleges	1.50	1.00
(8) Lady Reading Health School	0.71	.....
(9) Expenditure for the training of certain types of non-medical health personnel in the provinces	2.95	0.11
(10) Scholarships for training in medical social work (12 each year : course 2½ years) -		
One course of 2½ years—		
1st year—		
Scholarships	0.18	
Travelling allowance	0.018	
	<u>0.198</u>	
2nd year—		
Scholarships	0.36	
Travelling allowance	0.018	
	<u>0.378</u>	
First six months of 3rd year—		
Scholarships	0.54	
Travelling allowance	0.018	
	<u>0.558</u>	
(11) College of Pharmacy, Bengal	1.25	2.0
	<u>153.159</u>	<u>502.89</u>

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ALL INDIA INSTITUTE OF HYGIENE AND PUBLIC HEALTH

Table A—Existing Courses

Name of the course	Duration of the course	Present maximum No. of admissions	Size of the class after enlargement if any
1. Diploma in Public Health and Hygiene	9 months	60	60
2. Diploma in Health and Hygiene	9 months		
3. Diploma in Maternity and Child Welfare	9 months		
4. Doctor of Science (Public Health)	2 years	10	20
5. Certificate in Maternity and Child Welfare	3 months	10	20
6. Certificate in Industrial Hygiene	3 months	10	15
7. Certificate in Nutrition	3 months	10	15
8. Certificate in Laboratory Technique	6 months	30	30
9. Certificate in Biometric Technique	3 months	8	15

ALL INDIA INSTITUTE OF HYGIENE AND PUBLIC HEALTH

Table B—Proposed New Classes

Name of the Section	Name of the course	Duration of the course	No. of courses	Maximum No. of in the year admissions	Remarks
Sanitary Engineering Section.	(a) Course for water and sewage plant operators.	3 months	One	6	The course will consist of lectures and laboratory work in Calcutta for 2 months followed by an examination and regular work on plant control for a month at Calcutta, Jamshedpur or Delhi.
	(b) Course for officers in charge of training for health inspectors in the provinces.	2 months (Jan. and Feb.) each year.	One	3	To study the methods of assessing sanitary condition, rural health work etc.
	(c) M. Sc. in Public Health Engineering.	14—20 months.	One	30	This training is meant for qualified engineers.
	(d) A short course in Sanitary Engineering.	3 months	One	10	This course is meant for overseers and sub-overseers.
Section of Bio-chemistry, Nutrition and Physiological Hygiene.	(a) A short course for Social workers.	3 months	One	30	This course is meant for health visitors, health inspectors, junior medical officers in charge of maternity and child welfare centres, labour welfare officers, persons in charge of canteens and communal feeling in industrial centres, officers deputed by the Food and Agriculture departments, school teachers, etc.
	(b) Diploma Course in Nutrition.	1 year	One	8	This course is meant for medical graduates, particularly with D.P.H. qualification and those with M.A. in Chemistry or Physiology. Students will learn chemical analysis of foodstuffs, the technique of spectrophotometry, the use of photometers etc., the principles of diagnosis of sub-nutrition and mal-nutrition, etc.

Name of the Section	Name of the Course	Duration of the course	No. of courses	Maximum No. in the year of admissions	Remarks
					Candidates can after training be employed by the provinces as Nutrition Officers. This course is intended to replace, in due course, the existing 3 months course.
	(c) Dietitian's Course.	9 months	One	20	To be undertaken by the Nutrition Section of the institute jointly with the Medical College Hospital at Calcutta.
	(d) Post-graduate course in Industrial Hygiene.	6—8 months	One	20	The course is intended only for doctors.
	(e) A shorter course for medical and non-medical types of personnel.	3 months	One	20	The course is intended for medical officers already employed in 'Industry health visitors sanitary inspectors, welfare Officers etc.
Section of Statistics.	(a) Course in Public Health Statistics.	1—2 years.	..	8	Qualified science graduates with mathematics in degree course or medical men with good mathematical career to be admitted for the course. They will be qualified for the post of Statistician to the Health Departments of provincial Governments, Municipal Corporations etc.
	(b) Training for the proper collection of data in social surveys.	10 weeks	Two	24	Workers interested in economic diet, vital statistics and other surveys are expected to take the course.
Section of Micro-biology.	(a) Clinical Pathology course.	1 year (on the London Post-graduate School Model).	One	6—10	Qualified doctors will be eligible for this course. After training a successful candidate should be able to run a Clinical laboratory independently.
Section of Epidemiology.	Special course in Epidemiology for urban and rural health officers.	9 months	One	6	This course is intended to improve the knowledge of the subject of health officers, who have already had a course of training during their D.P.H. training

CHAPTER V

Requirements of Technical and Scientific personnel for Industrial Development and their Training Programme by J. N. Ray

In the Statement on Industrial Policy, the Government of India decided to participate in industrial progress by—

- (i) making loans or by subscribing a share of the capital in industrial undertakings which are considered to be of importance to the country's development;
- (ii) guaranteeing a minimum dividend on capital or undertaking to meet the revenue losses for a fixed number of years;
- (iii) giving adequate financial support to research organisations set up by industrial associations representing organised industries;
- (iv) promoting industrial investment corporation or similar institution for meeting the capital requirements of industries which will be started;
- (v) assisting industrialists in the procurement of capital goods required by them.

2. Uptill now, no legislative sanction has been obtained for the objectives stated above. In view of the political uncertainties, it has not been possible to formulate any concrete plans on the above lines. Except in so far as the Fertiliser Project is concerned no progress has been made with regard to various industries which it has been thought necessary for Government to participate in. Several schemes such as the production of steel, penicillin, sulphur drugs, anti-malarials, etc., are under the consideration of the Government of India, but no definite decisions have been taken. It is, therefore, extremely difficult to state, at this stage, what would be the requirements of technical personnel for direct employment by Government. The various Development Directorates need only specialists and they are available except in certain industries such as Rubber, Plastics, Rayon, Glass, etc.

3. The Development programme followed by the Department has been entirely left to private initiative uptill now. By giving guidance and help, it was possible to interest Indian industry in expanding existing capacity and starting new lines of production. The profit motive was the only inducement. Rightly, or wrongly, since the last Budget Session, there has been considerable falling off of applications from industry to start new lines of manufacture. It is, therefore, not possible to foresee what would be the requirements of industry for technical personnel unless it is definitely known what would be the precise industrial policy of the Central Government.

In the Statement of Government of India's Industrial Policy referred to above, a striking omission has been the absence of any reference to the views of Government about the role of foreign capital in the industrial development of India and the conditions under which assistance of foreign capital will be sought in the promotion of that objective. Many applications have been received from foreign industrialists asking for permission to start industries in India on 50-50 partnership between Indian and outside capital. As far as is known to me, no definite decisions have yet been made in this connection by Government.

4. When these various issues have been clarified, it will be possible to gauge with a certain amount of exactitude the requirements of technical personnel during the next few years. The only way in which an assessment can be made of the immediate requirements is to analyse the new Capital Floatations allowed by Government and infer from that the increased requirements of technicians. The table below gives the position of new capital issued for various industries since January 1946. In the last column is shown the

number of additional technical personnel that would be required for the successful running of these industries. The technical personnel have been divided into three categories:—

- 'A'—Experts.
'B'—Technicians with superior qualifications.
'C'—Lower grade technicians including mechanics.

Industries.	New Capital floated in 1946 (in lakhs)	Estimated requirements (Grades).		
		A'	B'	C'
1. Glass & Ceramics	213	10	30	200
2. Chemicals and Drugs	570	20	100	250
3. Soap and Oils (excluding edible Oils and Vanaspati).	110	8	10	100
4. Rayon and Art Silk	402	6	30	200
5. Paper, Board etc.	281	10	50	150
6. Plastics	50	10	40	200
7. Leather	65	5	13	35
8. Cement	463	10	20	80
9. Woollen	137	10	36	100
10. Rubber	117	7	94	188
11. Engineering	1,242	25	150	1,000
12. Electrical	910	25	150	300
13. Non-ferrous Metals	98	6	45	250
14. Machine Tools	122	100	400	1,000

5. It will be seen that new Capital floated in 1946 is 47 crores. In 1937 the capital invested in organised industry was estimated at 80 crores. It is therefore clear that in 1946 alone the capital issued in Industry increased by about 60 per cent., and in this, the increase of Capital for Textiles, Collieries and Food Industries has not been included.

6. 'A' Grade Technicians are experts and specialists in the subject and it would be difficult to obtain their training in India in most cases. The overseas Scholarships Scheme provides for the training of 'A' Grade Scientists. We have sent out Scholars as shown below:—

Subjects	No. of scholarships allotted.	
	1946-47	1947-48
(1) Chemical Engineering including Fertilisers	6	5
(2) Fuel Technology	2	...
(3) Glass Technology	1	2
(4) Industrial and applied chemistry including Tanning, Currying, and Leather Technology.	2	...
(5) Small Arms and Ammunitions :		
(a) Manufacture of High Explosives and Propellants	1	...
(b) Manufacture of small arms ammunitions	1	...
(6) Mechanical Engineering Power House Maintenance and Operation	2	5
(7) Wood Technology	3	2
(8) Electrical Engineering . . . . .	...	4
(9) Fermentation Power Alcohol . . . . .	...	1
(10) Metallurgy . . . . .	...	3
(11) Rubber Technology . . . . .	...	1
(12) Paints . . . . .	...	3
(13) Paper Technology . . . . .	...	1
(14) Plastics . . . . .	...	3
(15) Statistical Economics . . . . .	...	2
(16) Cellulose . . . . .	...	1
	18	33

In thus selecting scholars, we have taken into consideration, the recommendation of the various Panels set up by the late P & D. Deptt.

7. We are, however, finding difficulties in placing these students for higher technical training abroad. We have, therefore, already drawn the attention of

Education Department to the fact that a certain number of these should be trained in India. We have suggested that a priority list of subjects should be drawn for this purpose. It should indicate those subjects in which training cannot be imparted in India and for which scholars should perforce be sent abroad. For other subjects, training should be arranged on a co-operative basis through the Inter University Board so that a scholar may, for some length of time, be attached to one University for specialising in a particular branch and on completion of training there, may be passed on to another. For example, the following subjects can be easily dealt with by the Indian Universities on a co-operative basis:

- (1) Oils and Fats.
- (2) Glass except very highly specialised aspects.
- (3) Natural products.
- (4) Textile Chemistry.
- (5) Leather Technology.
- (6) Refractories and Ceramics.
- (7) Paint and Varnishes.
- (8) Paper Technology.
- (9) Synthetic Drugs, etc. etc.

After he has completed the university course, he should be placed for practical training with the industries here.

8. We understand that certain industries will accommodate a limited number of students provided they are not a financial burden on the firms giving the training. Reluctance on the part of firms to give practical training can be overcome by introducing suitable clauses in Govt. contracts or by other measures so that it becomes incumbent on them to train a certain number of students. It has also been brought to our notice that one of the principal difficulties in the way of firms taking up students for training is housing. We have been told that certain important firms like the Tatas may take an increasingly larger number of students, provided Government is prepared to build accommodation for them.

9. The present facilities for training 'B' Grade technicians are as follows:—

	Present output
Chemical Engineering and Technology	244
Civil and Municipal Engineering	467
Mechanical Engineering	258
Mining Engineering	27
Metallurgical Engineering	27

We have indicated our immediate requirements of 'B' Grade technicians for various industries. It will be noticed that except in Chemical Technology, specialist training is not imparted in most of the subjects. Our recommendation would, therefore, be that the existing technological departments be given immediate grants so that the ordinary M. Sc. graduates in Chemical Technology can be trained in special subjects for a short period to supplement their basic scientific training. We feel that the following institutes, if reinforced with capital grant and a certain additional recurring grant, would be able to provide a short term course to these technological graduates:—

	Capital grant (Lakhs.)	Recurring grant. (Lakhs.)
(1) Harcourt Butler Technological Institute, Cawnpore	5	1
(2) College of Technology, Hindu University, Benares	5	*2
(3) Department of Applied Chemistry, Calcutta-University	7	*2

(4) Laxminarayan Tech. Institute, Nagpur	3	0.8
(5) University College, Andhra University	3	0.5
(6) Indian Institute of Science, Bangalore . . . . .	..	*2
(7) Bengal Tanning Institute, Calcutta	1	0.5
(8) Institute of Leather Technology, Madras	1	0.5
(9) Engineering College, Guindy, Madras	2	0.75
(10) Department of Engineering and Technology, Annamalai University	1	0.5
(11) Department of Chemical Technology, Bombay University	1	0.5
(12) Forest Research Institute	2	0.7
(13) College of Engineering and Technology, Jadavpur	2	1.0
(14) Victoria Jubilee Technical Institute, Bombay	1	0.5

10. We have indicated against each institute what, in our opinion, would be required by way of capital grant and recurring expenses to fit them for these intensive post-graduate courses of short term duration. Each institute should select a group of subjects and a student trained in one aspect of the subject should supplement his training in one or more institutes. The whole course should not exceed 12 months in these institutes and should be followed by 6 months practical training. The recurring grant also envisages the recruitment from abroad of a few specialists by some of these institutes on a short term basis for training instructors. These are marked with a star mark.

11. The training in tanning and footwear has a special importance, as India is one of the largest producers of skins, hides and footwear. I am indebted to Mr. Randall for the following:—

“TANNERIES” —“There are only two institutions of importance in India, *vis.*—The Bengal Tanning Institute, Calcutta and the Institute of Leather Technology, Madras. The Bengal Tanning Institute has a degree course and also diploma course. The Madras Institute is believed to be initiating a degree course; hitherto they had only a diploma course. Both institutions should turn out potential grade technicians if students of a sufficiently high calibre take the degree course. In the past such students have been in the minority.

“It is estimated that these two Institutes pass out approximately 30 students annually and when the Degree Course is fully established, these would be composed of 10 of the degree class and 20 diploma class. The 10 may be classified as potential grade ‘A’ and ‘B’ technicians and the rest as grade ‘C’. Other less important institutions such as the Jullunder and Bombay Institutes cater largely for the training of students interested in the cottage industry section of leather production.

‘FOOTWEAR AND LEATHER INDUSTRIES’:

“There are no instructions catering for the training of technicians for these two industries other than small institutions such as the Cawnpore Leather Working School. The training given is wholly for hand made production and produces men of the craftsman type rather than the technician.

“Although it is essential that facilities for technical training in these two industries should be provided, there are many difficulties in the way of immediate progress, *e.g.* non-availability of the necessary plant and trained instructors for teaching the use of such plant.

“The P. & D. Department Panel’s recommendation concerning the Tanning, Footwear and Leather Goods Industries and the training of technologists was:—

- (1) The existing Tanning Institutes should be made more efficient and useful by adding to their equipment and by their having better paid staff.”

- (2) The students of these Institutes before they get their final certificates or diplomas should be made to work in Industrial concerns. Central and Provincial Governments should arrange with industrial concerns provision of facilities for such training and apprenticeship.

"It is considered that the development and promotion of scientific and technical research would be best stimulated by:—

- (1) Leather chemistry being accepted as one of the special subjects in the M.Sc. degree in Industrial Chemistry.
- (2) Students who take leather technology as a special subject and obtain their M.Sc. degree may then carry on research work in leather chemistry with a view to obtaining their Doctorate."

12. The most difficult part of the scheme would be the training of grade 'C' technicians. The existing facilities in India are totally inadequate and unless these lower grade technicians are thoroughly trained, we fear that the industrial development of India will be considerably delayed. At present the institutions which can profitably undertake the training of technicians are limited in number. As far as we know, the following offer scope for training of 'C' grade technicians and with the strengthening of their resources as indicated will be able to achieve a great deal:—

	Capital Grant (lakh)	Recurring Grant (lakh)
(1) Technological College, Dayalbagh	1.5	0.75
(2) Government Technical Institute, Lucknow	1.5	0.75
(3) Delhi Polytechnic, Delhi	—	—
(4) Engineering College, Anantpur	1.5	0.75
(5) College of Engineering, Cocanada	1.5	0.75
(6) College of Engineering, Bangalore	1.5	0.75
(7) Sri Jayachamarajendra Occupational Institute, Bangalore	1.5	0.75
(8) College of Engineering and Technology, Jadavpur	1.5	0.75
(9) Bengal Textile Institute, Serampore	1.5	0.75
(10) Victoria Jubilee Technical Institute, Bombay	1.5	0.75
(11) Railway Workshops	—	—
(12) Ordnance Factories	—	—

13. We have not been able to assess accurately the cost involved, but we feel that it will be necessary to train at least 1,000 to 2,000 'C' grade technicians, in the immediate future. We feel that a system of scholarships should also be instituted to make it possible for 'C' Grade technicians already engaged in industry to take a short special course. This should be arranged in co-operation with the Railway Workshops, Ordnance Factories and the various Engineering firms. In our opinion, a sum of 5 lakhs of rupees should be immediately earmarked for giving scholarships and maintenance allowances of lower grade persons engaged in industry.

14. The total number of students that can be trained under the above scheme can be calculated according to the formula laid down by Education Department. We will effect a considerable amount of saving on account of scholars that we would have otherwise sent abroad.

15. The firms in the attached list would with a proper understanding arrived at between them and the Government offer suitable opportunities for practical training to both 'B' and 'C' grade technicians.

PAY AND STATUS OF THE TECHNICIAN

16. The status of the technician in Industry today is rather unsatisfactory. It is suggested that there should be a basic uniformity in the grades of pay of

technicians over the entire range of organised industry. This applies particularly to C grade technicians.

17. At present, the technician suffers from an inferior position in relation to the executive branch of business organisations. Unless this is remedied, the inflow of technician will be hampered.

18. So far as technicians in Govt. service are concerned, it has been stated that their status requires to be raised. We are not worried about the position of technicians and scientists in Government employ, as we are sure that in future their status would largely be determined by the goods they can deliver. Mere allocation of status to a scientific man would not ensure that he would be able to exercise authority. He should have the requisite knowledge and ability.

19. The question of an All India Scientific Service has been raised. We are in full agreement with the view that an All India Scientific Service should be instituted so that the inequalities existing in different spheres of employment might disappear. Also, we agree that it is desirable to eliminate isolationist tendencies to which scientists in Government employment have become subject; but we feel that the solution suggested, namely, that scientists amongst universities, Provincial Governments and Industry should be periodically interchangeable is hardly practicable. There would be innumerable administrative difficulties which it would be hard to overcome.

Conclusion.

20. To summarise, my recommendation would be:—

- (1) To appoint an expert Committee to examine what subjects can be taught in India and arrange for their teaching in co-operation with Universities and technical Institutions for training 'A' Grade Technicians.
- (2) To institute a course of intensive short training for 'B' Grade technicians on a co-operative basis by Universities and Industrial Concerns. The cost of such a Scheme would be 34 lakhs in Capital Grant and 18.25 lakhs in Recurring Grants.
- (3) To arrange for the training of 'C' Grade Technicians at a cost of 13.5 lakhs in Capital Grant and 6.75 lakhs in Recurring Grants.
- (4) To earmark Rs. 5 lakhs per annum for refresher and supplementary courses for technicians engaged in Industry.
- (5) To earmark a certain sum for providing housing and other necessities at Selected Factories for training 'B' and 'C' grade technicians.
- (6) To enact legislative measures for enforcing a factory to take a certain number of students every year for factory training.

J. N. RAY.

LIST OF FIRMS, WHICH CAN OFFER SUITABLE OPPORTUNITIES FOR PRACTICAL TRAINING TO BOTH 'B' & 'C' GRADE TECHNICIANS

CHEMICALS AND DRUGS

1. M/s. Bengal Chemical and Pharmaceutical Works, Calcutta.
2. M/s. Tata Chemicals, Bombay.
3. M/s. D. C. M. Chemical Works, Delhi.
4. M/s. Shambhunath Acid Factory, Amritsar.
5. M/s. Dharamsi Murarji Chemical Company, Bombay.
6. M/s. Mysore Chemicals and Fertilisers, Mysore.
7. M/s. Eastern Chemical Co., Bombay.
8. M/s. CIPLA, Bombay.
9. M/s. Zandu Pharmaceutical Works, Bombay.
10. M/s. Mettur Chemicals, Mettur Dam.
11. M/s. Alembic Chemical Works, Baroda.
12. M/s. Bengal Immunity Co., Calcutta.
13. M/s. Standard Pharmaceutical Works, Calcutta.
14. M/s. Bathgate and Company, Calcutta.
15. M/s. Smith Stanistreet and Company, Calcutta.
16. M/s. Cawnpore Chemical Works, Cawnpore.

LEATHER INDUSTRY

17. M/s. Cooper Allen and Company, Cawnpore.
18. M/s. The Cawnpore Tannery Ltd., Cawnpore.
19. M/s. The Eastern Tanneries Ltd., Cawnpore.
20. M/s. The Indian National Tannery, Cawnpore.
21. M/s. The Hindusthan Tanneries Ltd., Cawnpore.
22. M/s. The Chrome Leather Company, Ltd., Cawnpore.
23. M/s. The Gordon Woodroffe Leather Mfg. Co., Madras.
24. M/s. The Mysore Chrome Tanning Co., Bangalore.
25. M/s. The National Tannery Company Ltd., Calcutta.
26. M/s. The Calcutta Tanneries Ltd., Calcutta.
27. M/s. The Bata Shoe Co., Ltd., Batanagar.
28. M/s. The Western India Tanneries Ltd., Bombay.

PAINTS AND VARNISHES

29. M/s. Shalimar Paint Colour and Varnish Co., Ltd., Calcutta.
30. M/s. Jenson and Nicholson (India), Ltd., Calcutta.
31. M/s. Napier Paint Works, Calcutta.
32. M/s. Murarka Paint and Varnish Works, Calcutta.
33. M/s. Hadfields (India) Ltd., Calcutta.
34. M/s. Hoyle Robson & Barnett and Company, Calcutta.
35. M/s. Macfarlane and Co., Ltd., Calcutta.
36. M/s. Calcutta Paint Colour and Varnish Works, Calcutta.
37. M/s. Solar Paint and Varnish Mfg. Co., Calcutta.
38. M/s. P. C. Chanda and Company, Calcutta.
39. M/s. Goodlass Wall (India), Ltd., Bombay.
40. M/s. Elephant Oil Mills, Ltd., Bombay.
41. M/s. Cooper and Company, Bombay.
42. M/s. Harcastle Waud and Company, Bombay.
43. M/s. Jyoti Paint and Varnish Industries, Madras.
44. M/s. D. Waldie and Company, Ltd., Calcutta.

PAPER

45. M/s. Titaghur Paper Mills, Titaghur.
46. M/s. Bengal Paper Mills, Calcutta.
47. M/s. Shree Gopal Paper Mills, Abdullapur.
48. M/s. Orient Paper Mills, Calcutta.
49. M/s. Rohtas Industries, Dalmianagar.

- 50. M/s. Jaswant Straw Board Mills, Meerut.
- 51. M/s. Straw Board Mfg. Co., Saharanpur.

Non-Ferrous.

- 52. M/s. The Indian Copper Corporation Ltd., Ghatsila, P.O. B.N. Rly.
- 53. M/s. Star Metal Refinery, Bombay.
- 54. M/s. Aluminium Corporation of India, Ltd., Cawnpore.
- 55. M/s. Indian Aluminium Company, Alwaye.
- 56. M/s. Biani Metal Works, Ltd., Calcutta.
- 57. M/s. Kamani Metal Refinery and Metal Industries, Bombay & Jaipur.
- 58. M/s. Bengal Ingot Co. Ltd., Calcutta.
- 59. M/s. The National Rolling Mills, Calcutta.
- 60. M/s. The India Rolling Mills, Ltd., Calcutta.
- 61. M/s. Venesta Ltd., Calcutta.
- 62. M/s. The Shapraria Iron and Steel Works, Bombay.

MACHINE TOOLS.

- 63. M/s. Jessop and Company, Calcutta.
- 64. M/s. Cooper Engineering Works, Satara.
- 65. M/s. Indian Machinery Ltd., Howrah.
- 66. M/s. Mysore Kirloskar Ltd., Mysore.
- 67. M/s. Britannia Engineering Co. Ltd., Tittaghur.
- 68. M/s. Maya Engineering Works, Calcutta.
- 69. M/s. Investa Machine Tools and Engineering Co. Ltd., Bombay.
- 70. M/s. Richardson and Cruddas Ltd., Bombay.

MECHANICAL ENGINEERING.

- 71. M/s. Kirloskar Bros., Kirloskarwadi.
- 72. M/s. P. S. G. & Sons, Coimbatore.
- 73. M/s. Bahri Engineering Company, Jamshedpur.
- 74. M/s. Jay Engineering Works, Calcutta.
- 75. M/s. Cooper Engineering Works, Satara.
- 76. M/s. India Machinery Ltd., Dum Dum, Calcutta.

ELECTRICAL INDUSTRIES.

- 77. M/s. Clyde Fan Co., Calcutta.
- 78. M/s. Kaycee Industries, Calcutta.
- 79. M/s. India Electric Works, Ltd., Calcutta.
- 80. M/s. Calcutta Electrical Mfg. Co., Calcutta.
- 81. M/s. Model Industries, Dayalbagh.
- 82. M/s. British India Electric Construction Co., Calcutta.
- 83. M/s. Everest Engineering Company, Calcutta.
- 84. M/s. Greaves Cotton and Crompton Parkinson, Bombay.
- 85. M/s. Bengal Electric Lamp Works, Calcutta.
- 86. M/s. Electric Lamp Manufacturers of India, Ltd., Calcutta.
- 87. M/s. Mysore Lamp Works, Ltd., Bangalore.
- 88. M/s. Lux Lamps Ltd., Calcutta.
- 89. M/s. Associated Electrical Industries (India), Ltd., Calcutta.
- 90. M/s. Phillips Electrical Co. (India), Ltd., Calcutta.
- 91. M/s. General Electric Co. (India), Ltd., Calcutta.
- 92. M/s. F. & C. Osler Ltd., Calcutta.
- 93. M/s. Siemens (India), Ltd., Calcutta.

POTTERIES.

- 94. M/s. Bengal Potteries, Calcutta.
- 95. M/s. Gwalior Potteries, Gwalior and New Delhi.
- 96. M/s. Parashuram Potteries, Thangadh.
- 97. M/s. Sodapore Potteries, Sukohar.

- 98. M/s. Bengal Porcelain Company, Calcutta.
- 99. M/s. Burn and Company, Calcutta.
- 100. Government Porcelain Factory, Bangalore.
- 101. M/s. Parry and Company, Madras.

GLASS.

- 102. M/s. Scientific Indian Glass Company, Ltd., Calcutta.
- 103. M/s. U. P. Glass Works, Ltd., Bahjoi.
- 104. M/s. Seraikella Glass Works, Kandra.
- 105. M/s. Allahabad Glass Works, Naini.
- 106. M/s. Capital Glass Works, Melaknagar.
- 107. M/s. Ganga Glass Works, Ltd., Balawali.
- 108. M/s. Kaycee Glass Works, Shikohabad.
- 109. M/s. Khandelwal Glass Works, Sasni.
- 110. M/s. New India Glass Works, Calcutta.
- 111. M/s. Ogale Glass Works, Ogalewadi.
- 112. M/s. Paisa Fund Glass Works, Talegaon.
- 113. M/s. Vibhuti Glass Works, Benares.
- 114. M/s. Sodepur Glass Works, Calcutta.
- 115. M/s. Jain Glass Works,

REFRACTORIES.

- 116. M/s. Burn and Company, Calcutta.
- 117. M/s. Reliance Firebrick and Pottery Co. Ltd., Calcutta.
- 118. M/s. Behar Firebricks and Potteries Ltd., Calcutta.

SOAP AND OILS

- 119. M/s. Lever Bros., Bombay.
- 120. M/s. Tafa Oil Mills, Bombay.
- 121. M/s. Godrej Soaps, Bombay.
- 122. M/s. Swastik Oil Mills, Bombay.
- 123. M/s. Mysore Govt. Soap Factory.
- 124. M/s. The Kerala Soap Factory, Calicut.
- 125. M/s. Bengal Chemical and Pharmaceutical Works, Ltd., Calcutta.
- 126. M/s. Jadavpore Soap Works, Calcutta.
- 127. M/s. Modi Soap Works, Meerut.
- 128. M/s. Techno Chemical Industries, Calicut.

RUBBER

- 129. M/s. Dunlop Rubber Company, Calcutta.
- 130. M/s. Firestone Tyre and Rubber Company, Bombay.
- 131. M/s. Bata Shoe Company, Bata Nagar.
- 132. M/s. Bengal Waterproof Company, Calcutta.
- 133. M/s. A. K. Sarkar Company, Calcutta.
- 134. M/s. Travancore Rubber Works, Trivandrum.
- 135. M/s. Indian Rubber Manufacturers, Calcutta.

WOOLLEN

- 136. M/s. Cawnpore Woollen Mills, Cawnpore.
- 137. M/s. Raymond Woollen Mills, Bombay.
- 138. M/s. Indian Woollen Mills, Ltd., Bombay.
- 139. M/s. Bangalore Woollen Mills, Ltd., Bangalore City.
- 140. M/s. Shri Dinesh Mills, Ltd., Baroda.
- 141. M/s. Raj Spinning Mills, Amritsar.
- 142. M/s. Oriental Carpet Manufacturers (India), Ltd., Amritsar.
- 143. M/s. B. K. Subbaya and Sons, Bangalore City.
- 145. M/s. Nagpal Woollen Mills, Bombay.

CEMENT

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सत्यमेव जयते

CHAPTER VI

R.I.A.F. Training, Research and Development in Collaboration with Civil Institutions

By

H. SINGH

OBJECT OF MEMORANDUM

To explore possibilities of training, research and development for R.I.A.F. in collaboration with civil Institutions and research bodies.

1. Technical training and expansion in collaboration with civil aviation.

Training.—It is strongly recommended that the present Technical Training Scheme of Government of India, Civil Aviation be co-related to the Training Scheme of R.I.A.F. in as far as common trades are concerned. This closer fusion can provide many advantages as:—

(i) Pace of training can be quickened.

(ii) Uniform standard of training can be attained.

(iii) Facilities can be available by which Air Force Personnel in peace time could be provided to Civil Aviation and the Civil Aviation Technicians could be switched on to Air Force should a national emergency arise. A pool of trained personnel can meet the requirements of both the organisations at any time.

Trade Testing.—The Ground Engineers with A,B,C,D, & X licenses and Tradesmen in Civil Aviation can be usefully employed by Air Force but in such it is essential that Air Force is fully represented on the examining bodies and if suitable for Air Force their certificates endorsed "Acceptable to Defence Services".

A detailed scheme in this connection can further be discussed by which the common trades of Civil Aviation and Air Force as well as the basic and specialist courses of common design could be worked out to uniform standard. The Civil Aviation Training Centre at Saharanpur could be utilized for such purpose.

2. Development and Research.—Defence Services appreciably rely on the works done by Scientists who also work to the requirements of Forces. Up to now R.I.A.F. has been a prominent part of R.A.F. in the U.K. Air Ministry holds the functional control of both the R.A.F. and the Civil Aviation. In all the researches and developments in Aircraft, Air Ministry is the supreme authority. R.A.F. is fully represented in Air Ministry. In this way R.I.A.F. has been dependent on the authority of Air Ministry. It is now strongly emphasised that similar link between R. I. A. F. and Civil Aviation be formed which would actively keep liaison with Civil Institutions and eminent works in the advancement and researches of Indian Development on Aircraft side. Further possibilities should be explored for the following Institutions:—

(i) Hindustan Aircraft Factory, Bangalore.

(ii) Institute of Science (Aeronautical Engg.), Bangalore.

(iii) Engineering University, Roorkee, Aeronautic 1 Engg. Group.

(iv) Forest Research Institute, Dehra Dun.

(v) Supdt., Instrument and Optical Factory, Dehra Dun.

(vi) Ordnance Laboratories, Cawnpore.

There are number of resources which have been untouched and could be remarkably utilized in the interest of aircraft development for Civil and Air Force purpose. Indian Timber opened a great subject during the War for Aeronautical Manufacture but no efforts were further made to utilize the work for Airframes and Propellers. Greatest steps are now required to have a team of Civil and Air Force Engineers organised to take up this work in hand.

Radio Training and Research.—Wireless applied to aviation has become an instrument of very high importance. It has proved beyond doubt that the **safety of Aircraft in Air, in Operations, or in Flight is highly dependent on Wireless appliances connected to flying.**

In passive Air Defence against Enemy Aircraft, Wireless has played a part of decisive nature.

The training provided by Indian Universities in physical science and post-graduate study in physics hardly gives a turn out of young men who would normally be utilized beyond that of maintenance standard of wireless appliances. India has not been able to make advancement in Radio Communication owing to the lack of facilities of research in this subject. Joint representations should be made to provide development facilities to the interest of Civil Aviation and Air Force with important institutions such as:—

- (i) Institute of Science (Bangalore).
- (ii) Govt. Radio Factory, Bangalore.
- (iii) Victoria Jubilee Technical Institution, Bombay.

and any other such institutions which could be agreed upon to be of help in setting up the development machinery. The institutions should be actively collaborated in the achievement of peace-time and operational necessities of Wireless. Continuous references for service and civil training in these lines should be made to these institutions.

Airborne Armaments and Explosives.—No facilities are available in this country by which the specialist armament and explosives for Aircraft could be taken up for manufacture. Indian Air Force has been predominantly dependent on the supply and directions of Air Ministry. A high field of work lies untouched whereby the work on armament and ammunitions should be carried on for reserve storage and experimental basis. In this connection the Command Armament should be reorganised on a higher status. Closer liaison should be set up with Army Ordnance and further possibilities should be explored for taking advantage of Ordnance and Explosive Factories now in existence in Command. Ample encouragement should be given for appointing desirable chemists, physicists and engineers to do research work directly in contact with the Ordnance Factories and who on their part will pass their higher problems for special investigations, with civil research institutions.

General.—For such achievements it would be desirable to set up Armed Explosives, Scientific Aircraft Experimental Stations which would pass their work to Air Council. It is worth mentioning on this issue that Air Council will be the supreme body for maintaining foreign liaison, collecting command requirements, collecting and controlling experimental stations and final approval of the works through Command Armament.

CHAPTER VII

**Programme for provision of facilities for education, training and research
in GEOLOGY and MINING which can be initiated within the
next six months**

By

D. N. WADIA

Facilities for advanced geology education and research, unlike those for the physical and biological sciences, were, until very lately, practically non-existent in Indian Universities. That was largely because, prior to war, there was hardly a demand for five geologists a year and not more than double that number of mining men, all for subordinate positions in industry, teaching line, and very rarely in Government employ.

2. Within the last 7 or 8 years, there has sprung up a sudden increase in this demand—over 400 to 500 per cent—and the few existing geological training institutions, namely some five universities and the Indian School of Mines, have been hard put to it to meet this sudden increase in intake. Up to 1940, there were only four universities which had geology departments, equipped for teaching up to B.Sc. (Hons.) or M.Sc. standard, but which possessed insufficient means for giving practical field geological training. Since 1940, four more universities (Andhra, Lucknow, Patna and Nagpur) have instituted geological faculties, though these are also not in a better position than the older universities for providing adequate facilities for post-graduate research as well as an efficient system of practical field training.

3. The education of working geologist is different from that of other scientists and demands not only class-room and laboratory teaching, as in the other sciences, but also a system of field training and instruction in the open country, requiring prolonged camping seasons in distant geological provinces and mining areas—a type of instruction which is rather costly and out of the common and few of our colleges and universities were, and even yet are, in a position to provide efficiently. The Geological Survey of India is the only agency that can help the educational institutions in this post-collegiate training in the field to supplement the purely academic education of the class-room. The limited facilities at the command of the Geological Survey, however, for this purpose have been fully taxed in training their own recruits which have of late largely multiplied.

4. It is from this background that the question of man-power in Geology has to be viewed. The pre-war set-up being so unsatisfactory for providing to the country the right type of geologists, Government directed its attention in 1944 to improve the situation. In 1945, two committees were formed—the Geology Education Committee and the Indian School of Mines Re-organisation Committee—with the object of improving Geology and Mining education and increasing the out-put of properly trained personnel. These two committees have completed their work and submitted their reports, recommending measures for securing the desired results within the coming five years. The recommendations of the Geology Education Committee for help to geology departments of universities, viz financial grants, procuring of laboratory apparatus, camp equipment and in the training abroad of one member of the tutorial staff, side by side with suggestions for management and strength of classes, limit of number of students and length of different courses, are likely to result in increase in the number of graduates and post-graduates in Geology, to a level more or less in keeping with the demand, and also improve the quality of the turn out. The Indian School of Mines, after the suggested re-organisation of its staff, buildings, laboratory extensions and revised courses of underground training, will turn out double the number of qualified mining engineering graduates, which it is doing at present (a target figure of 48 per year plus

12 Applied Geology students). The standard of training and practical instruction imparted to these mining men will compare favourably with that of foreign mining schools, both as regards theory and the practical side of mining.

5. Since the present sub-committee is called upon to frame a programme for provision of facilities for education, training and research in Geology and Mining which can be initiated within the next six months, it cannot do better than ask for a speedy implementation of the two reports that have lately been presented to Government—(1) by the Geology Education Committee in October 1946, and (2) by the Indian School of Mines Reorganisation Committee in June 1947. Both these reports have suggested procedure and programme of requirements and recommended facilities to be provided for improving the quality and quantity of trained geological and mining personnel that will be required soon for manning the expanded Geological Survey of India, the various mineral industrial development projects and mining and metal industry of the country.

6. The effect of these measures, if quickly implemented will be to produce, on an average, about 64 qualified mining and metallurgy graduates per year (48 from Dhanbad School of Mines plus 16 from Benares Hindu University) after 1950, and between 70 and 80 Geology graduates annually of M.Sc. and B.Sc. (Hon.) standard (60—70 from the universities plus 12 from Dhanbad School of Mines). The quality and grade of instruction provided in the revised schemes at these institutions, however, though considerably improved, will not be such that the trainees can go into direct employment without at least six months of field experience and training in methods of geological survey and mapping. For this, extra provision is necessary and the present Scientific Man-power Committee should make recommendations to Government to this effect.

This field course constitutes the most difficult part in the training of geologists, but it is quite necessary and must be imparted, either during their final year of study, or immediately after their passing out. The only satisfactory way of imparting this practical training, under present-day conditions prevailing in India, is to assign the freshly passed graduates to the various field parties of the Geological Survey, for at least one full field season. Parties of 3 to 5 men may thus be assigned to 10 working field parties every year. Similarly a small number of students, during the latter part of their course, may be assigned to the vacation Mining Camps of the Indian School of Mines, Dhanbad, for securing practical experience of underground mining methods. The cadre of Geologists in the Geological Survey of India when it is complete by the addition of 14 new recruits this year, will be able to spare fairly senior officers, who can superintend this work of giving to fresh university graduates the necessary field training and practice in geological mapping, survey methods, etc.

7. I would, however, impress upon the sub-committee that the combined demand of India for Geology and Mining men will always be within rather narrow limits. I do not anticipate that, with all the new development projects in active operation, the total demand, within the next five years, will exceed 400 fully qualified geologists and mining engineers. Once the target of 150 geologists to be recruited for the Geological Survey of India within the next few years, is completed and the requirements of educational institutions expanding under Government grants scheme are satisfied, it is probable that the increased out-turn of geology M.Sc's and post-graduate research men, and mining engineering men from the Indian School of Mines as well as from the improved mining faculty of the Benares Hindu University, may more than saturate the field of employment in these subjects, unless India:

mining industry take a phenomenal turn. We should, therefore, be careful to see that an over-multiplication of highly specialised men in these two subjects is not produced. The present programme may, therefore, be considered adequate to meet the demands of the next five years, at the end of which a fresh stock of the situation may be taken.

8. In the above paragraphs, consideration is given only to the requirements of higher ranks of professional geologists and mining men. But, in a modern State, Civil Engineering, Agriculture, Soil Science, Irrigation and Underground Water Supply need knowledge of geology as an essential subsidiary, and provision for imparting this elementary geological instruction has to be made. The revised B.Sc. Geological courses of our Universities and Colleges (which will now number about 12) and the Geology courses usually given in the Engineering and Agricultural Colleges will ordinarily meet the demand for this type of instruction, both as regards theory and the practical side. Civil Engineering and Agricultural Colleges are being modernised and re-equipped and Government is giving special grant to such institutions as the Jadavpur Engineering College, this will doubtless improve the facility for geology teaching in the non-specialist institutions.



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CHAPTER VIII**Programme for the Improvement and Development of Higher Technical Education**

By
S. R. SEN GUPTA

The inadequacy of the existing facilities for higher technical education in India is admitted on all hands. The Sarker Committee appointed by the Government of India to consider the development of higher technical institutions in India was of the opinion that both in quality and quantity the present facilities fell short of India's needs to produce high grade engineers and technologists. This Committee recommended the early establishment of four Regional Higher Technical Institutions on the lines of the Massachusetts Institute of Technology, each of them to provide a wide range of facilities for post-graduate study and research in addition to producing annually about 380 graduates in engineering and technology.

2. The Committee's recommendations were endorsed by the All-India Council for Technical Education, which were established on the 30th November, 1945, to survey the needs of the country as a whole for higher technical education and to advise the Government of India on all matters concerning higher technical education. This Council were of the opinion that in order to upgrade the existing institutions of engineering and technology it was most urgent that generous grants should be given by the Governments, Central and Provincial.

3. In the light of the above and other recommendations of the Council the Government of India have decided to initiate and implement the following development schemes within the quinquennium commencing from the year 1946-47:—

(i) Establishment of Regional Committees of the All-India Council for Technical Education to ensure the co-ordinated development of technical education and generally to raise its standard.

(ii) Improvement and expansion of existing non-governmental institutions of Engineering and Technology by giving them financial assistance.

(iii) Procurement of scientific and technical equipment for distribution free of charge or at nominal price, to deserving scientific and technical institutions including research institutions.

(iv) Development of the Delhi Polytechnic.

(v) Development of the Indian Institute of Science, Bangalore.

(vi) Establishment of the Eastern and the Western Higher Technical Institutions.

(vii) Establishment of a Central Training College for teachers in Technology.

(viii) Establishment of a Central School of Indian Architecture and Town and Regional Planning.

(ix) Establishment of an Administrative Staff College for administrators engaged in industry, commerce and in Government employ.

4. **Establishment of Regional Committees of the All-India Council for Technical Education.**

Financial implication:—

Capital—Nil.

Annual Recurring—Rs. 1,84,000.

In order to enable the Council to tender judicious advice to the Government for the provision of facilities for technical education in every part of the country adequate in relation to the possible industrial development of

each region, the Council have decided to establish regional committees in co-operation with the provincial and state Governments, the latter have now under consideration definite proposals as formulated by the Council, in regard to the demarcation of the regions as well as the composition and functions of such committees. The Government of India have sanctioned a nucleus staff for the proposed Regional Committees and there is every reason to hope that these committees will commence their work within six months.

Budget Provision.

1947-48—Rs. 20,00,000

5. Improvement and expansion of existing non-governmental institutions of Engineering and Technology.

The All-India Council for Technical Education are of the opinion that simultaneously with the establishment of high grade institutions of engineering and technology, the Government of India should give generous grants for upgrading and expanding some of the existing institutions of engineering and technology. A nominal provision of Rs. 20 lakhs has been made in the budget for the year 1947-48 without prejudice to expenditure sanction for implementing sound recommendations that may be made by the Council in this behalf. The Council consider that the following institutions require to be improved and developed:—

- (i) College of Engineering and Technology, Jadavpur.
- (ii) Department of Applied Chemistry, University College of Science and Technology, Calcutta.
- (iii) Department of Applied Physics, University College of Science and Technology, Calcutta.
- (iv) Engineering College, Benares Hindu University.
- (v) College of Mining and Metallurgy, Benares Hindu University.
- (vi) College of Technology, Benares Hindu University.
- (vii) Engineering College, Dayalbagh.
- (viii) Engineering College, Aligarh Muslim University.
- (ix) N.E.D. Engineering College, Karachi.
- (x) Victoria Jubilee Technical Institute, Bombay.
- (xi) Department of Chemical Technology, Forman Christian College, Lahore.
- (xii) Department of Chemical Technology, Bombay University.
- (xiii) Luxmi Narayan Institute of Technology, Nagpur University.
- (xiv) Department of Technology, Andhra University.
- (xv) Department of Chemical Technology, Madras University.
- (xvi) Engineering College, Annamalai University.

The Council have appointed expert committees to visit these institutions and to make recommendations for their improvement and development. The expert committees for (i), (iv), (v), (vi), (vii), (viii), (xi), (xii) and (xvi) have already submitted their reports and the committees for the remaining institutions are expected to submit their reports within a fortnight or so. A scrutinising committee of the Council is expected to examine all these reports and to submit its recommendations to the Co-ordinating (the Executive) Committee of the Council by the 31st August, 1947, which has been authorised by the Council to submit on their behalf the final recommendations to the Government of India early in September, 1947. If adequate funds are made available, it should be possible to initiate steps for the improvement of the

above institutions in October, 1947. This should raise their existing standard of education and in some cases also increase their training capacity, leading to a gradual increase in the annual output of graduates from them. The tabulated statement in Annexure shows the present as well as the additional anticipated output from each of these institutions when the development plans are implemented with financial assistance from the Government of India.

6. Procurement of Scientific and Technical Equipment.

(A Fund of one crore of rupees).

A considerable amount of stores and equipment of educational value was rendered surplus on the cessation of hostilities. These are being disposed of by the Government of India. A small organisation was set up in the Education Department for securing some of them for educational institutions. It was soon discovered, however, that if educational institutions, all of whom had been unable to secure any equipment since 1939, were to secure even their minimum requirements from this surplus stock, it would be necessary to provide them also with funds to purchase these. For, owing to the abnormal rise in prices, the institutions were able barely to meet their day-to-day expenditure out of the funds at their disposal.

Further, it was found that if materials of educational value were not to pass into the hands of dealers as a consequence of the disposals policy of the Government, it would be necessary for a Central Organisation to purchase and hold the required stock. The Government of India were accordingly requested about nine months back to provide a fund of one crore of rupees. But unfortunately Government decision in the matter has not been obtained as yet with the result that substantial quantities of valuable materials have already found their way into the hands of private dealers. If funds are made immediately available, even now it may not be too late to secure a substantial quantity of the materials for educational purposes.

It should not be overlooked that most of the institutions are ill equipped while much of their existing equipment is now old and require thorough overhauling. With a view to assisting the institutions to bring their equipment up-to-date, model inventories of minimum equipment required in an engineering college have been prepared and circulated to all engineering colleges, universities and Provincial Governments.

The Government of India can also help to improve the situation indirectly in other ways by instructing the Supply Missions to attach the highest priority to secure from abroad scientific and technical equipment and by removing all restrictions on the import of these articles.

7. Development of the Delhi Polytechnic.

Financial implications:—

Capital—Rs. 79,70,000.

Annual Recurring—Rs. 5,70,000.

Owing to the war-time difficulties, the Delhi Polytechnic which was started in 1941 could not be developed to its full stature. It is a unique institution of its kind in India in as much as it provides instructional facilities both full-time and part-time in a wide range of subjects such as Engineering, Applied Science, Textile Technology, Commerce, Art, Architecture, etc.

The inadequacy of teaching accommodation and the acute shortage of teaching staff are now hindering its proper development. While the first of these obstacles will be removed when funds asked for are made available, it is feared that unless the Government of India sanction more liberal salaries for teachers than at present, it would be well nigh impossible to develop the institution properly.

With the small extension of buildings that has now been taken in hand it should be possible to increase within the next six months the annual intake by the margin shown below, provided the terms and conditions of service of teachers are made sufficiently attractive:

(i) Architecture	30	} Full-time
(ii) Arts & Crafts	15	
(iii) Radio Servicing	10	} Part-time
(iv) Cooperative		
Course in Textile Technology	10	

8. Development of the Indian Institute of Science, Bangalore.

Financial implications:—

Capital—Rs. 1,03,000.

Annual Recurring—Rs. 7,94,000.

A four-year plan for the development of the Indian Institute of Science is now in the second year of its operation. Two new departments namely, Departments of Metallurgy and Internal Combustion Engines have been established and some of the existing departments improved. A High-Voltage Laboratory for research and a department of Power Engineering for the post-graduate training of power development engineers (civil, mechanical, electrical) are being established and should be ready to admit scholars from July, 1948.

In Annexure II will be found a statement showing the number of students admitted to different courses in the Institute in the year 1945-46. From this year, it may be possible to increase the annual intake as follows:—

- (i) Physics (Research)—3.
- (ii) Biochemistry (Research)—5.
- (iii) Pure and Applied Chemistry and Chemical Engineering (Teaching and Research)—30.
- (iv) Electrical Technology (Teaching and Research)—20.
- (v) Aeronautical Engineering (Teaching and Research)—5.
- (vi) Metallurgy (Teaching and Research)—12.
- (vii) Internal Combustion Engineering (Teaching and Research)—10.

9. Establishment of the Eastern and the Western Higher Technical Institutions.

Financial implications:—

Eastern Higher Technical Institution.

Capital—Rs. 3,04,95,000.

Annual Recurring—Rs. 44,61,000.

Western Higher Technical Institution.

Capital—Rs. 3,50,00,000.

Annual Recurring—Rs. 44,00,000.

From the experiences gained during the recent war years, the Government of India came to the conclusion that for meeting India's post-war needs it would be necessary to augment and improve considerably the present facilities for technical education and decided to—

(a) introduce the overseas scholarship scheme for advanced education and training abroad of Indian graduates in engineering and technology.

(b) set up a committee under Mr. N. R. Sarker to recommend steps for the development of higher technological institutions for post-graduate study and research.

In February, 1946, the Sarker Committee submitted its report urging upon the Government of India the necessity of establishing with the least possible delay at least four Regional Institutions on the lines of the Massachusetts Institute of Technology, so that India's post-war needs might be met adequately.

The Government of India have decided to establish within the quinquennium commencing from the year 1946-47 two of these regional institutions namely, the Eastern and the Western Institutions, each for about 2,000 undergraduates and 1,000 post-graduates and research students. Each of these institutions is to have wide facilities for post-graduate study and research. For example, the Eastern Institution is expected to provide facilities for post-graduate study and research in the following subjects:—

Fuel Technology.

Pharmaceutics and Fine Chemicals.

Regional Planning.

Paper Technology.

Glass and Ceramics.

Plastics.

Paints and Pigments.

Hydraulic and River Research.

Transportation (including Railway Engineering).

Structural Engineering (including High Dams).

Design of Electrical Machinery.

Refrigeration and Air conditioning.

Automobile Engineering.

Machine-Tools.

Design of Machinery and Instruments.

Light Alloys.

Industrial Physics.

Electronics (including Radio Engineering).

Economics, Botany.

Geophysics, Geology, Mineralogy.

Meteorology.

Food Technology.

A number of sites for the proposed Eastern and the Western Higher, Technical Institutions have been examined and the Government are expected to complete the purchase of two suitable sites within the next two or three months. The requisitions for the recruitment of the necessary planning staff are expected to reach the Federal Public Service Commission early next month. It has also been decided to send in autumn this year a small delegation to Europe and America to recruit such of the staff for certain key posts as are not likely to be available in India. It is hoped that it would be possible to fill up at least some of the key posts within the next six months. The planning of the college buildings and laboratories, the placing of order for equipment, and helping in the recruitment of the other staff are some of the important tasks that are to be assigned to the planning staff. Although it would take two to three years for the institutions to come fully into operation, it is hoped that a certain amount of post-graduate and research work and the training of junior teachers would commence much earlier in hired or temporary buildings near the sites.

The Department of Education attach the greatest importance to the early establishment of these institutions for, the sooner they are the sooner will India be free from the necessity of sending overseas a large number of scholars for advanced training in different branches of technology.

It may not be out of place to mention here the following two important matters both of which call for liberal decision, as on this will largely depend the success of these institutions :—

(a) the necessity of offering adequate salaries to teachers so as to attract the best brains to the teaching profession. The present salaries obtaining in the country discourage rather than encourage talented young men to take to teaching posts.

(b) the need for exercising only the barest minimum of governmental control during the formative period of the Institutions. The only way to establish these institutions speedily is to entrust the work to a small Managing Committee empowered to recruit staff, purchase equipment and to take such steps as could expedite the construction of buildings. The grant of such powers to the managing Committee as suggested above would necessarily involve the relaxation of much of the existing rules and procedure.

10. Establishment of the Training College for teachers in Technology.

Financial implications:—

Capital—Rs. 9,81,000.

Annual Recurring—Rs. 1,40,000.

The details of the scheme have been worked out. It is proposed to establish this institution as a Department of the Delhi Polytechnic for the training of teachers for technical high schools and senior technical institutions. For various reasons, such as the inadequacy of teaching accommodation, shortage of staff, equipment, etc., it will not be possible to initiate this scheme for another six months.

11. Establishment of a Central School of Architecture and of an Administrative Staff College.

Financial implications:—

School of Architecture.

Capital—Rs. 1,00,000.

Annual Recurring—Rs. 98,000.

Administrative College.

(Details are being worked out.)

The details of these two schemes are now being worked out. The schemes will be ready for implementation in 1948-49.

12. Effect of initiating the development schemes.

In addition to the schemes outlined above, some of the Provincial Governments are also initiating schemes for the improvement of the government institutions and the establishment of a few new ones. An attempt has been made to estimate the likely effect on the total output of engineers and technologists from all institutions for India as a whole. Information collected either from replies to a questionnaire issued by the All-India Council for Technical Education or through a direct reference on the subject matter to the institutions concerned has been arranged in the Annexure III, IV, V and VI. Annexure III gives an estimate of the likely annual intake into degree or equivalent courses in different institutions for each branch of technology. Annexure IV gives estimates (a) for the present annual output of engineers and technologists with degree or equivalent qualifications and (b) of their probable output by 1951

and 1954 respectively. Corresponding estimates for Diploma courses are given in Annexure V and VI.

As will be seen from these figures, the annual output of graduates in engineering and technology is expected to rise from its present level of 1,300 to approximately 4,000 by 1954 on the assumption that all the development plans outlined above will be implemented within the next two or three years.

13. Overseas Scholarship Scheme.

Financial implications:—

For five years—Rs. 2,40,45,350.

The Overseas Scholarship Scheme was introduced in the year 1945-46 to meet the needs of the Central and Provincial Governments for high-grade technical and scientific personnel. Under this scheme, nearly 1,000 scholars have been sent for advanced education and training in foreign institutions. Some of these scholars are expected to return within the next six months and will be available for employment under the governments.

The scholarship scheme was recently reviewed by an expert committee under Dr. B. C. Roy. It is understood that the Committee has submitted an interim report which is now under consideration of the Government of India and it is anticipated that, as a result of the Roy Committee's recommendations, the scope of the scheme will be considerably widened so as to enable educational institutions, public utility concerns, and industry to participate in it.

14. Development of the Indian School of Mines, Dhanbad.

On the recommendations of a Committee of the Works, Mines and Power Department, the Government of India have already initiated a scheme for doubling the training capacity of the Indian School of Mines and improving the standard of education.

15. Geological Education Committee Report.

The Parija Committee's report on Geological Education has been under examination by the Universities and Provincial Governments concerned and also by the Government of India. It ought to be possible to give effect to some of the major recommendations within say six months. The schemes drawn up on the lines of the committee's recommendations should, when fully implemented, result in a substantial improvement and expansion of the facilities for undergraduate and postgraduate education in Geology in the Universities of Calcutta, Benares, Aligarh, Bombay (Fergusson College) and Mysore.

16. Fund for the Promotion of Fundamental Research.

Financial implications:—

For five years a fund of Rs. 75,00,000

plus

Indian Association.

Capital—Rs. 13,82,000.

Annual Recurring—Rs. 2,71,000.

The Government of India have agreed to provide a fund of Rs. 75 lakhs for the promotion of fundamental research in Universities and research institutions during this quinquennium.

A scheme for the development of the Indian Association for the Cultivation of Science has been sanctioned, under which the association is expected to commence within the next half-year research work in High Polymer Physics and Chemistry.

A scheme for the development of the Tata Institute of Fundamental Research is now under consideration of the Government of India, which, if sanctioned, will be initiated within six months' time.

17. Development of the Central Universities.

Financial implication:—

Delhi University.

Capital—Rs. 39,75,000.

Annual Recurring—Rs. 8,56,000.

Benares University.

Capital—Rs. 20,45,000.

Annual Recurring—Rs. 2,00,000.

Aligarh University.

Capital—Rs. 2,50,000.

Annual Recurring—Rs. 30,000.

The Development programmes which have been already initiated should bring about an all-round improvement of the three Central Universities of Delhi, Aligarh and Benares.

For example, the Delhi University is offering from this year degree courses in some of the biological sciences.

18. Other Central Schemes for the development of general education.

Financial implication:—

Training College.

Capital—Rs. 20,45,000.

Annual Recurring—Rs. 2,00,000.

Jamia Millia.

Capital—Rs. 2,50,000.

Annual Recurring—Rs. 30,000.

Visva-Bharati.

Capital—Rs. 4,78,000.

Annual Recurring—Rs. 90,000.

It is hoped to start in Delhi (within six months) a Teachers' Training College which, to begin with, will train 60 graduate teachers. Thirty basic school teachers are being trained in the Jamia Millia Islamia. The Visva-Bharati is expected to commence (also within six months) the training of 30 Music Teachers, 80 Arts and Crafts Teachers and 80 Basic School Teachers.

19. Practical Training of young Engineers and Technologists.

One other aspect of Engineers' education deserves special attention, namely, facilities for their post-collegiate practical training.

Past experience has abundantly shown the necessity of more positive steps to ensure that fresh graduates receive adequate field or shop training. Employers including Governments should appreciate that Engineering Colleges cannot provide them with finished products for ready employment in responsible posts and that it would be to their own interest to take in raw graduates and train them up properly. Unless employers willingly face this responsibility and readily undertake to provide facilities for the practical training of young engineering graduates who will be coming out of the Colleges in increasing numbers, the basic object of expanding the facilities for technical education as now envisaged, will be largely frustrated.

20. Training Officers in Technical Departments of Governments—Apprentice Engineers.

At present even when a Government Department takes in young engineers for training, their training is hardly ever properly overseen and the graduates ostensibly complete their practical training without improving themselves.

It is suggested that the Technical Departments of the Governments should undertake the task of training a fairly large number of young graduates and for this purpose each of them should have an officer specifically entrusted with the task of looking after their practical training.

At present, a young engineer can get a minor post before taking any practical training and there is a tendency to continue to use him in this minor capacity without further developing his skill.

The best course would seem to be for Departments to take them as apprentice engineers in greater number than their actual requirement for staff and to put them through an all-round training.



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ANNEXURE I

Additional output from the Institutions for which Expert Committees of the All-India Council for Technical Education have recommended grants.

Name of Institution	Courses leading to degrees in	Present output	Additional output	Available from the year	Grant recommended by Expert Committees in lacs of rupees
College of Engg. and Technology, Jadavpur.	Mech. Engg., Chem. Engg., Elect. Engg.	200	100	1952	Capital = 26.00 Recurring = 5.00 rising to 7.00
Engg. College, Benares Hindu University.	Mech. and Elect. Engg.	146	14	1952	Capital = 36.126 Recurring = 9.65
College of Mining and Metallurgy, Benares Hindu University.	Mining Metallurgy.	16 26	16 17	1952 1952	Capital = 17.11 Recurring = 1.48
College of Technology, Benares Hindu University.	Fuel Techno-logy.	nil	25	1952	Capital = 21.28 Recurring = 8.33065
Engineering College, Aligarh University.	Civil Engg.	60	nil	Current	Capital = 5.13 Recurring = 2.6
Engg. College, Dayalbagh.	Mech. & Elect. Engg.	nil	60	1952	Capital = 17.75 Recurring = 1.33
Victoria Jubilee Technical Inst., Bombay.	Civil Engg. Mech. & Elect. Engg.	nil nil	50 60 40 20 10 10	1952 in 1951 in 1952 in 1951 in 1952	Capital = 21.28 Recurring = 2.003
Dept. of Chemical Technology, Bombay University.	Chemical Eng. Textile Chem. Chemical Technology Research.	nil 16 64 40	20 18 17 20	1952 1952 1952 1952	Capital = 10.30 Recurring = 1.072
Annamalai University.	Civil Engg. & Mech. Engg. Elect. Engg. Chem. Engg.	127 23	nil nil	1949 1949	Capital = 50.00 Recurring = 0.10

ANNEXURE II

Admission to different departments of the Indian Institute of Science in 1945-46.

Department	New admissions whole-time course	New admissions short-term course	Total number whole-time students in 1945
Physics	11	10	16
Pure and Applied Chemistry	33	6	93
Biochemistry	15	2	33
Electrical Technology	46	3	70
Aeronautical Engg.	20	..	16
Metallurgy	..	..	..
Internal combustion engines	..	..	..
Total	125	21	228

APPENDIX III

ESTIMATE OF ANNUAL INTAKE OF DEGREE OR EQUIVALENT COURSES

Aeronautical Engineering

Indian Institute of Science, Bangalore	20
*College of Engineering (Vizag), Cocanada	20
*Engineering College, Hindu University, Benares	approx. 20
	approx. 60
**Eastern H. T. I.	60

Architecture & Building Construction

Delhi Polytechnic, Delhi	30
J. J. School of Art, Bombay	30
	60
**Eastern H. T. I.	90
**Western H. T. I.	90
	180

Chemical Engineering, Chemical Technology and Allied Subjects

Bombay University, Department of Chemical Technology	80
Indian Institute of Science, Bangalore	25
Lakshminarayan Institute of Technology, Nagpur	18
College of Engineering & Technology, Jadavpur, Bengal	70
Delhi Polytechnic, Delhi	40
Annamalai University, Department of Engineering & Technology	23
Benares Hindu University, College of Technology	53
Indian Institute of Sugar Technology, Cawnpore	31
Bangalore Engineering College, University of Mysore	20
Travancore University, College of Engineering Trivandrum	20
Madras University, Department of Chemical Technology	20
**Dacca Engineering College	20
Harcourt Butler Technological Institute, Cawnpore	40
Andhra University, Department of Chemical Technology	30
Calcutta University, Department of Applied Chemistry	18
	508
**Eastern H. T. I.	90
**Western H. T. I.	90
	180

Food Technology

**Eastern H. T. I.	30
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Civil and Municipal Engineering

Indian Institute of Science, Bangalore	15
N. E. D. Engineering College, Karachi	80
College of Engineering, Guindy, Madras	44
*Anantpur Engineering College, Madras	20
*Visagapatnam Engineering College	60
*Annamalai University, Department of Engineering & Technology	67
**Benares Hindu University, Engineering College	30
**Dayalbagh Technical College, Agra	20
Travancore University, College of Engineering, Trivandrum	25
**Orissa Engineering College, Cuttack	20
*Birla Engineering College, Pilani, Jaipur	20
Osmania University, Engineering College, Hyderabad Deccan.	25
Bangal Engineering College, Sibpur, Howrah	100
Thompson College of Civil Engineering, Roorkee	30
College of Engineering, Poona	100
Bangalore Engineering College, University of Mysore	90
Bihar College of Engineering, Patna	50
Aligarh Muslim University, College of Engineering & Technology	25

**Dacca Engineering College	40
Punjab College of Engineering & Technology, Lahore	40
*Jubbulpore Engineering College	30

1002

**Eastern H. T. I.	60
**Western H. T. I.	60

120

Electrical Engineering

Indian Institute of Science, Bangalore	60
N. E. D. Engineering College, Karachi	10
College of Engineering, Jadavpur, Bengal	150
Delhi Polytechnic, Delhi	30
College of Engineering, Guindy, Madras	40
*Anantpur Engineering College, Madras	15
*Vizagapatam College of Engineering, Madras	20
*Annamalai University, Department of Engineering & Technology	30
Benares Hindu University, Engineering College, Benares	70
**Dayalbagh Technical College, Agra	20
Travancore University, College of Engineering	12
**Orissa Engineering College, Cuttack	20
*Birla Engineering College, Pilani, Jaipur	20
Osmmania University, Engineering College, Hyderabad, Deccan	25
Bengal Engineering College, Sibpur, Howrah	60
College of Engineering, Poona	20
Thompson College of Civil Engineering, Roorkee	15
Bangalore Engineering College, University of Mysore	40
Bihar College of Engineering, Patna	18
Aligarh Muslim University, College of Engineering & Technology	30
**Dacca Engineering College	30
Punjab College of Engineering & Technology, Lahore	15
*Jubbulpore Engineering College	20
**Sindri Engineering College	30
Calcutta University, Department of Applied Physics	12
Andhra University, Department of Applied Physics	15

837

**Eastern H. T. I.	90
**Western H. T. I.	90

180

Geo-Physics

**Eastern H. T. I.	30
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Mechanical Engineering

Indian Institute of Science, Bangalore	35
N. E. D. Engineering College, Karachi	10
College of Engineering & Technology, Jadavpur, Bengal	165
Delhi Polytechnic, Delhi	20
College of Engineering, Guindy, Madras	40
*Anantpur Engineering College, Madras	15
*Vizagapatam College of Engineering, Madras	25
*Annamalai University, Department of Engineering & Technology	30
Benares Hindu University, Engineering College, Benares	70
**Dayalbagh Technical College, Agra	20
Travancore University, College of Engineering, Trivandrum	12
**Orissa Engineering College, Cuttack	20
*Birla Engineering College, Pilani, Jaipur	20
Osmmania University, Engineering College, Hyderabad (Dn.)	25
Bengal Engineering College, Sibpur, Howrah	80
College of Engineering, Poona	30
Thompson College of Civil Engineering, Roorkee	15
Bangalore Engineering College, University of Mysore	60
Aligarh Muslim University, College of Engineering & Technology	30
**Dacca Engineering College	30

Punjab College of Engineering & Technology, Lahore	15
*Jubbulpur Engineering College	20
**Bhindri Engineering College	30
	<hr/> 817
**Eastern H. T. I.	90
*Western H. T. I.	90
	<hr/> 180

Metallurgical Engineering

Indian Institute of Science, Bangalore	20
Benares Hindu University, College of Mining & Metallurgy	20
B. E. College, Shibpur, Howrah	30
	<hr/> 70
**Eastern H. T. I.	30
**Western H. T. I.	30
	<hr/> 60

Mining Engineering

Benares Hindu University, College of Mining & Metallurgy	16
Indian School of Mines, Dhanbad	48
	<hr/> 64

Naval Architecture and Marine Engineering

*Vizagapatam Engineering College, Madras	20
	approx.
**Western H. T. I.	90

Textile Technology

V. J. T. I., Bombay	10
Madras University	20
	approx.
Sri Krishnarajendra Silver Jubilee Technological Institute, Bangalore	15
	<hr/> 45
**Eastern H. T. I.	30
**Western H. T. I.	90
	<hr/> 120

Research Workers, Teachers & Planners

**Eastern H. T. I.	500
**Western H. T. I.	500
	<hr/> 1000

NOTE.—*Represents new colleges.

**Represents proposed colleges yet to be established.

APPENDIX IV

ESTIMATE OF ANNUAL OUTPUT OF ENGINEERS AND TECHNOLOGISTS

Branch of Study	Present annual output	No. of seats planned for in institutions other than Central Govt's proposed Higher Tech. Institutions	Estimated annual output			
			By 1951-52 from Institution other than H.T.I's	From Eastern H.T.I.	From Western H.T.I.	Total from all Institutions by 1954.
Aero-Engineering	15	60	45	42		875
Architecture & Bldg. & Construction.	20	50	45	65	65	17
Chemical Eng. & Chemical Technology.	244	506	375	65	65	50
Food Technology	—	—	—	21	—	1
Civil & Municipal Engineering.	467	1002	750	42	42	24
Electrical Engineering	285	827	620	65	65	83
Geo-physics	—	—	—	21	—	751
Mechanical Engineering	258	817	613	65	65	20
Metallurgical Engineering	27	70	53	21	21	743
Mining Engineering	27	64	48	—	—	85
Naval Architecture & Marine Engineering.	—	20	15	—	65	48
Textile Technology	—	45	34	21	65	80
Research Workers, Teachers, & Planners.	—	—	—	200	200	0
						12
						400
Total	1,343	3,471	2,598	628	653	3,879

APPENDIX V

ESTIMATE OF ANNUAL INTAKE TO DIPLOMA, OVERSEER OR EQUIVALENT COURSES

Architecture & Building Construction

Kalabhavan Technical Institute, Baroda 20

20

Chemical Technology

V. J. T. I., Bombay 20

Kalabhavan Technical Institute, Baroda 25

Harcourt Butler Technological Institute, Cawnpore 19

64

Civil and Municipal Engineering

V. J. T. I., Bombay 10

N. E. D. Engineering College, Karachi 100

College of Engineering, Guindy, Madras 90

Annamalai University, Department of Engineering and Technology 79

Kalabhavan Technical Institute, Baroda 25

Orissa School of Engineering, Cuttack 50

College of Engineering, Poona 100

Thompson College of Civil Engineering, Roorkee 40

Calcutta Engineering College, Ballygunge, Calcutta 48

Government Engineering School, Nagpur 30

Bihar College of Engineering, Patna 50

Ashanullah School of Engineering, Dacca 120

Aligarh Muslim University, College of Engineering & Tech. 54

Hewett Engineering School, Lucknow 112

988

Electrical Engineering

V. J. T. I., Bombay	60
N. E. D. Engineering College, Karachi	16
College of Engineering & Technology, Jadavpur, Bengal	14
Dayalbagh Technical College, Agra	12
Osmania Technical College, Hyderabad, Deccan	27
Kalabhavan Technical Institute, Baroda	25
College of Engineering, Poona	25
Calcutta Engineering College, Ballygunge	24
Government Technical Institute, Gorakhpur	20
Aligarh Muslim University, College of Engg. & Tech.	20
Government Technical Institute, Lucknow	12
Government Technical Institute, Jhansi	12

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Mechanical Engineering

V. J. T. I., Bombay	60
N. E. D. Engineering College, Karachi	15
College of Engineering & Technology, Jadavpur, Bengal	45
Dayalbagh Technical College, Agra	12
Osmania Technical College, Hyderabad, Deccan	27
Kalabhavan Technical Institute, Baroda	25
Calcutta Engineering College, Ballygunge	24
Government Engineering School, Nagpur	25
Government Technical Institute, Gorakhpur	20
Aligarh Muslim University, College of Engg. & Tech.	15
Jamalpur Technical Institute	25
B. E. College, Sibpur, Howrah	8
Government Technical Institute, Lucknow	12
Government Technical Institute, Jhansi	16
Poona Engineering College	25
Kanchrapara Technical School	19
Parakh Technical Institute, Surat	90
Ashanullah School of Engineering, Dacca	60

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Textile Technology

V. J. T. I., Bombay	40
Institute of Textile Technology, Travancore University, Trivandrum	24
Delhi Polytechnic, Delhi	30
Kalabhavan Technical Institute, Baroda	25
Government Central Textile Institute, Cawnpore	47
Bengal Textile Institute, Serampore	60
Sri Krishnarajendra Silver Jubilee Technological Institute, Bangalore	16
Bengal Silk Technology Institute, Berhampore	50
Government Central Weaving Institute, Benares	20

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APPENDIX VI

ESTIMATE OF ANNUAL OUTPUT OF PERSONS QUALIFYING IN DIPLOMA & OVERSEER COURSES

Branch of Study	Present Out-put	No. of Seats	Expected out-put by 1951-52
1. Architecture & Building construction	18	20	18
2. Chemical Technology	50	64	55
3. Civil Engineering	641	988	741
4. Electrical Engineering	227	266	200
5. Mechanical Engineering	282	523	400
6. Textile Technology	165	312	234
Total	1,383	2,173	1,648