

INDIA
Bureau of Education

Scientific Manpower Committee
1947

(Interim & Final)
Report

Chairman
Shanti Swarup Bhatnagar.

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.

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

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

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

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.

Rai 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.

CHAPTER I
PROGRAMME FOR THE IMMEDIATE IMPROVEMENT AND EXPAN-
SION 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 requirements (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=oil 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	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) Laxmi Narayan 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, Jadavpur	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:—

- 300 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 293 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 Bore 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. 132.8 lakhs.

Capital—Rs. 446.3 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) Lac Research Institute, Ranchi	5
(8) Jute Research Institute, Calcutta	5
(9) Laboratory of the Indian Academy of Sciences, Bangalore	3
(10) Palaeo Botanical Research Institute, Lucknow University	3 (for the present)

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	11
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	Capital Rs.	Grants
(3) Andhra . . .	2 lakhs . . .	Recurring 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	Capital Rs.	Grants
(1) Madras . . .	5 lakhs . . .	Recurring 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 300 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 expending 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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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 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. 1.3 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, Iac 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 72 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).

PART II.

NOTES BY :—

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

Dr. J. N. Ray.

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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 200 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 in charge 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 in charge 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.
	Total 60 lakhs.
<i>Capital grant</i>	60 lakhs.
<i>Recurring grant</i>	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

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 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 scholarship 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 scholarships for 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 out turn 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.	8	

(Universities of Indian States are not included in the above list).

Educational Institutions not affiliated to any University.

16. Bengal Tanning Institute.	Leather, Chemistry and Technology	5	Facilities exist for research and advanced study in Leather, Chemistry and Technology.
17. Leather Trades Institute, Madras.	Leather, Chemistry and Technology	5	Facilities exist for research and study in Leather Technology.
18. Harcourt Butler Technological Institute.	Oils and fats and general Chemical Technology.	4	Some facilities exist for technological research in soaps, oils, fats and applied chemistry.
19. Imperial Institute of Sugar Technology.	Sugar Chemistry, Sugar Technology and Sugar Engineering, Fermentation, Chemistry and Technology.	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. Metallurgy and Engineering.				
(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) V. K. Steel and Iron Co; (12) Indian Rolling Mills, Negapatam.	(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) Kirloskar Co.; (6) Maya Engineering Co.; (7) Hind Machines.	..	..	Excepting firm (2) 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) Tax-maco; (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.

the concerns have good workshop 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.

(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) Greeves 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.

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The above remarks hold good in general.

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

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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.
(h) 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 20 people may be trained in these fields.
(i) 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's Coke 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) Mettur 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) Modi Industries ; (7) D. C. M. Soap Works ; (8) Bengal Chemical & Pharmaceutical Works ; (9) Calchemico ; (10) Mysore Soap Factory and many other concerns.	(1), (3), (7) and (8) 15	The other concerns also might admit trainees.
5. Textiles	All affiliates of Indian Textile Manufacturers Association and other major textile Mills.	.....	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.
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 Allen & Co ; (10) The Eastern Tanneries & many others, big and small.	.....	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, Rosin and Turpentine.	(1) Shalimar ; (2) Jenson & Nicholson ; (3) Constituents of IPMA ; (4) Good Lass 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 Kearsley & Co ; (12) Lyall Marshall & Co ; (13) Jay Engineering Works ; (14) Spence Ltd.; (15) Robert Ingham Clark ; (16) Jello Rosin Co.	.....	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.
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, 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.

(xi) 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 3,291.

Expenditure (Non-recurring).—557.21 lakhs.

B. Staff.—Gazetted—143; 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.

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- 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.

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 63).
 - (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 62).
- (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 of 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

<i>A—2 year courses in agriculture—</i>		1937-38	1938-39								
Lyallpur		37	31								
Dhulia		16	14								
Dacca		18	22								
Bulandshahr		30	34								
Gorakhpur		36	41								
 <i>B.—Number of passes in Agricultural Degree Examination—</i>											
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 agricultural 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

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 output	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 output	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—

<i>Indian Agricultural Research Institute (Five years).</i>			
Gazetted	56	<i>Non-recurring Expenditure in lakhs.</i>	
Technical Non-Gazetted	205	Buildings	52.00
Annual Average	52	Equipment	8.00
Years).			
<i>Indian Fisheries Research Institute (Three</i>			
Gazetted	64	<i>Non-recurring Expenditure in lakhs.</i>	
Technical Non-Gazetted	48	Capital	63.99
Annual Average	37		
<i>Institute for Fruit Culture (Three Years).</i>			
Gazetted	28	<i>Non-recurring Expenditure in lakhs.</i>	
Technical Non-Gazetted	154	Buildings	10.75
Annual Average	61	Equipment	6.00
<i>Institute for Vegetable Culture (Three Years).</i>			
Gazetted	27	<i>Non-recurring Expenditure in lakhs.</i>	
Technical Non-Gazetted	131	Buildings	10.18
Annual Average	53	Equipment	6.00
<i>Institute of Agricultural Economics.</i>			
Gazetted	9		
Technical Non-Gazetted	39		
<i>Agricultural Marketing Department (Three Years).</i>			
Gazetted	76	<i>Non-recurring Expenditure in lakhs.</i>	
Technical Non-Gazetted	20	Buildings	5.00
Annual Average	32	Equipment	7.00
<i>Soil Conservation Units (Three Years).</i>			
Gazetted	30		
Technical Non-Gazetted	92		
Annual Average	41		

Ornithology in Relation to Agriculture (Three Years).

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

Central Commodity Committees (Three Years).

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

Central Agricultural Colleges (Four Years).

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

Rice Research Institute (Five Years).

Gazetted	23	<i>Non-recurring Expenditure</i>	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	<i>Non-recurring Expenditure in lakhs.</i>	
Technical Non-Gazetted	34	Buildings	32.69
Annual Average	24	Equipment	2.50

Anti-Rinderpest Organization (Four Years).

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

Bull-Breeding Farms (Five Years).

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

Central Breeding Farms (Three Years).

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

Experimental Livestock Breeding Farms (Five Years).

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

Central Animal Husbandry College (Four Years).

Gazetted	23	<i>Non-recurring Expenditure in lakhs.</i>	
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	<i>Non-recurring Expenditure in lakhs.</i>	
		Buildings	25.00
		Equipment	1.00

		<i>Indian Council of Agricultural Research, Information Section (One Year).</i>	
Gazetted	8	<i>Non-recurring Expenditure</i>	
		Equipment	15.00
		<i>Quarantine Stations for plants (Three Years).</i>	
Gazetted	80		
Technical Non-Gazetted	160	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 Kamungos' 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 *zamidars*, 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 probationers are 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							

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 Post-graduate 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
	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 be as its objective, the provision of facilities for advanced training in such branches of the subject as malariology, maternity and child welfare, industrial public health administration, epidemiology, public health laboratory work 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 equipping of public health workers with a reasonable measure of proficiency in these subjects."

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 gazetted and non-gazetted officers under him.

The Degrees and Diplomas for which students are trained at 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 subject
maternity and child welfare, industrial hygiene, nutrition,
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 the extract from Chapter XIII of the report of the Bhole Committee which is given on page 5 of the

The Training of Lower Types of Personnel.—Under the present system three classes of workers are considered necessary, (1) health visitors, (2) health inspectors, and (3) public health or sanitary inspectors.

Midwife.—The number of practising midwives in India is about 5,000 while, on the basis of about 10 million population, the number required for providing adequate services is about 100,000. Provincial five-year plans do not in all cases provide for the training of midwives, but, from such information as is available, it is estimated that only a few hundred qualified midwives each year will not be trained. The health visitor is a fully trained person who is engaged in health work which, in different parts of the country, may last for an hour or more and a half. She has normally been mainly employed in this capacity.

of health visitors available in India.
information regarding the proposed

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

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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."

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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 antimalária 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 post-graduate 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 Bhoze 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 Bhoze Committee. For the sake of convenience the information is given below in tabular form:—

	Estimate of existing number	Number considered desirable	Approximate rate of increase required
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 standard).	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 Bhoré 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 330 and 331 of Volume III of the Bhoré 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 1,230 if the rate of admission be 100 and about 1,530 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 Bhow 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>	1·49	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
<i>Health visitors</i>	20 (10 at Poona and 10 at Bombay Schools).	50 (20+15) at each of two new schools for Gujarat and Karnatak.
<i>Health inspectors</i>	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.	Rs. 2,000 Rs. 10,000
2. Laboratory Assistants	6		
3. Laboratory Technicians (six months' course).	12-24	Pasteur Institute, Shillong.	8,000 1,000
4. Vaccinators	60	Government Vaccine Depot, Shillong.	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 Bhore 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 reorganisation 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	10.50	115.50	
(3) Provision of Departments of Preventive Medicine and Public Health in 3 medical colleges at Calcutta, Bombay and Madras	6.75	6.00	
(4) Scholarship scheme for post-graduate training in India (50 scholars).	{ Scholarships	0.60	...
	{ tuition fees	0.15	
	{ Travelling allowance at Rs. 150 each	0.075	
		<u>0.085</u>	

(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	2.05	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	
	<hr/>	
	0.198	
	<hr/>	
2nd year—		
Scholarships	0.36	
Travelling allowance	0.018	
	<hr/>	
	0.378	
	<hr/>	
First six months of 3rd year—		
Scholarships	0.54	
Travelling allowance	0.018	
	<hr/>	
	0.558	
(11) College of Pharmacy, Bengal	1.25	2.0
	<hr/>	<hr/>
	153.159	562.89
	<hr/>	<hr/>

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	10	20
4. Doctor of Science (Public Health)	2 years	An occasional student	
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.
	(a) 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	85	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:	1	...
(a) Manufacture of High Explosives and Propellants	1	...
(b) Manufacture of small arms ammunitions	2	5
(6) Mechanical Engineering Power House Maintenance and Operation	3	2
(7) Wood Technology . . . . .	...	4
(8) Electrical Engineering . . . . .	...	1
(9) Fermentation Power Alcohol . . . . .	...	3
(10) Metallurgy . . . . .	...	1
(11) Rubber Technology . . . . .	...	3
(12) Paints . . . . .	...	1
(13) Paper Technology . . . . .	...	3
(14) Plastics . . . . .	...	2
(15) Statistical Economics . . . . .	...	1
(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 aspect.
- (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, viz.—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, Coacanada	1.5	0.75
(6) College of Engineering, Bangalore	1.5	0.75
(7) Sri Jayachamarajendra Occupational Institute, Bangalore	1.5	0.76
(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 13.25 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. Hardecastle 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., Tittaghar.
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. Sodepore 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,

REFRATORIES

- 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. Taja 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. Subbavah and Sons, Bangalore City.
- 145. M/s. Nagpal Woollen Mills, Bombay.

CEMENT.

- 146. **M/s. Associated Cement Companies Ltd., Bombay.**
- 147. **M/s. Dalmia Cement Limited, Dalmianagar.**
- 148. **M/s. Assam Bengal Cement Co. Ltd., Calcutta.**
- 149. **M/s. Andhra Cement Co. Ltd., Bezwada.**

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 (66—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.

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 (xv) 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	
	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. 13,32,000.

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, 30 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.

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 Techno- logy 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	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	224

APPENDIX III

ESTIMATE OF ANNUAL INTAKE OF DEGREE OR EQUIVALENT COURSES

Aeronautical Engineering

India Institute of Science, Bangalore	20
*College of Engineering (Vizag), Cocanada	20
**Engineering College, Hindu University, Benares	approx. 20
	approx.
**Eastern H. T. I.	60
	60

Architecture & Building Construction

Delhi Polytechnic, Delhi	30
J. J. School of Art, Bombay	30
**Eastern H. T. I.	60
**Western H. T. I.	90
	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	16
	506
**Eastern H. T. I.	90
**Western H. T. I.	90
	180

Food Technology

** Eastern H. T. I.	30
---------------------	----

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
*Vizagapatam 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
Bengal 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
Aigarh Muslim University, College of Engineering & Technology	96

**Dacca Engineering College	40
Punjab College of Engineering & Technology, Lahore	40
*Jubbulpore Engineering College	30
	<hr/>
	1002
**Eastern H. T. I.	60
**Western H. T. I.	60
	<hr/>
	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
Osmania 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
	<hr/>
	837
**Eastern H. T. I.	90
**Western H. T. I.	90
	<hr/>
	180

Geo-Physics

**Eastern H. T. I.	30
--------------------	----

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
Osmania 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
**Sindri Engineering College	30

 817

**Eastern H. T. I.	90
*Western H. T. I.	90

 180

Metallurgical Engineering

Indian Institute of Science, Bangalore	20
Benares Hindu University, College of Mining & Metallurgy	20
B. E. College, Sibpur, Howrah	30

 70

**Eastern H. T. I.	30
**Western H. T. I.	30

 60

Mining Engineering

Benares Hindu University, College of Mining & Metallurgy	18
Indian School of Mines, Dhanbad	48

 64

New 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
---	----

 45

**Eastern H. T. I.	30
----------------------------	----

**Western H. T. I.	90
----------------------------	----

 120

Research Workers, Teachers & Planners

**Eastern H. T. I.	500
----------------------------	-----

**Western H. T. I.	500
----------------------------	-----

 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
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

266

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. F. 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

GOVERNMENT OF INDIA
MINISTRY OF EDUCATION



REPORT OF THE
SCIENTIFIC MAN-POWER
COMMITTEE

JUNE 1949

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

DR. S. S. BHATNAGAR, D.Sc., F.R.S.,
Chairman, Scientific Man-power Committee.

DEPARTMENT OF SCIENTIFIC RESEARCH,
GOVERNMENT OF INDIA,

New Delhi, the 14th June, 1949.

Letter of Transmittal

MY DEAR MAULANA SAHIB,

I enclose the report of the Scientific Man-power Committee. The report is in two parts. Part one is the Main Report of the Committee—our findings and recommendations—and part two is the Basic Report on the Survey and Assessment of the country's requirements for and the resources of Scientific and Technical Man-power.

It is hardly necessary for me to refer here to any particular aspect of the problem of Scientific Man-power as our report is comprehensive in all respects and covers all the Terms of Reference. I should, however, like to stress the significance of the report in the context of all-round national development. Standing on the threshold of a new era, India faces to-day, great trials, great duties and great rewards. The most precious of all the gains towards which we may hope to progress is in the development of our industries, agriculture, scientific research, transport, defence, medical and public health services, education and other lines of creative activity, which contribute to the strength and well-being of the country. In the trials and in the duties essential to that progress, the Scientists and Technologists of the country in their infinitely varied types, have to play their rightful part and bear their full share. Indeed theirs is a responsibility unequalled by that of any other section of the people. To have them to do so, it behoves the state to create the necessary scientific and technical capital in the coming years.

We have examined the whole question of Scientific Man-power, its present and future in all its bearings and have to observe that the present position is anything but satisfactory. Such a state of affairs is doubly unfortunate at the present stage which might be considered crucial in the history of the country. If steps are not taken with a sense of urgency to develop the training and research facilities on a scale commensurate with the needs of the country, the situation may well become past remedy. Indeed the education and the training of the Man-power required should be the sheet-anchor for every plan of national development. I am to express the sincere hopes of the Committee that prompt action on the part of the Government would ensue on our recommendations.

(ii)

I have to place on record the Committee's high appreciation of the valuable services rendered by Dr. S. R. Sen Gupta, Mr. L. S. Chandrakant, Dr. P. Sheel and other officers of the Ministry of Education in the preparation of the reports. This has considerably facilitated the work of the Committee. It has been a pleasure and privilege to work with them and I consider it a great honour to have been called upon to guide the deliberations of the committee.

With best regards,

I am,

Yours very sincerely,

S. S. BHATNAGAR.

The Hon'ble Maulana Abul Kalam Azad,
Minister for Education,
NEW DELHI.

CHAPTER I

Introduction

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 communique issued on the 20th April, 1947. The present composition of the Committee is as shown below :—

- (1) Dr. Shanti Swarup Bhatnagar, F.R.S., Secretary, Department of Scientific Research, Government of India, New Delhi. (*Chairman*).
- (2) Dr. Homi J. Bhabha, F.R.S., Director, Tata Institute of Fundamental Research, Bombay.
- (3) Dr. J. C. Ghosh, Director General of Industries and Supplies, Government of India, New Delhi.
- (4) Mr. Ram Ratan Gupta, Director-in-Chief, B. R. Industries, Kanpur.
- (5) Dr. K. A. Hamied, C/o Messrs. Cipla Ltd., Bombay.
- (6) Mr. Humayun Kabir, Joint Educational Adviser to the Government of India, New Delhi.
- (7) Mr. A. N. Khosla, I.S.E., Chairman, Central Water-power, Irrigation and Navigation Commission, New Delhi.
- (8) Dr. K. S. Krishnan, F.R.S., Director, National Physical Laboratory, Delhi.
- (9) Mrs. Hansa Mehta, Bombay.
- (10) Professor J. N. Mukherjee, Director, Indian Agricultural Research Institute, New Delhi.
- (11) Dr. Bainsi Prasad, Fisheries Adviser to the Ministry of Agriculture, Government of India, New Delhi.
- (12) Dr. K. C. K. E. Raja, Director-General of Health Services, Government of India, New Delhi.
- (13) Dr. Birbal Sahni, F. R. S., Professor of Botany and Dean of the Faculty of Science, Lucknow University, Lucknow (Now Deceased).
- (14)* Wing Commander H. Singh, Technical Branch, Air Headquarters, New Delhi.
- (15)* Dr. R. S. Thakur, Scientific Adviser to the General Staff Branch, Ministry of Defence, Government of India, New Delhi.
- (16) Dr. D. N. Wadia, Minerals adviser, Department of Scientific Research, New Delhi.
- (17) Dr. S. R. Son Gupta, formerly Deputy Educational Adviser (Technical) to the Government of India, New Delhi. (*Secretary*).

*W/Cdr. H. Singh and Dr. R. S. Thakur, who were the representatives of the Ministry of Defence have now been replaced by Dr. D. S. Kothari and Mr. Raghunath Pershad of the same Ministry.

Terms of Reference.

The terms of reference to the Committee are :—

- “ (1) To assess the requirements for different grades of scientific and technical man-power 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 man-power ;
- (2) To make recommendations regarding the 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 man-power ; and
 - (e) the maintenance of a register of scientific and technical personnel to facilitate their utilisation to the best advantage.”

Interim Report

On the 7th July, 1947, the Government of India, requested the Chairman to let them have by the 5th August, 1947, 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 obvious shortage of scientific and technical personnel. A sub-committee consisting mainly of the local members of the Committee was accordingly appointed to formulate certain interim recommendations, prompt action on which on the part of Government might relieve this shortage to some extent. The sub-committee consisted of—

Dr. Shanti Swarup Bhatnagar, F.R.S. (*Chairman*),
Mr. A. N. Khosla,
Dr. J. N. Mukherjee,
Dr. K. C. K. E. Raja,
Dr. J. N. Ray,
Wing Commander H. Singh,
Dr. D. N. Wadia, and
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 initiated 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 industrial research.”

The sub-committee held meetings on July 16th, 25th, 26th, 28th, and August 3rd, 1947; prepared a report recommending a comprehensive programme for the immediate improvement and expansion of facilities for scientific and technical education, research and training; and submitted it to Government pending its acceptance by the main Committee. This report was considered by the main committee at its meeting held on the 22nd and 23rd August, 1947, and was accepted as the "Interim Report of the Committee." It is gratifying to note that the Government have made provision for Rs. 50 lakhs in 1949-50 budget for implementing some of the important recommendations made in the Interim Report with special reference to industrial training, intensive short term training in Chemical technology, expansion and development of research training facilities in Indian Universities and special institutions, etc.

Collection of Data

At its exploratory meeting held on the 12th and 13th May, 1947, the Scientific Manpower 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, had to be collected before the Committee could begin its work. It was felt that the speedy collection, sifting and collation of such data was possible only if the Government could place a few officers at the disposal of the Committee for this purpose. The Government of India accordingly sanctioned ten posts of officers on Special Duty in July, 1947, and the following were appointed:—

Name of Officer	Date of appointment	Date of termination of service
1. Mr. L. S. Chandrakant of the Council of Scientific and Industrial Research.	23-7-47	31-8-48
2. Dr. B. L. Chona of the Indian Agricultural Research Institute	24-9-47	1-3-48
3. Dr. D. C. Chopra of Lahore	17-9-47	31-8-48
4. Mr. J. K. Ganju of Lucknow University	10-9-47	1-3-48
5. Dr. K. S. Narang of East Punjab University	14-9-47	30-4-48
6. Mr. S. R. Nilkanth of Scindia Steam Navigation Co., Bombay	1-9-47	30-4-48
7. Dr. T. S. Sadasivan of Madras University	26-9-47	1-3-48
8. Mr. P. N. Sen Gupta of the Ministry of Education	1-10-47	30-4-48
9. Dr. P. Sheel of the Council of Scientific and Industrial Research	5-8-47	31-8-48
10. Dr. V. B. Shukla of Nagpur University	23-9-47	20-4-48

With the able assistance of these officers and the willing and active co-operation generally given by Industry, Government Departments, and Educational Institutions, a fairly comprehensive survey was carried out and up-to-date data collected regarding the present and the projected activities of Industry and of the various scientific and technical departments of Central and Provincial Governments and States which have acceded to the Indian Union, as well as the facilities available in the country for scientific, technological, agricultural and medical education and training. It may, however, be mentioned that some of the authorities concerned have not been able to furnish the requisite information and even repeated personal calls and appeals have failed to produce any response from them. The information collected is, therefore, not so complete as it might otherwise have been.

This survey was conducted by first of all issuing three different questionnaires designed by the Committee—one for Industries, one for Government and Government

sponsored Departments and one for Educational and Research Institutions. These are reproduced as Annexures VII, VIII, and IX of this Report. Over 3,000 sets (2,450 to Industry, 310 to Government Departments and 290 to Educational and Research institutions) of these questionnaires were issued in addition to 15,000 copies of a questionnaire for individuals (Annexure X). The issue of the questionnaires was followed by visits by the Officers on Special Duty to the industrial concerns, government departments and educational institutions concerned.

For the purpose of this survey, the country was divided into the following five zones :—

- (1) *Northern Zone*.—comprising East Punjab, Ajmer and Merwar, U. P. and Rajputana and Central Indian States.
- (2) *Eastern Zone*.—comprising West Bengal, Bihar, Orissa, Assam and Indian States falling within this region.
- (3) *Southern Zone*.—comprising Madras, Mysore, Travancore and Cochin.
- (4) *Western Zone*.—comprising Bombay, C. P. & Berar and Kathiawar States.
- (5) *Central Zone*.— comprising Delhi (Central Government Departments—Head quarters).

Each of the above five zones was covered by two Officers on Special Duty who carried out an extensive tour of the zone contacting the recipients of the questionnaire with a view to collecting the necessary data and discussing with them the various issues of importance before the Committee. Replies to questionnaires were furnished by 582 Industrial concerns, 224 Government Departments and 213 Educational and Research institutions i.e., 1019 establishments in all. The information thus collected and summarised by the Officers on Special Duty was examined and vetted by the following gentlemen who were appointed to act as assessors :—

Mr. A. N. Khosla in respect of Engineering Science and Engineering Industry,	
Dr. K. S. Krishnan in respect of Physics, Mathematics and Statistics,	
Dr. J. N. Mukherjee in respect of Agricultural Sciences,	
Dr. K. C. K. E. Raja in respect of Medical Sciences,	
Dr. J. N. Ray in respect of Chemistry and Chemical Industry,	
Prof. Birbal Sahni in respect of Biological Sciences,	
Dr. D. N. Wadia in respect of Geological Science and Mining Industry,	
Dr. S. L. Hora	} Fisheries and Allied Sciences.
Dr. Bains Prasad	

For facility of analysis and study, the information thus collected was compiled in the form of separate analytical statements in three different series, pertaining to Industries, Government and Government sponsored Departments and Educational and Research Institutions respectively.

The data about industrial concerns relate to—

- (a) the nature and lines of activity,
- (b) products of manufacture, their annual out put and value,
- (c) scientific and technical staff employed and their salaries,
- (d) available industrial training and research facilities ; and
- (e) expansion and development projects contemplated for the next 5 or 10 year periods and the requirements for scientific and technical personnel, plant and machinery, etc., to carry out these projects.

The views of Industry on a number of issues, *e.g.*—

- (i) adequacy or otherwise of the basic training which the fresh recruits may have undergone in educational institutions,
 - (ii) co-operative research,
 - (iii) industrial training,
 - (iv) training of Indian technical personnel, etc.,
- have also been obtained and summarised.

The data about Government and Government sponsored Departments relate to—

- (a) the field and the scope of activities of the departments,
- (b) scientific and technical staff employed,
- (c) expansion and development projects for the next five and ten year periods and estimated requirements for scientific and technical personnel,
- (d) existing training facilities and possibilities of their improvement ; and
- (e) the subjects in which, and the number of persons for whom, training should be organised abroad.

The views of Heads of Departments have also been obtained on questions such as—

- (i) drift or leakage of scientific talent,
- (ii) standardization of technical training,
- (iii) status of scientific workers,
- (iv) co-ordination with other organizations,
- (v) new lines of manufacture that should be started in the country in the interests of national self-sufficiency and the requirements for technical personnel, etc.

The analytical statements on Educational and Research Institutions have been designed to give a clear picture of the facilities now available for scientific and technical education and research in all its aspects.

Institution-wise these indicate :

- (a) courses of study provided ;
- (b) annual intake and out-turn ;
- (c) adequacy or otherwise of facilities in respect of staff, equipment, building, etc.
- (d) annual income and its sources ; and annual expenditure under various heads ;
- (e) special subjects of study or research at the institution, lines of research, and out standing contributions ;
- (f) details of expansion and development projects contemplated by the institution for teaching and research, consequential increase in intake and out-turn, and the requirements for staff, equipment, buildings and their financial implications.

The views of the Heads of the Institutions and of the Professors on—

- (i) drift and wastage of talent ;
 - (ii) need for training abroad of Indian students and the subjects or branches in which such training should be organised ; and
 - (iii) other issues of importance in the context of the improvement of the scientific man-power resources of the country
- have also been obtained.

Report of Survey and Assessment—Basic Report

On the basis of the information thus collected and analysed, Part II of this report (hereafter referred to as the *Basic report* or the Survey Report) has been prepared by piecing together into one composite whole all available information, both qualitative as well as quantitative, and giving a comprehensive picture of our requirements for and our present resources of scientific and technical man-power. In assessing the requirements for scientific and technical man-power, it has been found necessary to study also the Central and Provincial Governments' reports on development plans, especially those of the industrial panels. It may, however, be stated that while the responsibility for details and accuracy of the statements made in this basic report rests solely on the Secretary, the Committee as a whole are in general agreement with the findings presented therein. The basic report forms the foundation on which the Committee's work mainly rests.

The basic report is also presented in three parts dealing with Industry, Government and Government-sponsored Departments, and Education and Research respectively.

The part dealing with industries covers over 20 principal industries—Heavy Chemicals, Pharmaceuticals, Fine Chemicals and drugs, Soaps, Oils and fats, Paints, Pigments and varnishes, Plastics, Sugar and Fermentation, Paper and Boards, Cement, Metallurgy, Mining, Fuel, Power and Carbonisation, Leather, Textiles, Engineering, etc. The present state of each of these industries in the country has been outlined in some detail and plans for development or expansion during the next five or ten year periods indicated.

From a close study of the conditions obtaining at present in each industry in respect of the scientific and technical personnel employed, an attempt has been made to arrive at an approximate ratio between production and personnel wherever possible, for different groups of products, each group consisting of products, the manufacture of which entails similar or closely allied technical operations. This ratio indicates the number of personnel required for the manufacture of a certain quantity of a particular commodity and also gives an idea of the 'Pattern of Employment', i.e., the types and categories of personnel required. On the basis of this 'Production to Personnel Ratio' an assessment has been made of the requirements for scientific and technical personnel for the various development and expansion projects. Where it has not been possible to work out this ratio either for want of data for a particular industry or owing to the non-existence of an industry in the country at present, the assessment has been based on other factors such as the possible size of the industry, technical operations involved, conditions obtaining in similar industry in other countries. In the case of most of the engineering industries, the requirements for personnel have been worked out for production units of different sizes and the figures for medium sized economic units have been taken for purposes of calculation of the man-power requirement for the proposed future development of any one industry as a whole.

It seems necessary to mention here that considerable uncertainty about the future industrial development prevailed in the country at the time of the survey and a large number of industrial concerns had not definitely formulated their development plan pending an announcement of the Government of India's Industrial Policy.* In order, therefore, to present as true a picture as possible of the trend of industrial development in the country during the next 5 or 10 year periods, the basic report discusses in some

*The Government of India have since announced their Industrial Policy.

detail such of the development projects as were being contemplated by the existing concerns and also the development programme for industries as recommended by the Industrial Panels set up by the Government of India, sometime ago. In the absence of other authentic information regarding the scope and lines of industrial development in the country in the years to come, reliance on the targets of production suggested by the industrial panels has been necessary in the context of the work of the Scientific Manpower Committee. As a matter of fact, it has been observed that all the Industrial development plans, details in respect of which are available, follow closely the recommendations of the Panels and there is little doubt that the industrial development of the country as a whole will be essentially as envisaged in the Panel reports. It is, however, realised that there might be some time lag in view of the prevailing uncertainties in the field of industrial enterprise. During the survey, details could be obtained only in respect of development plans of existing concerns and occasionally of those, which are expected to come into being, during the next five years. The latter are no less important since they form a substantial part of the envisaged future industrial development of the country as a whole. The report also discusses in detail the training facilities available in the country in each industrial group and the extent to which training of Indian personnel abroad has to be arranged, in order to meet the requirements of industry.

The second part of the report concerning Government and Government-sponsored Departments deals in detail with a large number of scientific and technical activities of public utility carried on by Governments directly through the various Ministries or Departments or organizations sponsored by them. These activities are grouped broadly under the following Heads :—

- (a) Communications including Posts and Telegraphs, Meteorology, Civil Aviation,
- (b) Rail, Road and Water Transport,
- (c) Mercantile Marine,
- (d) Port Trusts,
- (e) Highways,
- (f) Broadcasting,
- (g) Public Works and River Valley Projects,
- (h) Electricity,
- (i) Medical and Public Health,
- (j) Agriculture,
- (k) Mining and Geological Survey,
- (l) Education,
- (m) Industries,
- (n) Defence and
- (o) Scientific and Industrial Research,

The present activities under these heads and the part assigned to scientific and technical personnel have been outlined in this report. The various plans contemplated for the development of these activities have been briefly outlined and the requirements for scientific manpower indicated. In most cases the details of the requirements for personnel including their categories and types have been furnished by the departments concerned. Only in a few cases where the necessary information was not available, an estimate has been made on the basis of the lines of development, nature of work involved and other factors. Some of the Government and Government-sponsored Departments

have facilities for the practical training of technical personnel and these have been described in the report indicating the number of persons who can be trained. On the basis of information furnished by the departments regarding the need for the training of Indian personnel abroad, an estimate has also been made of the number and categories of personnel, who are required to be sent abroad for training with a view to carrying out the various development projects.

A comprehensive and co-ordinated picture of the present educational facilities in the country as well as the facilities available for research is presented in the third part of the basic report under four separate divisions, *viz.*

- (a) Engineering and Technology,
- (b) Scientific Education and Research,
- (c) Agricultural Education and Research, and
- (d) Medical Education and Research.

An analysis has been given of the various courses of study or training offered in each institution, the annual intake and outturn of students and the facilities available in respect of staff, equipment and accommodation. A review of the whole position is given zone-wise indicating prominently a picture of the training facilities available in each zone, of the special institutions and their activities, and of the details of research work carried out and other important matters. On the basis of the present outturn of trained personnel, an attempt has been made to make a forecast of the total number in the various categories of scientific and technical personnel, *i.e.*, diploma holders, graduates, post-graduates etc., that is likely to pass out of the institutions during the next five years and be available for suitable employment. Details of research training facilities available in each zone have also been considered with a view to indicating in detail the number of research workers who might be trained in various branches of Science and Technology.

The development and expansion projects of all educational and research institutions which can be put through if funds are made available have also been analysed as regards their main objectives, consequential increase in the intake and outturn of students, and financial implications. A consolidated statement showing the increase in the outturn of trained personnel of various categories and in various branches of science and technology, consequent on the implementation of the development plans has also been incorporated in this part of the report.

The basic report also refers to a number of important issues, such as drift or leakage of talent, standardisation of training, shortage of teachers, equipment etc., and suggests measures for dealing with them on the basis of information collected by the officers.

At its meeting held on the 20th August, 1948, the Scientific Manpower Committee considered the Report and decided that the part dealing with Government and Government-sponsored Departments be referred to the concerned Ministries of the Government for comments especially on the assessment of the requirements for man-power. It was also decided that the part dealing with Industries be referred to the Director-General, Industries and Supplies for examination by the technical experts of his department. In the light of the suggestions/comments thus received from the various Ministries and the Director-General of Industries and Supplies, the Basic Report has been considerably revised and the factual data presented therein have been checked and confirmed.

The Ministry of Defence have for security and other reasons, not been able to supply detailed information as to their development plans and their scientific and technical manpower requirements. According to them a large part of the requirements of the Defence Services regarding technical personnel were met by recruitment at pre-University stage, the necessary technical training being provided at establishments maintained by the Defence Services, themselves ; also, the technical developments relating to defence were intimately conditioned by the expansion of industry. The Ministry estimate that if the industrial development and expansions in educational and other spheres, as envisaged in the report, came about, then, as a rough estimate, the defence requirements will be from 5 to 10 per cent. of the civil demand, for scientific manpower.

Acknowledgments

Earlier in the introduction it has been stated that the various Central and Provincial Government reports have been freely drawn upon.

The views of many notable industrialists, educationists, scientists and high Government officials were solicited on many important issues. Some of them have freely expressed their views and tendered advice which has proved to be of great value in drawing up the basic report. To them the Committee is indebted and is grateful.

That so many industrial concerns, Government Departments and educational institutions should have replied to the questionnaire only goes to prove how much importance they have attached to the work of the Committee. Their willing co-operation and help are gratefully acknowledged.

CHAPTER II

Assessment of requirements for Scientific
and Technical Manpower

1. Our terms of reference being somewhat wide and broad-based raise a large number of issues, directly or indirectly. Many of these seemingly diverse issues are basically inter-related and represent but various facets of one single problem, namely, the removal of the present shortage of scientific and technical man-power. However important these issues may appear to be individually, we have necessarily to consider all of them together as parts of the wider problem.

Assessment of the requirements for Scientific and Technical Manpower.

2. The first part of the Terms of Reference requires that we 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." The number of subjects to be covered in the assessment being quite large, we have found it convenient to consider all national activity which requires scientific manpower under two principal groups, viz., 'Industries' and 'Government and Government-sponsored Departments'. Such a grouping has certain obvious advantages, especially in that it enables us to consider together, closely allied activities requiring scientific manpower for industrial enterprises—whether privately organised or state-owned—require certain well-defined types of personnel possessing varying degree of academic qualification and practical training. For convenience, agriculture, transport, medical and public health etc., have been considered under Government and Government-sponsored Departments since all these activities have a public utility value and are generally carried on by or sponsored by Government.

Industries

3. In all industrially advanced countries of the world Industry is by far the largest employer of scientific and technical manpower. The reverse is the case in India for obvious reasons and Government is at present the largest employer of Scientific Manpower. The position will, however change as the country's industries develop on an adequate scale. We have in this section endeavoured to assess the requirements for scientific and technical manpower of over 20 principal industries—Heavy Chemicals, Pharmaceuticals and Drugs, Soaps, Oils and Fats, Paints and Varnishes, Plastics, Sugar and Fermentation, Cement, Paper, Metallurgy, Mining, Fuel and Carbonisation, Textiles, Leather, Engineering etc. Facts and figures have often been marshalled to show that India is industrially backward. This is undoubtedly so, considered in the broadest sense and in comparison with the more progressive countries of the world. But as in the case of all generalisations there are exceptions to this statement also; and the exceptions in this case are many and important. In certain fields the industrial development has been considerable whereas in others much lee-way has yet to be made. The last Great War gave great impetus to Indian Industries and the country now produces a considerable portion of her requirements for various consumer goods such as textiles, soaps, leather, paper, sugar and alcohol, paints and varnishes, drugs, rubber goods, hydrogenated oils, cement etc. Iron and steel are also being produced in considerable quantities. It is however true that in respect of some of these industries, the development has not been commensurate with our rapidly growing needs nor with our potential resources for development.

4. The following figures furnished by the Indian Labour Gazette, February, 1949, relating to the employment of industrial labour in the country during 1947 may be of interest in this connection.

TABLE I

Average daily number of factory workers in different industries during 1947 (Divided India)

Industries	No. employed
Government and local fund factories	2,79,166
Textiles	9,71,665
Engineering	2,06,188
Minerals and Metals	83,708
Food, drink and tobacco	1,40,461
Chemicals, dyes, etc.	94,169
Wood, stone and glass	87,788
Gins and presses	16,721
Skins and hides	29,887
Paper and Printing	54,307
Miscellaneous	2,49,501
Total	<u>2.2 millions approx.</u>

(The above statement excludes the labour employed in East Punjab and Indian States. A factory is taken as an establishment employing a labour force of 20 and above).

5. From the basic survey report, we observe that the development of Heavy Chemical and Engineering Industries, has been poor. These two being 'key' industries feeding a large number of other subsidiary industries, the development of the latter has also suffered thereby. India's production of heavy chemicals—sulphuric and other mineral acids, alkalis, chlorine, soda ash, ammonia and ammonium sulphate, inorganic salts, etc., is small and falls far short of requirements. Except for the production of aluminium and alkali chlorine, the Electro-chemical Industry has also made very little progress. Several large heavy chemical and electro-chemical projects have, however, been planned, some of which, notably the Government of India's large fertiliser and chemical factory at Sindhri, are under execution. Another fertiliser and chemical factory has recently gone into production at Alwaye.

6. Although India produces nearly 60 per cent. of her requirements for pharmaceuticals and drugs such as tinctures, extracts, galenicals, vaccine and sera, she has made little headway in the manufacture of synthetic chemotherapeutic products, vitamins, hormones and antibiotics which represent mile-stones in the conquest of disease. This is chiefly due to the absence of a well-developed coal-tar distillation and dyestuff intermediates industry. Lack of concerted and co-ordinated research in drugs is also largely responsible. Both in the range of products and their production, engineering industries in the country have shown little progress. At present these industries are confined to jobbing and constructional works, small scale manufacture of wires, nuts, and bolts, pumps, electric motors, transformers, incandescent lamps and a few other electrical items, certain items of minor industrial machinery such as sugarcane crushers, oil mills, textile spinning frames etc.—Aircraft and automobile industry, ship-building, machine-tool industry and electrical industry are still in the process of establishment.

7. In contrast to and notwithstanding the present position of 'Key' industries, various consumer industries have made fair progress. India produces generally the larger part of her requirements for most of the important consumer goods and has also built up a small export trade in several of them.

8. A number of scientists, technologists, engineers and other categories of personnel are employed in Indian industries but the present state of the pattern of employment of the personnel in relation to the nature of the industry and production is generally not well-defined. However, wherever possible attempts have been made in the Survey Report to arrive at certain relationships between the pattern of employment of manpower and the industry. While we do not subscribe to all that has been stated in the Survey Report, we are of view that the assessments have been made generally on the right lines and the figures arrived at in regard to "production to personnel ratio" are of the right order.

9. Against the background of the present state of industrial development, a picture of the trends of industrial development of the country during the next five and ten year periods has also been presented in the Survey Report. This picture is based both on the factual data obtained during the survey and the various developments recommended by the Industrial Panels set up by the Government of India sometime ago. We need hardly stress here the necessity for our accepting generally the suggestions made in the panel reports rather than the actual plans of the existing industries as the basis for purposes of assessment of requirements for scientific and technical man-power. During the survey, it was observed that industrialists had not decided on their development projects, for various reasons. That the Government of India had not till that time clarified their industrial policy* also provided grounds for the reluctance of the industrialists to indicate their future plans. There has consequently been many a gap in the data obtained during the survey. Furthermore, the expansion plans of the existing establishments would not and could not fully account for the overall development that would be required. The gap could only be bridged by taking note of the plans proposed by the Industrial Panels. It may be contended in certain quarters that the development plans of the Industrial Panels, at least some of them, are too ambitious and perhaps far removed from the realities. We do not subscribe to this view. In the matter of industrial development of a country like India whose potentiality is great and the need for development urgent, plans have to be ambitious and planners adventurous. In the context of our present work especially, we have to take a most optimistic view.

10. Further, in accordance with the Government's industrial policy all the industries have been classified into three categories. The first category comprises industries, which are either state monopolies, or in the further development of which only Central, Provincial and Indian State Governments, and other public authorities will participate; the second comprises such items in which both the state and private initiative will be allowed to participate, the planning and regulation of their development being however, vested in the Central Government. The last category of industries has been left entirely to private enterprise to develop. It has also been envisaged that wherever private enterprise fails to play its part the development of such industries will be taken up by the Government.

We, therefore, believe that the Industrial Panel reports provide the best blue-prints obtainable under the existing circumstances. We also observe that whatever industrial

*The Government have since announced their industrial policy.

projects have been decided upon either by the industrialists or by Government are generally in accordance with the plans drawn up by the Panels. From the information furnished in the survey report, it will be observed that large-scale developments have to take place in the ' Key ' industries, such as Chemical and Engineering Industries, in order to accelerate the development of numerous other industries. Fertiliser production will have to increase several times in order to make the country self-sufficient in the matter of food. Pharmaceuticals and drugs industry, the scope of which is at present limited, has to expand to include synthetic chemotherapeutic products, vitamins, antibiotics and other latest developments. Engineering Industries will have to be organised on a large scale and geared to the multifarious requirements of the country for an all-round development. In the matter of consumer industries India is yet to exploit all her raw material resources, not only to meet in full her requirements for consumer goods, but also to expand her export trade in these commodities.

11. In Annexure I we reproduce from the survey report a comprehensive statement indicating the main features of the present state of industries in the country and their possible scope of development. As regards the latter, we have indicated in column 3 the additional production now contemplated either by the existing industrial concerns or by the Government and in column 4 the various targets of production recommended by the industrial panels.

It will be observed that the various development plans cannot be classified strictly into those relating to the next five and ten year periods separately, as we cannot, at this stage, foresee the pace of industrial development in the country in the years to come. Such a classification may not also be absolutely necessary, especially since we have to take a comprehensive view over the next ten years period. Besides, it is also likely that at least some of the five-year projects may well extend beyond this period in the course of execution. We may, therefore, consider all the development plans relating to the next five years as coming into fruition between the next five and ten years, depending on the pace of industrialisation.

12. On the basis of available data relating to production, personnel and other factors for each industry and from a detailed consideration of its technical aspects, an assessment has been made in the survey report of the requirements for scientific and technical man-power. A consolidated statement indicating, industry-wise, the requirements for all categories of scientific and technical manpower for implementing the various industrial development projects will be seen at the end of this report (Appendix II).

13. We are of the view that although the requirements for Scientific and Technical personnel as assessed in the Survey Report are generally of the right order, certain categories of personnel, as for instance Physicists, who would be required in much larger numbers as and when certain new lines of manufacture like Scientific instruments not envisaged in the Survey Report are developed have not been given the importance they deserve. The requirements for geologists also will be greater than what has been estimated, viz. 100 especially because the work of the Geological Survey of India as carried out till now leaves much to be desired from the national development point of view and organised industrial enterprise will have to play an important role in the survey and development of the mineral resources of the country.

14. We assess the total requirements for Scientific and Technical Manpower for the industrial development of the country during the next 5-10 year period as given below :—

TABLE II

Category	No. required	
	Senior grade	Junior grade
Engineers of all categories	7,950	9,100
Chemists and Chemical Technologists	2,660	2,300
Fuel and Furnace Technologists	280	..
Physicists	500	..
Geologists	300	(100 Fieldmen)
Chemists and Refractory Technologists	130	110
Metallurgists and Metallurgical Engineers	690	820
Textile Technologists	570	820
Glass Technologists	180	230
Leather Technologists	250	400
Botanists	2	..
Biologists	20	..
Doctors	180	..

(In the above, Senior Grade consists of personnel with degree in engineering, technology and other professional courses as the minimum academic qualifications or scientists with post-graduate qualifications ; the Junior grade consists of personnel who are graduates in science or hold diploma or licentiate ship in engineering and technology).

Government and Government sponsored Departments

15. In a wide technical sense all progressive governments resemble huge organised industry in as much as their activities extend far beyond the normal administrative spheres and include numerous activities calculated to be of direct and indirect service and benefit to the people. Organisation and maintenance of public health and medical services, construction of national highways, roads, bridges and irrigation projects, power generation and transmission, promotion of agricultural and industrial development, planned utilisation and conservation of national resources and promotion of higher scientific and technological education and research are among the most important of the activities of a modern government. As a country tends towards socialism, the activities of its government progressively increase. Such matters as transport, communications, fuel, power etc., which are otherwise left to individual or private enterprise are brought gradually under State control and management. In all governments therefore numerous departments or establishments are created to discharge these productive functions requiring the use of scientific and technical man-power. Consequently, Government and Government-sponsored Departments are also the largest employers of scientific and technical talent.

16. We deal in this section with the scientific and technical activities of the Central, Provincial and Indian States' Governments and attempt to assess the requirements for scientific and technical man-power for the development of these activities during the next five year period. It is well known that under the present set-up of the country, certain subjects, viz., Communication, Railway Transport, Broadcasting and Defence are

the direct concern of and are managed by, the Central Government. Even in other subjects in which the Provincial Governments are autonomous, the Central Government exercise powers of direction and co-ordination of the activities of the Provincial Units.

17. Considered department-wise, the activities of the Central and Provincial Governments closely follow a common and well-laid out pattern. For instance, all Public Health activities comprising establishment and maintenance of hospitals and health units, manufacture and distribution of vaccine and sera, training of public health officers sanitary inspectors, midwives, nutrition survey etc., are the concern of the Department of Medicine and Public Health in the Province as well as in the Centre. Construction of roads, bridges and buildings, planning and execution of irrigation projects and all other civil engineering activities come under the Public Works Departments. Similarly soil survey, seed multiplication and distribution, plant protection and quarantine, distribution of agricultural implements and manure, development of important varieties fall within the purview of the Departments of Agriculture. Along with activities directed towards the general industrial development, some governments participate directly as well in industrial enterprises, and we have already taken note of these activities under 'Industries' in this report.

18. In the Survey Report are out-lined briefly the activities of about 20 Government and Government sponsored Departments indicating the lines and scope of their activities. How important these activities are from our point of view will be seen from the following rather incomplete table showing figures of present scientific and technical personnel employed in Government and Government-sponsored Departments.

TABLE III

Name of Department	No. employed		Total
	Gazetted	Non-gazetted	
Posts and Telegraphs	531	1,100	1,631
Meteorology Deptts.	150	1,450	1,600
Civil Aviation	331	18	349
Rail Transport	1,138	1,476	2,614
Mercantile Marine	48	..	48
Roads Organizations	27	59	86
Port Trust Administration	353	45	398
Radio and Broadcasting	43	266	309
Public Works Department including CWINC and Multi purpose Projects	2,101	6,759	8,860
Electricity Departments	483	1,300	1,783
Deptt. of Scientific Research including the council of Scientific and Industrial Research*	149	890	1,039
Defence Establishments	2,804	3,011	5,815
Education Deptts.	259	127	386
Geology and Mines Deptts.	171	49	237
Medical and Public Health Deptts.	1,655	1,755	3,410
Departments of Industries, Civil Supplies and Development	740	724	1,464
Department of Revenue	21	84	105
Departments of Agriculture including the Indian Council of Agricultural Research	1,469	3,798	5,267
TOTAL	12,473	22,911	35,384

*Figures relate to 1948-49 Employ

19. A large number of national reconstruction projects have been contemplated by the Central, Provincial and Indian States Governments, some of which are already in the course of execution. The survey report describes the main features of these development projects, bringing forth in particular the objectives of these plans ; and it is, therefore, not necessary for us to dilate on them here. We should, however, like to observe that the most important of these development plans are the construction of several multi-purpose projects and national highways, establishment of health centres and extension of medical facilities to rural population, hydro-electric generation, transmission and distribution, improvement of the agricultural prosperity of the country, establishment of National Research Laboratories, and Higher Technical Institutions, promotion of basic education of the masses etc. Considered purely on the basis of the financial implications of the projects alone, which are estimated to cost several thousand crores of rupees, one is impressed by the magnitude of the projects and their requirements for scientific and technical man-power. For the organisation of Defence which is perhaps of the greatest importance to the country the need is for the expansion of all the three Arms on right scientific lines and the strengthening of the scientific and technical side of the ' Defence Machinery '. We have had the benefit of discussing with the Commander-in-Chief and other senior officers of the Defence Ministry the various questions relating to the re-organisation of the forces, with special reference to the requirements for scientific and technical man-power.

20. Mainly on the basis of the data furnished by the Departments concerned, an assessment has been made in the survey report of the requirements for scientific and technical man-power for Government and Government sponsored activities. We generally accept the assessment made. In the case of Defence the necessary details being not available the assessment has been based on certain technical considerations, and is given in the Survey Report under two heads *viz.* Requirements for the normal expansion of the Armed Services and Anticipated Requirements in the event of a first class national emergency. We are of the considered view that if the Defence Organisations of the Country are to be re-organised along proper lines the requirements for scientific and technical man-power are considerable and will be of the order as indicated under the former head above. It is, however, suggested in the Survey Report that in the context of drawing up a forward plan for the development of educational and training facilities in the country the latter estimates may be taken into consideration so that our resources might ultimately be developed to the extent of being able to train the requisite man-power in the event of a national emergency. We support this view.

A consolidated statement showing department-wise the requirements for scientific and technical man-power during the next 5-year period will be seen at the end of the report (Annexure III). We should like to mention here that in the case of Medical and Public Health activities only a few of the Provinces and States have furnished their plans ; and even these are incomplete in many respects and barely touch the fringe of the problem. Consequently, we have had to consider in detail the Health Development Scheme,—a most comprehensive plan drawn up in 1946 by the Health survey and Development Committee (*i.e.*, Bhore Committee) of the Government of India. The Survey Report indicates the requirements for Medical and Public Health personnel both for such of the Provincial plans as have been received by us, and the Bhore Committee's scheme, separately. We consider that the requirements of personnel for the implementation of the Bhore Committee's recommendations should be taken for purposes of this report.

21. We estimate that the requirements for scientific and technical man-power for Government and Government-sponsored activities during the next 5 years are as follows

TABLE IV

Category	No. required	
	Senior Grade	Junior Grade
Engineers of all categories	17,300	19,600
Chemists and Chemical Technologists	3,900	1,600
Fuel and Furnace Technologists	30	..
Metallurgists and Metallurgical Engineers	400	..
Glass and Ceramics Technologists	10	..
Geologists and Geophysicists	1,120	..
Textile Technologists	210	130
Leather Technologists	100	50
Architects	310	..
Physicists	2,800	220
Botanists	900	..
Zoologists	1,430	..
Biologists	660	..
Agricultural Scientists	2,640	610
Dairy Technologists	700	..
Mathematicians and Statisticians	1,560	60
Doctors	19,560	..
Non-medical personnel (Nurses)	32,510	..
Science Teachers :		
Post-graduate	Included under Physicists, Chemists, Botanists, Zoologists, Geologists, etc., above.	
Graduates	16,220	
Intermediates in Science	1,82,300	
Intermediates in Science as Technical Personnel after training.	500	
Unclassified Scientific and Technical personnel	3,820	

22. It is to be noted that in the above assessment we have classified the personnel required into 'Senior' and 'Junior' grades. This classification will serve to indicate the educational standard of the personnel in question. Generally speaking, the senior grade staff comprises graduates in engineering, technology and other professional courses and post-graduates in the various branches of science. The Junior grade staff comprises graduates in science, or diploma holders in engineering, technology or other professional courses. Both of these categories are required to possess necessary practical or industrial training.

It is also to be noted that in the Survey Report the requirements for Dentists have been estimated as 180. This estimate covers only part requirements whereas the total requirements for Dentists for the whole country are far greater, which, however, we have been unable to assess to an appreciable degree of accuracy. Lest an estimate of 180 Dentists should create a wrong impression we have thought it best to exclude the total requirements for Dentists from the above assessment.

23. A summary of our assessment of the requirements for Scientific and Technical man-power for Industry and Government and Government-sponsored departments is given below :—

TABLE V

Category	No. required	
	Senior Grade	Junior Grade
Engineers of all categories	25,250	28,700
Architects	310	..
Chemists and Chemical Technologists	6,560	3,990
Physicists	3,300	220
Metallurgists	1,090	150
Glass and Ceramics Technologists	320	340
Fuel and Furnace Technologists	310	..
Textile Technologists	780	950
Leather Technologists	350	450
Geologists and Geophysicists	1,420	..
Mathematicians and Statisticians	1,560	60
Botanists	900	..
Zoologists	1,430	..
Biologists	680	..
Agricultural Scientists	2,640	610
Dairy Technologists	700	..
Doctors	19,740	..
Non-medical personnel (Nurses)	32,510	..
Science Teachers :		
Graduates in Science	16,220	..
Intermediates in Science	1,82,300	..
Intermediates in Science as Technical personnel	500	..
Unclassified Scientific and Technical personnel	3,820	..

CHAPTER III

Review of Resources of Scientific and Technical Manpower
and Research Development

1. Having estimated in the preceding chapter the requirements for various grades of scientific and technical personnel during next 5-10 year period, we now proceed to examine the question of availability of such personnel. We consider the problem under four broad heads *viz.*: 'Engineering and Technological Education'; 'Scientific Education and Research'; 'Agricultural Education and Research' 'Medical Education and Research.' The survey report presents a co-ordinated picture of the existing educational and research facilities in the country in respect of all the above four categories. An analysis has been made to show the various courses of study or training offered in the institutions, the annual intake and outturn of students and the position of each institution in the matter of staff, equipment and accommodation.

Scientific Education and Research

2. It is observed that facilities for post-graduate education and research in engineering and technology are almost non-existent. There are no more than five established institutions in the whole country which impart education upto post-graduate standard and even there, the range of subjects covered is limited. Only one institution offers post-graduate courses in aeronautical engineering, metallurgy, internal combustion engineering and power engineering; 2 in chemical technology, one each in ceramics, glass, sugar technology, pharmaceuticals, and oil technology, and 2 in applied physics. Most of these post-graduate courses have been started, fairly recently and the departments are generally in a formative stage and the intake and outturn are small.

3. The progress of engineering education has not been unsatisfactory upto the under-graduate or degree standard. There are over 23 first-grade engineering colleges in the country offering courses in civil, electrical and mechanical engineering. Recently chemical engineering courses have been organised in four; electrical communication engineering in two; metallurgical engineering in one and highway engineering also in one of these colleges. Combined courses in mechanical and electrical engineering subjects is a special feature of some of the engineering colleges, especially in the Northern and Western Zones. It has, however, to be noted that there is at present little scope for specialization in the numerous branches of engineering at the degree or post-graduate stages and consequently, the existing system may be regarded as one relating mostly to general engineering education in the three basic branches of engineering—*viz.*, civil, mechanical and electrical. Technological education has not kept pace with engineering education and shows only limited development both in the range of subjects covered and in the number of institutions providing such courses. There are only 8 first-grade institutions in the country teaching technological subjects upto the degree standard. Of these, three institutions offer courses in chemical technology, two in oil technology, one each in ceramics, glass, pharmaceuticals, metallurgy and leather, two in mining and three in textile technology. The courses in some of these institutions have been started fairly recently. In the matter of junior engineering and technological education up to the diploma standard, the present position is somewhat satisfactory in that over 45 institutions distributed all over the country are engaged in imparting instruction in a fairly wide range of subjects in engineering and technology.

The Survey Report gives in detail the necessary information relating to the present intake and outturn for the various engineering and technological courses. These are summarised in the following statement:—

TABLE VI

<i>Standard of training</i>	<i>Outturn in 1946-47</i>	<i>Admission in 1947-48</i>
ENGINEERING :		
Diploma Courses	1150	8150
Degree and Post-graduate Courses	950	2520
TECHNOLOGY :		
Diploma Courses	290	510
Degree and Post-graduate Courses	320	420

4. From the above, it will be observed that the admissions in 1947-48 have been considerably larger than in the previous years and this increased intake is likely to be maintained in the years to come. A number of new institutions have also been started, some with new courses of study and training not provided in other institutions at present. Consequently the outturn of personnel during the next five years will be greater than before. Taking all those factors into consideration, a forecast of the likely outturn of various categories of personnel qualifying in engineering and technological subjects over the next 5 years (1947—52) is given at the end of this report.

5. The Survey Report gives a detailed account of the present position of each institution in respect of staff, accommodation and equipment. From this, we note that all the engineering and technological institutions in the country suffer from such handicaps as lack of equipment or lack of adequate staff or lack of adequate accommodation or all the three. This is chiefly due to two factors, *viz.*,

- i) that well-established institutions which have increased their normal intake have not always been able to expand their facilities correspondingly ; and
- ii) institutions which have been started recently have been progressing rather slowly mainly due to the lack of funds.

e available facilities in respect of equipment, staff, teaching accommodation etc. in many of these institutions hardly fulfil 40% of the minimum requirements suggested by the All-India Council for Technical Education. This unsatisfactory state of affairs is having an adverse effect on the standard of education. In our opinion, the first approach to the problem of development of engineering and technological education should be to strengthen the existing facilities in the institutions by equipping and staffing them adequately for the present intake of students and to bring up the standard of training to the desired level.

6. We also note that little or no research either in engineering or in technology is being carried out at present in any of the institutions except perhaps in one, *viz.*, the Indian Institute of Science, Bangalore. The reasons are not far to seek. The institutions have developed only for teaching and in many of them, the available facilities are not adequate even for this purpose. The academic atmosphere prevailing in the institutions is also anything but conducive to research. The teaching staff of almost all the institutions are heavily burdened with routine teaching work and

are left with little time for research. The equipment and other facilities available for research are very poor and there is little collaboration and contact between Industry and the Institutions. Besides, there are no research scholarships or fellowships worth mentioning in any of the institutions. Unless these existing handicaps are removed no real impetus can, in our considered opinion, be given to engineering and industrial research. Members of staff should be enabled to find sufficient time to devote to research and suitable research fellowships or scholarships should be instituted in each institution. The existing physical facilities with regard to staff, equipment, accommodation etc. should be improved not only for teaching but also for research purposes and there should be close liaison between Industry and Educational Institutions so that the latter might cater to the needs of Industry both in the matter of research and in the training of personnel.

Scientific Education and Research.

Basic Scientific Education.

7. A large number of institutions more or less evenly distributed over the whole country provide facilities for basic scientific education up to I.Sc., B.Sc., and B.Sc. (Hons.) standards in Physics, Chemistry, Mathematics, Botany, Zoology, Geology, and other biological Sciences. B.Sc. (Hons.) course is of three years' duration in certain universities, while in others, it is only of two years' duration. The outturn of I.Sc.'s and B.Sc. and B.Sc. (Hons.) graduates for 1946-47 is shown below :--

TABLE VII

	<i>Outturn in 1946-47</i>	<i>Admissions in 1947-48</i>
Intermediate in Science	19000	Not known
B. Sc. graduate (Pure Sciences)	4790	8000 (estimated)
B. Sc. (Hons.) graduates	1100	1200 (estimated)

8. Almost all the institutions teaching upto I.Sc. and B.Sc. standards are now working at full strength, some in two shifts, and no appreciable increase in the outturn of graduates and intermediates in science can be expected from them in the near future. Any appreciable increase in the output which might be required will have to be brought about by starting new institutions, since it is understood that the introduction of double shift system in institutions where it has not already been introduced can only be possible by effecting all-round expansion of the institutions concerned, i.e., by providing additional staff, equipments and buildings which may practically amount to starting new institutions. It has been noted that even in many of the existing institutions the facilities available are extremely unsatisfactory. The intake of students into the various courses in these institutions has increased in recent years, but there has been no corresponding increase in the facilities. Class rooms are generally crowded, the staff over-worked and there has been no replacement of the old and unserviceable equipments nor any addition made thereto. We need hardly stress here that

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if basic scientific education in the country is to be maintained at the requisite standard all these deficiencies should be first removed. There is need for more than passing reference to the condition in which teachers are working in these institutions. Although in some of these institutions some limited facilities for research are available, the staff is so heavily burdened with routine teaching work—25 hours per week or more—that they find little time for research. The condition is much the same in some of the colleges which offer Honours and Post-graduate courses in addition to undergraduate courses. The salary scales are far from satisfactory. In some cases they are ridiculously low. There is general discontent amongst the members of the staff, and the institutions, we understand, are finding it increasingly difficult to attract qualified teachers.

Higher Scientific Education and Research.

8. Although research is intended to be covered separately according to our terms of reference, we find it necessary to link up Higher Scientific Education with Research. Higher Scientific Education and Research go together and the right combination of teaching and research work is one of the distinguishing features of the University—specially in India, where the universities are primarily responsible for Higher Scientific Education. There are at present 25 universities in the country of which seven are still in a formative stage. In some of the Indian Universities, M.Sc. degree is obtainable mainly by research; in some others, either by research or by examination and in the rest by both. Most of the universities are maintaining departments for post-graduate education and research in the various branches of basic sciences—Physics, Chemistry, Mathematics, Botany, Zoology, Geology and other biological sciences. Some of these Post-graduate Departments are fast growing into active and important centres of research. But there have always been a great many bottlenecks in the development of research at university research centres and we shall refer to this at a later stage in the report. The Survey Report gives a detailed account of the various fields of research in which the University Departments are engaged. In addition to the Post-graduate Departments of Universities, a number of first-grade science colleges, either affiliated to the universities or directly maintained by them, have facilities for post-graduate research and training which though at present not quite satisfactory in all respects are capable of being developed especially for the training of research workers. The following is a brief review of the present state of research at university research centres and the special fields of research engaged in.

In *Physics*, spectroscopy, atmospheric and wireless, crystal physics, Raman Effect and ultrasonics are generally covered by most of the universities. Facilities for specialised research in Nuclear Physics are available at one university research centre.

In *Chemistry*, plant products, colloids, dyes, and intermediates, general physical chemistry, inorganic chemistry, applied chemistry, pharmaceuticals and fine chemicals, soaps, oils and fats are the subjects of research.

Excepting at 2—3 institutions Mathematical research is being gradually relegated to the background. This, in our opinion, is really unfortunate in that the great tradition India has all along had in the field of Mathematics is not being maintained. The present scope of work in the field is limited and relates chiefly to the theory of functions, zeta-function of Riemann, configuration of spaces and mathematical aspects of monopoly and imperfect competition and applied mathematics. Facilities for post-graduate education and research in geological sciences are available at five of the university centres.

In *Botany*, research in cytogenetics, systematics, morphology, micro-biology is generally being carried on at many of the university research centres. An important development in the field of botanical research, however, is the Institute of Palaeo-Botany, which has recently been established at Lucknow.

In *Zoology*, vertebrate zoology, embryology and marine biology are the special fields of research. It is to be noted that of late Applied Research is receiving considerable attention at a large number of university research centres chiefly due to the impetus given to it by the council of Scientific and Industrial Research. A large number of research projects—over 300 sponsored by C.S.I.R. are at present in operation at various university laboratories. These research projects besides contributing to the development of Indian industries and to scientific knowledge are fulfilling a very important need, namely the training of research workers.

9. Research work carried out at universities represents but one aspect of research development. In order to complete the picture of scientific and industrial research in the country, we have to refer to the activities of several special institutions also, special in the sense that unlike the university institutions, these do not ordinarily cater for routine post-graduate teaching of scholars for higher degrees or diplomas but are whole-time research establishments. In the context of Higher Scientific Education, however, these special institutions have their own importance in that many of them function as research training centres and also provide facilities for research students to work for higher post-graduate degrees of universities. The chief centres of scientific and industrial research in the country at present are, the Indian Institute of Science, Bose Research Institute, Indian Association for the cultivation of Science, Tata Institute of Fundamental Research, and the National Laboratories of the Council of Scientific and Industrial Research that are in the process of establishment. There are also several other research institutions meant specially for certain specific branches of science and technology such as solar physics, jute, lac, fisheries, etc. which are important in themselves. The Indian Institute of Science covers a wide range of subjects for research—Physics, general and inorganic chemistry, organic chemistry, physical chemistry, bio-chemistry, aeronautics, and communication engineering. Research facilities in metallurgy, internal combustion engineering and power engineering are still in the development stage. The institute is perhaps the oldest and the best equipped whole-time research institution in the country at present and the lines of research in the various branches of science have been described in the survey report. Excepting Nuclear Physics all other branches of Physics are covered in the Physics Division. Besides General, Inorganic, Organic and Physical Chemistry, the Chemistry Division specialises in fermentation technology. The Bio-chemistry Division specialises in food and nutrition problems, sanitation chemistry including water sewage and trade wastes, soil sciences and enzyme chemistry. An important aspect of research development in the Institute is industrial research which is of late receiving considerable attention. A large number of research schemes of industrial importance sponsored by the Council of Scientific and Industrial Research, problems bearing on plastics, catalytic synthesis, synthetic drugs, electro-chemistry, vegetable oils and fats and industrial fermentations are being investigated and in many cases on a pilot plant scale. The Departments are equipped with all the unit process plants and pilot plants have been constructed for the development of certain processes. A noteworthy feature of the Fermentation Chemistry Section is the National Collection of Type Cultures. The Institute functions as a first-rate research training centre and provides facilities for over 120 research workers. The Bose Research Institute is "devoted to the fuller investigation of the many ever opening problems of the nascent science which include

both life and non-life with the application of methods of science to problems of agriculture, industry and medicine". The specialised branches of research carried on are Physics and Bio-physics, Plant Physiology, Plant breeding and cytogenetics, Microbiology and Anthropology. The lines of research in each of these branches are described in the Survey Report. The Tata Institute of Fundamental Research which has started functioning recently specialises in theoretical physics, experimental Physics, nuclear Physics, Mathematics and advanced statistics with special reference to the study of cosmic radiation, quantum mechanics and theory of elementary particles, nuclear physics, etc. The Institute is very well equipped for investigations in these fields and especially in Cosmic Rays and Nuclear Physics. It is also one of the centres of Atomic Research and will shortly have a high-energy Betatron installed in its laboratories. The laboratories of the Indian Academy of Sciences, Bangalore, which are in a formative stage at present and will start functioning soon, will cover research in Physics, Crystallography and Mineralogy. Besides the above, there are 8 more research institutions—The Solar Physics Laboratory, The Central Marine Fisheries Research Institute, The Lac Research Institute, Jute Technological Laboratory, Cotton Technological Laboratory, Institute of Palaco-botanical Research, Forest Research Institute and the Nutrition Research Laboratory which are meant for research in certain special branches of science or technology. The Survey Report gives in detail the activities of each of these institutions. The National Laboratories of India, a chain of which is in the process of establishment now under the auspices of the Council of Scientific and Industrial Research, represent what might be called, a positive and conscious effort for the promotion of scientific and industrial research in the country and towards the development of the country's industries. The nuclei of some of these National Laboratories which are at present located in Delhi have trained a fairly large number of research workers in the course of investigation of diverse research problems. Five of these National Laboratories, *viz.*, the National Chemical Laboratory, National Physical Laboratory, National Metallurgical Laboratory, Central Glass and Ceramics Research Institute and the fuel Research Institute are now in the process of establishment. The Survey Report describes in detail their scope and functions. Plans are underway for the establishment of 6 more National Laboratories, *viz.*, Road Research Institute, Building Research Institute, Leather Research Institute, Food Technology Research Institute, Electrochemical Research Institute and Central Drug Research Institute. All the National Laboratories will, when completed, also provide facilities for the training of a considerable number of research workers on stipendiary or fellowship basis. We note with particular gratification that the Government of India have recently created a Department of Scientific Research, thereby attaching to scientific research a new significance and importance in the context of national development.

10. The Survey Report gives in detail all the necessary data relating to the present annual outturn of personnel with higher scientific qualifications as well as the facilities available in the country for research training. A forecast of the outturn of such personnel over the next five years is presented at the end of this Report. In the statement below, we summarise the present position in respect of the facilities for higher scientific education and research training. As regards research training, no correct estimates have been furnished by the institutions, presumably because research training does not ordinarily conform to any specified time limits unlike other training or educational courses and the scholars under research training stay at the institutions either as long as their scholarships last or until they complete their work for a higher degree or diploma. Often research students also leave the institutions for suitable posts outside without, however, completing the training. Besides, in many institutions, the available research training facilities are not fully utilised chiefly due to, as we have stated earlier (*i*) lack of suitable fellowships or scholarships to attract

research students and (ii) the teaching load on the tutorial staff of science colleges being too heavy to permit of any considerable research on the part of the staff. All these factors, consequently, make the present rate of out turn of trained personnel indeterminate. We have, however, made an attempt to present in the statement, the possible rate on the assumption, that the average period of research training is about 3 years and that, if all the available training facilities are fully utilised, the annual outturn will be about 30-35% of the total number of research workers, for whom training facilities are available.

TABLE VIII

	Out turn in 1946-47	Admissions in 1947-48
M. Sc. courses in Basic Sciences	640	700
Ph. D., D. Sc., etc. in Basic Sciences		
Total out turn for the last 10 years		130

Research Training.	Total No. of workers for whose training facilities are available.	Possible rate of outturn /year
Physics		140
Chemistry		310
Mathematics		30
Statistics		10
Botany		70
Geology		20
Zoology		20
Applied Biology		3
Marine Biology		15
Physiology		5
Other subjects		10

Agricultural Education and Research

There are about 18 institutions in the country which provide facilities for education and training in agriculture, dairying, forestry, veterinary sciences, fisheries, and other allied subjects. Of these, seven institutions teach upto degree and ten upto post-graduate standards. One of the institutions *viz.*, Agricultural Institute, Allahabad, also trains students in agricultural engineering upto the degree standard. The chief centres of agricultural research are: Indian Agricultural Research Institute, Delhi, Agricultural Research Institute, Coimbatore, Sugarcane Research Station, Coimbatore, Indian Veterinary Research Institute, Izatnagar, Forest Research Institute, Dehra Dun, Indian Dairy Research Institute, Bangalore, the Central Tobacco Research Institute, Guntur and the Central Rice Research Institute, Cuttack. The last two of these have just begun to function. In addition some of the University Botany Laboratories are also active centres of agricultural research. The survey report describes in detail the scope and lines of research at each of these research centres.

To mention here in brief the research activities, the Agricultural Research Institute, Coimbatore and the Indian Institute of Agricultural Research, Delhi, carry on research in all branches of agriculture and allied sciences, comprising mycology, agricultural chemistry, entomology, food crops, paddy, cotton, agronomy, etc. These institutes and specially the latter also train post-graduate research workers. The Indian Sugarcane Research Institute in Coimbatore is a part of the Indian Agricultural Research Institute and is meant for specialised research on all aspects of sugar-

cane cultivation and its development. It participates in the training of post-graduate students also. The Central Tobacco Research Institute which is in a formative stage at present has before it an extensive programme of work bearing on the genetics of tobacco with special reference to quality tobacco and the curing of tobacco. In addition to training students in dairy sciences, the Indian Dairy Research Institute carries on research on all aspects of dairy sciences including Dairy husbandry, animal nutrition, dairy technology, dairy chemistry, dairy bacteriology and dairy engineering. The Central Inland Fisheries Station, the Central Rice Research Institute, the Central Sericultural Station, the Central Horticultural Research Institute, Indian Institute of Fruit Technology, and Central Jute Research Institute are all specifically meant for specialised research in the respective branches of agricultural sciences or technology. The Botanical Survey of India carries on fundamental research bearing on systematic botany as well as allied botanical research on plants of economic importance. The Indian Veterinary Research Institute is a combined research and teaching institution and its research work relates to all aspects of an animal chemistry, physiology, pathology, bacteriology, nutrition, genetics, poultry research, parasitology and manufacture of vaccine and sera. Advanced post-graduate courses are conducted by the Institute in the various branches of veterinary sciences. The Indian Forest College and Research Institute is also a combined teaching and research institute, post-graduate training being given at the college in forestry, wood technology and allied subjects. In addition to the above research organization, some of the agricultural colleges are also active centres of research in agricultural sciences and the survey report describes in detail the lines of research at these centres. All the important agricultural institutions educational and research offer facilities for the training of research workers. As a matter of fact, post-graduate courses in many institutions include research training as well. The Survey report gives in detail the present intake and out turn of students for the various courses in agriculture and allied sciences. On the basis of these data a forecast of the out turn of agricultural personnel of various categories over the next 5-year period is given at the end of this report. In the statement below we summarise the present position in respect of agricultural education and research.

TABLE IX

Courses	Out turn in 1946-47	Admissions in 1947-48	Probable out turn during the next 5 years
Dairy and allied sciences	180	140	900
B.Sc. in agriculture and agricultural engineering	350	990	3,650
M.Sc. and Doctorates in Agricultural sciences	80	80	480
Post-graduate diplomas in agriculture, veterinary, forestry, dairying and allied sciences.	160	170	940
Total number of post-graduate research workers for whose training facilities are available.	170	..	
Agricultural Sciences	5		310
Dairying, Veterinary Sciences	10		Trained Research workers.*

* (On the assumption that all the research training facilities are fully utilised and the duration of training is about 3 years).

12. From the survey report relating to Medical Education and Research, we observe that the facilities available in the country for post-graduate training and research in medical and allied branches are poor. Nine medical colleges, it is stated, provide facilities for such training but considered in the light of the out turn of trained personnel every year, there is considerable doubt whether the claims of most of these institutions are justified. There is no regularity in the intake and outturn of students to and from the post-graduate courses in medicine and surgery. However, we may assume that in not more than two or three of these institutions, facilities are available for post-graduate or advanced training in ophthalmology, gynaecology, obstetrics, otolaryngology and other clinical sciences. We also note that very little medical research is being conducted in the medical colleges. The chief centres of research in the country are the School of Tropical Medicine, Calcutta, the Haffkine Institute, Bombay, the King Institute of Preventive Medicine, Guindy, the Central Research Institute, Kasauli, the All-India Institute of Hygiene and Public Health, Calcutta, the Malaria Institute of India, Delhi, the Pasteur Institute, Coonoor, the Central Military Pathological Laboratory, Poona, the Central Drugs Laboratory, Calcutta and the Pathological Laboratories of the Tata Memorial Hospital, Bombay. Most of these research centres also offer post-graduate courses in various branches of medical sciences. The All-India Institute of Public Health and Hygiene offers courses in public health, maternity and child welfare and aims at becoming ultimately the foremost centre of advanced instruction and research in the methods of preventive and social medicine. Post-graduate courses in tropical medicine and allied branches are provided in the School of Tropical Medicine. The Universities of Bombay and Madras also provide training facilities in Hygiene and Public Health. The activities of the Central Research Institute, Kasauli, relate chiefly to the production of vaccine and sera and research connected with this subject. The Pasteur Institute, Coonoor, carries on research on anti-rabic vaccine and related problems. It also provides facilities for general bacteriological and clinical research. The King Institute of Preventive Medicine, Guindy, provides facilities for training and research in public health work, manufacture of vaccines, sera and lymph as well as analysis of water, foods and drugs. In the Malaria Institute of India, basic research is carried out on all aspects of malariology. The Institute also conducts advanced courses in malariology, particularly for the public health officers of governments, and the army medical personnel.

13. Training of medical personnel upto degree standard is perhaps the most important aspect of medical education in the context of our present work. The survey report describes in detail the facilities available in the medical colleges in the country for education upto graduate standard and training in medicine and surgery. From this we observed that there are at present 28 medical colleges more or less evenly distributed, over the whole country. Of these, 12 are well-established institutions and the rest were started only recently—either as new colleges or by conversion from Schools. The latter comprise 5 medical schools that have been re-organised for imparting education upto the degree standard. We note that double shift system has been introduced as an experimental measure in two institutions, *viz.*, Medical College, Bombay and Medical College, Calcutta. Excluding the new institutions which have been started recently, the fifteen established colleges have been turning out in recent years an average of 860 graduates every year against an intake of 1,150 students. The latest intake into all the institutions both old and new is about 1,700 students. With a view to augmenting the number of qualified medical personnel in the country and as a part of the re-settlement scheme, the Government of India have sanctioned a 5-year project for producing about 975 medical graduates within the next 5 years by giving advanced training to ex-servicemen who were licentiates or diploma holders from medical schools. The

scheme has since June, 1947, been put into operation in the Lake Medical College Calcutta, with an intake of 150 students every six months. The duration of this training is 12 to 24 months.

14. There were 18 medical schools in the Indian Union which used to account for an annual outturn of about 700 licentiates. But following the accepted principle of raising the standard of medical education in the country, 11 of these medical schools have already been converted into medical colleges for training upto the graduate standard. We understand that proposals have been formulated for converting 5 more medical schools into collegiate institutions at an early date. It is not unlikely that all the medical schools in the country will, before long, be re-organised into medical colleges.

15. From the survey report, we observed that both for undergraduate and post-graduate training in dentistry, the available facilities in the country are totally inadequate. There is yet no dental college in the country offering training upto degree standard in the dentistry. At present dental training is imparted in 3 dental colleges, one in Calcutta and two in Bombay. The number of students who qualify as dentists from these institutions, we understand, is not over 50 per year.

16. The total number of qualified and practising nurses in India is estimated to be about 7,000 in the proportion of one for every 43,000 of the population which obviously is very low when compared to corresponding ratios obtaining in other countries. In view of the absence of facilities for advanced training in the provinces in nursing the Government of India started in 1946 a Nursing College in Delhi which offers a B.Sc. (Hons.) course in nursing in addition to short-term training courses for qualified nurses. The Nursing College has provision for an annual admission of 25 students into degree courses and at present there are 17 students in the first year.

17. We note that generally the existing facilities in all the institutions by way of staff, equipment, accommodation and hospital requirements are just adequate for the present intake of students but shortages in one respect or another have in recent years been felt particularly in such of the institutions as have had to increase the intake.

18. A forecast of the total outturn of various categories of medical personnel during the next 5 years is given at the end of this report. The following summarises the present position in respect of facilities for medical education and research in the country.

TABLE X

	Outturn in 1946-47	Admissions in 1947-48	Forecast of outturn for the next 5 years 1947— 1952.
Licentiate courses in Medicine and Surgery	500	Not known	Cannot be estimated as most of the schools are being conver- ted into colleges
Degree courses in Medicine and Surgery	860	1,700	5,940
Post-graduate courses in various branches of medicine and Surgery, Public Health, etc.	220	50	1,040
Degree courses in Nursing . . . . .	..	50	250
Diploma holders in Dentistry	50	70	300

19. To sum up the foregoing review of the resources of scientific and technical manpower in the country, we present below a consolidated statement showing the number of men that are likely to be turned out of our educational and research institutions during the next five years.

TABLE XI

Category	Outturn in 1946-47	Admissions in 1947-48	Forecast of outturn over the next 5-year period 1947-52
A. Basic Scientific Education :			
Intermediate in Science	19,660	No information	98,300
B. Sc. graduates (Pure Sciences)	4,790	8,000 (estimated)	23,950
B.Sc. (Hons.) Graduates	1,100	1,200 (estimated)	5,500
B. Higher Scientific Education :			
M. Sc. in Pure Sciences	640	700	3,210
Ph. D., D. Sc., etc. in Pure Sciences	260	..	130
(Outturn in the last 10 years.)			On the basis of the out-turn for the last 10 years.
Total number of post-graduate research workers for whose training facilities are available in all branches of Science and Technology.	..	660	1,100
			On the assumption that all the research training facilities would be fully utilized and the duration of training is about 3 years).
C. Engineering Education :			
Diploma courses	1,150	3,150	8,250
Degree and Post-graduate courses	950	2,520	6,610
D. Technological Education :			
Diploma courses	290	500	1,780
Degree and Post-graduate courses	320	420	2,180
E. Medical Education :			
Licentiate course in Medicine and Surgery	500	No information	Cannot be estimated as most of the schools are being converted into colleges.
Degree course in Medicine and Surgery	860	1,800	5,940
Post-graduate courses in various branches of Medicine, Surgery, Public Health, etc.	220	350	1,040
Degree courses in Nursing . . . . .	...	50	250
Diploma courses in Dentistry	50	50	250
F. Agricultural Education and Research :			
Diploma courses in Agriculture, Dairying, etc.	180	140	900
Degree courses in Agriculture, Agricultural Engineering, etc.	350	900	3,650
M. Sc., Ph.D., D. Sc., etc. in Agricultural Sciences	70	80	450
Post-graduate Diploma courses in Agriculture, Dairying, Veterinary, Forestry and Allied Sciences.	160	170	950
Total number of Post-graduate research workers for whose training facilities are available.	310	On the assumption that all the facilities would be fully utilized and the period of training is three years.	
Agricultural Sciences	170		
Dairying	5		
Veterinary Sciences	10		

CHAPTER IV**Development of Scientific and Technical Manpower Resources—A five-year Education Plan**

1. A comparative study of the requirements for scientific and technical manpower for the next 5-year period and the existing resources as indicated in the previous chapters at once reveals that there is a wide gap between the probable requirements and the anticipated output and that the available sources of this man-power are inadequate to meet our requirements, let alone our having a small potential reserve to draw upon in case of emergency or unforeseen circumstances. Even on stretching the five-year requirements to the next ten years, the gaps still exist. The gaps are both qualitative and quantitative. The shortages and surpluses, if any, are shown in the following statement :

TABLE XII
BALANCE SHEET

Category of personnel	Senior/Executive					Junior					
	No. required during next 5 years (1947-52)	Outturn during next 5 years (1947-52)	Balance (Difference of 1 and 2)	Outturn during next 10 years (1947-57)	Balance (Difference of 1 and 4)	No. required	Outturn during next 5 years (1947-52)	Balance (Difference of 6 and 7)	Outturn during next 10 years (1947-57)	Balance (Difference of 6 and 9)	
	1	2	3	4	5	6	7	8	9	10	
1. Engineers:											
Civil and Structural Engineers	8,170	22,40	5,930	5,240	2,930	}	28,690	8,310	20,380	18,000	10,690
Architects	320	40	280	90	230						
Mechanical Engineering	5,610	1,020	4,590	2,050	3,560						
Electrical Engineers	4,520	1,210	3,310	2,660	1,860						
Chemical Engineers	600	460	140	1,020	+420						
Electrical Communication Engineers	1,060	160	900	410	650						
Aeronautical Engineers	700	80	620	160	540						
Mining Engineers	360	170	190	340	20						
Automobile Engineers	270	..	270	..	270						
General Electrical & Mechanical Engineers	2,840	1,390	1,450	4,410	+1,570						
Unclassified Engineers											
Marine Engineers and Naval Architects.	1,120	..	1,120	..	1,120						
2. Chemists & Chemical Technologists	6,540	2,290	4,250	4,790	1,750	3,990	5,70	3,420	1,140	2,850	
3. Physicists & Applied Physicists	3,290	1,020	2,270	2,050	1,240	..	..	..	..	..
4. Glass & Ceramics Technologists	320	130	190	300	20	330	90	240	190	140	
5. Fuel & Furnace Technologists	310	..	310	..	310	..	..	..	..	..
6. Metallurgists & Metallurgical Engineers.	1,060	290	770	580	480	150	..	150	..	150	
7. Textile Technologists	750	100	650	340	410	940	590	350	1,270	+330	
8. Leather Technologists	350	30	320	110	240	450	130	320	250	200	
9. Mathematicians & Statisticians	1,620	610	1,010	1,210	410	No Junior Personnel.					
10. Geologists & Geophysicists	1,420	190	1,230	410	1,010	100 (Fieldmen)	..	..	..	..
11. Botanists	900	290	610	610	290	No Junior Personnel.					

	1	2	3	4	5	6	7	8	9	10
12. Zoologists	1,430	360	1,070	720	710		No Junior Personnel.			
13. Marine Biologists, Fisheries Experts and other categories of Biologists	690	50	640	100	590	..	90	..	..	..
14. Agricultural Scientists	2,640	4,360	*1,720	8,730	*6,090	610	640	*30	1,290	*680
15. Dairy Scientists and Technologists	700	90	610	180	520	..	260	*260	520	*520
16. Unclassified Scientific and Techni- cal Personnel.	3,820	..	..	..	..	..	..	..	..	..
17. Doctor	15,043	5,940	13,800	11,740	8,000	..	..	..	..	..
18. Non-Medical personnel	32,510	250	(The requirements are for qualified/trained nurses) Balance : 31,900							
19. Science Teachers:										
(a) with post-graduate qualifica- (This item has been included under Chemists, Physicists, Geologists, Botanists, Zoologists and Mathematicians tions in Science. above)										
(b) Graduates . . . . .	..	..	..	..	..	16,220	<i>Nil</i>	(Explained in the report).		
(c) Intermediate in Science . . . . .	..	..	..	..	..	182,300	<i>Nil</i>	(Explained in the report).		
20. Intermediates in Science as technical personnel.	..	..	..	..	..	500	<i>Nil</i>	(Explained in the report).		

*Indicates surplus.

2. It will be seen from this statement that we have to take immediate steps to make good deficiencies in all categories and grades of scientific and technical personnel excepting possibly of Agricultural personnel of the senior or executive type. Our estimated requirement for Agricultural personnel of the senior category is about 2,640 while the facilities available in the existing institutions may make possible the production of about 4,360 graduates and post-graduates in Agriculture and allied Sciences during the next 5 years, leaving thereby a surplus of 1,720. But in reality there would be no surplus at all. For, our estimated requirements are only for Government and Government-sponsored activities in agriculture which are at present mostly confined to advisory functions and to a certain extent to research. The actual field activity in agriculture along modern scientific lines has to be carried out by agriculturists through private enterprise for which we will require a fairly large number of trained personnel. Besides, agriculture in India being in a primitive state of neglect at present, needs to be developed on an extensive scale with the aid of scientifically trained personnel, and this fact has not been fully noted in the Survey Report.

3. In the Table No. XII given above, under the caption 'Scientists and Science Teachers' belonging to the junior or supervisory grade, the number available is stated to be *nil* while the estimated requirements are for 16,220. The minimum educational qualification for this category of personnel being an University Degree in Science (B.Sc.), the statement might create a wrong impression that no graduates in science will be produced during the next 5 years. An explanation is, therefore, necessary. Our universities and other educational institutions are at present producing about 5,890 graduates in science every year and will continue to do so at the present rate unless facilities are expanded. During the next 5 years 29,450 graduates in science are expected to pass out of the institutions. But in our opinion the bulk of them may not be available for effective employment for the purposes for which we have made the assessment. Some will go in for higher scientific and technological education and research and some will by choice or otherwise 'drift' into non-scientific occupations such as secretarial or clerical jobs, which are at present more remunerative than many a scientific or technical job, trade and commerce, etc. and others would be required for positions of a non-technical character for which a degree in science is considered as a minimum qualification much the same way as a degree in arts. The same explanation holds good in the case of 'Teachers with I. Sc. qualifications' as mentioned in the above statement about 182,300 of whom would be required for implementing the compulsory 'Basic Education Plan'. In planning for the development of scientific and technical man-power resources of the country therefore, due consideration should be given to increasing the output of I. Scs and B. Scs to meet all possible requirements. We estimate that the additional requirements for I. Scs during the next 10 years would be of the order of 3,00,000 i.e. about 30,000 per year. Assuming that the present out-turn is about 20,000 per year, the effective out-turn of I. Scs should be more than double itself during the next 10 years. The out-turn of Science graduates also should be nearly double the present figure.

4. Referring to the detailed assessment made in the Basic Report we find that qualitatively the types and categories of scientific and technical personnel required are many and varied—various types of chemical technologists and specialists in chemical manufacturing operations, production engineers, design engineers, power engineers, electrical engineers with special knowledge of electrical knowledge of electrical furnace technology and electro-thermics, fuel and furnace technologists, marine engineers and naval architects, foods and drugs analysts, etc. A considerable number of these specialists would be required during the 5-10 year period as the various lines of activity dependent on them develop. Fermentation industry, especially using by-product molasses as the principal raw material has considerable scope for development in this country

and requires chemists and chemical technologists trained in industrial fermentation. The strict enforcement of Foods and Drugs Act requires chemical and biological assayists to man the regional laboratories, as and when established. Fuel and Furnace Technologists are necessary for the development of chemical, glass and ceramics and fuel industries, while electro-chemists would be required for electro-chemical industries which will develop as the several large multi-purpose and hydro-electric projects are executed. Training in Cellulose technology is important for the development of rayon, paper and other industries, dependant on cellulose. Engineering industries, which are in a backward state would require for development a large number of production engineers. So is the case with ship-building industry, which calls for over 1000 marine engineers and naval architects. one of our institution has facilities for the training of these specialists except perhaps in the chemistry of Foods and Drugs. But whatever facilities are available in this subject are not quite adequate. As regards personnel for research the position is equally bad, if not worse. It is our considered opinion that atleast 1000 research workers well trained in the various branches of science and technology would be required to man the several National Laboratories and other research establishments of industry, Governments, etc. But with the poor encouragement given to research in our institutions it would be well nigh impossible to produce such a large body of trained research workers if the present inadequacies and serious short-coming continue. The position would undoubtedly become desperate if the ever-widening realisation of the importance of scientific research to national development brings in its wake, as it must the need for increased output of research and if we do not have a correspondingly large number of research men to shoulder that responsibility.

5. It is appropriate at this state to analyse in brief the quantitative picture presented in the Balance Sheet so that certain factors might be brought forth to guide us in formulating a forward plan for the development of educational and research facilities in the country. Taking into consideration the *probable* requirements, we observe that there will be a serious shortage of civil and structural, mechanical, electrical and communication engineers and this shortage as of necessity, has to be made up if not during the next 5 years, at least during the subsequent 5-year period. Architects also have to be trained in a large number, more so because, the requirements of Government and Government sponsored departments and the number of architects likely to be required especially for the development of the architectural profession in the country have not been considered. Although the estimates show a deficit of 540 aeronautical engineers we feel that special arrangements on a large scale are not necessary to cover it. The industry is yet to be established in the country, while certain facilities for advanced training in the subject are available at the Indian Institute of Science, Bangalore and the scope of employment of personnel trained at the institution is at present very limited. As regards marine engineers and naval architects we have already referred to the total absence of training facilities in the subject. Here again, although the estimates are for over 1000 marine engineers and naval architects it is in our considered opinion unlikely that such a large number would be required during the next 5-10 years, especially in view of the fact that the ship-building industry might not develop to the same extent as has been envisaged in the Survey Report. But that facilities for training in the subject should be organised in certain selected institutions there is no doubt.

6. As regards chemists and chemical technologists and physicists and applied physicists although the gap between the estimated requirements and anticipated output might not at first sight appear big, it is necessary to make good the deficit by expanding the training facilities available keeping also in mind the special fields in which necessary facilities are either totally absent or are below par. The deficit in the case of metallurgists and metallurgical engineers, mathematicians and statisticians, botanists, zoo-

logists, geologists and biologists has also to be covered in a like manner. It may, however, be mentioned that the estimates for botanists, zoologists, geologists, physicists and to some extent chemists also include the requirements for science teachers with post-graduate science qualifications, which compared to corresponding requirements for non-educational activities are indeed considerable. Unless therefore, the educational development of the country proceeds according to plan, there is every possibility that the requirements for these categories of personnel will be less. In that event the extent of expansion of training facilities that might be necessary will be less and this is a factor of considerable importance to note in drawing up our development plans. In the case of textile technologists it is our considered view that normal expansion of the facilities available in the institutions should be enough to meet the situation and no unusual expansion or establishment of any large institution is necessary. The position regarding Dairy Scientists and Technologists is a little obscure. The estimates for this category of personnel are based on a plan, which was drawn up some time ago for the proper development of dairy industry along right scientific lines. Whether such a large scale development is likely to take place during the next 5 or 10 year period is something about which we are not quite certain. At present training facilities in this branch of technology are available at the Dairy Research Institute up to the post-graduate standard and up to diploma standard at one or two agricultural institutions. We believe that these should be adequate but with a little reorganisation, which eventually aims at having a Dairy College at the Dairy Research Institute.

7. The position about Doctors is we are afraid a difficult one. More than in any other professional course the factors limiting the expansion of training facilities are many and critical, chiefly due to the reason that any expansion in this direction is largely dependent on a corresponding expansion of hospital facilities for the institutions. At present, even though the available hospital facilities are by no means adequate medical colleges have been obliged to increase the intake of students and any further increase can only be at the sacrifice of the standard of training. Even if the hospital facilities were to increase there is a certain optimum number of students which any medical college should normally admit and this optimum number has already been reached in most of the established colleges. Consequently, the only solution is the establishment of new institutions along with hospitals, the latter to serve the dual purpose of development of health services on the one hand, and on the other providing the necessary training facilities for medical students. An immediate means of improving the situation is to upgrade the medical schools into medical colleges. This has already been done in a large number of cases. The rest must soon be brought to follow suit.

8. Anticipating serious manpower shortage we had suggested certain measures in our interim report to be initiated during the first six months, for the immediate improvement of the training facilities available in Universities and Educational and research institutions. We regret to note that our recommendations in this regard have not been given effect to fully. However, we proceed to suggest here certain long-term measures which should form a part of the co-ordinated plan for the development of the country. The first approach to the problem of scientific manpower is to see to what extent the existing resources can be supplemented, re-oriented and developed to meet the scientific and technical man-power requirements discussed in the preceding sections. We have in this connection examined in detail the development and expansion plans of all the educational and research institutions in the country. These plans are described under appropriate sections in the survey report and may be broadly grouped into :--

- 1) Projects envisaging introduction of specialised or post-graduate courses of study, and research in certain branches of science, engineering and technology not catered for now and projects envisaging rationalisation of the existing courses of study and their diversification.

- (2) Projects envisaging development of institutions that are in a formative stage at present
- (3) Projects envisaging expansion of training and research facilities in institutions where these are not of the requisite standard or where there is scope for such expansion.
- (4) Projects envisaging re-organisation of the existing polytechnics or junior technical institutions in order to impart higher instruction or institute graduate course in engineering and technology.
- (5) Projects envisaging increase in the intake of students into various courses in the existing institutions.

The financial implications of the development plans are analysed in Annexure V at the end of this Report.

9. It is not necessary for us to stress the importance of each of the above categories of projects in the context of our present work and especially that of development of our resources to the maximum, both in type and in extent. We should, however, like to point out that the development projects of the institutions cover one or more of the above. (2) and (3) do not ordinarily envisage increase in the intake of students in institutions for regular courses of study of training but as a result of the expanded facilities, a large number of research workers can be trained. We have in the last Chapter referred to inadequate facilities in almost all the institutions in the country and this state of affairs is having an adverse effect on the standard of training imparted in the institutions. We have also stated that unless the existing shortages in the teaching staff, accommodation, and equipment are made good soon, the technical personnel coming out of the institutions will not only be of doubtful quality but our forecast of possible out-turn during the next 5 years might not come true at all; in which case the shortage of scientific and technical manpower will be well in excess of our present estimates.

(1) also does not involve any increase in the intake of students into general engineering courses in the institutions but provides for specialisation. This will be carried out chiefly by giving re-orientation to the existing departments for starting advanced training in various specialised lines of engineering or technology such as hydraulic and irrigation engineering, public health engineering, soil mechanics, power plant engineering, production engineering, etc. or fermentation technology, technology of soaps, oils, and fats, pharmaceuticals and fine chemicals chemistry of foods and drugs, heavy chemicals. (4) and (5) are specially meant for increasing the out-turn of trained students in engineering technology and other courses. The research development plans need more than a passing reference. Except in a small number of institutions, research has not received the attention it merits and even in many first grade science institutions it has been all but neglected. Research development in universities and educational institutions has a double purpose to fulfil. Firstly, those being the real fountain heads of scientific knowledge, have to be continuously encouraged. The other aspect is that it is only through encouragement of scientific research in a general and broad manner that higher scientific education and training of research workers can be promoted. We, therefore, note with satisfaction that almost all the scientific and technical institutions have plans for the development of research in the various branches of science, technology, agriculture and medical sciences. Some of these research development plans, especially those relating to whole-time research organisations sponsored or maintained by Governments are for the normal development of their research activities, in the particular field of science or technology. These, however, envisage increase in the facilities for the training of research workers. The survey report takes all these various aspects into consideration and indicate the increases in the annual out-turn of personnel of various categories consequent on the implementation of the development plans. We observe that the anticipated

increased out-turn in respect of quantity and quality would to a considerable extent relieve the man-power shortage, if carried out in due course. We give in the following statement (Table XIII) a summary of the anticipated yearly increase in the out-turn of personnel as and when the development plans are implemented.

TABLE XIII

Category in personnel	Increase in out-turn year	
	Graduates and Post-graduates	Diploma holders—Junior Engineers
1. Engineers :—		
Civil Engineering	640	} 750
Mechanical Engineering	620	
Electrical Engineering	490	
General Mechanical and Electrical Engineering . . . . .	..
Communication Engineering	20	
Chemical Engineering	210	
Aeronautical Engineering	70	
Mining Engineering	30	
Marine Engineers and Naval Architecture	80	
Specialised branches of Engineering such as Highway Engineering, Automobile Engineering, Metallurgical Engineering, Building Engineering, Military Engineering, Hydraulics and Irrigation, Public Health Engineering, Soil Mechanics, Design and Manufacture of Electrical Machinery, Production Engineering, Power Plant Engineering, Traction Engineering, Fuel and Combustion Engineering etc.	430	
2. Chemists and Chemical Technologists	460	80
3. Glass and Ceramics Technologists	50	20
4. Textile Technologists	170	100
5. Leather Technologists	20	20
6. Metallurgists	20	..
7. Geologists	90	..
8. Physicists and Applied Physicists	250	..
9. Mathematicians and Statisticians	180	..
10. Botanists	150	..
11. Zoologists	160	..
12. Marine Biologists and other categories of Biologists	40	..
13. Dairy Scientists and Technologists . . . . .	..	70
14. Agricultural Scientists	290	50 (post-graduate Diploma-holders)
15. Doctors	960	

Research Training Facilities	Additional No. of students catered for	Possible rate of out-turn of trained research workers.
<i>Field of Research—</i>		
Physics	170	60
Chemistry	230	70
Mathematics and Statistics	30	10
Botany	50	20
Zoology	30	10
Biology including physiology	30	10
Geology	30	10
Agricultural Science	160	60
Medical Sciences	No estimates available.	
Engineering and Technology	No estimates available.	

10. A comparative study Tables XII and XIII reveals that on implementation of the development plans of all the institutions concerned the out-turn of scientific and technical personnel would increase and the requirements for the total man-power could be met to a considerable extent. Assuming that the plans take about 5 years for full implementation and the increase in the out-turn is obtained at the end of this period the requirements for civil engineers, mechanical engineers, electrical engineers, chemical engineers, mining engineers, chemists and chemical technologists, physicists, and applied physicists, glass and ceramic technologists, textile technologists, leather technologists, mathematicians and statisticians, botanists and dairy technologists all of the senior or executive type could be met in full. In the case of some of these categories of personnel there would indeed be a small surplus which might be taken to cover any possible additional requirements. The out-turn of trained research workers will also increase giving thereby a much needed fillip. The categories in which we still see gaps are electrical communication engineers, aeronautical engineers automobile engineers, general mechanical and electrical engineers, architects, fuel and furnace technologists, metallurgists and metallurgical engineers, marine engineers and naval architects, geologists and geophysicists, zoologists, biologists and doctors. It should be possible to fill some of those gaps, especially in the case of engineers and technologists by establishing two more Higher Technical Institutions one in the Southern Zone and the other in the Northern Zone, on the lines of the Eastern and Western Higher Technical Institutions described in the Survey Report. For the training, however, of marine engineers in production engineering, design engineering etc. fuel and furnace technologists, specialist chemical technologists there are no facilities available in the country nor has the creation such facilities been envisaged in the development plans, not at least to the extent required. Consequently, special measures would be required to make up the shortages. As regards aeronautical engineers, however, it may not be necessary to plan, at least not until the industry has reached a definite stage of development for any considerable expansion of training facilities for reasons already mentioned in para 5 above. The deficits in the case of geologists, zoologists will have to be made good by creating additional facilities for training in the subjects either at the existing institutions or at new ones according to needs.

The gaps are largest in the case of doctors and junior engineers of the supervisory category. The requirements for doctors as assessed for the *next 5 years* is far in excess of the number of medical graduates likely to be produced during the *next 10 years* with the facilities now available plus those resulting from the various development projects; and the former is certain to increase further, unless the progress of health development schemes slows down due to financial and other reasons, which, however, should not be the case considering that the problem of health is in its importance next only to food. No doubt the various plans described in the Survey Report for the development of facilities for training and research in medical sciences envisage an increase of 960 medical graduates every year. But a considerable deficit still remains which would in all probability increase as the demand for doctors increases. We have in para 7 referred to the several factors limiting any further expansion of the training facilities available at the existing medical colleges and the only means of increasing the out-turn of doctors is to establish new institutions along with new hospitals.

12. As regards the large deficit in the case of junior engineers the situation might be met in two different ways. Obviously the first of these is to establish a number of new institutions-polytechnics for the training of engineers and technologists up to the Diploma Standard. The other is to re-orient the present system of technical education in such a way that the 'Supervisory' category of technical personnel is produced by Industry in conjunction with technical institutions. The latter has much to commend especially

since the supervisory category of technical personnel employed in Industry are essentially required to be practically trained men with a certain amount of academic background, which can be imparted to them at technical institutions on part-time basis, while they are being trained as apprentices in Industry. It is not necessary that they should possess on the academic side, the same high standard of training as the present day diploma holders. The usefulness of the Diploma courses in engineering is greatly limited in that the personnel, who have undergone such courses are neither full-fledged engineers of the executive type nor fully trained technicians of the 'Supervisor' or 'Foreman' type. They are a sort of hybrid and industries have to train them all over again for employment as foremen.

13. On the basis of the foregoing considerations we recommend that a 5-year plan for the development of educational and research training facilities in the country be worked out having the following main features :-

- (a) Establishment of four Higher Technical Institutions as recommended by the All-India Council for Technical Education for advanced and post-graduate technical training.
- (b) Implementation of the various development plans of the institutions described in the Survey Report which envisage--
 - (i) introduction of specialised or post-graduate courses of study and research in certain branches of science and technology not catered for now,
 - (ii) rationalisation of the existing courses of study and their diversification,
 - (iii) full development of the institutions which are in a formative stage at present,
 - (iv) expansion of training and research facilities in the institutions where these are not of the requisite standard or where there is scope for such expansion,
 - (v) re-organisation of some of the existing polytechnics or ~~technical~~ ^{Junior} technical institutions in order to impart in them higher instruction,
 - (vi) increasing the intake of students into various courses in some of the existing institutions.
- (c) Creation of facilities for training in production engineering, design engineering, fuel and furnace technology and other special fields at certain selected institutions on a regional basis.
- (d) Establishment of a College of Marine Engineering and Naval Architecture or creation of facilities for training in the subject at one or two selected institutions.
- (e) Establishment of new medical colleges for increasing the out-turn of doctors.
- (f) Opening of Post-graduate Science Departments in such of the Universities as do not have them at present and strengthening of the existing ones in order to increase the out-turn of scientists of all categories to the desired extent.
- (g) Training of supervisory category of technical personnel in conjunction with industry.

CHAPTER V

Industrial Training of Engineers and Technologists

1. In the preceding paragraphs we have been concerned mainly with suggesting measures for the expansion of educational facilities to meet the requirements for scientific and technical man-power. We feel that this report would be incomplete unless we also deal with the question of industrial training of the large number of scientific and technical men who would be passing out of our educational institutions and require "conditioning" for their gainful employment in industry and in other similar scientific and technical activities.

2. We have in our interim report suggested certain interim measures for the expansion of facilities for industrial training of the scientific and technical personnel. In this report we now make certain specific recommendations which can be implemented immediately and suggest certain measures which should go a long way in solving this difficult problem.

3. A glance at the estimates of requirements for scientific and technical personnel will at once reveal how diverse are the types required. While educational institutions could in due course be expected to be able to impart the required basic education, the practical training of the men must necessarily rest with the employers (industry or Government departments). Employers, whether Government or Industry, naturally prefer to employ men who have already had the necessary practical training elsewhere, and frequently demand that the products from the educational institution should emerge with adequate practical outlook and experience. The men with the requisite theoretical and practical training can only be turned out by the joint effort of educational institutions and industry. Unfortunately this joint responsibility is recognised only by a few of our progressive industrialists.

4. We reproduce below from the survey reports a statement showing the practical training facilities that it may be possible to arrange now in the various industrial concerns and Government and Government-sponsored Departments. As regards facilities in the latter, it has to be noted that the Survey Report gives an estimate of the training facilities likely to be available after the implementation of the development plans while our estimates shown below relate to facilities that may be made readily available now :

TABLE XIV

Industry	No. of concerns	No. of persons who can be trained at any one time
<i>Industrial Concerns</i>		
1. Chemical Industries—		
Heavy Chemicals	19	149 (including Sindhri Fertiliser Factory).
Pharmaceuticals and Drugs	19	40
Soaps, Oils and Fats	15	100
Paints and Varnishes	19	52
2. Sugar and Fermentations	50	300
3. Paper and Boards	10	128
4. Cement	11	96

Industry	No. of concerns	No. of persons who can be trained at any one time
5. Metallurgy —		
Ferrous	5	108
Non-ferrous	9	22
6. Mining	6	50
7. Fuel, Carbonisation and Tar Distillation	Not known	15
8. Textiles	30 groups of mills	240
9. Glass	8	32
10. Ceramics and Refractories	9	40
11. Leather	40	300 (The standard of training facilities available in most of the concerns is very poor.)
12. Engineering	30	120
	240*	1192*

(*Excluding leather.)

Department	Field of Training	No. of persons who could be trained every year
<i>Government and Government sponsored Departments</i>		
Posts and Telegraphs	Tele-communication Engg.	20
Directorate General of Observatories	Meteorology and weather forecasting	25
Director General of Civil Aviation	Aeronautical Engineering, Tele-communication Engineering, Air Navigation, Radio and Radar technique.	25
Railways	General, mechanical, electrical and civil engineering with special reference to railway communications, testing and standardisation of scientific stores.	100 in workshops and other works, 20 in Laboratories.
All India Radio	Radios and Tele-communication engineering.	50
Public Works Departments	All aspects of civil engineering, and with particular reference to design and construction of dams, bridges, buildings and irrigational projects, municipal engineering, soil mechanics etc.	200
Central Waterpower, Irrigation and Navigation Commission.	Hydrology and hydraulic research, design and construction of dams.	15
Electricity Departments.	Electrical generation, transmission and distribution.	65
Government Test House	Testing, standardisation and certification	15
Coal Commissioner's Department	Mining	2
Mathematical Instruments Office	Instrument technology with special reference to optical instruments.	5
Control Laboratories of Central Board of Revenue.	Chemical Assaying	2
Botanical Survey of India	Systematic botany and museum work	6
Zoological Survey of India	Animal Zoology	5
Defence Establishments	General mechanical engineering and Production engineering.	50
	Testing and standardisation of general stores.	15
	Testing and standardisation of ordnance stores.	4
Metallurgical Inspectorate	Metallurgical Testing and Research	5
Ordnance Factories . . . . .	.....	200

5. From the above statement it will be observed that about 240 industrial concerns can, among themselves, train about 1,200 scientists, engineers and technologists of the senior or executive category; and 18 Government and Government-sponsored organisations can train about 800 of these at a time. Except in a few cases, the available training facilities, we believe, have not been mobilised fully owing chiefly, we understand, to the rather luke warm attitude of industry and various Government Departments 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 candidates seeking necessary practical or industrial training to equip themselves for useful employment. Considering the vast number of technically trained personnel that would be required for the various development projects during the next few years, one cannot be satisfied with the present position. Urgent and far-reaching measures should be adopted to make available the existing facilities for practical training to as many qualified students as possible. We sincerely hope that Industry and other organisations engaged in scientific and technical activities will come to appreciate that it would be in their own interests to take a more liberal view in the matter. There has lately been an encouraging change in outlook and a large number of concerns and Government Departments have agreed to provide training facilities to the maximum extent and to co-operate with a central authority in carrying out any industrial training programme that may be organised. Even so, it may be necessary for Government to introduce legislative measures so that it becomes incumbent on every established industrial concern to provide training facilities for qualified candidates in all the grades, notwithstanding whether the persons thus trained will be required by the concern or not. The large number of Government and Government-sponsored Departments should provide practical training facilities no less than industrial concerns. It is also necessary that in every contract entered into by the Government and other establishments 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. We have referred to these measures in detail in our interim report.

6. From a comparative study of the statement on the readily available training facilities and our estimate of requirements for trained personnel, we observe that, while these two factors are fairly well-balanced for certain development projects, there are wide gaps in others. The gaps are both qualitative and quantitative in as much as, on the one hand, no facilities are at present available for the training of certain types of personnel due to lack of development of the relevant branches of Industry, and on the other, although some training facilities are available they are not adequate to cover all our requirements. Instances of the former are lack of facilities for the training of personnel for the manufacture of electro-chemicals, synthetic and chemotherapeutic products, antibiotics, rayon, plastics, etc., and various lines of engineering industry. This situation is characteristic of all countries which face the problem of large scale industrial development after remaining comparatively inactive for a long time, and there is no ready-made measure for remedying it. We have mainly to depend on progressive development of industry which would result in a corresponding increase in the training facilities. It would also be necessary to send some of our scientists and technicians abroad to acquire first hand knowledge of the working of some of the industries. We shall refer to this aspect of the question elsewhere in the report.

7. As a general measure we recommend the following :—

(i) The technical departments of Governments should organise, in their establishments, facilities for the industrial training of—

(a) the artisan type of personnel,

- (b) the supervisory or foreman type of personnel, and
 (c) the executive type of personnel,

and the expenses for the organisation and careful supervision of training facilities for all the above three types should be borne by Government. Even though the expenditure may at first sight appear to be unproductive it is not really so in the long run.

(ii) All factories or industrial establishments both private and state owned, should include schemes of practical training and expenditure on this account should be regarded as legitimate expenditure of the establishment. For effective implementation of the recommendations made, Government should, following the French system, impose a certain levy on every industrial concern—say about 3% of the total wages paid by the concern, and the proceeds of such levy supplemented by Government subvention of an equal amount should be utilised for organising practical training of various grades and categories of personnel in industrial concerns under Government's supervision.

We have no suitable basis at this stage to estimate the total amount likely to be available for Industrial Training consequent on the above measure being given effect to. However, it will be considerable and will progressively increase as the industrial development of the country proceeds and should be adequate for the industrial training of all categories of personnel—Executive, Supervisory and Artisan.

(iii) In all the three above types of establishments, trainees should be paid wages or stipends, the value of which in the case of scientifically or technically trained men should be adequate to meet the trainees' expenses on board and lodging.

(iv) Industry and Government Departments should recruit fresh graduates as officer trainees and put them through an organised training programme with a view to their ultimate employment as executive officers.

8. Our requirements for technically trained personnel of the senior type for the next five—ten year period being over 40,000 for industrial development and Government and Government-sponsored activities, every effort should be made to mobilise fully all available training facilities now as well as in the years to come, and to utilise them in a planned and co-ordinated manner. Towards this end, a definite programme of Industrial Training extending over the next five—ten years should be drawn up for the training of a certain number of graduates every year on a stipendiary basis in industrial concerns and Government and Government-sponsored Departments. The scheme should work in a progressive manner starting with the training of such persons for whom the necessary facilities may now be available in industrial concerns and Government Departments as stated in para. 4 above, and increasing the number of trainees as the training facilities increase. The number and distribution of trainees among the branches should be correlated to the requirements for personnel of all grades as assessed by us. The Government should also institute Industrial Training Stipends, each of the value of Rs. 200 per month for this training programme and the number of stipends should be half that of candidates undergoing training i.e., about 20,000.

9. In view of the unavailability of facilities for both theoretical and practical training of personnel required for rayon and cellulose industries, special arrangements should be made for such training in certain selected institutions or in the Co-operative Research Laboratory that might be established for this group of industries.

FOOT NOTE.—Mr. Ram Ratan Gupta does not support the proposed compulsory levy on Industry for training purposes.

CHAPTER VI

Overseas Training

1. Before we deal with the question of training of Indian personnel abroad, we consider it necessary to give here a brief review of what has already been done in this matter. The Government of India sponsored about three years ago an Overseas Training Scheme and about 720 Indian students have so far been selected and sent abroad for "advanced training and research" in the various branches of science and technology, primarily with a view to providing the necessary talent for the various development projects under contemplation. We are not aware to what extent these objectives have been realised. However, the scheme was initiated at a time when the universities and technical institutions abroad lacked accommodation and facilities even for their own nationals. In spite of this, the Government secured with great difficulty certain number of seats in foreign institutions, but it is now understood that great difficulties are being experienced regarding the arrangement of practical training for these students. Some of them are now returning after acquiring whatever training they could obtain under the prevailing circumstances and the problem of usefully employing them is engaging the attention of the Government. But we regret to observe here that generally the Government's scheme of overseas training has left much to be desired both in its conception and execution. Recently, the Government also appointed a Committee under the Chairmanship of Dr. B. C. Roy to review the scheme of Overseas Training as being worked out at present, and advise them on the future course of action. In its interim recommendations the Committee has stated that it would be desirable to expand the scope of the Overseas Scholarship Scheme so as to meet the needs of educational institutions and industry in addition to those of Government Departments, for scientific personnel with higher training and also to include a few other important subjects, *e.g.*—Humanities, for which scholars may be sent overseas for higher training. The number of scholars to be trained abroad would consequently become larger if that Committee's suggestions are accepted by Government. In view of the limited accommodation available in foreign institutions as well as the limited financial resources of the country, Roy Committee has suggested that a list of priorities be drawn up both in the subjects of study or training and the number of scholars to be sent abroad. Further, the Committee has expressed the view that fresh graduates from Indian Universities or technical institutions should work in India for at least one or two years before they are selected for training abroad. For this purpose, the Committee has also recommended that a Scheme of Auxiliary Scholarships tenable in India be instituted. This is the background against which we now have to consider the question of Overseas Training. It is our considered opinion, and this opinion is also shared by the leading industrialists of the country, educationists and other persons who count, that—

- (1) Indian Scientific and Technical personnel need to be trained abroad with a different emphasis on the scholar's educational and training programme so as to meet the immediate needs of the country for specialists.
- (2) In the context of the requirements of the country, necessity exists for training our men overseas to fulfil three distinct but specific needs, namely, (a) training of personnel for industrial development, (b) training of personnel for scientific and industrial research and education, and (c) training of personnel to meet certain specific requirements of Government and Government-sponsored Departments.

- (3) Personnel whom it is required to train abroad for industrial development should be selected from amongst those who have had a certain amount of industrial experience in the particular industry concerned and also have the necessary academic qualifications. They should preferably be selected from amongst those employed in industry and sent abroad to undergo training for specific periods in appropriate industrial concerns. Trainees should be sent abroad to specialise in particular in those industries in which training facilities in India are inadequate and the development of which are in the national interest. It may not be necessary for such men to receive any academic training in institutions abroad. What is most important in this connection is that our technical men should study the modern methods of production, pick up the 'know how' of new developments in particular branches of industries, etc. In organising this training, teams of different categories of personnel rather than individuals should be sent abroad especially for such industries which for development depend on the co-operative or joint effort of engineers, chemists and other categories of personnel.
- (4) As regards the training of personnel for research and educational purposes, the obvious course is to select men from university research centres and other research organisations of the country and send them to work in laboratories abroad for short periods to study the trends of modern research, their developments and technique and to establish contact with research workers elsewhere in the world. The period of their study abroad should not ordinarily exceed one year since these scholars are not expected to work for post-graduate degrees of foreign universities. They are expected to be fully trained and equipped in this country as far as our facilities permit. In order that these objectives might be realised, the method of organising the training should also be different from what has been followed in the past in that definite quotas of scholarships should be allocated to each university or institution based on the scope of educational or research activity of the institution concerned, its development plans and other like considerations. At the same time a central pool of Overseas Scholarships should be created out of which deserving candidates selected from all the institutions may be sponsored for Overseas Training. As a sequel the method of selecting candidates for the training should also be different. The institutions concerned should select candidates from amongst their staff or whole time research workers according to rules framed by the Government; and the selections thus made should be subject to the approval of an overall Selection Board set up by the Government. This method will give a certain amount of freedom to the authorities of the institutions to select suitable candidates, who in their opinion will help to develop them and is the only realistic approach. The chief object of overseas training with reference to higher education and research is to give university teachers and others engaged in them an opportunity to learn latest teaching methods or research techniques as followed in more advanced countries and to equip themselves to develop their own institutions in this country. For the general improvement in the standard of teaching, it may also be desirable generally to send abroad a team of workers rather than individuals to study modern developments in teaching methods and research technique in selected subjects.

- (5) No out and dried suggestions are necessary in regard to overseas training to meet the needs of Government Departments. Generally, members of the staff of technical departments should get an opportunity to visit corresponding departments or institutions abroad to acquaint themselves with the latest developments in their own fields. This is not, in a strict sense, any kind of training but is in the nature of short-term visits of technical personnel in Government service to foreign countries. This is also different from the Study Leave Scheme already provided for in Government Departments.
- (6) Persons who have been technically or industrially trained abroad should not only be utilized for the industrial development of the country but also for the training of additional technical personnel in the country itself, thereby reducing the number of people who would otherwise have to be sent abroad for training.
- (7) Sending of fresh graduates to foreign universities for another course of academic training in the hope that such persons will, on their return, be useful in the industrial development of the country should be discouraged.

2. We have given in Appendix VI a list of subjects in which Indian technical personnel should be trained abroad. We have also shown in it the number of candidates who should be thus trained for each of the three purposes, (a) Industrial development, (b) Government and Government-sponsored activities, and (c) Higher scientific education and research. As regards the last we have made an attempt to allocate quotas to institutions in each zone on the basis of the scope of educational and research activity in each institution. To summarise our requirements in the matter of overseas training are:—

TABLE XV

Objective	No. of persons to be trained during the next 5 years
(a) Industrial Development.	460
(b) Govt. and Government sponsored activities.	603
(c) Higher Education and Research.	909

3. It is obvious that the training of such a large body of scientific and technical personnel abroad as shown in the statement would involve large national expenditure, even if the training were to be organised for the next 10 years. There is also, as has been noted, the present difficulty of obtaining suitable training facilities in industrial concerns, universities and other institutions abroad. Both these factors put a limit to the number of men who can be sent for foreign training in the near future. Consequently, other means of providing the necessary training facilities especially to personnel required for industrial development have to be explored. We have been informed that the Ministry of Industry and Supply, in consultation with industries have drawn up a list of foreign technical experts whom it might be desirable to bring into this country for the development of various industries. If three or four understudies are attached to each of these foreign experts, it may be possible to train a certain number of our technical personnel in this country itself. We commend that the possibilities in this respect be examined.

CHAPTER VII

Equal Opportunities, Free Places, Science Talent Search,
Shortage of Teachers etc.

1. In this chapter we shall deal with certain general questions of importance, to the progress of scientific and technical education in the country.

2. We feel that special measures should be adopted for attracting talented students to pursue higher scientific and technical education. Scholarships and Free Places, which represent the most practical steps to enable poor but talented students to obtain higher education are limited, while the cost of technical education compared with the *per capita* income of the people is high. Generally, only a small section of the people, who can afford the high cost of such education join the Universities and technical institutions, and that section does not necessarily represent the best talent. The best way of improving the situation is to create Free Places and Scholarships for about 50% of the annual admissions to our educational institutions and award them on merit alone. While amounting to a great measure of social justice this would enable really talented students to obtain higher education and thereby help to build up the scientific man-power resources of the country.

3. It will be observed from the survey data relating to educational facilities presented in the Basic Report and reviewed in Chapter III of this report that the actual admissions to various definite courses of study and training during 1947-48 and the provision that exists for research training are as follows:—

<i>Courses of Study</i>	<i>Admissions in 1947-48</i>
A. Engineering & Technology—	
Degree and Post-graduate courses	2944
Diploma courses	3658
B. Pure Sciences—	
Post-graduate courses—M.Sc., etc.	700
C. Agricultural Sciences—	
Degree & Post-graduate courses	1245
Other courses, mostly Diploma courses	140
D. Medical Sciences—	
Degree & Post-graduate courses	2152
Diploma courses only in Dentistry	50
<i>Research Training—</i>	
Pure & Applied Sciences	630
Agricultural Sciences	183
Engineering & Technology	Actual figures are not available, may be assumed to be about 100
Medical Sciences	Actual figures are not available, may be assumed to be about 50

The tuition fee varies from institution to institution for the same courses. In addition, students have to pay various other seasonal fees, such as, library fee, sports fee, examination fee, etc. There is also a trend to increase the fees in most institutions. Considering all these factors we might take the maximum fees per student per year to be about Rupees four hundred for degree and post-graduate courses in Engineering and Technology, Agriculture and Medical Sciences; and about Rupees two hundred for the diploma courses. For Pure Sciences

the fees are about Rupees three hundred, and for research training about the same amount. Scholarships amounting to 50% of the total number of Free Places should be instituted. The value of each scholarship should be about Rupees one thousand per year for degree and post-graduate courses and about Rupees five hundred for diploma courses. The value of research training scholarships, however, should be about Rupees eighteen hundred per year. On this basis the number of Free Places that should be instituted and the expenditure involved are as shown below. In estimating the expenditure we have taken into consideration the duration of the various courses—4 years for degree courses in engineering, technology and agriculture, 3 years for diploma courses in the same subjects, 2 years for M.Sc. course in pure sciences, 5 years for degree courses in medicine and surgery and 3 years for research training. On this basis, column 4 of the following statement indicates the maximum annual expenditure.

Courses	Number of Free Places	Number of Scholarships	Annual expenditure (Rs. lakhs)
<i>A. Engineering and Technology—</i>			
Degree and Post-graduate courses.	1470	740	53.0
Diploma courses.	1830	920	25.0
<i>B. Pure Sciences—</i>			
Post-graduate courses—M. Sc., etc.	350	180	6.0
<i>C. Agricultural Sciences—</i>			
Degree and Post-graduate courses.	620	310	22.5
Other courses, mostly diploma courses.	70	40	6.0
<i>D. Medical Sciences—</i>			
Degree and Post-graduate courses.	1080	510	48.5
Diploma courses only Dentistry.	40	20	6.0
<i>Research Training—</i>			
Pure and Applied Sciences.	320	320	30.5
Agricultural Sciences.	90	90	
Engineering and Technology.	50	50	
Medical Sciences.	30	30	
Total	5950	3240	197.5

Similar provision perhaps on a somewhat reduced scale should be made in the I.Sc. and B.Sc. stages also.

4. Now that the importance of scientific research to national progress is being increasingly realised and that a chain of National Laboratories is in the course of establishment it is only right that special efforts should be made to search for scientific talent suited to take to research. In America, National Science Talent Search Competition among young men and women from High Schools and Colleges has proved its value. We strongly feel that some such method of locating and encouraging scientific talent should also be employed in this country.

Shortage of Teachers.

5. Of all the handicaps from which our educational institutions are at present suffering the shortage of teachers is perhaps the worst. We have referred to it in brief in our Interim Report and in the survey report we have described how this is adversely affecting the standard of training in the institutions. The inadequacy of teachers' salaries is the

root cause of this deficiency. Even in first grade institutions the salaries of teachers are deplorably low. The salary of a Demonstrator or Tutor averages about Rs. 75 to 100 per month and that of a Lecturer about Rs. 100 to 150 and that of a Professor about Rs. 500 in Universities and about Rs. 300 to 400 in the colleges. In contrast, clerical and administrative jobs in Government Departments are very much better paid. So also are scientific and technical jobs in Industry and Government Departments. The result has been that there is a steady 'drift' of teachers from Universities and other educational institutions into scientific and technical jobs in Industry and Government Departments, whenever available and when these are not available, into clerical and technical jobs and educational institutions are finding it increasingly difficult to attract suitably qualified persons for teaching posts. Unless the situation is tackled immediately with a sense of urgency, there is no likelihood of any of our long-term development plans materialising. The problem is capable of solution only on an economic plane since economic factors are at the root of it.

We suggest after mature consideration that the salary scales of teachers of various categories should be as shown below :—

(a) *University Institutions, Professional Institutions and other Post-graduate Institutions—*

Professors (Senior)	Rs. 1,500 to 2,000
Professors (Junior)	Rs. 1,000 to 1,500
Readers, Assistant Professors and Senior Lecturers.	Rs. 750 to 1,200
Junior Lecturers, Demonstrators, etc.	Rs. 250 to 600

(b) *Science Colleges (under-graduate standard)—*

Professors	Rs. 600 to 1,200
Assistant Professors	Rs. 350 to 850
Lecturers, Demonstrators, etc.	Rs. 250 to 500

6. We reiterate here our previous recommendation in our Interim Report that engineers in government service should be encouraged wherever necessary to assist in instruction in engineering colleges. While this recommendation would, no doubt, relieve the shortage of teachers in our technical institutions, it has another commendable significance in that, it would enable the institutions to improve the standard of training, especially from the practical point of view.

7. During the factual survey, the desirability of associating wherever possible senior technical executives of industrial concerns with the training of students in technical institutions was discussed with prominent industrialists. A majority of the industrialists welcomed the proposal and assured that the services of their technical personnel would be made available for training purposes in institutions located close to the industrial establishments. We, therefore, recommend that suitable arrangements be worked out whereby the services of the senior officers of engineering departments of Governments and the technical executives of industrial concerns might be utilised for the training of students in engineering and technological institutions located close to their headquarters. This arrangement will besides improving the standard of training relieve to a considerable extent, the acute shortage of trained teachers in institutions which is a factor of great importance in the present set up.

8. We cannot conclude this chapter without referring to the method of admission of students to educational institutions. We understand that in certain University and Government Institutions admissions are still being made on communal and caste considerations. We also understand that communal influences play a considerable role even in such an important matter as the appointment of teachers. We need not stress here how irrational and dangerous communal policies are, especially in educational matters. Denial of opportunities for higher education to any particular section of the people for reasons of caste, creed or community represents, to say the least, a most reactionary step and the pursuit of such a policy is bound to have far-reaching repercussions on the quality of scientific man-power as well as on the calibre of post-graduate research in Universities. Incidentally, it also represents a most flagrant violation of the secular policy of the State. It might be argued in defence of the communal basis of admission to educational institutions that the backward communities should be given an opportunity to raise themselves to the same level as the more advanced ones but the remedy is not to shut out from the colleges the youth of educationally more advanced ones but to enable the poor but intelligent student to whichever community he may belong to obtain higher education as of right. It is therefore most important for the progress of education and research in this country completely to jettison the irrational restrictions and prohibitions which have been erected in certain places to defeat the wholesome principle that admission to collegiate institutions should be by merit alone. We strongly urge that Government take immediate steps to investigate the conditions obtaining in educational institutions in the country with particular reference to the principle of admission of students, appointment of teachers etc., and adopt suitable measures to discourage the institutions from following a policy which is likely to militate not only against the efficiency of scientific man-power—consideration with which this Committee is vitally concerned—but also clearly defies a fundamental right envisaged in the constitution of the country.

CHAPTER VIII

Unemployment, Drift and Leakage of Talent, National Register of Scientific & Technical Personnel.

1. We feel that our report would be incomplete if we did not refer to wastage of scientific and technical talent. Considered as a wealth of a country, scientific and technical talent has much in common with other material resources—mineral, agricultural etc. in as much as prevention of wastage and profitable utilization characterise any plan of national development dependent on these resources.

2. In the context of scientific and technical man-power, wastage of talent assumes several forms. Of these the worst and at the same time the simplest is unemployment which is chiefly caused by over production and lack of suitable openings. Drift and Leakage of talent which represent the other forms are more complex in that their causes are subtle, various and sometimes ill-defined. Though in net effect they constitute wastage of talent, drift and leakage are not identical. To explain the terms as we understand them, drift means migration of talent from scientific to non-scientific activities, as it happens when a scientist takes a non-scientific job, or an engineer is put on a job which had better be carried by one who is not an engineer. Leakage of talent occurs when a scientist or a technologist, who has specialised in any particular branch or possesses expert knowledge of some aspect of science or technology does not find opportunities to use such knowledge, which in consequence becomes a waste. He might continue to do work of a scientific or technical nature, but still represents 'Leakage' if any of his special abilities, for the acquisition of which he has devoted time, labour and money is not properly utilised. Instances are a research chemist, who is obliged to do routine analytical or chemical inspection work in factory without opportunities to use his research talents, or an engineer, who has specialised in Designing finds himself only in the position of a supervisor in charge of production or construction work.

3. Various factors—economic, geographical, and personal are responsible for Drift and Leakage and in every progressive country of the world there is always a certain amount of wastage of talent, which in the very nature of things is unavoidable. But it is the essence of human planning that such wastage is brought down to an irreducible minimum. No country faces a more desperate situation than when a large body of the educated people are unemployed or unsuitably employed.

4. So far no reliable data have been collected regarding the extent of wastage of scientific and technical talent in India and we therefore considered it necessary to ascertain the true state of affairs. A 'Questionnaire for Individuals' (as reproduced in Appendix X) was circulated along with the questionnaires relating to Government and Government-sponsored Departments, Industries and Educational Institutions. So far (i.e. upto 24-7-48) we have registered over 8,000 such completed questionnaires and more are awaiting registration. An analysis of the information thus collected is given below :—

	Unemployed	No. employed in non-scientific occupation	Total registration
1. B.Sc. (Pure Sciences)	24	148	1904
2. B.Sc. (Applied Sciences)—			
Agriculture	2	2	271
Chemical Technologists	1	1	22
Geologists . . . . .	..	..	116
Mining	1	..	58
Metallurgy	2	1	97

	Unemployed	No. employed in non-scientific occupation	Total registration
3. M.Sc. or Higher Qualifications:			
Agriculture . . . . .	..	..	42
Chemistry	2	5	595
Mathematics	2	16	163
Physics	4	4	248
Botany	3	4	209
Zoologists	2	..	187
Chemical Technologists . . . . .	..	..	5
Geography & Geophysics . . . . .	..	..	13
4. Medical Licentlates	2	..	54
5. Medical Graduates or Higher qualifications	9	..	533
6. Engineers-graduates or Higher qualifications	88	..	2361
7. Engineers-Diploma Holders	48	..	1254
Total	190	181	8117

5. Although the above analysis relates to only about 8000 persons, we may take it as a cross-section of the entire scientific and technical capital of the country and representing as nearly as possible the correct state of affairs. We find from it that the wastage of talent is about 4% made up of 'unemployment' & 'Drift' approximately in equal proportions. It may be that when the state of employment of all the scientific and technical personnel in the country is correctly known the wastage figure might be a little more, but in any case we do not expect it to be much over 10%.

6. An overall wastage of 10% does not seem to us high, especially in a country like India where due to lack of industrial development suitable openings for scientists and technologists are somewhat limited. However, it is comparatively high in the case of those who have B.Sc. as the maximum qualification. We discussed this question with a number of distinguished educationists, and they were of the opinion that the drift at the B.Sc. stage is usually very high rising to as much as 50% in some cases. This is not surprising since the B.Sc. degree in most cases is a qualifying degree preparatory to higher scientific or technical studies and the facilities for such studies are limited. We need not, however, feel undue anxiety on that score since science graduates also should be employed in non-scientific occupations where they will try to bring to bear their scientific outlook on methods on general problems. We are of the opinion that much benefit would accrue from a wider diffusion of scientific knowledge through all spheres of activity, provided sufficient number of technical men can be spared. The drift amongst personnel above B.Sc. stage is small and is largely due to general unsatisfactory conditions of work in teaching and scientific occupations and the generally lower salaries and fewer privileges offered in technical posts as compared to administrative posts.

7. In our analysis of the state of employment, we have not indicated the leakage of talent—that is to say the number of scientists and technologists, whose special qualifications and attainments are not being fully utilised in their present employment. This is so not because there is no leakage but we have not had any suitable basis on which to assess the leakage; and we could not take the views expressed by

individuals regarding their special qualifications and how little such qualifications are being utilised for absolute truth. But that there is considerable leakage of talent, there is no doubt and we know from our own experience that there is a large number of scientists and technologists, who given better opportunities and encouragement are capable of making a large contribution to the development of the country in their respective fields. To examine individual cases and suggest remedies is a formidable task and we can only suggest general measures, designed to improve the present situation and these we outline in the following para.

8. The cost of training in scientific and technical subject is comparatively high and if a person thus trained leaves the scientific work for administrative or non-scientific profession for monetary gain or position, the money and effort spent on his training are generally a loss, except is so far as such persons may find themselves in a position where they can bring to bear on administrative problems their scientific outlook. Keeping in view the shortage of scientific and technical personnel in the country, we feel that it will be in the national interest if this drift is minimised as far as possible. It is therefore necessary that the main causes leading to this drift, viz., inadequate salary, inferior status and disparity of privilege between technical and administrative personnel should be eliminated. Towards this end and particularly to minimise leakage of talent we also recommend the creation of a Central Scientific & Technical Service on the lines of the Indian Administrative and other All-India Services.

9. Compilation of a National Register of Scientific and Technical personnel of India is one of our Terms of Reference and is very important in the context of prevention of wastage of talent. Every progressive country of the world has not only compiled a National Register of its scientists, technologists, doctors, etc., but is maintaining the register up-to-date. In these countries, special machinery has been set up on a permanent basis for the purpose and the work is being carried out in a systematic and co-ordinated manner. The register serves the dual purpose of a directory of the scientific and technical capital of the country and provides the necessary basis for determining how best to utilise the talent both in times of peace and war. No effort has so far been made in this country to compile a corresponding National Register in a systematic manner. Although every province and Indian State has compiled a register of qualified medical personnel under the Indian Medical Registration Act, such registers are neither up-to-date nor do they fulfil the objectives of a National Register. We consider that compilation of a register of all the scientists, engineers, technologists, doctors and other categories of scientific and technical personnel available in India should be vigorously pursued and the register should contain full information regarding an individual's qualifications, experience, special attainments, etc. In order that the register might at all times be up-to-date the work should be carried out in a sort of permanent basis.

At our first meeting we decided that the compilation work should be undertaken by the Council of Scientific and Industrial Research in conjunction with the National Institute of Sciences of India. These two organisations have, we understand, called upon the scientific and technical personnel in the country to register their names and particulars. We are also gratified to note that the Prime Minister himself has evinced keen interest in this work and has urged all qualified persons to register themselves. So far the Council of Research and the National Institute of Sciences have received particulars in respect of about 20,000 persons, which are now being compiled. Although, this number represents a good response, we are of the opinion that the scientific and technical capital available in the country is much greater and a large number of qualified persons are yet to register themselves and therefore, every effort should be made to com-

plete the register as far as possible. It seems to us that we might have to enforce some measure whereby it becomes incumbent on every qualified scientific technical person to register himself. In the United Kingdom, no scientific or technical person can seek employment unless his name appears on the National Register and he bears a National Register Number. We recommend that immediate steps be taken to enforce suitable measures in this country also.

NOTE—(The report has not been signed by Mrs. Hansa Mehta as she is abroad).

S. S. Bhatnagar
 H. J. Bhabha
 R. R. Gupta
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 A. N. Khosla
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 D. S. Kothari
 Regunath Prasad
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SUMMARY

A summary of the findings and recommendations of the Scientific Man-power Committee is presented in the following :—

A.—Assessment of Manpower.

The Scientific Man-power Committee assesses the requirements for scientific and technical personnel during the next 5 to 10 year period (1947-52—57) for Government (civil and defence), for teaching and research and for industry, agriculture, transport medicine and other fields dependent on the use of scientific and technical man-power as follows :—

Category	No. required	
	Senior grade	Junior grade
Engineers of all categories	25,250	25,700
Architects	310	..
Chemists and Chemical Technologists	6,560	2,000
Physicists	3,300	220
Metallurgists	1,000	150
Glass and Ceramics Technologists	320	340
Fuel and Furnace Technologists	310	..
Textile Technologists	780	950
Leather Technologists	350	450
Geologists and Geophysicists	1,420	..
Mathematicians and Statisticians	1,500	80
Botanists	900	..
Zoologists	1,430	..
Biologists	680	..
Agricultural Scientists	2,640	810
Dairy Technologists	700	..
Doctors	19,740	..
Non-medical personnel (Nurses)	22,510	..
Science Teachers—		
Graduates in Science	16,220	..
Intermediate in Science	1,82,300	..
Intermediates in Science as Technical personnel	500	..
Unclassified Scientific and Technical Personnel	2,520	..

(CHAPTER II—PARA. 23)

B.—Survey of Manpower Resources

(a) *Engineering and Technological Education—*

1. The Committee observes that facilities for post-graduate education and research in engineering and technology are almost non-existent. There are no more than 5 established institutions in the whole country which impart education upto post-graduate standard and even there the range of subjects covered is limited. However, the progress of engineering education has not been unsatisfactory upto the undergraduate or degree standard. There are 23 first-grade Engineering Colleges in the country offering courses in Civil, Electrical and Mechanical Engineering. Recently

Chemical Engineering courses have been organised in 4, Electrical Communication Engineering in 2, Metallurgical Engineering in 1, and Highway Engineering also in one of these Colleges. Combined courses in Mechanical and Electrical Engineering subjects is a special feature of some of the Engineering Colleges, especially in the Northern and Western zones. The Committee notes that there is at present little scope for specialization in numerous branches of engineering at the degree or post-graduate stages and consequently the existing system may be regarded as one relating mostly to general engineering education in the three basic branches of engineering, namely, Civil, Mechanical and Electrical. Technological education has not kept pace with engineering education and shows only limited development both in the range of subjects covered and in the number of institutions providing such courses. There are only 8 first-grade institutions in the country teaching technological subjects upto the degree standard. Of these 3 institutions offer courses in Chemical Engineering, 2 in Oil Technology, 1 each in Ceramics, Glass, Pharmaceuticals, Metallurgy and Leather, 2 in Mining and 2 in Textile Technology. The courses in some of these institutions have been started fairly recently. (CHAPTER III,—PARAS. 2 & 3.)

2. In the matter of junior engineering and technological education upto the diploma standard the present position is somewhat satisfactory, in that over 45 institutions distributed all over the country are engaged in imparting instruction in a fairly wide range of subjects in engineering and technology. (CHAPTER III—PARA. 3.)

3. The present out-turn of technologists and engineers and the admissions into the various institutions in 1947-48 are as follows (CHAPTER III—PARA. 3).:—

Standard of training	Outturn in 1946-47	Admission in 1947-48
Engineering—		
Diploma Courses	1,150	2,150
Degree and Post-graduate Courses	950	2,520
Technology—		
Diploma Courses	290	510
Degree and Post-graduate Courses	320	420

4. The Committee observes that all the Engineering and Technological institutions in the country suffer from such handicaps as lack of equipment or lack of adequate staff or lack of adequate accommodation or all the three. This is chiefly due to two factors, namely, (i) that established institutions which have increased their normal intake have not always been able to expand their facilities correspondingly, and (ii) institutions which have been started recently have been progressing rather slowly, mainly due to lack of funds. The available facilities in respect of equipment, staff, teaching accommodation, etc., in many of these institutions hardly fulfil 40 per cent. of the minimum requirements suggested by the All India Council for Technical Education. This unsatisfactory state of affairs is having an adverse effect on the standard of technological education. The Committee is of the considered opinion that the first approach to the problem of development of engineering and technological education should be to strengthen the existing facilities in the institutions by equipping and staffing them adequately for the present intake of students and to bring up the standard of training to the desired level. (CHAPTER III—PARA. 4.)

5. The Committee observes that little or no research either in Engineering or in Technology is being carried out at present in the institutions excepting perhaps in one or two ; the reasons are, the institutions have developed only for teaching and in many of them the available facilities are not adequate even for this purpose. The academic atmosphere prevailing in the institutions is also anything but conducive to research. The staff of almost all the institutions are heavily burdened with routine teaching work and are left with little time for research. The equipment and other facilities available for research are very poor and there is little collaboration and contact between Industry and the institutions. It is the considered opinion of the Committee that unless these existing handicaps are removed no real impetus can be given to engineering and industrial research. Members of staff should be enabled to find sufficient time to devote to research and suitable research fellowships or scholarships should be instituted in each institution. The existing facilities in respect of staff, equipment, accommodation, etc. should be improved not only for teaching but also for research purposes and there should be close liaison between Industry and educational institutions so that the latter might cater to the needs of industry both in the matter of research and in the training of personnel. (CHAPTER III—PARA. 5.)

(b) *Higher Scientific Education and Research—*

6. A large number of institutions, more or less evenly distributed throughout the whole country, provide facilities for Basic Scientific Education upto I.Sc., B.Sc., and B.Sc. (Hons.) standard in Physics, Chemistry, Mathematics, Botany, Zoology, Geology and other biological sciences. The out-turn of I.Sc B.Sc. and B.Sc., (Hons.) graduates for 1946-47 is as shown below :—

	Outturn in 1946-47	Admissions in 1947-48
Intermediate in Science	19,860	Not known
B.Sc. graduate (Pure Sciences)	4,790	8 000 (estimated)
B.Sc. (Hons.) graduates	1,100	1,200 (estimated)

(CHAPTER III—PARA. 6.)

7. Almost all the institutions teaching upto I.Sc. and B.Sc. standards are now working at full strength, some in two shifts, and no appreciable increase in the out-turn of graduates or intermediates in science can be expected from them in the near future. Any appreciable increase in the out-turn which might be required will have to be brought about by starting new institutions, since the introduction of Double Shift System in institutions where it has not already been introduced can only be possible by effecting all round expansion of the institutions concerned, that is, by providing additional staff, equipment and buildings which may practically amount to starting new institutions. The Committee observes that even in many of the existing institutions the facilities available are extremely unsatisfactory. The intake of students into the various courses in these institutions has increased in recent years, but there has been no corresponding increase in the facilities. Classrooms are crowded, the staff over-worked and there has been no replacement of the old and unserviceable equipment nor any additions made thereto. The Committee stresses that if basic scientific education in the country is to be maintained at the requisite standard all

these deficiencies should be first removed. The Committee also refers to the condition in which teachers are working in the institutions. Although in some of these institutions some limited facilities for research are available, the staff is so heavily burdened with routine teaching work—25 hours per week or more—that they find little time for research. The condition is much the same in some of the colleges which offer Honours and post-graduate courses in addition to under-graduate courses. The salary scales are far from satisfactory. In some cases they are ridiculously low. There is general discontent amongst the members of the staff and the institutions are finding it increasingly difficult to attract qualified teachers. (CHAPTER III—PARA. 7.)

8. Linking up Higher Scientific Education with Research, the Committee observes that there are at present 25 Universities in the country of which 7 are still in a formative stage. In some of the Indian Universities M.Sc. degree is obtainable mainly by research; in some others either by research or by examination and in the rest by both. Most of the Universities are maintaining departments for post-graduate education and research in the various branches of basic the sciences—Physics, Chemistry, Mathematics, Botany, Zoology, Geology and other biological sciences. Some of these post-graduate Departments of Universities,—a number of first-grade science Colleges either affiliated to Universities or directly maintained by them—have facilities for post-graduate research and training which, though at present not quite satisfactory in all respects, are capable of being developed especially for the training of research workers. The Committee completes the picture of scientific and industrial research in the country by referring in detail to the activities of several special institutions also, special in the sense that, unlike the university institutions, these do not ordinarily cater for routine post-graduate teaching of scholars for higher degrees or diplomas, but are whole-time research establishments, such as the National Laboratories of the Council of Scientific and Industrial Research, Bose Research Institute, Indian Institute of Science, Tata Institute of Fundamental Research, Solar Physics Laboratory, etc. The Committee observes that in the context of Higher Technical Education and Research these special institutions have their importance, in that many of them function as research training centres and also provide facilities for research students to work for higher post-graduate degrees of Indian Universities. The Committee summarises the present position in respect of Higher Scientific Education and Research in the following statement :—

	Outturn in 1946-47	Admissions in 1947-48
M.Sc. courses in Basic Sciences.....	640	700
Ph.D., D.Sc., etc., in Basic Sciences.....	Total outturn for the last 10 years—130	
Research Training	Total No. of workers for whose training facilities are available	Possible rate of out-turn per year
Physics	140	45
Chemistry	310	100
Mathematics	30	10
Statistics	10	3
Botany	70	20
Geology	20	7
Zoology	20	18
Applied Biology	3	1
Marine Biology	15	5
Physiology	5	1
Other subjects	10	3

(c) Agricultural Education and Research—

9. The Committee observes that there are about 18 institutions in the country which provide facilities for education and research in Agriculture, Dairying, Forestry, Veterinary Sciences, Fisheries and other allied subjects. The Committee also describes in brief the activities of all the agricultural research institutions in the country, with particular reference to the scope of work and the facilities available in them for research training. The Committee's findings about the present position of agricultural education and research in the country are summarised in the statement below :—

Courses	Outturn in 1946-47	Admissions in 1947-48	Probable outturn during the next 5 years
Dairy and Allied Sciences	180	140	930
B.Sc. in Agriculture and Agricultural Engineering	350	990	3,650
M.Sc. and Doctorates in Agricultural Sciences	80	80	480
Post-graduate diplomas in Agriculture, Veterinary, Forestry, Dairying and Allied Sciences	160	170	940
Total number of post graduate research workers for whose training facilities are available	Agri. Sciences 170 Dairying 5 Veterinary Sciences 10		310 trained research workers

* (On the assumption that all the research training facilities are fully utilised and the duration of training is about 3 years).

(CHAPTER III—PARA. 11).

(d) Medical Education and Research—

10. The Committee observes that the facilities available in the country for post graduate training and research in Medical and allied branches are poor. Nine Medical Colleges are said to provide facilities for such training but considered in the light of the outturn of trained post-graduate personnel every year, the Committee expresses considerable doubt whether the claims of most of these institutions are justified or whether medical graduates do take to post-graduate training. The Committee also notes that very little medical research is now being conducted in the Medical Colleges and the only centres of research are certain special establishments, such as the All-India Institute of Public Health and Hygiene, Pasteur Institute, King Institute, Malaria Institute, Haffkine Institute and a few other Government and semi-Government establishments. (CHAPTER III—PARA. 12.)

11. The Committee considers that the training of medical personnel upto the degree standard is perhaps the most important aspect of medical education in the context of the requirements for medical personnel. The Committee estimates that facilities for training up to degree standard in medicine and surgery are available in about 28 Medical Colleges which are more or less evenly distributed over the whole country. Of these 12 are well-established institutions and the rest have been started only recently—since 1946 or thereafter. The latter comprise both new institutions and 5 Medical Schools that have been re-organised for imparting education upto the degree

standard. The Committee notes that Double Shift System has been introduced as an experimental measure in two institutions. Excluding the new institutions which have been started recently the 12 established colleges have been turning out in recent years an average of 860 graduates every year against an intake of 1,050 students. The latest intake into all the institutions, both old and new, is about 1,700 students. The Committee also notes that with a view to augmenting the number of qualified medical personnel in the country, and as a part of the resettlement scheme, the Government of India have sanctioned a 5-year project for producing about 975 medical graduates within the next 5 years by giving advanced training to ex-servicemen who were licentiates or diploma-holders from Medical Schools. (CHAPTER III—PARA. 13.)

12. There are 18 Medical Schools in the Indian Union which used to account for an annual outturn of about 700 licentiates. But, following on the accepted principle of raising the standard of medical education in the country, eleven of these Medical Schools have already been converted into Medical Colleges for training upto the degree standard. The Committee hopes that all the other Medical Schools in the country will, before long, be re-organised into Medical Colleges. (CHAPTER III—PARA. 14.)

13. The Committee observes that both for under-graduate and post-graduate training in Dentistry the available facilities in the country are totally inadequate. There is as yet no Dental College in the country offering training upto the degree standard in dentistry. (CHAPTER III—PARA. 15.)

14. The Committee estimates that the total number of qualified and practising nurses in India is about 7,000 in the proportion of 1 for every 43,000 of the population, which obviously is very low when compared to corresponding ratios obtaining in other countries. In view of the absence of facilities for the advanced training in Provinces in nursing the Government of India started in 1946 a Nursing College in Delhi which offers a B.Sc. (Hons.) course for nursing in addition to short-term training course for qualified nurses. The Nursing College has provision for an annual admission of 50 students into the degree courses. (CHAPTER III—PARA. 16.)

15. The Committee observes that generally the existing facilities in all the medical institutions by way of staff, equipment, accommodation and hospital requirements are just adequate for the present intake of students but shortages in one respect or another have in recent years been felt particularly in such institutions as have had to increase the intake. The Committee summarizes the present position in respect of facilities for medical education and research in the country as follows:—

	Outturn in 1946-47	Admission in 1947-48	Forecast of outturn for the next 5 years 1947-52
Licentiate Courses in Medicine and Surgery	800	Not known	Cannot be estimated as most of the Scho- ols are being convert- ed into Colleges.
Degree Courses in Medicine and Surgery	860	1,700	5,940
Post-graduate Courses in various branches of Medicine and Surgery, Public Health, etc.	220	350	1,040
Degree Courses in Nursing	50	50	250
Diploma holders in Dentistry	50	70	300

16. The Committee has presented an overall picture of the present scientific manpower resources in the country in Statement XI of its main report.

C.—5-year Plan of Development

1. On the basis of a comparative study of the requirements for scientific and technical man-power for the next 5-year period (1947—52) and the existing resources, the Committee estimates that there are wide gaps between the possible requirements and the anticipated output and that the available resources of man-power are inadequate to meet our requirements, let alone our having a small potential reserve to draw upon in case of emergency or unforeseen circumstances. The Committee observes that even on stretching the 5-year requirements to the next 10 years the gaps still exist. The gaps are both qualitative and quantitative. The Committee has shown in Statement XII of its report (page 62) the shortages and surpluses, if any. In order to make up the gaps the Committee recommends that a 5-year plan for the development of education and research facilities in the country be worked out having the following main features :—

- (a) Establishment of four Higher Technical Institutions as recommended by the All-India Council for Technical Education for advanced and post-graduate technical training.
- (b) Implementation of the various development plans of institutions described in the Survey Report which envisage—
 - (i) introduction of specialised or post-graduate courses of study and research in certain branches of science and technology not catered for now ;
 - (ii) rationalisation of the existing courses of study and their diversification ;
 - (iii) full development of institutions which are in a formative stage at present ;
 - (iv) expansion of training and research facilities in institutions where these are not of the requisite standard or where there is scope for such expansion ;
 - (v) reorganisation of some of the existing polytechnics or lower technical institutions in order to impart in them higher instruction ;
 - (vi) increasing the intake of students into various courses in some of the existing institutions.
- (c) Creation of facilities for training in production engineering, design engineering, fuel and furnace technology and other special fields at certain selected institutions on a regional basis.
- (d) Establishment of a College of Marine Engineering and Naval Architecture or creation of facilities for training in the subject at one or two selected institutions.
- (e) Establishment of new medical colleges for increasing the out-turn of doctors.
- (f) Opening of post-graduate Science Departments in such of the Universities as do not have them at present, and strengthening of the existing ones in order to increase the outturn of scientists of all categories to the desired extent.
- (g) Training of supervisory category of technical personnel in conjunction with industry.

The Committee also recommends that the effective outturn of I.Sc.s during the next 10 years should more than double itself ; and the outturn of science graduates should be nearly double the present. (CHAPTER IV—PARA. 13.)

U.—Industrial Training

The Committee estimates that the requirements for technically trained personnel of the senior or executive type for the next 5—10-year period are over 40,000 for industrial development and Government and Government-sponsored activities and feels that the question of industrial or practical training of the large number of scientific and technical men passing out of our educational institutions to 'condition' them for their gainful employment should receive urgent consideration. The Committee estimates that about 240 leading industrial concerns in the country can, among themselves, train about 1,200 Scientists, Engineers and Technologists of the senior or executive category and 18 Government and Government-sponsored Departments can train about 800 of these personnel at a time. The Committee believes that, except in a few cases, the available facilities have not been mobilized fully owing chiefly to the lukewarm attitude of Industry and various Government Departments in the matter of admitting trainees in numbers larger than required for their own purposes. This situation, the Committee contends, has contributed in no small measure to a denial of opportunities to suitably qualified candidates seeking necessary practical or industrial training to equip themselves for useful employment. Considering the vast number of technically trained personnel that would be trained for various development projects during the next few years, the Committee recommends that urgent and far reaching measures should be adopted to make available existing facilities for practical training to as many qualified students as possible. Towards this end the Committee recommends that Government should introduce legislative measures so that it becomes incumbent on every established industrial concern to provide training facilities for qualified candidates in all grades notwithstanding whether the persons thus trained are required by the concern or not. The large number of Government and Government-sponsored Departments should provide practical training facilities no less than industrial concerns. As a general measure the Committee also recommends the following :—

1. The technical departments of Government should organize in their establishments facilities for the industrial training of—

- (a) artisan type of personnel ;
- (b) supervisory or foreman type of personnel ; and
- (c) executive type of personnel ;

and the expenses for the organisation and careful supervision of training for all the above three types should be borne by them. (CHAPTER V—PARAS. 1—7.)

2. All factories or industrial establishments, both private and state-owned, should include schemes of practical training and expenditure on this account should be regarded as legitimate expenditure of the establishment. For effective implementation of recommendations made, Government should, following the French system, impose a levy on every industrial concern— say about 3% of the total wages paid by the concern— and the proceeds of such levy, supplemented by Government subvention of an equal amount, should be utilized for organizing practical training of various grades and categories of personnel in industrial concerns under Government's supervision. (CHAPTER V—PARA. 7.)

3. In all the above three types of establishments trainees should be paid wages or stipends the value of which, in the case of scientific or technically trained men, should be adequate to meet the expenses on board and lodging. (CHAPTER V—PARA. 7.)

4. Industrial and Government Departments should recruit fresh graduates as officer-trainees and put them through any organised training programme with a view to their ultimate employment as Executive Officers. (CHAPTER V—PARA. 7.)

The Committee recommends that every effort should be made to mobilize fully all available training facilities now as well as in the years to come and to utilize them in a planned and co-ordinated manner. Towards this end a definite programme of industrial training, extending over the next 5—10-year period, should be drawn up for the training of a certain number of graduates every year on a stipendiary basis in industrial concerns and Government-sponsored departments. The scheme should work in a progressive manner, starting with the training of such personnel for whom the necessary facilities may now be available in industrial concerns and Government departments, and increasing the number of trainees as the training facilities increase. The number and distribution of trainees among the various branches should be correlated to the requirements of personnel of all grades as assessed by the Committee. The Government should also institute industrial training stipends each of the value of Rs. 200 per month for this training programme and the number of stipends should be half the number of candidates undergoing training, i.e., about 20,000. (CHAPTER V—PARA. 8.)

In view of the unavailability of facilities for both theoretical and practical training of personnel required for Rayon and Cellulose industries, special arrangements should be made for such training in certain selected institutions or in the Co-operative Research Laboratory that might be established for this group of industries. (CHAPTER V—PARA. 9.)

E.—Overseas Training

In the matter of training of scientific and technical personnel abroad, the Committee is of the opinion that the Scheme of Overseas Training, so far worked by the Government of India, leaves much to be desired both in its objectives and the method of execution.

1. The Committee feels that Indian Scientific and Technical Personnel need be trained abroad with a different emphasis on the scholars' educational and training programme so as to meet the immediate needs of the country for specialists. (CHAPTER VI—PARA. 1.)

2. In the context of the requirements of the country, necessity exists for training of men overseas to fulfill distinct but specific needs, namely :—

- (a) training of personnel for industrial development,
- (b) training of personnel for scientific and industrial research and education and
- (c) training of personnel to meet certain specific requirements of Government and Government-sponsored departments. (CHAPTER VI—PARA. 1.)

3. Personnel whom it is required to train abroad for industrial development should be selected from among those who have had a certain amount of industrial experience in the particular industry concerned and also have the necessary academic qualifications. They should preferably be selected from amongst those employed in industry and sent abroad to undergo training for specific periods in appropriate industrial concerns. Trainees should be sent abroad to specialize in particular in those industries in which training facilities are inadequate and the development of which is in the national interest. It may not be necessary for such men to receive any academic training in institutions abroad. What is most important in this connection is that our technical men should study the modern methods of production, pick up the "know how" of new developments in particular branches of industries, etc. In organising this training, teams of different categories of personnel, rather than individuals, should be sent abroad especially for such industries which for development, would depend upon the co-operative or group effort of Engineers, Chemists and other categories of personnel. (CHAPTER VI—PARA. 1.)

4. As regards the training of personnel for research and educational purposes, it is necessary to select men from the University Research Centres and other Research Organizations of the country and send them to work in laboratories abroad for short periods to study the trends of modern research, their development and techniques and to establish contact with research workers elsewhere in the world. The whole period of study should not ordinarily exceed one year, since these scholars are not expected to work for post-graduate degrees of foreign universities. They are expected to be fully trained and equipped in this country as far as our facilities permit. In order that these objectives might be realized the method of organizing the training should also be different from what has been followed in the past in that definite quotas of scholarships should be allocated to each University or Institution based on the scope of educational or research activities of the Institution concerned, its development plans and other like considerations. At the same time a central pool of Overseas Scholarships should be created out of which deserving candidates selected from all the Institutions may be sponsored for overseas training. As a sequel the method of selecting candidates for the training should also be different. The Institutions concerned should select candidates from amongst their staff or whole time research workers according to rules framed by Government and the selection thus made should be subject to the approval of a Selection Board set up by the Government. For the general improvement in the standard of teaching, it is also desirable generally to send abroad a team of workers rather than individuals to study modern teaching methods and research technique in selected subjects. (CHAPTER VI—PARA. 1.)

5. In order to meet the needs of Government Departments, members of the staff of technical departments should get an opportunity to visit corresponding departments or institutions abroad to acquaint themselves with latest developments in their own fields. (CHAPTER VI—PARA. 1.)

6. Persons who are technically or industrially trained abroad should not only be utilized for the industrial development of the country but also for the training of additional technical personnel in the country itself thereby reducing the number of people who would otherwise have to be sent abroad for training. (CHAPTER VI—PARA. 1.)

7. Sending of fresh graduates to Foreign Universities for another course or academic training in the hope that such persons will on their return be useful in industrial development of the country should be discouraged.

The Committee makes a provisional estimate as shown below of our requirements in the matter of overseas training during the next 5—10-year period.

Objective	Number of persons to be trained abroad
(a) Industrial Development	460
(b) Government and Government-sponsored Activities	603
(c) Higher Education and Research	909

In order to reduce as far as possible the number of persons to be trained abroad, the Committee recommends that three or four Indian under-studies should be attached to every foreign expert who is engaged to work in this country. (CHAPTER VI—PARA. 2.)

F.—Equal Opportunities, Free Places, Science Talent Search, Shortage of Teachers, etc.

The Committee feels that special measures should be adopted for attracting talented students to pursue higher scientific and technical education and recommends that the best way of realising this objective is to create Free Places and Scholarships and such other facilities in our educational institutions and award them on merit alone. While amounting to a great measure of social justice the Committee feels that this would enable really talented students to obtain higher education and thereby help to build up the scientific man-power resources of the country. The Committee feels that such concessions be created in all branches of Engineering, Technology, Medicine, Agriculture, etc., as shown in the following statement :—

Courses	Number of Free Places	Number of Scholarships	Annual expenditure in Rs. Lakhs
A. Engineering and Technology—			
Degree and post-graduate courses	1,470	740	53.0
Diploma courses	1,830	920	25.0
B. Pure Sciences—			
Post-graduate courses (M.Sc., etc.)	350	180	6.0
C. Agricultural Sciences—			
Degree and post-graduate courses	620	310	22.5
Other courses, mostly diploma courses	70	40	1.0
D. Medical Sciences —			
Degree and post-graduate courses	1,080	540	48.5
Diploma courses—only Dentistry.	40	20	1.0
E. Research Training —			
Pure and Applied Sciences	320	320	} ₹ 30.5
Agricultural Sciences	90	90	
Engineering and Technology.	50	50	
Medical Sciences	30	30	
Total .	5,950	3,240	197.5

Similar provision, perhaps on a somewhat reduced scale, should be made in the I.Sc. and B.Sc. stages also. (CHAPTER VII—PARAS. 1—3.)

The Committee is of the considered opinion that special efforts should be made to search out scientific talent suited to take to research in the various National Laboratories and other research establishments and recommends that a National Science Talent Search Competition as adopted in the U.S.A. should also be inaugurated in this country for locating and encouraging scientific talent in this country. (CHAPTER VII—PARA. 4.)

The Committee is of the opinion, that of all the handicaps from which our educational institutions are at present suffering, the shortage of teachers is the worst and that this

bottleneck is adversely affecting the standard of training in the institutions. The inadequacy of teachers' salaries is the root cause of this situation and the consequential result is that there is a steady 'drift' of teachers going on from Universities and other educational institutions into scientific and technical jobs in industry and Government Departments, whenever available and when these are not available, into clerical and technical jobs which are more often better paid than teachers' posts. The Committee feels that unless the situation is tackled immediately with a sense of urgency, there is no likelihood of any of our long-term development plans materialising and that the problem is capable of solution only on an economic plane since economic factors are at the root of it. The Committee recommends that the salary scales of teachers of various categories should be as shown below :—

(a) *University Institutions, Professional Institutions and other Post-graduate Institutions—*

	Rs.
Professors (Senior)	1,500 to 2,000
Professors (Junior)	1,000 to 1,500
Readers, Assistant Professors and Senior Lecturers	750 to 1,200
Junior Lecturers, Demonstrators, etc.	250 to 600

(b) *Science Colleges (under-graduate standard)—*

Professors	600 to 1,200
Assistant Professors	350 to 830
Lecturers, Demonstrators, etc.	250 to 500

In order to overcome the shortage of teachers and to improve the standard of training in educational institutions specially from the practical points of view, the Committee recommends that suitable arrangements be worked out whereby the services of Senior Officers of Engineering Departments of Governments and Technical Executives of industrial concerns might be utilized for the training of students in Engineering and Technological institutions located close to their headquarters. (CHAPTER VII. PARA 4.)

The Committee observes that in certain University and Government Institutions admissions are still being made on communal and caste considerations and that communal influences also play a considerable role even in such an important matter as the appointment of teachers. The Committee stresses how irrational and dangerous communal policies are, especially in educational matters, and maintains that denial of opportunities for higher education to any particular section of the people for reasons of caste, creed or community, represents, to say the least, a most reactionary step, and the pursuit of such a policy is bound to have far-reaching repercussions on the quality of scientific man-power as well as on the calibre of post-graduate research in Universities. The Committee is of the opinion that it is most important for the progress of education and research in this country completely to jettison the irrational restrictions and prohibitions which have been erected in certain places to defeat the wholesome principle that admission to collegiate institutions should be by merit alone, and strongly urges that Government should take immediate steps to investigate the conditions obtaining in educational institutions in the country with particular reference to the principle of admission of students, appointment of teachers, etc., and adopt suitable measures to discourage the institutions from following a policy which is likely to militate not only against the efficiency of scientific man-power but also clearly defies a fundamental right envisaged in the Constitution of the country. (CHAPTER VII—PARA. 4.)

Unemployment Drift and Leakage of Talent—National Register of Scientific and Technical Personnel.

The Committee estimates, on the basis of factual data collected, that the wastage of scientific and technical talent in the country, is about 4%, made up of unemployment and drift approximately in equal proportions, and that the wastage figure cannot in any case be over 10%. The Committee is of the opinion that an over-all wastage of 10% is not high, especially in a country like India, where, due to lack of industrial development, suitable openings for scientists and technologists are somewhat limited. Whatever drift or leakage there is, the Committee believes, is largely due to general unsatisfactory conditions of work in teaching and scientific occupations and the generally lower salaries and fewer privileges offered in technical posts as compared to administrative posts. In order therefore, to keep the drift or leakage at an irreducible minimum level, the Committee recommends that the main causes leading to the drift or unemployment or leakage, namely, inadequate salary, inferior status and disparity of privileges between technical and administrative personnel should be eliminated. Towards this end the Committee also recommends the creation of a Central Scientific and Technical Service on the lines of the Indian Administrative and other All India Services. (CHAPTER VIII—PARAS. 2—8)

The Committee stresses that compilation of a National Register of all the Scientists Engineers, Technologists and other categories of scientific and technical personnel available in India, is an important national task and should be pursued vigorously and the register maintained up-to-date at all times. In order to ensure that every one coming under the scope of the Register registers himself, the Committee recommends enactment of suitable legislative measures on the lines of the National Register Act of U.K. (CHAPTER VIII—PARA. 8.)

ANNEXURE I

Line of Manufacture	Present production capacity (tons/year)	Additional production contemplated (tons/year)	Targets fixed by industrial panels or by Govt. (tons/year)
<i>Chemical Industries—</i>			
Heavy chemicals & Electro-chemicals	257780	776234	1267600
<i>Pharmaceuticals Drugs and Fine chemicals—</i>			
Plant Products, alkaloids etc.	Quinine—100,000 Lbs. Alkaloids—42,000 Lbs. Tinctures etc. 0.75 million gallons		} 2.111 million lbs.
Synthetic drugs, etc.	Nil.		
Shark Liver Oil	Some quantities are being produced		1 million gallons.
Penicillin	Nil.		1 million units.
Harmones	Nil.		60 lbs.
Liver Extracts	Some quantities are being produced		250 million ccs.
Pyrethrum	Small quantities		50,00 tons of dry flowers.
D. D. T.	Nil.		30,000 tons.
Paris Green	Included in Heavy chemicals		50,00 tons.
Refrigerating chemicals	Nil.		6,00,000 lbs.
Photographic & fine Chemicals.	Included in Heavy Chemicals		10,200 tons.
Solvents	Alcohol 14 million gallons Benzene 1.2 million gallons		Alcohol 10 million gallons. Benzene & Toluene 5.5 million gallons. Others 8370 gallons.
Miscellaneous			1760 tons.
Soaps	140,000	160,000 tons (Additional production proposed)	
Hydrogenated oils	310,000	90,000 tons (" " ")	
<i>Paints & Varnishes—</i>			
Paints & Enamels	50,000	50,000 tons (Additional production proposed)	
Varnishes	25 lakhs gallons	114 lakhs gallons (" " " ")	
Pigments	8,500 tons	13,500 " (" " " ")	
Synthetic Resins		500 tons	
<i>Plastics—</i>			
Synthetic Resins	Very little	5,000 tons	
Raw films	Nil	50 million sq. feet.	
Sugar	1.04 million tons	350,000 tons (Additional production)	
<i>Alcohol—</i>			
Rectified Spirit	14 million gallons		
Power Alcohol	1.75 million gallons	19 million gallons (Additional production)	
Food Yeast	Small quantities	3,000 tons	
<i>Paper Industry—</i>			
Paper	88,000	166,700 tons (Additional production for 5 year period)	
Boards	47,900	50,600 tons (" " " " ")	
Chemical Cotton		5 million lbs.	
Cement	2.075	2.92 million tons (Additional production)	

Line of Manufacture	Present production capacity (tons/year)	Additional production contemplated (tons/year)	Targets fixed by industrial panels or by Govt. (tons/year)
<i>Metallurgical Industry—</i>			
Iron & Steel	1.264 million	1.306 million tons (Additional production. for 5 yr.)	
Non-ferrous metals	Copper 6,000 tons Alluminium 7,500 tons	Copper 6,000 (Additional production) Alluminium 12,500 („ „ „)	
<i>Textiles</i>	Cotton cloth 4737 million yds. Cotton yarn 1.615 million thousand lbs.	Cotton cloth 18 million yards (Additional production) Cotton yarn 0.426 million thousand lbs. (Additional production)	
Rayon	Nil	Rayon	70 tons/day
Glass	No correct information	Bangles Sheet glass Glass globes	1.5 lakhs tons 48 million Sq. ft. 25 million pieces.
Ceramics & Refractories	No correct information but the production of 8 concerns is about 40,000 tons.	Whiteware Stoneware Insulators Refractories	5640 tons (increase in production) 5400 „ „ „ 6225 „ „ „ 20,0000 „ „ „
Leather	No correct information but pre-war production was 373 lakhs pieces of leather & 730 million pairs of foot-wear & 73 million of sq. ft. of Box & Willow sides.		Targets of production are 495.5 lakh pieces of leather, 140 million sq. ft. of box and willow sides and 1545 million pairs of foot-wear.
<i>Engineering Industries —</i>			
Diesel Engines	700 engines		9060 engines and 56 steam turbines.
Machine Tools	11,00 Nos.		Double the present production.
Wire and Wire Products.			1600 tons.
Electrical Goods	Motors 100,000 H.P. Transformers 102,000 K.V.A. Fans 250,000 Nos. Starters Switch Gears Lamps 13 million pcs. Measuring Instruments Storage Batteries 172,000 Nos. Wireless equipment Small Numbers Insulators—42,00,000 Nos.		38,000 Nos. 300,000 K.V.A. 2,00,000 Nos. 41,000 Nos. Worth 2 crores of rupees. 31 million pcs. 100,000 pcs. 200,000 Nos. 500,000 Sets. 5,000 tons. Worth Rs. 211 crores.
Industrial Plant and Machinery			
Locomotives and Railway Wagons	Production of some of these has just begun		600 locomotive boilers; 420 steam rollers; 500 broad gauge chassis; 100 complete locomotives.
Shipbuilding	About 10,000 tons		50,000 tons by the end of 1950
Automobiles and Tractors			45,000 vehicles.
Aircraft	Under development.		

ANNEXURE V

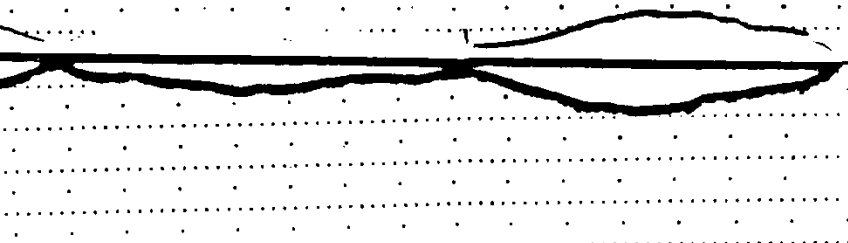
SUMMARY OF FINANCIAL IMPLICATIONS OF DEVELOPMENT PLANS

Description	Total Cost		Funds likely to be available		Balance required	
	Capital	Recurring	Capital	Recurring	Capital	Recurring
	(Rs. Lacs)		(Rs. Lacs)		(Rs. Lacs)	
Medical Education and Research	1020.31	20.07	437.94	4.87	582.37	15.2
Agricultural Education Research	239.54	61.97	12.00	1.00	227.54	60.97
Higher Scientific & Education Research	524.725	70.397	29.99	10.3164	494.735	60.0806
Engineering & Technological Education and Research.	2111.371	334.353	773.42	183.618	1337.951	150.735
Total	3995.946	485.854	1253.35	198.3869	2641.777	285.1640

ENGINEERING AND TECHNOLOGICAL EDUCATION AND RESEARCH

Developments Plans—

Institutions administered by	Number	Financial Implications		Remarks
		Capital	Recurring	
Central Government	7	774.31	192.272	3 Institutions have not submitted development plans. The requirement of the two Higher Technical Institutions viz. Capital 609.90 lakhs Recurring 179.072 lakhs are under Government's consideration.
Central/Universities	4	116.065	20.72	..
Central/Non-Government	1	195.00	7.00	..
State Governments	6	124.2	4.62	The full expenditure for one new Institution i.e. Rs. 26 Lakhs Capital and Rs. 3 Lakhs Recurring is to be met by the Baroda Government. Half the expenditure for one Institution i.e. Rs. 5.5 Lakhs Capital and .25 Lakhs Recurring will be met by the Travancore Government Half the expenditure of another Institution i.e. Rs. 5 Lakhs Capital and .36 Lakhs Recurring will be borne by the Cochin Government. Balance required Capital 87.7 Lakhs Recurring 1.01 Lakhs
State/Universities	1	36.136	8.5	Rs. 3 Lakhs has been sanctioned by the Travancore University. Balance required Capital 33.136 Lakhs Recurring 8.5 Lakhs
State/Non-Government	1	45.00	1.5	..



14	—	6	14
14	8	15	21
3	—	1	4
3	3	1	5
2	—	1	15
—	—	—	1

TOTAL (5)

36 11 24 60

NUMBER OF RESEARCH WORKERS FOR WHOM TRAINING FACILITIES ARE AVAIL

STALLOGRAPHY

		16	
		2	
		5	
		1	
31	13	9	30
		5	
		3	
		3	
		8	
		5	
7			

O-PHYSICS

		17	
		2	
90	64	4	35
		8	
		20	
60		4	
		1	

4

Institutions administered by	Number	Financial Implications		Remarks
		Capital	Recurring	
Provincial Governments	22	558.69 (For 19 Institutions)	82.785	Two of these are new Institutions for which development plans have not been submitted. Madras Government have sanctioned 7.5 lakhs Capital and 0.276 Lakhs Recurring for one Institution. Bombay Government have sanctioned 8.52 Lakhs Capital and 0.66 Lakhs for one institution. Balance required Capital 542.67 Lakhs Recurring 81.949 "
Provincial/Universities .	7	143.72	15.186	For one of the institutions Rs. 5 Lakhs has been sanctioned by the Government of Madras and Rs. 5 Lakhs by a Donor. Balance required Capital 133.72 Lakhs Recurring 15.186 Lakhs
Provincial/Non-Government.	2	18.25 (For one Institution)	1.75	One Institution has not submitted development plans.
Total	51	2111.371	334.353	Balance required Capital 1337.951 Lakhs Recurring 150.735 Lakhs

HIGHER SCIENTIFIC EDUCATION AND RESEARCH

Development Plans

Central Government .	5	62.73 (For 3 Institutions)	10.75	Financial implications of plans for two institutions are not available.
Central/Universities .	3	29.08	4.156	..
Central Non-Government	4	94.40	11.30	For one of these Institutions Central Government have sanctioned 4.32 Lakhs Capital and 4.057 Lakhs Recurring. Balance required Capital 90.08 Lakhs Recurring 7.243 Lakhs
State Governments .	5	46.72 (For three Institutions)	12.965	No information is available about two institutions. The Government of Travancore will bear half the cost of one institution i.e. 17.75 Lakhs Capital and 5.875 Lakhs Recurring. Balance required Capital 28.97 Lakhs Recurring 7.09 Lakhs
State/Universities .	2	15.65	2.23	Half the expenditure required for one institution will be met by the Government of Travancore i.e. 5.25 Lakhs Capital and 0.25 Lakhs Recurring. Balance required Capital 10.4 Lakhs. Recurring 1.98 Lakhs.
State/Non-Government .	..	..	..	..
Provincial Government .	8	71.24	9.07	..

Institutions administered by	Number	Financial implications		Remarks
		Capital	Recurring	
Provincial/Universities .	13	165.450 (For ten Institutions)	16.486	One University has no development plan. The development plan of the Bombay University is included in the Engineering and Technology Section. Rs. 0.0144 Lakhs Recurring grant has been promised by one University. C.P. Government have sanctioned 0.67 Lakhs Capital and .12 Lakhs Recurring for one University. Balance Required Capital 100.035 Lakhs Recurring 17.4526 Lakhs
Provincial, Non-Government	11	39.40 (For nine Institutions)	3.44	Development plans of two Institutions are not available. Half the expenditure for one Institution i.e. Rs. 2 Lakhs will be met from private sources. Balance required Capital 37.40 Lakhs Recurring 3.44 Lakhs.
Total	51	524.725	70.397	Total promised or sanctioned Capital 29.99 Lakhs. Recurring 10.3164 Lakhs. Balance required Capital 494.735 Lakhs Recurring 60.0806 Lakhs

MEDICAL EDUCATION AND RESEARCH

Development Plans

Central Government .	2 (Res. Inst.)	..	..	Financial implications of the development plans have not been submitted.
State Governments .	3 (Education & Research)	185 (For two colleges)	5.55	The Government of Travancore will bear half the expenditure for Establishing a Medical College, i.e. 87.5 Lakhs Capital 2.5 Lakhs Recurring. One is a new Medical College (Baroda) details of which are not available. Balance required Capital 97.5 Lakhs Recurring 3.05 Lakhs.
Provincial Governments	23 (Education & Research).	835.31 (For eleven Colleges)	14.52	Four of these are Medical Schools to be converted into Colleges. Financial details are not available. Four are new Colleges proposed to be Established. Details are not available. Two are newly started Medical Colleges. Development plans are not available.

Institutions administered by	Number	Financial Implications		Remarks
		Capital	Recurring	
				Two are established Colleges. Developments are not available. The following grants have been promised or sanctioned or are under consideration. (In Lakhs of Rupees).
				Capital Recurring Authority.
		112.25	61	(E. P. Govt.)
		7.86	..	(West Bengal)
		23.00	..	(Orissa)
		1.33	.5	(Central)
		201.00	..	(Bombay)
		5.00	..	(Madras)
		..	1.26	(Bombay)
		350.44	2.37	(Total)
Total	28	1020.31	20.07	Balance required
				Capital 582.37 Lakhs
				Recurring 15.2 Lakhs

AGRICULTURAL EDUCATION AND RESEARCH

Development Plans

Central Government	10	136.92	36.45	Three of these Institutions have not submitted development plans. Indian Central Tobacco Committee have already sanctioned the full amount of Rupees 10 lakhs Capital and 1 Lakh Recurring grant for one of these Institutions. Part of the amount of Rs. 6 Lakhs Capital and Two Lakhs Recurring may be met by the Indian Central Sugar Cane Committee.
		(For seven Institutions)		Balance required
				Capital 126.92 Lakhs
				Recurring 35.45 Lakhs
State Governments	1	..	..	Development plans are not available.
	(Research).			
Provincial Governments	6	55.62	17.52	For one of these Institutions the U.P. Government have sanctioned Rs. 2 Lakhs Capital.
				Balance required
				Capital 53.62 Lakhs
				Recurring 17.52 "
University/Central	1	32	5	
University/Provincial	1	15	3	
Total	19	239.54	61.97	Balance required
				Capital 227.54 Lakhs.
				Recurring 60.97 Lakhs.

ANNEXURE VII

SCIENTIFIC MANPOWER COMMITTEE

Questionnaire for Industries

N. B.—The object of this enquiry is:—

- (a) to assess the requirements of scientific and technical personnel and
- (b) to make recommendations to Government regarding action to be taken to meet these requirements.

All inquiries in this Questionnaire relate to such scientific and technical personnel who have Bachelor's Degree as the minimum qualification.

In so far as Engineering is concerned, replies are to include requirements of the Foremen type of personnel, i.e., personnel having Diploma as the minimum educational qualification.

(NOTE:—If the space provided is inadequate, please attach a separate sheet.)

This questionnaire after completion may be returned to the Secretary Scientific Man-Power Committee, Ministry of Education, Government of India, New Delhi, unless handed over directly to an Officer of this Committee.

1. Name of the Company
2. Full Postal and Telegraphic address
3. Nature of business :
 - (i) Manufacturing, service, utility, consulting, etc.
 - (ii) Indicate principal lines of manufacture
4. Brief particulars regarding :
 - (i) laboratory and other facilities available for research.
 - (ii) Are you contemplating expansion of plant and equipment? If so give brief particulars.
5. (i) State names, designation and experience of scientific and technical executive engaged by you.

	Names of Technical Executives	Designation	Experience of scientific and technical nature
	1	2	3
(a) Chemists,			
(b) Physicists,			
(c) Biologists & Bacteriologists,			
(d) Engineers of all categories.			
(i) Aeronautical,			
(ii) Electrical,			
(iii) Chemical,			
(iv) Civil,			
(v) Mechanical,			
(vi) Mining,			
(vii) Radio,			

	Names of Technical Executives 1	Designation 2	Experience of scientific and technical nature 3
(viii) Other engineers.			
(e) Metallurgists.			
(f) Geologists.			
(g) Agricultural Scientists.			
(h) Medical Scientists (fully qualified).			
(i) Veterinary Scientists.			
(j) Other technical staff engaged in research work not including above.			
(k) Administrative personnel, etc. in scientific pursuits.			
6. What is the salary, grade and status of the scientific staff in your industry ?			
7. Outline in brief field of scientific activities (major or minor activities by subjects).			
8. Nature of research activities. (Strike out those not applicable).			
(a) Fundamental or basic.			
(b) Applied.			
(c) Testing and control.			
(d) Additional activities.			
9. What is your annual budget for			
(a) Scientific staff			
(b) Research work.			
10. Are you a member of any Research Association ? If so, give details and your contributions.			
11. (a) Are you prepared to offer facilities for university professors, research workers and students to work for stated periods in your industry ?			
(b) Are you prepared to send your staff for 'refresher' courses to Universities or research Institutions ?			
12. How do you select your superior staff ?			
13. Have you found any difficulty in finding qualified technologists ? If so please specify instances with details.			
14. Are you satisfied with the type of technical and scientific men you are getting from the universities, or other institutions ? If not can you suggest any definite lines of improvements in their training ?			
15. Have you any definite suggestions to make for collective research in your Industry and for collaboration amongst inter dependent industries ?			
16. How do you keep abreast of the latest developments in your particular industry ?			
17. Are you in favour of the establishment of a Central Scientific Information Bureau for the collection and distribution of information on the latest researches pertaining to the various industries.			
18. Have you any post-war plans for the development of your industry ? If so, give the general outline.			

_____	Name of Technical Executives 1	Designation 2	Experience of scientific and technical nature 3
<p>19. Are you in favour of levy of cess on industry in order to meet the expenses of industrial research as it is done for the lac industry and jute industry? If so, state whether in your opinion the cess should be on a voluntary or statutory basis.</p>			
<p>20. What is the assistance you are getting from (a) Research Departments and from Government services and (b) have you met with any difficulties in respect of 20(a). If so, please give details.</p>			
<p>21. Have you any pilot plants? If so, give full description of the Plants.</p>			
<p>22. Will you give an estimate of the number of scientific men in various subjects you require in your expansion programme during the next five years?</p>			

ANNEXURE VIII

SCIENTIFIC MANPOWER COMMITTEE

Questionnaire for Government and Government-Sponsored Department.

Object of Enquiry :

- (a) to assess the requirements of scientific and technical personnel and
- (b) to make recommendations to the Government regarding action to be taken to meet these requirements.

All enquiries in this questionnaire relate to such scientific and technical personnel who have Bachelor's Degree as the minimum qualification.

In so far as Engineering is concerned, replies are to include Foremen Type of personnel i.e., personnel having Diploma as the minimum educational qualification.

This questionnaire after completion may be returned to the Secretary, Scientific Man-Power Committee, Ministry of Education, Government of India, New Delhi, unless handed over directly to an officer of the Committee.

I. Name of Government.

II. Name of Department.

III. State the number of engineers, scientists and technicians in the permanent and temporary cadres of the Department under sub-heads given below or the corresponding sub-heads and classifications prevalent in your Department. These should be shown under gazetted and non-gazetted or Commissioned and non-Commissioned Officers.

Gazetted Officers	Non-Gazet- ted Officers	Commis- sioned Offi- cers	Non-Commis- sioned Offi- cers	
1	2	3	4	
				1. <i>Physical Sciences</i> —
				(i) <i>Physics</i> —
				(a) Theoretical Physics
				(b) Atomic Physics (cosmic rays and nuclear physics.)
				(c) Aerodynamics
				(d) Electricity
				(e) Electronics and sound
				(f) Optics
				(g) Radio
				(h) Micro-waves and radar
				(i) Heat and power.
				(ii) <i>Chemistry</i> —
				(a) Inorganic and general chemistry.
				(b) Organic (including general organic, dyestuffs, plant products, oils, fats and waxes, animal products, carbohydrates and drugs pharmaceuticals).
				(c) Physical chemistry
				(d) Nuclear chemistry
				(e) Electro-chemistry
				(f) Analytical chemistry
				(g) Applied chemistry
				(h) Biochemistry & fermentation chemistry.
				(iii) <i>Mathematics</i>
				(iv) <i>Statistics.</i>
				(v) <i>Meteorology.</i>

1 2 3 4

2. Biological Sciences—

(i) Botany

(ii) Zoology.

3. Agricultural Animal Husbandry & Veterinary Sciences.

4. Medical Sciences.

5. Engineering—

(i) *Civil Engineering—*

(a) Building & Structural

(b) Steel bridges & structures

(c) Irrigation, Irrigation work and hydraulic engineering.

(d) Dams

(e) Navigation and Navigational work

(f) Roads

(g) Railways

(h) Municipal and Sanitary Engineering.

(ii) *Mechanical Engineering—*

(a) General (Machines and Machine tools)

(b) Power plant

(c) Locomotives

(d) Automobiles

(e) Aeronautical

(f) Ventilating, heating and air conditioning

(g) Armaments.

(iii) *Electrical Engineers—*

(a) Power generations, transmission and distribution

(b) Heavy machinery

(c) Traction

(d) Electric appliances, meters and instruments

(e) Heating and Lighting

(f) Tele-communication and wireless.

(g) Refrigeration.

(iv) *Military Engineers—*

(A) Defence including fortification, trenches and camouflage

(B) Engineers

(a) Civil Engineering—

(i) Building and structural

(ii) Steel Bridges and structures

(iii) Irrigation, Irrigation works and hydraulic engineering.

(iv) Dams

(v) Navigation and navigational work

(vi) Roads

(vii) Railways

(viii) Municipal and sanitary engineering.

(b) Mechanical Engineering—

(i) General (Machines and machines tools)

(ii) Power Plant

(iii) Locomotives

(iv) Automobiles

(v) Aeronautical

(vi) Ventilating, heating and air conditioning

(vii) Armaments.

(c) Electrical Engineering—

(i) Power generation, transmission and distribution

(ii) Heavy machinery

(iii) Traction

(iv) Electric appliances, meters and instruments

1 2 3 4

- (v) Hoating and lighting
- (vi) Tele communication and wireless
- (vii) Refrigeration

(v) *Architects and Town Planners.*

(vi) *Marine Engineers—*

(a) Ports and harbours

(b) Ship building, Naval and Mercantile.

(vii) *Chemical Engineers*

(viii) *Agricultural Engineers*

(ix) *Mining Engineers*

(x) *Metallurgists*

(xi) *Geologists*

(xii) *Geophysicists*

(xiii) *Marine Biologists*

(xiv) *Fishery Experts*

(iv) (a) State qualifications required for the different categories of the above personnel, that is, (a) scientific or technical degree or diploma from a recognised University.

(b) a minimum period of practical experience in workshop or laboratory; or post-graduate or other specialised training in any particular field.

V. (a) State the training facilities which are available in your Department in special branches of technical work which are generally lacking in India and for which engineers, scientists and technicians have to go for training abroad.

(b) State the categories in which special training has to be given abroad and the countries and organisations where such training can be given.

(c) State the number of men under different categories who should be sent abroad for such training in the first, second and subsequent years and the countries to which they should be sent.

(d) State what provision or improvisation you are making in your Department or Branch to impart specialised training in special branches of engineering and sciences in which training is not available in India at present, but in respect of which, it is essential in the interest of self-sufficiency, that such training should be made available in this country.

VI. State the annual intake of technical personnel under categories indicated in question III above in the first, second, third, fourth and fifth years and in block in the sixth to tenth years. (This intake should be given by classifications as well as by grades of pay. It is possible that there may be abnormal demands in one or two particular years due to impending changes in the political set up and subnormal demands in other years. A clear explanation in this respect should be given).

VII. What are your development plans for the next five and ten years respectively? State the number of recruits under various categories in addition to the annual intake mentioned under question VI required for these development plans, also the consequential modifications in the permanent and temporary cadre mentioned in question III.

VIII. State the field and character of your scientific and industrial research activities, if any—

(a) fundamental or basic research,

(b) applied research.

- (c) testing and consultation work,
- (d) additional activities.

- IX. (a) What facilities have you for research ?
- (b) To what extent do you carry out co-operative work in other Departments and industries ?
- X. (a) Is there any agency for ensuring collaboration between the research workers in your Department and elsewhere working on similar or allied subjects?
- (b) Is there any agency for co-ordinating the research work in your organisation and similar research organisations in other Government Departments, industry or Universities ?
- (c) Is there any arrangement whereby the services of your scientific and technical personnel can be placed on deputation or in co-operative work with other departments of the Government, quasi-Government or private bodies ?
- (d) Is there any arrangement whereby the services of technical personnel from other Governments, quasi-Government or private bodies can be temporarily requisitioned to supplement the manpower in your Department or to carry out specialised research ?
- XI. Have you any advisory bodies having representatives of other Departments of Government, technical or professional associations or industries to advise you on the training required for the scientific and technical personnel to be employed by you ?
- XII. (a) What in your opinion should be the general policy underlying the remuneration to be paid to the scientific and technical personnel of your Department in the context of the general level of salaries in other technical or non-technical departments of Government, Universities or Industry ?
- XIII. How would you ensure that the technical and scientific talent of the country is utilised to the best advantage over the whole field of national activity and not concentrated in one or two channels to the detriment of balanced development ? If so, please give details.
- XIV. Can you state in order of priority new manufactures connected with the activities of your Department which must be undertaken in this country for purposes of self-sufficiency in times of peace and war ?
- XV. State your views in regard to the standardisation of engineering and scientific training in the different institutions and universities throughout the country and what agency would you recommend for the implementation of your recommendations ?
- XVI. Give information regarding the library facilities at the disposal of your Department and the way the library is maintained.

Also please furnish—

- (a) List of the scientific and technical journals for which your Department is subscribing.
- (b) List of back numbers of scientific & technical journals.
- (c) List of scientific and technical books, subject-wise.
- (d) List of any special reference books that you may have.

ANNEXURE IX

SCIENTIFIC MANPOWER COMMITTEE

Questionnaire for Educational and Research Institutions only

Objects of Enquiry—

- (a) to assess the requirements of scientific and technical personnel, and
- (b) to make recommendations to Government regarding action to be taken to meet these requirements.

For the purpose of this questionnaire scientific and technical personnel must be taken to mean persons possessing Bachelor's degrees in science or technology as the minimum qualification.

In so far as Engineering is concerned, replies are to include personnel of the standing of foremen *i.e.*, persons having Diploma as the minimum educational qualification.

This questionnaire after completion may be returned to Secretary, Scientific Manpower Committee, Ministry of Education, Government of India, New Delhi, unless handed over directly to an officer of the Committee.

The enquiry is divided into three parts, *viz.*

- (a) General information regarding the institution,
- (b) Factual survey of the present resources,
- (c) Scope for maximum utilisation of the present resources, and for future expansion, during the next five year (1947-52) and ten year (1947-57) periods

Note.—If the space required in any column is inadequate particulars may be enclosed on a separate sheet.

Part (a)

GENERAL INFORMATION

1. Name of Institution.
2. Full address.
3. Year of establishment.
4. Name, designation and address of the present head of the Institution.
5. Name and designation of the officer submitting completed questionnaire.
6. Is the institution purely for
 - (a) Teaching
 - (b) Research
 or (c) Combined teaching and research ?
7. Name of Department or subjects covered by the institution.

1	9
2	10
3	11
4	12
5	
6	
7	
8	

8. Please give details and location of any attached sub-station, special laboratories, experimental farms, workshops, factories, etc., if any.
9. Do you publish prospectus or hand book of information regarding your institution ?

If so, please send a copy (This questionnaire should nevertheless be completed).

10. Have you any advisory body or bodies, having representatives of industry technical or professional associations to advise you on the training given at your institution ?

If so, please state names of members and the organisation they represent :

1	6
2	7
3	8
4	9
5	10

11. Please state your annual income :—

Average of 1941-46	Amount in Rupees 1946-47
1. Students fees	
2. Endowment	
3. Grant from Central Government	
4. Grant from Provincial, State Governments	
5. Voluntary public support	
6. Other resources	
TOTAL	

12. Please state your annual expenditure :—

	Amount in rupees.	
	1941-46	1946-47
1. On salaries (a) teaching staff		
(b) administrative and office staff		
(c) other staff		
2. On equipment (a) new		
(b) replacement		
3. On research and development		
4. On library		
5. Contingencies including travelling allowances, municipal charges, power, consumable stores and miscellaneous expenses		
TOTAL		

13. Please say 'yes' or 'no' against each of the following subjects :—

- (a) whether facilities are available in your institution for the study of the subject leading to diploma and/or degree ; and
- (b) whether research work is carried out in your institution.

Branches of studies	(a)	(b)
Physics		
Chemistry		
Mathematics		
Statistics		
Botany		
Zoology		
Physiology		
Anthropology		
Geology		
Geography		
Mineralogy		
Geophysics		
Mining		
Metallurgy		
Agriculture (including animal husbandry and dairying)		
Sericulture		
Horticulture		
Veterinary Sciences		
Fisheries		
Forestry		
Electrical Engineering		
Communication Engineering		
Mechanical Engineering		
Civil Engineering		
Chemical Engineering and Technology		
Marine Engineering		
Agricultural Engineering		
Other Subjects		

14. What are the diplomas and degrees awarded by your institution ?

15. What are the subjects taught for the diplomas and degrees mentioned above?

Degree	Subject	Diploma	Subject

16. Please give the following particulars of the Bachelor's degree or the diploma courses in your institution :

Particulars required	Degree course	Diploma course
I. (a) Abbreviations used for degrees and diploma		
(b) What is the equivalent degree or diploma of a British or American University ?		
II. Admission requirements (minimum)—		
(a) educational qualification		
(b) physical fitness.		

Particulars required	Degree Course	Diploma Course
(c) aptitude test, if any		
(d) entrance test, if any		
(e) pre-entry experience, obligatory or not		
(f) special considerations, if any		
III. (a) Duration of course of study inclusive of the period of training outside the institution, if any		
(b) Duration of such training		
(c) Is this training continuous?		
(d) Is this training supervised by institution staff?		
(e) Is post-graduate training obligatory for award of degree or diploma?		
(f) If so, the length of such training		
(g) Is this training supervised?		
(h) Posts e.g., Executive, Supervisory etc. for which the degree or diploma qualifies them		
IV. Distribution of student working hours :		
(i) No. of working hours per week		
(ii) No. of working hours per academic year		
(iii) No. of hours per week spent on :		
(a) Lecture work		
(b) drawing office		
(c) laboratories		
(d) tutorials		
(e) workshop or field work		
(f) compulsory physical training or games		
(g) military training		
(h) research		

17. Please give the following particulars concerning the teaching staff :—

Designation	No.	Salary, grade if any	No. of hours of teaching work including lectures, laboratory and practical work per week.
Professor			
Reader			
Assistant Professor			
Senior Instructor			
Lecturer			
Part-time or visiting lecturer			
Demonstrator			
Instructor			
Workshop or Lab. Superintendent			
Workshop or Lab. Instructor			

(For entries below, only the highest degree of a teacher is to be taken into consideration ; e.g., entry concerning a teacher who possesses both Master's and Doctor's degrees should appear in 1st row only)

	Indian Universities	Foreign Universities	Both Indian and Foreign Universities
18. Qualification of teachers :			
Number of teachers with Doctor's degree			
Number of teachers with Master's degree			
Number of teachers with Bachelor's degree			
Number of teachers with Diploma			

Number of teachers with Teacher's training Diploma _____

Number of teachers having three years of research industrial or business experience _____

Number of teachers having five year of research industrial or business experience.

Number of teachers having ten or more years of research, industrial or business experience.

Number of teachers connected with Scientific Societies, Learned Bodies, Professional Associations, etc.

Number 1	Society of Association 2	Grade of Membership or Fellowship 3

19. Further particulars concerning Professors, Assistant Professors, Readers, Lecturers, Part-time or Visiting Lecturers :—

Name	Brief particulars of: (i) age (ii) designation (iii) general education (mention degrees, universities) (iv) technical, scientific education (mention degree Universities) (v) industrial and/or Business experience (vi) research qualification (vii) Connection with scientific societies professional associations etc. (viii) previous posts held (ix) number of years spent in teaching.
------	---

N. B.—It would also be desirable to enter the above particulars in the questionnaire 'for individuals only' (sent herewith)

20. Please give following particulars of student's amenities and extra curricular activities, if any.

(a) facilities for games and sports

(b) Extra curricular activities

(i) magazine published, if any

(ii) debating societies, Science clubs, etc. if any

(iii) periodical tours by students for visiting technical, technological or industrial institutions and for field work and scientific excursions.

PART(b)—FACTUAL SURVEY OF THE PRESENT RESOURCES

1. Please give the following particulars regarding the Annual intake and Outturn of Students from your institution :—

(The number of students to be shown in each column are the total number of these students who had this subject in their curricula)

N.B.—In the following questionnaire a separate form is to be filled in for each subject *i.e.*, one for Physics, one for Chemistry, one Mechanical engineering and so on.

Particulars required	Province and States of India													Total						
	Assam	West Bengal	Orissa	Bihar	Eastern Indian States	U. P.	C. P.	Central Indian States	Delhi	East Punjab	North Indian States	Bombay	West Indian States	M. dras	South Indian States	East Bengal	West Punjab	Stud	N. W. F. P.	
Number of applications for																				
(a) Bachelor's Degree courses per year																				
Number of students admitted to :—																				
(a) the bachelor's degree course																				
(i) Average per year during 1941-46																				
(ii) in 1946-47																				
(b) the Diploma course																				
(i) Average per year during 1941-46																				
(ii) in 1946-47																				
Outturn of students with																				
(a) Diploma :—																				
(i) Average per year during 1941-46																				
(ii) in 1946-47																				
(b) Bachelor Degrees :—																				
(i) Average per year during 1941-46																				
(ii) in 1946-47																				
(c) Bachelor's degree (two year-Honours) :—																				
(i) Average per year during 1941-46																				
(ii) in 1946-47																				
(d) Bachelor's degree (three year-Honours) :—																				
(i) Average per year 1941-46																				
(ii) in 1946-47																				
(e) Master's Degree :—																				
(i) Average per year during 1941-46																				
(ii) in 1946-47																				
(f) Higher Degree :—																				
(i) Average per year during 1941-46																				
(ii) in 1946-47																				

PHYSICS

2. Please state the number of students passing out annually from your institution with the degree of M.Sc. and or its equivalent. (Give average figure for 1941-46).

Subject	Indicate whether by research, examination or both and also special subjects, if any.	No.
Physics		
(ii) Applied Physics		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degrees in any one of the following branches of Physical Science.

Branch of Physical Science under which subject of thesis can be classed	State Ph. D. D.Sc. D. Phil.	State Experimental or Theo- retical	No.	Special research facilities
(a) General Physics				
(b) Fluid dynamics				
(c) Acoustic				
(d) Heat and Power				
(e) Optics and spectroscopy				
(f) Electricity				
(g) Electronics				
(h) Wireless				
(i) Micro-waves				
(j) Radiology				
(k) Nuclear Physics				
(l) Cosmic Rays				
(m) Quantum mechanics				
(n) Bio-physics				

Note.—Any other categories not included above should be specified.

CHEMISTRY

2. Please state the number of students passing out annually from your institution with the degree of M.Sc. and or its equivalent. (Give average figure for 1941-46)

Branch of Chemistry	Indicate whether by research, examination or both and also special subjects, if any.	No.

CHEMISTRY—

- (i) Inorganic and General
- (ii) Organic
- (iii) Physical
- (iv) Chemical Technology, or Applied Chemistry
 - (a) Heavy Chemicals including fertilisers
 - (b) Fuels including carbonisation, petroleum products etc.
 - (c) Dyestuffs and textile chemistry
 - (d) Paints, Pigments and varnishes
 - (e) Explosives and industrial gases
 - (f) Oils, fats and waxes
 - (g) Glass, ceramics and refractories
 - (h) Drugs and pharmaceuticals
 - (i) Plastics or high polymers
- (v) Biochemistry and industrial fermentation
- (vi) Pharmaceutical Chemistry
- (vii) Chemical Engineering

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degree in any one of the following branches of chemistry :—

Branch of chemistry under which subjects of thesis can be classed	State Ph.D. D. Sc., D. Phil.	State Experi- mental or Theoretical	No.	Special research facilities
CHEMISTRY—				
(a) Inorganic and General Chemistry				
(b) Organic Chemistry				
(i) General				
(ii) Dyestuff and intermediates				
(iii) Plant products				
(iv) Oils, fats and waxes				
(v) Animal products including hormones				
(vi) Carbohydrate Chemistry				
(vii) Drugs and Pharmaceuticals				
(c) Biochemistry and fermentation Chemistry				
(d) Physical				
(e) Colloidal Chemistry				
(f) Nuclear Chemistry				
(g) Electro-chemistry				
(h) Analytical Chemistry				
(i) Applied Chemistry				
(j) High Polymers				

NOTE.—Any other categories not included above should be specified.

STATISTICS

2. Please state the number of students passing out annually from your institution with the degree of M. Sc. and/or its equivalent.

(Give average figure for 1941-46)

Name of subject	Indicate whether by research, examination or both and also special subjects, if any	No.
<i>Statistical—</i>		
(1) Theoretical		
(2) Applied		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate Degree.

Name of Subject	State Ph. D., D. Sc., D. Phil.	State experimental or theoretical	No.	Special research facilities
<i>Statistics—</i>				
(i) Theoretical				
(ii) Applied				

2. Please state the number of students passing out annually from your institution with the degree of M. Sc. and/or its equivalent. (Give average figure for 1941-46)

Branch of Mathematics	Indicate whether by research examination or both and also special subjects if any	No.
<i>Mathematics—</i>		
(i) Pure		
(ii) Applied		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degrees in any of the following branches :—

Branch of Mathematics	State Ph.D., D.Sc., D.Phil.	State Experimental or Theoretical	No.	Special research facilities
<i>Mathematics—</i>				
(i) Pure				
(ii) Applied				

BOTANY

2. Please state the number of students passing out annually from your institutions with the degree of M. Sc. and/or its equivalent. (Give average figure for 1941-46).

Name of subject	Indicate whether by research examination or both and also special subjects, if any	No.
BOTANY		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degrees in any one of the following branches :—

Name of subject	State Ph. D., D.Sc., D.Phil.	State Experimental or Theoretical	No.	Special research facilities
BOTANY				
Taxonomy, Morphology of living plants				
Paleo botany, Physiology and Ecology				
Mycology and plant pathology, Cytology Genetics and plant breeding				
Geographical distribution, variation, Heredity and evolution.				

ZOOLOGY

2. Please state the number of students passing out annually from your institution with the degree of M.Sc. and/or its equivalent.

(Give average figure for 1941-46)

Name of subject	Indicate whether by research examination or both and also special subjects, if any	No.
ZOOLOGY		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degrees in any one of the following branches of Zoology.

Name of subject	State Ph. D., D.Sc., D.Phil.	State Experimental or Theoretical	No.	Special research facilities
ZOOLOGY—				
Invertebrate Zoology—				
(a) Proto-Zoology				
(b) Entomology				
(c) Helminthology				
Vertebrate Zoology				
Variation, Heridity and evolution.				
Palæo zoology				

ANTHROPOLOGY

2. Please state the number of students passing out annually from your institution with the degree of M.Sc. and/or its equivalent. (Give average figure for 1941-46).

Name of Subject	Indicate whether by research examination or both and also special subjects, if any	No.
ANTHROPOLOGY		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degree :

Name of Subject	State Ph. D., D.Sc., D.Phil.	State Experimental or Theoretical	No.	Special research facilities
ANTHROPOLOGY				

PHYSIOLOGY

2. Please state the number of students passing out annually from your institution with the degree of M. Sc. and/or its equivalent.

(Give average figure for 1941-46.)

Name of Subject	Indicate whether by research examination or both and also special subjects, if any	No.
PHYSIOLOGY		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degree in any of the branches of this Science.

Name of Subject	State Ph.D., D.Sc., D.Phil.	State Experimental or Theoretical	No.	Special research facilities
PHYSIOLOGY				

GEOLOGY

2. Please state the number of students passing out annually from your institution with the degree of M. Sc. and/or its equivalent.

(Give average figure for 1941-46)

Name of Subject	Indicate whether by research examination or both and also special subjects, if any	No.
GEOLOGY		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degrees in any one of the following branches of this Science:—

Name of Subject	State Ph. D., D.Sc., D.Phil.	State Experimental or Theoretical	No.	Special research facilities
GEOLOGY—				
Minerology				
Petrology				
General Geology				
Historical Geology				
Structural Geology				
PALAEONTOLOGY—				
(a) Palaeo-botany				
(b) Palaeo-Zoology				

4. What facilities for field training have you in your institution for undergraduate and post-graduate students ?

5. How much time is given for instruction of students in tripographical and Geological mapping ?

6. Please indicate the lines of teaching and researching for which facilities exist in your institution for any particular branch of Geology, say specialisation in Geophysics, soil survey, glacialology, climatology, geochemistry etc.

7. Please indicate below the research or thesis with already carried out in your institution.

8. Please indicate branch of geology in which you recommended sending abroad students for special training and research.

9. What facility do you need for extending practical.

10. Have you experienced difficulties in providing adequate training especially in field geology ? If so, please give details and your suggestions to meet the difficulty.

11. In your expansion programme what is the estimate of increase in the number of students trained in special subjects, such as, geophysics, soil survey, glacialology, climatology, geochemistry in the next two successive five year period i.e. (1947-52) and (1953-58).

GEOGRAPHY

2. Please state the number of students passing out annually from your institution with the degree of M.Sc. and/or its equivalent.

(Give average figure for 1941-46).

Name of Subject	Indicate whether by research examinations or both and also special subjects, if any	No.
GEOGRAPHY		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degree in any of the branches of this Science.

Name of Subject	State Ph.D., D.Sc., D.Phil.	State Experimental or Theoretical	No.	Special research facilities
GEOGRAPHY				

GEOPHYSICS

2. Please state the number of students passing out annually from your institution with the degree of M.Sc. and/or its equivalent. (Give average figure for 1941-46.)

Name of Subject	Indicate whether by research, examination or both and also special subjects, if any	No.
GEOPHYSICS		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degrees in any of the branches of this Science.

Name of Subject	State Ph. D., D. Sc., D. Phil.	State Experimental or Theoretical.	No.	Special research facilities
GEOPHYSICS				

MINING

2. Please state the number of students passing out annually from your institution with the degree of M. Sc. and/or equivalent.

(Give average figure for 1941-46.)

Name of Subject	Indicate whether by research examination or both and also special subjects, if any	No.
MINING— (1) Coal (2) Metal		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degrees in any one of the following branches of this Science :—

Name of Subject	State Ph.D., D.Sc., D. Phil.	State Experimental or Theoretical	No.	Special re- search faci- lities
MINING— (1) Coal (2) Metal				

METALLURGY

2. Please state the number of students passing annually from your institution with the degree of B.Sc., M.Sc. or their equivalents.

Name of Subject	Indicate whether by research examinations or both and also special subjects, if any	No.
METALLURGY— (a) Ferrous (b) Non-ferrous		

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degrees in any one of the following branches of this Science :—

Name of subject	State Ph.D., D.Sc., D.Phil.	State Experimental or Theoretical	No.	Special re- search faci- lities.
METALLURGY—				
(i) Ferrous				
(ii) Non-ferrous				

For Agriculture and Allied Sciences only

Inquiries in this questionnaire relate to :

Agricultural science including animal husbandry and dairying veterinary sciences.
Sericulture, Lac culture, and Fisheries,
Forestry and other connected subjects.

The answer should deal with various branches of agriculture, including animal husbandry and dairying veterinary, forestry, etc., etc., and specific information should be given about such branches as :

1. Soil science and agricultural chemistry
Soil surveys, soil erosion control and soil conservation
Soil microbiology
2. Plant-ecology
Phytography
Insect ecology
Plant and animal taxonomy,
Animal (including insects) population studies
Plant breeding
Plant genetics
Plant physiology
Plant pathology
Entomology and mycology.
3. Botanical survey
4. Forestry and minor forest products
5. Commercial crops and their utilization
6. Horticulture and fruit technology
7. Sericulture and lac culture
8. Animal nutrition
Animal physiology
Animal pathology
Animal breeding
Animal genetics
Artificial insemination
Animal parasitology
Dairy sciences
Other specialised branches of study
9. Poultry sciences
10. Fisheries
11. Zoological survey
12. Anthropological survey
13. Agricultural meteorology
14. Agricultural economics
15. Agricultural engineering and mechanisation
16. Food technology

AGRICULTURAL SCIENCE

Please state the number of students passing out annually from your institution with the degree of M.Sc. or its equivalent.

(Give average figure for 1941-46)

Name of subject	Indicate whether by research examination or both and also special subjects, if any	No.

3. Please state the number of persons who during the last ten years received training in your institution and have been awarded Doctorate degrees in any one of the branches of this Science.

Name of Subject	State Ph.D., D.Sc., D.Phil.	State Experimental or Theoretical	No.	Special research facilities

4. What is your opinion regarding the comparative merits of graduates in pure sciences and graduates in agriculture as research workers in sciences applied to agriculture (veterinary or forestry)?

5. Are you of the opinion that graduates in pure sciences should receive special training to qualify themselves for research in applied sciences and graduates in professional courses should be given special training in pure sciences to qualify for research and applied sciences.

6. If so, what facilities exist in your institution for such training.

7. Are the results attained of such training satisfactory ?

8. What further facilities are required to improve the standard and increase the number of suitably qualified research workers ?

9. What are the lines of research or training for which it will be advantageous to send scholars abroad with a view to establish in this country centres of training and research ?

10. What are the requirements of your institution in respect of students whom you consider suitable for specific lines of research or training abroad ?

ENGINEERING

Please state against each of the following subjects :

- the number of students passing out with Diploma annually who had studied any of the following as special subjects in their curriculum ;
- the number of students graduating annually with ordinary degree who had any of the following special subjects in their curriculum ;
- the number of students passing out annually who had any of the following as an Honours subject in their curriculum ;
- the number of students passing out annually who had studied any of the following as special subjects for Post-graduate diplomas or degree course ;
-and
- the number of students passed during the last ten years with Doctorate degree.

19. If your institute is a purely research institute, please say :
 (a) whether you have facilities for training students, and
 (b) what steps are necessary to enable you to train them.
20. What are the lines of work in which your trained students are considered suitable for special study or research abroad ?
21. After how many years of training in your institution are these students generally considered qualified to avail of such opportunities for going abroad ?
22. Please give brief details as to what extent and in what ways you give special attention to field work, e.g., collection and study of materials in field, students excursions, etc.
23. What additional staff do you require in order to discharge your present teaching and other administrative duties adequately, leaving sufficient time to staff members for research ?
24. Have you any development or expansion project ? If so, please give details below showing in what manner and to what extent you expect the outturn of the trained students during the next ten years ?
- Please give a rough statement of the financial implications of the expansion, dividing it into two periods viz., 1947-52, 1952-57 :—
- (a) utilising present staff (without additional duty or equipment),
 (b) by additional staff, and
 (c) by an all round expansion.
25. Please give brief details of your scheme with regard to research (pure and applied) in your development project.
26. What material and financial assistance would you require to implement the above scheme ? Please state the amounts required for:—
- (a) Building
 (b) Equipment
 (c) Salary of personnel for (2) (b) as well as (2) (c) separately
 (d) Other recurring expenditure.
27. If a grant is made for implementation of your development plan for research and increased outturn of students, what contribution will your institution make towards
- (a) Building,
 (a) Equipment,
 (c) Salary of staff and research workers,
 (d) Other recurring expenditure.

Library:—

28. Please give information regarding the library facilities in your institution and supply catalogue or list. In particular please give:—
- (a) Journals subscribed for at present.
 (b) Back numbers of all scientific and technical journals.
 (c) Scientific and technical Books.
 (d) Special reference books.

SCIENTIFIC MANPOWER COMMITTEE

QUESTIONNAIRE

For individuals only

N. B.—The object of this questionnaire is:—

- (a) to assess the requirements of scientific and technical personnel and
- (b) to make recommendations to Government regarding action to be taken to meet these requirements.

All enquiries in this questionnaire relate to such Scientific and Technical Personnel who have Bachelor's Degree as the minimum qualifications.

In so far as Engineering is concerned, replies are to include requirements of the Foreman type of personnel, *i.e.*, personnel having Diploma as the minimum educational qualification.

This questionnaire after completion may be returned to the Secretary, Scientific Man-power Committee, Ministry of Education, Government of India, New Delhi, unless transmitted through the Head of the Organization or handed over directly to an officer of the Committee.

1. Name in Full.
2. Permanent Address.
3. Date of Birth.
4. (a) Please state your degrees, diplomas and connections with Scientific Societies, Learned Bodies, Professional Associations etc. and nature of publications, if any.
(b) Indicate the names of the Institutions where you received your training.
5. Please mention the type and number of assistants you have to deal with.
6. Past experience of service and present employment and salaries.
7. Do you think whether your special qualifications are being utilised to the best advantage in your present occupation ?
8. Can and how conditions of work in your present employment be improved ?
9. Any other remarks.

Signature _____

Date _____

Subject	(a) No.	(b) No.	(c) No.	(d) No.	(e) No.
i) CIVIL ENGINEERING— General Structural Engineering, buildings and Bridges Irrigation and Hydraulic engineering Dams Navigation and navigational works Ports and harbours Roads Railways Water Supply and Sanitary Engineering Air ports					
ii) MECHANICAL ENGINEERING— General Machine and machine tools Power plant Locomotive and Railways Automobile Textile machinery Ventilating, heating, air condition and refrigeration Other plant and machinery					
iii) ELECTRICAL ENGINEERING— General Heavy electrical industry, power generation Transmission and distribution Traction Electric appliances, metres and instruments F.ating and lighting Telecommunication and wireless					
iv) AERONAUTICAL ENGINEERING					
v) ARCHITECTURE AND TOWN PLAN- NING					
vi) MARINE ENGINEERING					
vii) CHEMICAL ENGINEERING					
viii) TEXTILE ENGINEERING					
ix) AGRICULTURAL ENGINEERING					
x) MINING ENGINEERING					

PART (C)

1. Do you consider the Educational Training already received by students joining your institution adequate ?

2. What is the percentage of graduates of your institution who take up employment—
 - (a) in teaching line allied to the subjects in which they have been trained.
 - (b) in industrial enterprise allied to the science in which they have been trained,
 - (c) within your institution in teaching or research,
 - (d) in state services where the training given is an essential requirement for employment?
3. What is the percentage of graduates of your institution who take up employment in occupations other than those for which they were trained ?
4. What steps can you suggest to prevent or minimise drift or "leakage" of trained personnel in your subject into occupations other than those for which they have been trained as well as reduce the number of misfits.
5. What in your opinion, should be the reasonable remuneration to be paid to the staff members and research workers employed in educational and research institutions? Please also give your views for raising the status of these workers.
6. Please give type and titles of publications, if any, by the staff of your institution.
7. Are you prepared to depute your teaching staff for practical training in industry ?
8. Is private practice permitted to your teaching staff ?
If permitted, under what conditions ?
9. Research :—
What facilities are available in your institution for research—
 - (a) by the post-graduate students.
 - (b) by the teaching staff.
10. Is research by the staff obligatory ?
11. State the field and character of your research activities :
 - (a) Fundamental or basic research.
 - (b) Applied research.
 - (c) Testing and consultation work.
 - (d) Additional activities.
12. What are the research problems you are now working on ? Give brief information only.
13. Have you any pilot plant in existence ? If so, please give details.
14. In what particular industries are you interested ?
15. Are you prepared to take industrial workers for "refresher" courses in your institution ?
16. Do you collaborate with any industries for investigating problems ? If so, please give details.
17. Are you receiving any financial or material support for research work from industry, government or other sources ? If so, please give particulars.
18. What is the number of students in addition to the present number that can be trained in the lines of research for which facilities are available in your institution.
Please give numbers against each branch of science.