REPORT

OF A

COMMITTEE APPOINTED BY THE SECRETARY OF STATE FOR INDIA

TO INQUIRE INTO

THE SYSTEM OF STATE TECHNICAL SCHOLARSHIPS ESTABLISHED BY THE GOVERNMENT OF INDIA IN 1904.

WITH APPENDICES.

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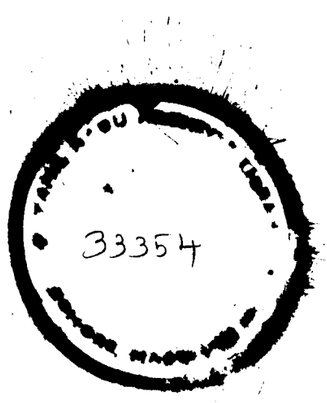

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REPORT

OF THE

INDIAN TECHNICAL STUDENTS COMMITTEE.

INTRODUCTION.

CONSTITUTION AND WORK OF THE COMMITTEE.

Constitution of the Committee.

1. On the 27th March 1912 the Secretary of State appointed a Committee "to inquire and "report as to the facilities available for Indian "students for industrial and technological training "in this country, with special reference to the "system of State Technical Scholarships estab-"lished by the Government of India in 1904." The Committee was constituted as follows :—

Sir Theodore Morison, K.C.I.E. (*Chairman*).
Sir K. G. Gupta, K.C.S.I.
Mr. J. H. Reynolds, M.Sc.
Professor W. E. Dalby, M.A.
Mr. P. H. Dumbell (*Secretary*).
Mr. R. E. Field (*Assistant Secretary*).

Proceedings at Glasgow.

2. The Committee held its first meeting at the India Office on 9th May 1912, for the purpose of discussing the itinerary, and considering questions of procedure.

3. On the 7th June 1912 the Committee proceeded to Glasgow, where meetings were held in the Court Room of the University, for the purpose of taking evidence, on the 10th and 11th June. The following witnesses were examined :—

Sir Donald MacAlister, K.C.B., LL.D. (Vice-Chancellor).
Professor A. Barr, D.Sc. (Civil Engineering and Mechanics).
Dr. C. H. Desch, D.Sc. Ph.D. (Metallurgical Chemistry).
Mr. H. Bamford, M.Sc. (Engineering-Drawing, and Design).
Mr. J. S. Nicholson, B.Sc. (Electrical Engineering).
Mr. D. Home-Morton, M.Inst.C.E. (of Messrs. D. and A. Home Morton, Civil Engineers).
Mr. W. A. Baird Laing (of Messrs. Kyle, Dennison, and Laing, Civil Engineers).
Professor Chas. Latham, M.Inst.M.E. (Mining).
Dr. Wm. Lorimer, LL.D., Member of the University Court and Chairman of the North British Locomotive Co., Ltd.
Dr. G. T. Beilby, F.R.S. (Chairman of the Board of Governors of the Royal Technical College).

Mr. H. F. Stockdale, F.R.S.E. (Director of the Royal Technical College).

Dr. T. Gray, D.Sc., Ph.D. (Applied Chemistry, Royal Technical College).

Mr. T. A. Boyd, of Shettleston Iron Works.

Mr. N. Martin (of Messrs. Warren and Stuart, Civil Engineers).

Mr. C. P. Hogg, M.Inst.C.E. (of Messrs. Crouch and Hogg, Civil Engineers), and

Mr. H. A. Mavor, M.Inst.C.E., M.Inst.E.E. (of Messrs. Mavor and Coulson, Ltd., Electrical Engineers).

Evidence was also taken from the following Indian students :—

Mr. Iqbal Hussain.
Mr. P. Saxena.
Mr. J. N. Bhattacharji.
Mr. Nand Lall.
Mr. Amarnath Puri.

On the 8th June the Committee paid a visit to the ship-building yard of Messrs. Yarrow & Co., and on the morning of the 12th inspected the laboratories, &c., of the Royal Technical College.

We desire to express our deep appreciation of the kindness and hospitality extended to us during our stay in Glasgow by Sir Donald MacAlister, the staff of the University and the Royal Technical College, and Mr. A. F. Yarrow. We owe a special debt of gratitude to Professor Barr for the invaluable assistance which he rendered to us throughout.

Proceedings at Leeds.

4. In the afternoon of the 12th June the Committee proceeded to Leeds, where further evidence was taken, in the Court Room of University House, on the 13th, 14th, 15th, and 17th ; the following witnesses were examined :—

Professor J. B. Cohen, B.Sc. (Organic Chemistry).

Professor A. Green, M.Sc. (Tinctorial Chemistry and Dyeing).

Professor J. Goodman, M.Sc. (Engineering).

Professor Roberts Beaumont, M.Sc. (Textiles).

Mr. C. James (of Messrs. J. Buckton & Co.) (Engineering).

Professor H. R. Procter, M.Sc. (Leather).

Dr. J. G. Parker (Principal of the Leathersellers' Company's College, Bermondsey).

Mr. J. A. Brooke (Textiles).

Mr. John McLaren (Engineering).

Professor A. Smithells, F.R.S. (Chemistry).

Mr. W. H. Perkins, M.Sc. (Assistant Lecturer in Chemistry and Supervisor of Students' Lodgings).

Alderman B. Broadbent, M.A., J.P. (Textiles).

Mr. H. Kitchen (Dyeing).

Mr. John Rhodes (of Messrs. J. Peate & Co.) (Textiles).

Mr. A. Meysey Thompson, M.Inst.C.E. (of Messrs. Hathorn, Davey, & Co., Ltd.) (Engineering).

Mr. Walter Ellis (of Messrs. Ellis, Crowther, & Co.) (Textiles).

Mr. A. G. Lupton (Textiles).

Mr. J. Lowden, J.P. (Director of the Leeds and District Dyers' and Finishers' Association) ;

and the following Indian students :—

Mr. K. C. Mookerjee.

Mr. S. Faiz-ud-din (Government Technical Scholar).

Mr. P. K. Dutt.

Mr. K. Menon.

Mr. Raj Krishna.

During our stay in Leeds we visited the various laboratories and inspected the leather and textile departments of the University.

We wish to record our appreciation of the kindness of the University authorities in placing the Court Room at our disposal, and our indebtedness for the assistance we received in the task of securing the attendance of representative witnesses.

Proceedings at Manchester.

5. On the evening of the 17th June the Committee left Leeds for Manchester, where we held meetings on the 18th, 19th, 20th, and 21st in the Council Chamber of the Victoria University which had been kindly placed at our disposal by the authorities. The following gentlemen gave us the benefit of their advice and experience :—

Professor E. Knecht, Ph.D., M.Sc.(Tech.) (Department of Pure and Applied Chemistry, Municipal School of Technology).

Professor J. E. Petavel, D.Sc. (Department of Civil and Mechanical Engineering, Victoria University of Manchester).

Professor H. B. Dixon, F.R.S. (Department of Inorganic Chemistry, Victoria University of Manchester).

Professor W. H. Perkin, Ph.D. (Department of Organic Chemistry, Victoria University of Manchester).

Mr. E. G. Hiller (Manager of the Boiler Accident and General Insurance Company).

Dr. G. J. Fowler (Consulting Chemist to the Rivers Committee of the Manchester Corporation).

Professor W. W. Haldane Gee, B.Sc., M.Sc.Tech. (Physics, Municipal School of Technology).

Mr. F. Garnett, of the Manchester Chamber of Commerce.

Professor T. W. Fox, M.Sc.Tech., (Department of Textile Manufacture, Municipal School of Technology).

Mr. Hans Renold (of Messrs. Hans Renold, Ltd.), Engineering.

The Rt. Hon. Sir William Mather, LL.D., (Chairman of Messrs. Mather and Platt, Ltd.), Engineering.

Mr. Ivan Levinstein, M.Sc.Tech. (Aniline Colour Manufacturer).

Professor J. Radcliffe, M.Sc.Tech., (Sanitary Engineering, Municipal School of Technology).

Sir F. Forbes Adam (of Messrs. Wm. Graham & Co.), Merchant.

Dr. Alfred Rée (Member of Chemistry Sectional Committee, Municipal School of Technology).

Sir T. H. Holland, K.C.I.E., F.R.S. (Professor of Geology, and Director of the Department of Geology and Mining, Victoria University of Manchester).

Mr. J. C. Maxwell Garnett, M.A. (Principal, Municipal School of Technology).

Mr. J. Hübner M.Sc.Tech., (Director of the Department for Bleaching, Dyeing, Printing and Finishing, and Paper Manufacture, Municipal School of Technology).

Mr. T. Butterworth (of Messrs. Butterworth and Dickinson), Textile Machinery.

Mr. A. K. Davies (Managing Director of the Cotton Bleachers' Association, Ltd.)

We also took evidence from the following Indian students :—

Mr. I. B. Damania (Malvi Technical Scholar).

Mr. A. Guha (Government Technical Scholar).

Mr. D. Nagarkatti (Bombay University Scholar).

Mr. R. V. Gurjar (Government Technical Scholar).

Mr. B. B. Pradhan (Government Technical Scholar).

On Thursday, 20th June, the Committee visited the bleaching, dyeing, finishing, and paper-making departments of the School of Technology, and on the following day inspected the textile and engineering workshops.

The Committee are especially indebted to the Vice-Chancellor, Sir Alfred Hopkinson, and Mr. Maxwell Garnett, Principal of the School of Technology, for their kind hospitality and assistance.

Proceedings at Birmingham.

6. On Monday, 24th June, the Committee re-assembled at Birmingham, at the new University buildings, Bournbrook, where we held meetings on the 24th and 25th, in the Court Room, which had been very kindly lent to us by the University authorities. Evidence was taken from the following professors :—

Professor R. S. Heath, D.Sc. (Vice-Principal).

Professor T. Turner, M.Sc. (Metallurgy).

Professor J. Cadman, D.Sc. (Mining).

Professor Cadman was accompanied during a portion of his evidence by three Indian students :— Messrs. G. C. Bardaloye, M. N. Sen-Gupta, and M. Obaidulla, all Government Technical Scholars. On the afternoon of the 24th the Committee attended an informal conference at Mason College, which Professor Ashley, Dean of the Faculty of Commerce, had kindly arranged with some of the leading manufacturers of the district. The following gentlemen attended this conference, and gave the Committee the benefit of their advice and experience : —

Sir George Kenrick, J.P. (Hardware).

Mr. J. A. Kenrick (Hardware).

Mr. R. K. Morcom, of Messrs. Belliss and Morcom (Engineering).

Mr. R. H. Krause, of Messrs. Stewarts and Lloyds, Heavy Metal Manufacturers.

Mr. G. H. Bœddicker, of Muntz's Metal Company.

Mr. J. S. Taylor, of Messrs. Taylor and Challen and the Rudge-Whitworth Cycle Company, and ex-Chairman of the Birmingham Chamber of Commerce.

Mr. Edward Hickman (Ironmaster).

Professor Martineau, of Messrs. Avery's, Limited, Weight and Scale Manufacturers.

Mr. Edward Cadbury, of Messrs. Cadbury, Ltd., Cocoa Manufacturers.

Professor W. J. Ashley, Dean of the Faculty of Commerce, Birmingham University.

Professor A. W. Kirkaldy, of the Faculty of Commerce, Birmingham University.

On the 25th June the Committee visited the new Mining Laboratories of the University and inspected the miniature mine which has been constructed for the use of mining students.

Our thanks are specially due to Sir Oliver Lodge and Professor Cadman for the kindness and hospitality extended to us, and we also wish to record our grateful recognition of the assistance rendered to us by Dr. R. S. Heath and Professor Ashley, in procuring suitable witnesses and generally contributing to the success of our visit.

Summary of provincial inquiries.

7. Altogether during the provincial meetings the Committee took evidence from 75 witnesses, of whom 29 were professors and other representatives of the universities and technical colleges, 28 gentlemen intimately connected with various industries as owners and managers of works, &c., and 18 Indian technical students.

Proceedings in London.

8. Further meetings of the Committee for the purpose of taking evidence were held at the India Office on 10th, 11th, and 12th July, when the ten following witnesses were examined :—

Mr. J. M. Campion, M.Inst.C.E. (Engineering Correspondent to the Educational Adviser for Indian Students).

Mr. A. Brereton, C.S.I. (Government Director of Indian Railways).

Sir R. N. Mukherji, K.C.I.E.

Sir D. J. Tata.

Sir D. M. Hamilton.

Mr. Ambalal Sarabhai (Mill-owner of Ahmedabad).

Dr. Morris Travers, F.R.S. (Director of the Indian Institute of Science, Bangalore).

Mr. R. A. S. Redmayne, C.B., M.Sc. (His Majesty's Chief Inspector of Mines).

Dr. A. D. Denning, M.A., Ph.D. (Superintendent of Industries, Bengal).

Lieut.-Colonel J. Clibborn, C.I.E. (lately Principal of the Thomason Civil Engineering College, Rurki).

Further investigation necessary.

9. We are aware that in this preliminary tour to four provincial centres—Glasgow, Leeds, Manchester, and Birmingham—we have by no means made an exhaustive survey of the facilities available for technical instruction in this country, but owing to the imminence of the long vacation it was impossible to extend the tour, and it was considered advisable to visit first of all those centres at which the greatest number of Indian technical students, and especially Government of India scholars, have received their training. The information laid before the Committee at these four centres has been sufficient to enable us to

prepare a Report which will indicate the main lines of the policy which in our opinion should be followed hereafter, but the inquiry as to the facilities available for Indian students for industrial and technological training is by no means exhausted, and it will, we think, be necessary—if possible, early next session—for some representative of the Secretary of State to visit such centres as Sheffield, Liverpool, Bradford, and Newcastle, where, from evidence given before us, it appears probable that special facilities exist for the study of particular subjects.

CHAPTER I.

History of the Technical Scholarship System.

Origin of the State Scholarship system.

The Simla Conference of 1901.

10. The policy of sending home picked Indian students for technical instruction in this country may be said to have first taken shape at the Simla Conference in 1901 when Lord Curzon as Viceroy summoned all the Directors of Public Instruction and other educational experts to Simla, and presided in person over the proceedings. The conclusions reached were embodied in a series of resolutions, of which the following relates to the system now under consideration.

"Resolution of Simla Conference, VI.—State Scholarships :—

"That it is desirable that the Government of India should institute a number of State technical scholarships, perhaps 10 in number, with an approximate allowance of 100*l.* a year in addition to travelling expenses and fees, to be awarded annually in fixed proportions by the Local Governments, subject to the sanction of the Government of India, to selected candidates who should be sent abroad to undergo definite courses of study in subjects connected with industrial science or research; that these scholarships might be held for an average duration of two years."

The Government of India's scheme of 1902.

11. In pursuance of this Resolution the Government of India addressed the Secretary of State in a despatch dated 9th October 1902. This despatch is given *in extenso* in Appendix I., p. 61.

The main points in it may be summarised as follows :—

The scholarships were to be granted only to natives of India, their chief object being to provide the higher technical education which would qualify the holders, on returning to India, to assist in promoting the improvement of existing native industries and the development of new industries, wherever possible. Agriculture was not included within the scope of the scheme, nor were the professions of law, medicine, engineering, forestry and veterinary science. The Government of India considered that the industries for which the scholarships were most suitable were those which were already, or might in the future be, organised on a considerable scale, and those in which native capital was or might be embarked. Subject to these main principles the industries to which the scholarships were to be applied were to be chosen by the Local Governments in consultation with the mercantile and industrial public. The number of scholarships to be awarded annually was to depend upon the extent to which suitable candidates were forthcoming. Certain general

History of the Scholarship system. —*cont.*

principles were laid down by the Government of India as to the choice of persons to whom the scholarships were to be awarded; in particular it was recognised as specially important that the scholars, in addition to being intelligent, should have a practical interest in the industries that they were appointed to study, and a real intention of returning to India and devoting themselves to the practice of what they had learned. Competitive examination was considered inappropriate for the testing of qualifications such as these, and no age limit was fixed. It was laid down that when it had been determined to offer a scholarship in connexion with a particular industry, the Local Government should give the widest possible publicity to this intention, and invite applications which it should judge with the help of persons cognisant of the industry, and of the officers concerned with technical education; and it was stated to be desirable that the scholar should not only have a competent knowledge of English or of the language of any other country to which he was to be sent, but that he should have had the best technical education available in the province in the particular industry which he was to study. The scholarships were to be tenable for two years in the first instance, an extension for a third year to be granted if the student should be well reported upon. The annual allowance originally proposed was 100*l*. The Government of India considered it undesirable to bind the scholars by actual agreement to serve either Government or private employers on their return, but their prospects of obtaining employment on the completion of their studies were to be well weighed at the time of selection.

Despatch from the Secretary of State (Lord G. Hamilton) in 1903.

12. The Secretary of State in his Public Despatch No. 65, dated 29th May 1903 (*see* Appendix I., p. 72), approved of the institution of technical scholarships, but entered a caveat. In the first place he intimated that the scheme must be developed gradually, as it was of the nature of an experiment, and appropriate courses of training would have to be carefully thought out in consultation with experts; secondly, he expressed the opinion that the allowance of 100*l*. per annum proposed by the Government of India might with advantage be increased to 150*l*. per annum, and it would be most desirable that the selected candidates should have some private means as well. It was not intended that the scholars should look to Government for the payment of all their expenses.

13. The Government of India readily accepted the modifications suggested by the Secretary of State, and made known their intention of offering scholarships by means of letters to Local Governments (*vide* circular letter to Local Governments Nos. 565–570, dated 21st September 1903, printed in Appendix I., p. 75).

Subsequent modifications of the scheme.

14. Some further points of general application have been settled from time to time in despatches that passed between the Secretary of State and the

History of the Scholarship System —*cont.*

Initiation of the scheme in India.

Government of India, of which a selection is printed in Appendix I.

15. The Fifth Quinquennial Review of the Progress of Education in India, 1902–7, gives in a convenient form the opinions of the local authorities on the Government of India's scheme, and shows the steps taken for its initiation. The more important passages from the Review are printed as Appendix II., p. 79.

Subjects studied by State technical scholars and institutions which they have attended.

16. Since the scheme came into operation in 1904, 66 men had, up to 31st March 1912, been granted scholarships by the Indian Government for the study of technical subjects covering a wide field of industry. The following list shows the industries to which the scholarships have been applied and the institutions at which the students have obtained the theoretical part of their training:—

Textile industries 24, all of whom have been sent to the Manchester School of Technology.
Mining and mining engineering 19; 16 of whom have attended Birmingham University, 2 Manchester University, and 1 the London School of Mines.
Electrical and mechanical engineering 7, of whom 2 were sent to the Manchester School of Technology, 1 to Birmingham University, 1 to the City and Guilds (Engineering) College, and 3 to Faraday House.
Leather industry 5; 3 to the Leathersellers' Company's College, Bermondsey, and 2 to Leeds University.
Metallurgy 3; 2 to Birmingham University and 1 to Berlin University.
Soap making and the chemistry of oils and fats, 2; one to the Battersea Polytechnic and the other to the private laboratory of Dr. Lewkowitsch.
Sugar industry 2; one sent to the Manchester School of Technology and the other to the West Indies.
Alkali manufacture 1, sent to Liverpool University.
Pottery 1, placed with the Pilkington Tile and Pottery Company, Ltd., Clifton Junction, near Manchester.
Engineering and sanitary science 1, sent to Liverpool University, and afterwards for an additional year to London University.

(The above particulars are given in tabular form as Appendix III., p. 83).

Summary of expenditure.

17. The annual expenditure has grown steadily, from 319*l*. 3*s*. 9*d*. for four students in 1904–05 to 6,120*l*. 3*s*. 5*d*. for 39 students in 1911–12.

Full particulars of the expenditure from the institution of the system in 1904 till 31st March 1912, are shown in Appendix IV., p. 84.

Working of the system summarised.

18. The detailed working of the system as applied to the 66 men who have held Government scholarships can only be shown by analysis of the

individual cases. The records hitherto kept are not as complete as could be desired, but the statement found in Appendix V. (pages 85-117), based on such information as is available, gives the salient facts.

This statement shows that out of the 66 men who had been granted scholarships up to 31st March 1912, 20 were graduates of Indian Universities, 2 had graduated at English Universities before receiving the scholarship, and 27 had received some technical instruction in India, while 30 were stated by the Government of India to have had practical experience of the industry which they were sent home to study.

Recent development of technical education in India: influx of Indian students to centres of technical instruction in the United Kingdom.

19. The movement towards technical education which has taken place in India since 1904 has not been by any means confined to Government. It has been a general movement affecting the whole of India. For instance, in Bengal there was established in 1904 "the Association for the Advancement of Scientific and Industrial Education of Indians," one object of which was "to enable properly "qualified students to visit Europe, America, "Japan or other foreign countries for studying "Arts and Industries," and it appears from the latest Report of the Association that up to 1912 no less than 222 students in all have been granted scholarships, or financial assistance in some other form, to enable them to pursue their studies abroad. We received evidence of the existence also of two other agencies for the promotion of technical education, viz., the South Indian Industrial Association and the Malvi Technical Scholarship Fund. Technical scholarships appear also to be given occasionally by the Bombay University, the Calcutta University, the State of Hyderabad, and the State of Baroda. A not inconsiderable number of students have come from India at their own expense and initiative. The result of the general movement of which the institution of the Government scholarship system and the formation of the Calcutta Association are the two most important developments, has been a great influx of Indian students since 1904 into the centres of technical education in this country. The effect, so far as the United Kingdom is concerned, may be illustrated by statistics furnished to the Committee from the registers of some of the more important Technological Colleges and Universities. It is sufficient to quote three cases:—

At Glasgow University there were no Indian scholars on the technical side previous to the 1905-06 session, when two Indian students enrolled themselves for a course of engineering. Since then the numbers have increased rapidly, until at present there are no less than 45 Indian technical students in attendance, and the total number of Indians whose names appear in the register as having enrolled for technical subjects since 1905 is approximately 60.

Again, at the Manchester School of Technology, up to the end of 1903 the number of Indian students who had joined that Institution was very small indeed; since then the number has steadily

grown until at the present time there are 19 students in attendance, and in all 78 Indian scholars have enrolled in the day departments of the School since the end of 1903.

At Birmingham University the first Indian technical scholars arrived in 1904, when five Government scholars were sent there to study mining; the total number of enrolments since 1904 is 23, and there are five technical students in attendance at the present time.

CHAPTER II.

Review of the working of the Scholarship System.

Working of the Scholarship System.

Three main questions for consideration.

20. In order to ascertain what success had attended the practice of sending Indian students to this country to study the application of science to industry, we directed our inquiry so as to elicit answers to the three following questions:—

(I.) How do Indian students acquit themselves at British universities and technological schools?

(II.) Is practical experience in workshops and manufacturing concerns an essential part of industrial training? If so, are Indian students able to get it?

(III.) Do Indian technological students succeed in finding employment on their return to India?

We give the conclusions at which we have arrived, after taking evidence, in the order of the questions above.

(I.) Indian students at British universities and technological institutions generally successful.

21.—(I.) As a class Indian students were well spoken of at the educational centres which we visited. Testimony was very generally borne to their industry and good behaviour. Exceptions there have been, of course, but the general opinion of Vice-Chancellors and professors was summed up in the phrase, "As a class Indians work hard and give no trouble." The report upon their ability was also favourable. Some of them have been men of very marked ability and earned from their professors very high praise indeed; these were men of the type that is easily recognisable by university teachers as fit for a first class in the honours list. One such Indian, a Government scholar, was described to us not only as the ablest Indian student who had ever entered the textile department of the Manchester School, but as "easily the first in his year." Another at Leeds was said to have been "extremely good, quite as "good a student as we have had of any kind here." Men of this class are of course exceptions in all countries, and it must not be inferred that the bulk of Indian students attain this high standard. The average Indian scholars appear, however, to be quite the equals of their British fellow-students in capacity; in so far as it is possible to generalise they are rather above the average at book work and in the class room; they are less good at experimental work in the laboratory and are said to be somewhat deficient in initiative. To this rule, however, there were certain notable exceptions, and on the whole the general opinion expressed to us was that Indian students were well able to keep abreast of their work in the universities and technological schools, and were in intelligence quite up

Working of the Scholarship System —*cont.*

Some failures, and the harm they do.

to the average of their class. This is not to say that we did not hear of particular Indian students who had proved highly unsatisfactory; they were men such as every educational institution has experience of, men with whom nothing could be done; their failings were of the ordinary kind, they were either stupid and indolent, or their moral character was bad. It is to be regretted that any men of this class should have been allowed to come from India. As an illustration of the harm they do, we may mention that one professor told us that he had succeeded in getting an opening for practical experience for two Indian students (who, it should be stated, were not Government scholars), but that they had behaved so badly that the firms which had offered them these advantages absolutely declined to take any more Indian students at all. Such students do harm altogether out of proportion to their number, and the greatest care should be taken, not only by the Government of India but by all philanthropic and patriotic agencies which send Indian students to this country, to avoid sending persons who may impair the chances of their fellow-countrymen in the United Kingdom.

Creditable record of the Government of India scholars, and of other picked students.

22. It is satisfactory to record that the scholars sent by the Government of India have on the whole been a credit to their country. They are picked men, and on the whole have proved themselves to be above the average of Indian students. One professor, ranging all the Indian students of whom he had had personal experience in classes as if awarding honours in an examination, placed five in the first class, and of these five, four proved on a scrutiny to have been holders of Government scholarships. Another scholar was described by Mr. Redmayne (now His Majesty's Chief Inspector of Mines), whose student he had been, as "an "extremely brilliant man, one of the most brilliant "students I have come across." It is only fair to add that in certain cases a high opinion was expressed of students who had not held Government of India scholarships. In particular, some of the scholars selected by the Universities and Native States, and by societies such as the Association for the Advancement of Scientific and Industrial Education of Indians stand out as eminently well fitted to benefit by the advanced training which they have received in this country.

Question of the sufficiency of Indian students' preliminary training in India.

23. We made special inquiries with a view to finding out whether, apart altogether from their natural abilities, Indian students had received an education in their own country sufficient to enable them to take full advantage of the instruction given them in the United Kingdom. The evidence upon this head was somewhat conflicting, but our conclusion is as follows:—Those who had read up to the standard of the B.Sc., or B.A. with Science, were adequately equipped on the side of pure science, and entered upon their course in this country rather better prepared than their British class-fellows, who come, as a rule, direct from secondary schools. Indians who had read up to the First

Arts or Intermediate were able to keep up with their classes in this country only if they had taken the group of scientific subjects for the Indian examination, and even then their preparation was hardly adequate. Those who had only passed the Matriculation examination or read for the Arts side of the Intermediate were incapable of following the lectures here, and should in the opinion of the University authorities have been kept for another two years in India before attempting to get admitted to a University or Technological school in the United Kingdom.

Working of the Scholarship System —*cont.*

Need for improving the teaching of drawing in Indian schools and colleges.

24. One other point is sufficiently important to deserve special mention. Complaints were very frequently made to us of the inadequacy of the teaching of drawing in Indian schools. There is no doubt that Indian students of engineering have been very seriously handicapped by their backwardness in this respect. We were told by representatives of the Faculty of Engineering at Glasgow that Indian students appear to have had no experience of drawing before they came to this country and some of them had not even seen a pair of compasses. This deficiency they are not able to overcome in the course of their college career, and they remain permanently behind their Scotch and English fellow-students in the more practical parts of the course. Professor Barr illustrated this by a reference to the list of prize winners in the previous year. In the lecture classes Indians had secured three first prizes and two second prizes. But no Indians had secured prizes for engineering-drawing and design. As far as Indians are concerned, said Professor Barr, "there is a blank "altogether in the drawing and design depart-"ment." We understand that attempts have been made recently to improve the teaching of drawing in India, but so far the results of these attempts have not been visible in the engineering schools of this country, and Indian students still remain at a serious disadvantage in this respect.

Paramount importance of previous works experience.

25. Natural capacity and sufficiency of general knowledge, however, are not the only factors to be taken into account in technological education; in addition to these two there is another factor essential to success, and that, is a preliminary acquaintance with the industry to be studied. It is conceded on all hands that, unless a student is familiar with the practical side of industry before he begins the study of the theory, he is unable to get the full advantage of the teaching in a university. This is altogether distinct from the practical training which he receives after he has been through the college, and which forms the subject of our second question. The practical experience to which we now refer is needed to enable him to understand what his university teachers are talking about, and it may, therefore, like a sufficient general education, be considered one of the necessary qualifications for his course of reading. It is so considered in the best organised institutions of this kind in the world. We understand, for example, that in the German Technical High Schools—notably Charlottenburg—a student is now required to have had at least a year's experience in a works before entering upon his technological studies.

Working of the Scholarship System —*cont.*

Views of the engineering profession, as formulated by the Institution of Civil Engineers (1903–5).

26. With regard to engineering, the great advantage of previous familiarity with a workshop was emphasised by almost all our witnesses. After he has actually grasped the things with his own hands, has swung a hammer and worked a lathe, after he has seen what a ton of steel actually looks like, then and only then is the student in a position to understand the bearing of what he learns in books and what his professor tells him. It is not necessary for us to deal at length with this point, because it has already been authoritatively settled by the Institution of Civil Engineers. In 1903 the Institution appointed a committee to inquire into the subject of the training of engineers. The report of that Committee (to which reference will be made again later), was endorsed by the Institution of Mechanical Engineers, the Institution of Naval Architects, the Iron and Steel Institute, the Institution of Electrical Engineers, the Institution of Gas Engineers, the Institution of Engineers and Shipbuilders of Scotland, the Institution of Mining Engineers, and the North East Coast Institution of Engineers and Shipbuilders, and it may therefore be accepted as an authoritative expression of professional opinion. The Committee, among other things, recommended an introductory workshop course of at least one year in mechanical engineering workshops for all students of engineering, including those who intend ultimately to specialise in mining, electrical engineering, and civil engineering.

The same principle recognised in metallurgical and textile industries, and in tanning, dyeing, and mining.

27. In all other industries with regard to which we inquired we found that very similar views prevailed, although professional opinion had not in most cases been codified with the same precision as in engineering. Representatives of the metallurgical, tanning, textile, and dyeing industries, all united in recommending that a young man should have at least a year's practical experience of the industry he was going to study, before coming up to the University. With regard to no industry was the importance of previous familiarity so much emphasised as with regard to mining. Professor Latham of Glasgow said with reference to the Indian student "What I would recommend the "Indian Government to do is to send these men to "their own mines for, say, a year, and after they "had proved their ability to send them over here." At Manchester, Sir Thomas Holland laid very great stress upon the desirability of preliminary acquaintance with mines, and the Professor of Mining at Birmingham, Professor Cadman, in describing the ideal training of a miner, recommended that after matriculation the student should go for two years actually down a mine. It is interesting to note that the Indian students whom we consulted were not less emphatic in asserting the value of obtaining practical experience before undertaking

a university course of study. A strong confirmation of the soundness of this view is to be found in the fact that those Indian students who were familiar with the industry in India have done uniformly well and that those who had not such experience have often turned out badly.

Success of Indian textile students.

28. The Indian students who as a class have done best are the textile students, and among these the Government technical scholars have done particularly well and have established a record of which any country might be proud. By a reference to the statement printed as Appendix V., it will be seen that these scholars had all had very considerable experience of their industry in India. Numbers 1, 2, 3, 12, 29, 34, 35, 37, 39 and 52 (or ten in all) had had several years' practical acquaintance with the industry which they came here to study, and in one case this had extended to as much as eight years' experience of the Bombay mills as jobber, sizer, and finisher.

Failure of Indian mining students.

29. In marked contrast with the textile students stand those who have come to England to study mining. In very few cases have they had even the most rudimentary acquaintance with the conditions of practical mining; and the mining students as a class have not done well. They are the only class of Indians upon whom we have to report unfavourably. At none of the Universities which we visited were the Professors satisfied with their Indian pupils who had studied mining. Professor Latham, at Glasgow, though recognising that they attended well at lectures and usually knew enough science to follow the classes, said that they "did badly"; he admitted that there were some exceptions, but declared that "90 per cent. of them were useless." Sir Thomas Holland, Professor of Geology in the Manchester University, was of opinion that only a very small number of the students who have received technical scholarships in mining have been a success, and believed that in the great majority of cases the money spent on their education had been thrown away. Professor Cadman at Birmingham was also of opinion that the money spent upon the students of whom he had had experience had been wasted in the majority of cases; of the 13 students who have studied mining at Birmingham since he took over control of the department, he declared that nine of them were "absolutely no good in mining." All these witnesses concurred in saying that the failure of this particular class of students was due to their being absolutely unfamiliar with the industry before they began to study it in the universities. The point was brought out with special clearness by Professor Cadman in a detailed analysis of the record of the 13 Indian students whom he had had under him. "My experience of these scholars" he wrote, "leads me to state emphatically that, with few exceptions, the men are very badly selected for the profession they are undertaking. The above list will show that out of 13 students only three had had previous experience

of mining, or indeed had any intention or ambition to follow the profession of mining engineer, prior to obtaining the scholarship." Professor Cadman brought to the notice of the Committee the case of three mining scholars then studying at the University whom he regarded as typical; we examined the students in his presence, and think that their evidence completely corroborated Professor Cadman's contentions. "These" said Professor Cadman, "are typical cases of the majority of Indian scholars, and are intended to illustrate to the Committee that such students sent to follow a course of mining cannot possibly benefit to the full, on account of their lack of preliminary knowledge of the subject of mining." In a note written for the Committee, Sir Thomas Holland emphasised the same point. "Unless," he said, "a student is apprenticed at a mine for some years he is unable to take full advantage of training similar to that given in English Universities; it is possible for him to obtain a certain amount of familiarity with mining terms and with the machinery employed, but no university training can take the place of actual familiarity with the special conditions underground. A raw student, therefore, does not form a true mental appreciation of the principles of mining taught at a university, and after obtaining his degree he is too old and is otherwise generally unfitted to go through the heavy drudgery required of the ordinary apprentice."

Contrast between textile and mining scholars illustrates the signal importance of previous familiarity with the industry.

30. Of the 66 scholarships given by Government up to 31st March 1912, 24 have been awarded to students of textiles and 19 to students of mining; it is therefore in these two branches that we have the most extensive experience upon which to base our conclusions. The textile students all had previous experience of the industry, and they have been very markedly successful; the mining students were in nearly all cases unfamiliar with the conditions that prevail down a mine, and they have with few exceptions proved signal failures. This is a forcible corroboration of the contention that previous familiarity with the industry to be studied is essential to success in technological education.

The leather industry—two distinct types of student.

31. Mining and textile manufacture are the two industries in India which have attained a considerable development upon modern lines, and selection of the right sort of scholar ought in them to be a comparatively easy task. Where the industry is not so well developed selection is more difficult. It is interesting, however, to find that familiarity with an industry conducted in an old-fashioned and more or less primitive way is of great value to the student. One of the Government scholars who came over here to learn tanning belonged to a family of hereditary tanners; he had had only a small amount of education in India, but he had an instinctive knowledge of leather; he had, as Dr. Parker of the Leathersellers' College said, "tanner's blood in him." Of this man Dr. Parker formed

a very favourable opinion; the following is his evidence upon this point:—

"He was a very good student, I thought. He was the class I should like to have some more of. His scientific training was not good, but he was actually gaining advantage because he knew something of the trade beforehand. His relations were in the trade, and therefore he was able to see where Indian skins could be used to advantage in this country. I took a great deal of trouble with him, and I sent him over to America, and gave him letters of introduction to many of my friends over in different yards. When he came back, from the letters he had with him and from letters I received, I think he did good business over there. In fact he actually started business relations with some firms, and he also learnt some of the purposes which the Indian-tanned goat skins were put to in America, and which he thought he could introduce into India, because they were buying them back in India. If he goes on as he went on with me—I wish he could have stayed another year as he was just beginning to get good—I think he will make money. That man, unless something happens, will undoubtedly benefit by his training to an enormous extent."

The man "with tanning in the blood."

32. Another student of tanning sent by the Government of India happens to be, in respect of scientific training and hereditary connexion with the industry, the antithesis of the man last mentioned. This is Mr. M. A. R. Paniker, member of a well-to-do family of good social position in Madras, and a Nair by caste; he had a brilliant career as a chemist at Leeds University. Dr. Parker, who happened to know his work, said of him, "He has a thinking "mind, and has really carried out some most excellent "research work; he is a man who can use his brain; "he can work out problems and apply them too." But when the Committee asked Dr. Parker which of these two types would, in his opinion, be most useful for the industrial development of India, he replied concisely, "I should back the tanner." The point is of importance, because in the present state of education in India the two types may constantly be found in contrast to one another. On the one hand is the intelligent and well-educated graduate who belongs to one of the communities in which intellectual culture is a tradition. On the other is the descendant of the old craftsmen of India, who has probably very little university education, but an intimate, though unconscious, knowledge of the materials and processes which pertain to his hereditary "mystery." It is to be desired that the latter type should also acquire a good education, and in time, no doubt, the desire for knowledge will filter down to his class, but for some time to come representatives of the old craftsmen will generally be very imperfectly educated. It is interesting to have the opinion of so competent an authority as the head of the Leathersellers' College that he prefers the hereditary craftsman, even with his educational deficiencies, to the University man.

The research chemist in the leather industry.

Good relations between Indian students and their British class-fellows.

33. Little else remains to be said about the position of Indian technological students at the universities except to add that in the four cities which we visited they got on very well with their British class-fellows. We detected no signs of racial prejudice in the people among whom they are thrown. Indians do not form a class apart but are merged in the general body of students, and they seemed generally to live quiet, industrious, and happy lives.

Summary of conclusions on the question, "How do Indian students acquit themselves at British universities and technological schools?"

34. We may therefore now formulate the answer to our first question. It is as follows: Indian students generally get on well at the universities and technological schools in which they pursue their industrial education. They are quite up to the average capacity of their classes; if they have read science in India up to the standard of the B.A. or B.Sc. they are rather better equipped than most of their class-fellows on the theoretical side; if they have read up to the Intermediate on the Science side they can with hard work keep up with their classes; those who have only passed the Intermediate on the Arts side or the Matriculation of an Indian University are unable to take full advantage of the instruction given. Students who have had practical experience of the industry are able to derive great benefit from the teaching given in England and do capitally. Those who, like most of the mining students hitherto sent, have had no previous acquaintance with the industry they propose to follow, do very badly, and the money spent upon their education has, for the most part, been thrown away. Indian students of engineering are handicapped by their general ignorance of machinery and the inadequacy of the training in drawing which they have received in India.

II. "Is practical experience in workshops and manufacturing concerns an essential part of industrial training?" Professors and men of business unanimous that it is.

35.—(II.) Our second question relates to the practical training which Indian students are able to secure in this country either during or after their university education. Of the imperative need for such practical training to supplement the theoretical education of the class-room we received abundant evidence. All the professors whom we consulted assured us that the teaching they gave was no substitute for practical experience, and that the university alone could not make an engineer, a tanner, a dyer, a bleacher, or a miner. The verdict of business men, who in this country are still somewhat sceptical of the value of a university education, was even more emphatic. A distinguished engineer at Glasgow said to us that a person who had had a university education in engineering but no practical experience "was not in his opinion an engineer at all." The Committee appointed in 1903 by the Institution of Civil Engineers, to which reference has been made already (page 15, paragraph 26), recommended that a student after finishing his college course should have three years practical training in workshops, or on works or in mines, and in offices, and this view was endorsed by practically

all the engineering witnesses whom we examined. With regard to tanning Professor Procter said that to make a complete tanner it was absolutely necessary that he should have other experience besides that of the university. "We can teach him" he said "a great deal in the university "which is extremely useful, but we cannot "give the practical experience that a man only "gains by handling large quantities of stuff." In the textile industries the evidence was to the same effect. The manager of a woollen cloth firm in Yorkshire said "the student when he leaves the "university is practically of no use at all if he enters "business." Mr. Ambalal Sarabhai, the owner of cotton mills in Ahmedabad, gave it as his opinion that Indian students should, if possible, receive a practical training lasting two years with an English firm after completing their course at the university or school of technology. In the chemical industries the force of circumstances is compelling business men to recognise the value of science, but even those who insist most strongly upon the importance of a good scientific education do not believe that the university alone can qualify a man for the direction of a chemical industry. Mr. J. Lowden, a Director of the Leeds and District Dyers' and Finishers' Association said "A man might spend three or four years "at the university and have a very good scientific "training and yet be unfit to take an active part in "the work of a dye-house." As this witness had said in an address delivered to the students of the Textile Department of Leeds University: "It "was a mistake to suppose that the scientific and "technical training, however good, took the place "of the old apprenticeship system or rendered a "practical training unnecessary. A combination "of the two produced the best results, and a man "who could unite the two would undoubtedly out-"pace the man who had not had the advantages of "a scientific and technical education. The value "of a scientific and technical training could not be "overestimated, but unless it was combined with, "or was supplementary to, a practical training, it "would not have that marketable value which it "was desirable it should have, and employers "would continue to prefer the practically trained "man to the technically trained student."

Indian students recognise the vital importance of works experience.

36. We were interested to find that Indian students, who have been accused of an excessive desire to obtain degrees, diplomas, and "letters after their names," placed as high a value upon practical training as any British employer. This was especially true of the textile students who were the most competent and successful students we met. One of these at Manchester, who had had three years' experience in a cotton mill in India, declared to us that his chances of getting employment on his return depended principally upon his acquiring practical experience, and that a mill manager in estimating the value of what he had learned in England would assign 75 per cent. to his practical experience and 25 to his theoretical training.

Extension of scholarship period necessary so as to allow for whole-time apprenticeship.

37. We are satisfied that in devising the scheme for technical scholarships sufficient attention was not paid to the importance of practical training. The scholarships are tenable for a period of two years, which may be extended to three. In most cases this is only sufficient to enable a student to complete a course at a university or technological school, and it makes no provision for a period of apprenticeship. In the Scotch Universities, as at Glasgow, the summer vacation lasts for six months, and the greater part of this time is ordinarily spent by industrious students in acquiring some sort of practical experience. Useful as this sandwich system is for keeping a student in touch with the actualities of industry, it does not serve the purpose of a whole-time apprenticeship. In order to give a student a complete industrial training, he should, in our opinion, after completing his university course, be apprenticed for a period ranging from one to three years, according to the industry, with a business firm. The system of Government scholarships does not make provision for so prolonged a stay in the United Kingdom as such an apprenticeship would necessitate, and, in consequence, very few Indian students have had as much practical experience as we think desirable. One or two have obtained salaried employment in business firms and have been allowed by Government to stay on in this country because it was hoped that they would gain experience which would be valuable to them in India, but such cases are altogether exceptional and outside the scheme as devised by the Government of India; the great majority are obliged to return with very slight experience of the practical conduct of industry in this country.

Works experience for Indian students generally obtainable by organised effort, and the co-operation of broad-minded employers.

38. But here a very important question arises. Are British manufacturers willing to give Indian students the opportunity of studying the actual conduct of their business? This we have felt to be the kernel of our inquiry; it is to obtain an answer to this question that we have devoted the best portion of our time. We have found that no uniform answer can be given, as conditions vary in different industries; in some, there is an insuperable objection to admitting Indian or any foreign students inside the factory, in others they are admitted freely, in others again there is no regular system of apprenticeship, but some employers are willing, if properly approached, to admit a few Indians upon the broad patriotic ground that they are fellow-subjects. We propose to deal later on in separate sections with the different industries which Indian students have come here to study, describing the conditions that prevail, and making special recommendations with regard to each one. Meanwhile it is possible to make a few general observations. We find that in those industries in which a system of apprenticeship or pupilage is in force Indians get the benefit of it with little trouble. Where no such system exists, even British students find it very hard to acquire practical experience unless they have some private

influence. We found on the whole very little evidence of a racial prejudice against Indians. The Indian students, who upon this point must be reckoned the best witnesses, assured us that they had nothing to complain of in this respect, and particularly mentioned that they experienced very friendly treatment from the working men and operatives with whom they were thrown in contact. Commercial jealousy there undoubtedly is, but it is not directed against Indians so much as against possible competitors. We observed one encouraging symptom; even where the reluctance to admit Indians inside the factory is strongest we generally found that there were a few broad-minded men who rose superior to the common opinion, and who were willing to offer or procure facilities for Indian apprentices. It is a pleasure to record what Sir Frank Forbes Adam, for instance, has done in Manchester. By his personal influence he has succeeded in getting Indian students, who were recommended to him by friends in Bombay, into dye works, into printworks, several into mills, and one or two into engineering works, and he added that in no case where he succeeded in getting students placed in the last ten years had he any business connexion with the owner of the works. We believe we have good grounds for thinking that if a patient inquiry were made in each industry in detail it would be possible, as Sir Frank himself thought, to draw up a list of firms who would be prepared to take in a certain number of recommended Indian students every year. The time at our disposal was altogether too short to carry out a complete research upon these lines, but we made such inquiries as were possible from the representatives of different industries who came before us, and we have been able to secure from certain firms promises of co-operation which we have transmitted to the India Office. In order to make the list adequate to the demands that are likely to be made upon it more extensive research is, however, necessary, and one of our recommendations (which will be found later—page 29, paragraph 53) has reference to the preparation of a list of such firms.

39. The answer to our second question is therefore that practical experience in works is indispensable for a complete industrial training; that the period for which Indian students stay in this country is usually too short to permit them to take advantage of such practical training as is open to them; that there are industries to which they are unable to get admission as apprentices by their own unaided efforts, even if their length of stay in England were prolonged for that purpose; that a careful inquiry conducted by the India Office would probably disclose the names of some firms in almost every industry who would be ready to offer a certain number of selected Indian students facilities for obtaining practical experience. In those industries in which apprenticeship or pupilage is the custom Indian students are accepted, along with British students.

Summary of conclusions on the question, "Is practical experience in workshops and manufacturing concerns an essential part of industrial training? and, if so, can Indian students get it?"

III. Employment of scholars on their return to India: immediate results not the true test of success.

A detailed examination of the conditions prevailing in the different industries which Indian students have up to the present desired to learn will be found in chapter iv. of our report.

40.—(III.) The third question which we set out to answer was "How far have Indian technical students found employment upon their return to India?" It is obvious that the materials for a complete answer to this question can only be found in India itself. We have been able, at most, to piece together a provisional answer; this we have done by examining the information supplied to us by the Government of India with regard to its technical scholars, by consulting the report of the Association for the Advancement of Scientific and Industrial Education of Indians, by hearing the opinion of such English professors and teachers as keep in touch with their old students after their return, and by learning the views of Indian students themselves. We would, however, deprecate drawing any very definite conclusion from the experience of a few years. In education generally, and not least in this branch of it, quick returns do not form a sound criterion of success, and it would be unreasonable to expect individual scholars, however carefully selected and thoroughly trained, to make their influence felt immediately. In all industries and professions a man must work in a subordinate position before he proves his worth and commands a high salary; a technical scholar whom after years may prove to be a splendid success, amply justifying the system, must at the present time, from the nature of the case, still be in the lower grades of his profession; something like ten or fifteen years must elapse before even the first batch of scholars can become managers of large firms and captains of industry.

After-careers of returned Government scholars.

41. With this caution we may now formulate our provisional answer. On the whole we see no reason to think that technical students fail to find adequate employment upon their return to India. Out of the 66 Government scholars who have come to this country since the system was first instituted in 1904, up to 31st March 1912 only 31 had returned to India. Of these, 26 are known already to have obtained employment falling within the scope of the scheme as originally drafted by the Government of India. Of the remaining five, one is dead, one has joined the Bar, and no definite information is available as regards the other three. Of the 26 scholars who are known to have obtained employment 18 are actually engaged in industries, one is in the service of the Mysore State, and seven are holding posts under Government, two of them being members of the Geological Survey of India. It is perhaps necessary to recall that those who have entered the service of Government are not outside the scope of the scheme as originally framed. In their Despatch of 9th October 1902 the Government of India remarked: "We think "that the services of the returned scholars are "sure to be in good demand, and that, failing

" private employment, Government will be glad to " turn their abilities to account as teachers in " industrial schools or in other capacities connected " with the improvement of local industries." Those who have joined the Geological Survey of India may certainly be regarded as fulfilling a definite and practical function in the development of Indian industries, for the activity of the Department is not confined to geological surveys, strictly so called, but embraces inquiries of direct economic importance, such as gold prospecting, the examination of copper ores and coal seams, and generally the investigation of the mineral resources of India, and members of the Department (until recently under the direction of Sir Thomas Holland, K.C.I.E., now Professor of Geology at the Victoria University of Manchester) have accomplished a great deal of practical work in the development of a very important branch of Indian industry.

Government scholars who stay on in Europe or America; a contingency to be provided for.

42. Five scholars have not yet returned to India though the period of their scholarships has expired; they are either carrying further their studies by research work or by investigation in specialised lines, or they are occupying salaried positions with British or Continental firms and are thus acquiring experience which should prove of value on their return to India. At the same time, if their absence from India be unduly prolonged there is a risk that the ultimate object of the scheme—" the improvement of existing " native industries and the development of new " industries wherever possible "—may be defeated. It appears, then, that out of 66 scholars one only, as far as can be judged at present, has been a a complete failure (No. 7 in Appendix V.); he undoubtedly perverted to other uses the money which was intended for the industrial development of India, and his case constitutes the one serious blemish in the record of the Government scholars.

After-careers of scholars of the Calcutta "Association for the Advancement of Scientific and Industrial Education of Indians."

43. Of the Indian students who came to this country otherwise than under the auspices of the Indian Government we necessarily possess less information. In the report of the Association for the Advancement of Scientific and Industrial Education of Indians for 1912, there is a statement showing what the students of the Association who have returned to India are doing. That statement will be found in Appendix VI. (pp. 118–124). From this it would appear that 80 students sent by the Association abroad for industrial training had returned to India by the time of the publication of the Report for 1912. Of these, 28 had found employment in industrial enterprises, 9 had started works on their own account and 19 had entered the service of the Government of India or municipalities or Native States or were engaged in teaching; 24, the great majority of whom had just returned, did not appear to have yet found employment. In certain cases, presumably the most satisfactory, the Association publishes the salaries upon which the students were

employed; these work out to an average of Rs. 196 a month. Even allowing for the possibly optimistic views of the Association regarding its students, we have here a record of successful achievement which is very encouraging.

Difficulties of the trained man on his return to India; some signs of progress.

44. On the other hand, several competent witnesses assured us that the difficulties awaiting the Indian scholar on his return were very great. The prejudices of race and class which complicate so many Indian problems are not absent from industry. A large number of the most successful business concerns in India are in the hands of Europeans, and we were told that they were, as a rule, reluctant to offer employment to Indians; but even to this rule there are exceptions, and Sir R. N. Mookerjee told us that there were English firms in India now who were willing to take in an Indian if they could get a really good one with practical experience, and that this particular difficulty was in process of being overcome. We learned that on the Bombay side other lines of division were manifest. A Brahman from the Deccan told us that the mills in that Presidency were generally owned by Parsees or Gujeratis and that they usually gave a preference to their own people or to Englishmen. A pleasing exception to this narrow practice is that prevailing in the mills controlled by Sir Dorabji J. Tata and his family. In those mills a system of apprenticeship has been in existence for 30 or 40 years, of which more than 100 Indian lads have had the advantage; it is not confined to Parsees, and though Sir Dorabji told us that his people were rather anxious to encourage the Parsees more than others, he had always struggled against this tendency and asked, " Why should you make it only open to Parsees ?" We found that a Government scholar, a Bengali Hindu from Dacca, of whom we formed a very favourable opinion, had had the benefit of one of these apprenticeships before coming to Manchester, and when we showed his record to Sir Dorabji and asked him whether such a man was likely to find employment in India on his return, he replied, " Personally, if this man came to me, I would write " to my manager and say, 'This is the type of " 'man I like; see if you can find something for " 'him to do.' "

Views of students now under training; prospects on the whole not bad.

45. The Indian students now in England have of course some information as to how their class fellows and countrymen have succeeded upon their return to India. That information appears to show that the majority of them do secure employment; they have no doubt to wait for a while and do not always get into very satisfactory concerns at first, but yet they do make a start. A Bengali student at Leeds, for instance, told us that out of seven or eight Indians who had studied tanning with him, five or six had found employment in some sort of tan-yard in India, and the same kind of evidence was given us with regard to dye works and textiles. There appears to be a very considerable number of small industrial concerns springing up in India

which are not of sufficient importance to be tabulated in any official returns; they are concerns with a capital of Rs. 25,000 or Rs. 50,000 which employ one skilled manager and 20 or 30 unskilled labourers working under his direction. These humble concerns would no doubt bring a smile to the lips of the directors of the well-equipped and well-officered industries of this country, but we are of opinion that they perform a very useful function in the industrial development of India. The manager is himself intimately associated with his workers, and he has to supervise personally all the processes of the industry; it is he who has to see to the marketing of his finished product, and he who has to look after the accounts; he therefore learns all branches of his industry in a very direct and practical way. Though there must necessarily be many failures, a certain proportion of these small concerns will probably thrive and expand, and a few of them may become important businesses. It is only in this very modest way that the technical scholars can hope to pioneer new industries at all. To expect a young man who has just quitted a technological school to set up a new industry on a large scale is palpably absurd. Such a man has usually no capital of his own and he is very unlikely to find anyone to lend it him. If he were to find a group of misguided enthusiasts so foolish as to finance him he would most probably lose all the money entrusted to him in a year. All that he has learnt in England is a certain amount of science and its application to industry; he has had no experience in handling men; no commercial training; he has not acquired the habit of "thinking in terms of money" which is instinctive in men of business. These reflections are so obvious that they would not be worth making were they not frequently forgotten; they help to indicate, too, the kind of industries for which scholarships may be given and those for which they should not be given. There are certain industries which can only be conducted successfully on a large scale. If a particular industry of this class does not already exist in India it is obviously unwise to give a young Indian a scholarship to study the technology of it in England. But if an industry is already developed, or if it can be conducted on a small scale with fair chance of success, its expansion in India may be helped by the grant of a technical scholarship.

Small concerns afford opportunities.

"Pioneering" of vast industries by returned scholars an impossibility.

46. Our answer to the third question is therefore as follows:—Judging from the somewhat scanty and imperfect evidence before us we think that Indian technical students, provided they are properly selected and trained, usually find employment upon their return to India. We make later on certain recommendations with regard to their selection and training, which will, we hope, improve their prospects of employment, and we make other recommendations with a view to increasing their opportunities of securing a place in the established industries of India.

Summary as regards prospects of employment for returned scholars.

CHAPTER III.

General Recommendations for improving the Scholarship System.

General Recommendations.

47. We pass now to the recommendations which are suggested by the review of the existing system in the last chapter. Our recommendations with regard to each particular industry which we have inquired into, will be found in the separate sections of which the next chapter is composed; some observations of a general character can, however, with advantage be made here.

A standard of general education on the science side laid down.

48. Students sent to this country should ordinarily have read in India up to the standard of the B.Sc. or B.A. with Science, or have obtained an equivalent Diploma. Exceptions may, however, be made in favour of students who have an hereditary connexion with the industry which they propose to study, provided that they know enough English to follow lectures in this country.

Preliminary practical experience important in all industries, essential in mining.

49. Wherever possible, students should be familiar in India with the industry which they are sent here to study. In mining, this condition must in the future be strictly enforced, and no student be sent to the United Kingdom to study mining unless he has had at least a year's experience down an Indian mine. In all industries the presumption is that some previous practical experience is necessary, and the rule should be relaxed only when this presumption can be rebutted. Where such experience cannot be had in India, the question should be referred home before the scholar is sent, with a view to inquiry being made as to the possibility of obtaining it in this country.

Elasticity in the system of selection desirable; the principle of choosing the man rather than the industry.

50. There is another direction in which the selection of technical scholars needs to be improved. We understand that the present practice is that the Local Government, which has a scholarship to give, makes a survey of the industries of the Province and then decides for what industry the scholarship shall be given. One consequence of this system is, as we have already noted (page 16, paragraph 29), that candidates present themselves who have no previous familiarity with the industry; they are tempted by the scholarship, and they undertake to study the industry specified as they would undertake to abide by any other condition upon which the scholarship is granted. Another untoward consequence is that the student frequently fails to find employment upon his return to India. The Local Government appears sometimes to be influenced in its selection of an industry by the fact that the Province contains great natural resources for that particular industry still awaiting development. It is perhaps not unreasonable to assume that the grant of a technical

scholarship would be one method of forwarding the industrial development desired, but, unless it is accompanied by other measures, the effect of this system of selection upon the technical scholar himself is often unfortunate. When he returns to India he finds the industry in which he hoped to secure employment still undeveloped; there is no firm in which he can get an appointment, and, as we have previously pointed out (page 26, paragraph 45), the creation of a new industry is altogether beyond the capacity of a young man without capital and without commercial experience. We recommend that the Local Governments should from time to time adopt the alternative principle of selecting the man rather than the industry to encourage. This principle was very strongly commended to us by Sir Thomas Holland and Dr. A. D. Denning, Superintendent of Industries in Bengal; they pointed out that officials in charge of technical schools, superintendents of industries, officers of the Geological Survey, and other public servants, frequently come across young men who have given proof of mechanical aptitude and an industrial bent of mind which they have followed in spite of severe discouragement. Such men can of course only be found in industries already started or in course of development; but they are the men who would make the best use of the opportunities offered by a technical scholarship, and who would be best able to find employment upon their return; in so far as it is possible to make any forecast of the subsequent careers of young men they appear also to be more likely than any others to do creative work in the development of Indian industries.

Scholarships to be awarded after consultation with business men and Employers' Associations in India.

51. We further recommend that Local Governments should, in making selections, consult the business men and directors of industry in the Province to a greater extent than appears to have been the practice hitherto. Business men are often likely to know of a promising lad who would make excellent use of a technical scholarship; they could also advise the Local Government as to the type of man whom the industries of the Province need, and to whom they would readily offer employment. It should, we think, be possible for the Local Government to approach the Chamber of Commerce, the Millowners' Association, or other body representative of an industrial interest in the Province, and say to them "if you will indicate to us the kind of "man whom you want and whom you find difficulty "in getting, we are prepared to spend money on "training him up, on condition that you offer him "a chance of employment upon his return."

Training after selection: period to be extended so as to include works experience.

52. After making the above recommendations with regard to the selection of technical scholars in India, we pass on to our recommendations with regard to their training in this country. As will have been gathered from the review in the previous chapter, we have no suggestions to make with regard to the theoretical education they receive in universities and technological schools; the modifications

which we suggest have reference solely to their practical training. We recommend that practical training in a business firm be considered an integral part of the technical scholar's education, and consequently that the period for which the scholarship is tenable should be extended so as to cover the time spent in undergoing such training. As to the length of the extension that will be necessary, it is impossible to lay down a rule of universal application; in some industries the time that can be usefully spent in practical training is shorter than in others; it may also sometimes occur that in consideration of the work done in an Indian University a student is excused a year of his academic training, and to that extent the duration of his stay in the United Kingdom may be curtailed. In our opinion a technical scholarship should not, except in rare cases, be tenable for more than five years, and in very few cases should it be granted for less than three; whatever duration is assigned to the scholarship it should be long enough to include a spell of continuous practical training. In the next chapter we make recommendations with regard to the training required in different industries.

Method of securing works experience for Indian scholars: a matter of organisation, and dependent on the continued co-operation of British employers.

53. Our next recommendation has reference to the way in which practical training can be secured, and this, we recognise, is the most difficult part of the task entrusted to us. We consider that, wherever possible, this training should be given in the United Kingdom. We have given elsewhere (page 21, paragraph 38) our reasons for thinking that in almost every industry some manufacturers may be found who will be prepared to receive Indian apprentices. The time at our disposal has been too short to enable us to secure promises of help from a sufficient number of firms to meet all the requirements of the scholarship system, but we believe that by patient inquiry the number can be very greatly extended, and we therefore recommend that an officer or department of the India Office be specially entrusted with the task of securing, at least for Government technical scholars, facilities for acquiring practical experience. We have already submitted to the India Office the names of certain employers who have expressed their readiness upon patriotic grounds to co-operate with the Government in giving an industrial training to Indians. We think that the officer who is entrusted with the continuation of our work will find that in almost all industries there are men who will co-operate with him upon this broad ground. In Manchester and other places, where trade jealousy is strong, the obligation to help India was generously recognised by individuals. Mr. Levinstein, for instance, said "We do not want Indians, but "there is a certain amount of patriotism, and we "will help England to help India." Sir William Mather was of opinion that there is no hope of success except by an appeal to patriotism, "I do not think," he said, "it is possible to meet "the case except by the Council of India in "London making it a matter of patriotic duty on

" the part of employers in certain industries to " contribute to the welfare of India by affording " opportunities for some of these well selected " young fellows." We believe that by careful and continued inquiry it may be possible to frame for every industry of importance a list of broad-minded employers who will undertake to receive Indian scholars in their works and who will take a pride in turning out well-trained and accomplished men. The spirit in which Mr. Levinstein approached the subject may well be quoted as a model for wider imitation. " If," he said, " I know " an Indian is coming to me who means afterwards " to go to a dye house or print works, I would give " him the kind of research work which would be " in harmony with the future of the man, viz., " research work connected with dyeing, printing, " bleaching . . . . I am not going to put " him to work which is useless to him afterwards."

Responsibilities of firms holding contracts from the India Office.

54. We have hope that by sustained inquiry and by the help of the gentlemen who have already promised to co-operate with the India Office it may be possible to draw up a list of firms willing to admit Indian students, and that this list may be large enough to provide facilities for all Government scholars. Should the appeal to the patriotism of British manufacturers meet with less response than we expect, it may prove possible to exercise influence through the Stores Department of the India Office. It must be remembered that the India Office purchases goods from the United Kingdom to the value of about 3,500,000*l.* per annum for the Indian Government, and has therefore a right to expect that those who benefit by this valuable custom should give its suggestions very friendly consideration. We recognise that it is the duty of the Stores Department to obtain for India the best goods at the lowest possible price, and that in accepting or rejecting a tender the only questions to be taken into account are quality and price; but when the contract has been settled, it would not, we understand, be an unwonted departure from business habits for the purchaser to say that he desired to obtain practical training for one or two young men, and that he would be glad if the manufacturer would take them into his works.

Due notice to be given by the authorities in India of the grant of scholarships.

55. In view of the fact that facilities for practical training can only be secured by negotiation with individual firms, we recommend that the Government of India should give the India Office notice at as early a date as possible of the Technical Scholarships which they propose to award. Cases have occurred of students being sent home to pursue a course of study for which, it was afterwards found, neither the Universities nor Technological schools make any adequate provision; even when academic instruction can be given, manufacturers may not be willing to offer facilities for practical training, but this cannot be ascertained without an investigation into the custom that prevails in the particular industry, and such an investigation may often require considerable time.

When therefore the Government of India desire to give a scholarship for an industry in which no Indian student has yet been trained, we recommend that inquiries should be addressed to the India Office, and that the scholarship be not awarded until it is ascertained that facilities exist for giving an Indian student a complete training in that branch of industry. Previous inquiry and early notice are of course less necessary in the primary industries, for these have already evolved something akin to a system of professional training.

Question of reducing the scholarship allowance.

56. We recognise that the allowance of 150*l.* a year, which Government technical scholars receive, places them in a somewhat better financial position than the majority of their class-fellows, but as the expenses of living are inevitably somewhat greater for a foreigner than for a native of this country, we do not recommend any reduction, nor will it, we think, be possible ordinarily to reduce the allowance during the years of apprenticeship or pupilage. As, however, some employers hold the opinion that it is a disadvantage to an apprentice to have so large an allowance as 3*l.* a week, we recommend that power should be taken to reduce the scholarship when necessary, and the scholar be warned that this may be done. In each case we recommend that the amount of the allowance be settled in consultation with the employer.

Revision of the Rules for Government scholars: obedience to the India Office, and and to employers and foremen during works training, to be strictly enforced.

57. We think that the rules laid down by the India Office for the guidance of Government technical scholars stand in need of revision, and we recommend that a new set of rules be issued, in which, among other things, the duties of the scholar towards the employer with whom he is apprenticed should be clearly stated. When a firm has undertaken to receive a technical scholar in its works, it is of paramount importance that it should have full control over him; it must be in a position to direct the young man to do what work it thinks best, and to exact absolute obedience to all orders and unfailing punctuality. Students from the technological schools and universities are apt to think that they are in a position to judge what sort of work will give them the most valuable experience and to resent being set to do menial work. It is important that they should get these notions knocked out of them, and understand that they are, for the time being, in all respects workmen. If Indians are to have practical training they must take it upon these terms, and be prepared to clean the machinery and the tools they have to use, and in every respect to carry out the instructions of the foreman to whom they are immediately responsible. We recommend that the revised rules should make it clear that the technical scholar must do work of this kind if so directed, and that the employer to whom he is apprenticed may exercise over him for the time being all the powers of the India Office; failure to give satisfaction to the employer will expose him to the risk of forfeiting his scholarship and his return passage to India.

58. The present rules are further defective in that they do not provide any guarantee that the scholar shall return to India after his industrial training has been completed. One case has already occurred of a student refusing to return to India unless he was provided with a Government appointment; we heard in the course of evidence that another is doing so well in America that he is unlikely to go back to India; a third is making a comfortable living in Europe, which he may not care to exchange for the uncertainties of an Indian career. We recognise that salaried employment in a European or American firm may supply valuable experience to an Indian, and we would not insist that a scholar should always return to India immediately upon the expiration of his scholarship, but there is a danger that he may stay too long, and even that India may lose altogether the advantage from having trained him. We therefore recommend that all Government technical scholars should execute a bond undertaking to repay the value of their scholarship if they fail to return to India within three years after its expiration.

Return to India within a specified period to be required, security being taken before the scholarship is awarded.

59. We have recognised in the last chapter (page 25, paragraph 44) that Indian technological students do find some difficulty in securing employment upon their return. We suggest that the Government of India might bring this fact to the notice of the Indian mercantile community, and appeal to them to co-operate with Government by giving friendly consideration to the claims of trained men. An Indian student suggested that such an appeal should be directed to the Bombay Millowners' Association, and added, "If people do care for technical education, it "is their duty to find something for their own people "whom the Government is trying to educate"; and this argument seems to us to have great force. We understand that the suggestion has been made that the Provincial Advisory Committees in India should take up the duty of Appointments Boards, and should help to find employment for the Indian students whom they originally recommended for education in Europe. We think it desirable that some local manufacturers and employers should be appointed to the Provincial Advisory Committees and be asked to co-operate in finding employment for those technical scholars who return to India with good credentials.

Measures for assisting returned scholars to secure employment: existing Advisory Committees might act as Appointments Boards in India.

60. We have had some difficulty in obtaining information about the subsequent careers of the technical students who have returned to India; no systematic effort appears to be made to keep a record of their doings. Our final recommendation therefore is that the Government of India should send to the India Office regular reports upon the technical scholars who have returned to their own country, showing how they are employed and what salaries they are drawing.

Record to be kept of the after careers of Government scholars, and regular reports to be sent to the India Office.

61. The general effect of our recommendations will, we recognise, be to increase the cost to Govern-

Financial effect of recommendations.

Only the *élite* to be trained at the public expense.

ment of the system of State technical scholarships. This additional expenditure will however be amply justified if in consequence of the changes we propose the men are better selected and better equipped for the work they have to do. Indeed the expense of technical scholarships cannot be defended at all unless they give the best preparation possible for the highest kind of industrial work. The ideal training for an industrial career is both lengthy and costly, and for this reason it should only be given, at public expense, to men of quite exceptional capacity. The average man, who can never be expected to do more than carry on well-known industries by well-known methods, can be trained in India; if he is trained in England it should be at private expense. But when the best men, as far as human foresight can discriminate, have been selected, it is false economy to give them any but the very best training.

CHAPTER IV.

Recommendations regarding Particular Industries.

62. We now proceed to deal with particular industries falling within the scope of our inquiry.

Particular Industries.

Engineering.

Engineering—General Summary.

63. Of all the industries which we have examined, engineering is the only one that possesses the rudiments of a professional system of training; even this, however, is far from uniform; every engineer and every works have rules which are individual, although conforming in general to an ill-defined system. Twenty years ago there was no recognition, on the part of the profession, of college courses; in fact, there were few college courses in existence as we know them to-day. But concurrently with the development of the great engineering schools and colleges which has taken place in recent years, there has been a gradual change of attitude on the part of professional engineers to the value of a college training, and it is in part due to the growth side by side of the means of teaching and the readjustment of ideas of the newer generation of employers that there are so many different apprenticeship rules in existence. The more conservative members of the profession cling to the old methods and incline to a prolonged period of practical training with a relatively short college course. The more advanced members give greater weight to a college training, and it is more and more being recognized that competition with our neighbours can only be met by combining a college training in engineering science of the highest possible type with a practical training either in the works of a manufacturing concern or on the works being carried out by a civil engineer. Many leading civil engineers demand a year or more in a manufacturing concern before they will take young men on to their constructive work to begin their practical training as civil engineers.

The ideal training for an engineer.

64. The Committee appointed by the Institution of Civil Engineers in 1903 (to which reference has already been made in Chapter II. page 15, paragraph 26) to inquire into the subject of the training of Engineers, reported in 1906, and the Report is printed in full in the Minutes of Proceedings of the Institution of Civil Engineers, Vol. CLXVI., 1905–06, Part V. This Report may be accepted as an authoritative expression of the opinion of all branches of the Engineering profession. The recommendations contained in it may be summarised as follows :—

(1.) An introductory workshop course of at least one year in mechanical engineering workshops for all students, including those who intend ultimately to specialise in mining, electrical engineering, civil engineering, and, in fact, every branch of engineering; during this introductory course the student should be treated as an ordinary apprentice and should keep regular hours, be subject to discipline and be paid wages.

(2.) A college course of normally three sessions; stress being laid upon the necessity of a sound and extensive knowledge of mathematics in all branches of engineering.

(3.) Two or three years' practical training, subsequent to the college course, in workshops, or on works, or in mines; it being particularly desirable that part of the time should be spent in the drawing office.

Particular Industries—Engineering —*cont.*

Training of Indian scholars must follow the approved practice of the profession in the United Kingdom.

65. The evidence given before us in the course of our inquiry was almost without exception in harmony with these recommendations; different individuals, whether representative of mechanical, civil, or electrical engineering, successively outlined to us ideal schemes of training, which were in essentials identical with the course recommended by the Institution of Civil Engineers.

66. In order, therefore, to provide Indian students with the best possible course of engineering training the India Office must base its regulations upon the general trend of professional opinion as it has been authoritatively codified by the Institution of Civil Engineers.

Preliminary workshop course in India recommended.

(i.) The preliminary workshop training is probably more important for Indians than for Englishmen, seeing that very few Indian lads have the opportunity of becoming so intimately familiar with machinery as residents in the manufacturing towns of England generally are; the former rarely see any engine but a passing locomotive, the latter are surrounded by machinery of every description from their childhood. We recommend therefore that all scholars in engineering of whatever branch should receive a year's preliminary workshop course in a mechanical engineer's shop in India. If such facilities cannot be obtained from a private firm, they should be given, at least for Government scholars, in the workshops attached to the railways owned by Government.

The college course: a higher standard maintained in English and Scotch Universities as compared with colleges in India.

(ii.) The second question is where the Indian student shall take his college course. We were given to understand by English and Scotch professors of engineering who had had under them students from Rurki and Sibpur, that the standard of engineering instruction in India, especially in mechanical and electrical engineering, is not at the present time as high as the corresponding standard in this country, and therefore for some time to come it may be necessary for the Indian student, who desires to get the highest possible training, to come to this country and enter one or other of our colleges. Before he comes he should have received a training in mathematics, physics, chemistry, and engineering-drawing, of a sufficiently advanced character to enable him to join the second year

class at once. The Indian universities could greatly facilitate the careers of these men by supplying them with authoritative certificates showing in what subjects they have passed the B.A. and intermediate examinations. The head of an English College has no means of ascertaining, from the certificates now given, whether a student has passed in science, and is therefore qualified to attend a course of engineering, or whether he has passed in philosophy and an Oriental classic, and is therefore totally unqualified. All Indian students who wish to attend an engineering college in the United Kingdom should receive special instruction in mechanical drawing and descriptive geometry in India.

A thorough grounding in specified subjects to be given before the scholar leaves India.

(iii.) The part of the course which requires special organisation is the two or three years' practical training after college. In order to understand the system into which Indian students have to be fitted, some description of the manner in which practical training is usually acquired in this country seems desirable. The practice differs to a slight extent in different branches of engineering.

Works experience as an integral part of an engineer's training: the practice in this country.

The young men receiving practical training in the workshops of the mechanical and electrical engineering firms of this country may be classified in three divisions, namely :—

1. Apprentices.
2. Premium apprentices.
3. Pupils.

Mechanical and electrical engineering three classes distinguished, (1) apprentices, (2) premium apprentices, (3) pupils.

Class 1.—In some cases there is a sharp division between these classes. For instance, in one large works employing about 7,000 men, the sons of the workmen are apprenticed to specified trades in the works, and during the whole period of their apprenticeship, from the age of 14 to 21 or 16 to 21, as the case may be, the apprentice of this class is kept at one trade. Thus he may learn to be a fitter, or a turner, or a boilermaker, or a coppersmith, or a pattern maker, or a moulder, or a smith, in fact, he becomes a craftsman in one particular trade. He pays no premium on entry and receives a commencing wage of about 5*s.* per week, increasing annually to about 21*s.* when he is out of his time. After this he may leave and obtain employment in another firm where he would probably receive the trade rate ruling in this particular craft, which would range between 36*s.* and 45*s.* per week for the crafts mentioned above, according to the district in which the works happen to be situated.

Class 2.—The premium apprentice in the works under review pays a premium of 60*l.* to the firm. He enters at 16 and is put to work in the machine shops, and later in the fitting shop and the erecting shop. He thus learns how the parts of an engine are machined, in fact he is put to work at all kinds of machines whilst he is in the machining department, and later he learns how to fit the parts together, and later still how to erect these fitted and machined parts into an engine. The premium apprentice gets a small wage to begin with and the rate increases to

about 21*s.* per week when he is 21. No guarantee of employment is given to him and usually he would leave to find employment with another firm. A good man might of course be kept on. He is subject to the same discipline and keeps exactly the same hours as the workmen.

The difference between apprentices of these two classes is that the premium apprentice is put through more than one department, and as a rule comes from a different social class. A premium apprentice nowadays sometimes gets a college education before he goes to the works, and sometimes after, but more often he relies upon evening study.

Class 3.—Some firms take a limited number of pupils, and this privilege is generally extended to the Chief Engineers of Public Companies. Pupils stand in a direct personal relation with the firm or the engineer. They receive no wages, but pay to the firm or engineer an annual fee of from 100 to 150 guineas. They are employed for a few months in each of the important departments of the works, and they are sent to the drawing office as a matter of course. With Class 2 apprentices, it is a matter of luck or influence or some special determining factor that gains them admittance into the drawing office. Drawing office experience is fundamentally important because it is in this Department that the actual designing of the engines and machinery is carried out. It is the brain of the whole works.

The distinctions described above are not universally recognised. There is always the workman apprentice. But in some workshops Classes 2 and 3 merge into one another. The rules in many firms now begin to show recognition of college training. In one firm whose rules were specially brought to our notice there are no premium apprentices or pupils, but admission to the works is based on educational qualifications alone, and we understand that there are many firms of repute that make similar provision in their rules.

Civil engineering—the "pupil system."

For practical training in civil engineering there is only one system in vogue, namely the pupil system. The pupil is employed partly in the drawing office and partly on the works, and aims eventually at securing a post of "Resident Engineer" on a works. For instance, if a dock is being built the design is made by a civil engineer for the Dock Company, and the engineer acting for the Company arranges the necessary specifications and makes the necessary drawings, and then tenders are invited. The successful contractor then proceeds to build the dock under the supervision of the engineer. The contractor is paid, as the work proceeds, only upon the signed certificate of the engineer. During the whole progress of the work the engineer will have one of his staff on the works, the "Resident Engineer," who acts for the engineer in everything. The engineer's pupils are down on the works with the Resident, and thus become familiar with the contractor's way of carrying out the work. There are many cases where young men go direct from college

into an engineer's office, and at once begin work on designs, or at once begin with the preliminary surveys on the ground, but as a rule a good deal of influence is required to get a youth into a good office without a premium.

67. We now proceed to discuss how far this system of training can be made available for Indian students.

Application of the system to Indian students.

Mechanical Engineering.

Mechanical engineering: list to be kept by India Office of firms willing to train Indian students as apprentices and to arrange, if necessary, for their college courses.

We find that in this branch of engineering Indian students have in the past frequently had opportunities for practical training given to them. This has especially been the case in Glasgow where the Engineering Faculty of the University has ever since its creation been in close touch with the engineering firms on the Clyde; the consequence has been that the professors have been in the habit of giving to their pupils letters of recommendation which enable them to get admission to workshops during the six months' vacation. Indian students have had the benefit of these recommendations along with their Scotch and English class-fellows. We were warned that it is growing more difficult to get all students into works because of the great rapidity with which the engineering classes of the Glasgow University have increased of recent years; obviously the manufacturers of Glasgow cannot provide training for an unlimited number of students, and we gather that they have now rather more applications than they can satisfy. It appears that it is more easy to become an apprentice for two or three continuous years than for short spells of a few months, and Indian students have occasionally failed to secure admission to works because they were unwilling to undertake to stay for the full term for which the employer was prepared to take them. We were assured that the India Office would find no difficulty in securing admission for a limited number of scholars as apprentices for two or three years, and we have obtained from several firms, both in England and Scotland, definite promises to give Indian students facilities for practical experience. It should be understood, however, that no firm surrenders its right to accept or reject a candidate for apprenticeship; the candidate will be sent by the India Office to the firm, and this introduction will secure for his claim favourable consideration, but he is engaged on his personal merits alone and not on the strength of an official recommendation; as to his suitability for admission the firm decides after personal inspection.

We have received some evidence to the effect that it is best for a student to be apprenticed to a firm immediately on arrival in England; in this case the firm will decide whether or not it is desirable for its apprentice to take a University course; after a short experience the firm may decide that this particular apprentice would profit by a course of scientific study, and would send him to a university or technological school; in this case, being on the books of the firm, he would

return to it during the vacation, and, on the completion of his academic course, for the remaining two or three years; and he would be looked upon throughout as an apprentice and not as a student. We recommend that where a manufacturing engineer is prepared to assume the whole responsibility for the education of his apprentice, this course should be followed.

Electrical engineering: the same system applicable, but advanced knowledge of mathematics essential.

Electrical Engineering.

68. The remarks that we have just made regarding mechanical engineering may be applied with but little modification to electrical engineering. No Indian student should attempt to study electrical engineering unless he has read up to the B.A. standard in mathematics. We have had from one manufacturer of electrical plant in Scotland an offer to take two Indian students a year. The course sketched would usually be somewhat as follows:—After being personally selected by the firm they would sign on for five years, they would start work with the firm in summer and go on to the University in the winter, returning to the firm in the summer, and continue such alternations of theory and practice until the University course was completed, after which they would work continuously in the several departments of the firm for two years. We believe that other firms of electrical engineers would be willing to take well recommended Indian apprentices upon the same terms, for we find that Indian students have either by themselves or with the assistance of their professors been successful in obtaining short spells of practical experience in the past. As far as we have been able to ascertain, the premium usually asked is 150*l.* for the whole period of apprenticeship; but there are firms of repute that do not demand a premium. We are of opinion that the system of apprenticeship to a firm which allows the apprentice to take a University course offers the best education in electrical engineering available in this country, and we recommend that it be adopted for Government scholars, and the scholarship extended so as to be tenable for five years or such other period as the apprenticeship lasts.

Civil engineering: better opportunities for practical training exist in India, especially on State railways.

Civil Engineering.

69. Civil Engineering was specifically excluded from the system of Government Technical Scholarships, but we find that many Indian students have come to this country on their own account to be trained as Civil Engineers. They find it very hard to get practical training, not because there is any prejudice against them but because there is very little new work to be done in England; the railways, roads, bridges, docks, and harbours of the country have all been built, and only a comparatively small staff is needed to keep them in repair. But there is a great deal of new work being done in India, the great bulk of which is controlled by the Indian Government, and we recommend the Indian Government to consider whether facilities might not be given to Indian students to obtain practical experience in

their own country. It is conceded on all hands that there is enormous scope for civil engineering in India, and that, owing to lack of funds, Government can only undertake a small part of the work which needs to be done. The growth of an independent engineering profession would probably assist in getting this work done outside Government; Indian engineers might prove more successful than Englishmen in pointing out to landowners and municipalities or other Indian capitalists the financial advantage of engineering works. It appears to us that it would be sound policy for the Government to offer facilities to Indian engineers, whether trained in England or India, for acquiring practical experience. It was suggested to us by Mr. Brereton (Government Director of Indian Railways) that the proper way to do this would be to allow engineers of the Public Works Department who were in charge of works of construction to take a certain number of premium-paying pupils. In view of the difficulty which civil engineers experience in getting practical training in England, and of the desirability of encouraging the growth of an independent engineering profession in India, we recommend that this suggestion be carefully considered by the Government of India.

Engineers in the Public Works Department might take premium-paying pupils.

In the specialised branch of Civil Engineering known as Sanitary and Municipal Engineering, good courses are given at the Manchester School of Technology and at University College, London, and practical experience can, we understand, be obtained without difficulty.

Sanitary and Municipal engineering: special facilities available in England.

Mining.

70. We discovered that at the time of our inquiry an acute controversy was in progress among experts as to the proper training of a mining engineer. Sir Thomas Holland, in a public speech, had put forth the view that the proper training for a mine manager was actual work in a mine, supplemented by evening classes at the colliery centres, and that the University classes were usually failures. Sir Thomas developed this view to us and said that, in the present condition of Indian mining, evening, or out-of-shift, classes at certain mining centres gave Indian students all the training that they needed, and roundly declared that a University education was of little use to the practical miner.

This opinion has been strenuously disputed, and the two points of view are set out in detail in Appendix VII. (pp. 125—130).

Mining: controversy as to the comparative merits of University training and evening classes in mining centres.

71. As the experts disagreed we submitted the point to Mr. R. A. S. Redmayne, His Majesty's Chief Inspector of Mines. He expressed a decided opinion in favour of University training:—

"The old idea, which we may call the rule-of-thumb idea, is that a man is much better employed at work in a mine and attending evening classes. All I can say, as a man who has worked as a workman, is that it is utterly impossible for a man

Opinion of His Majesty's Chief Inspector of Mines.

who is dog-tired to go home and set to work on science applied to mines; it is not impossible to learn something, but it is quite impossible to set to work on very serious brain-racking study. That class of teaching was quite advantageous, and is to a certain extent advantageous now, for elementary mining and a knowledge of the properties of mine gases—the detection of gas, simple questions of the strength of materials, and so on . . . . but now it is quite hopeless for a man to be an efficient mining engineer unless he has had a high education. I do not see how that education can be obtained unless a man has had a thoroughly good technical education at a University, of the kind that they insist on in America." Mr. Redmayne went on to give instances of the development of South African mines under men trained in American and Canadian Universities, and added: "Nobody has a stronger "belief in the necessity of a practical mining "education than myself—I had many years of it "underground myself—but I do think the only "proper combination is a combination of theory "and practice, and I think you cannot get "your theory better than at the best mining "departments in this country."

Opinion of Professor Cadman.

72. A similar opinion was expressed by Professor J. Cadman, D.Sc., of Birmingham University, who said: "I am entirely opposed to the view that "efficient mine managers and mining engineers "can be trained by evening instruction alone; "evening classes are in my opinion only suited, "and indeed eminently suited, for the instruction "of subordinates. . . . . I entirely and "emphatically disagree with the view that a mine "manager is made only by a long and often "painful practical experience, and that therefore "Universities ought not to, and could not, compete "with evening classes of technical schools. . . . "I have managed mines, and am still connected "with the direct management of mines, and I say "with absolute confidence that the successful mine "manager and mining engineer of the future is the "man who has a sound University education, "together with a sound practical training. . . . "In my opinion it is imperative that carefully "selected Indian mining students should be sent "to this country for instruction, particularly until "such time as Indian mining is more fully "developed; to qualify students in a country "which is developing is really driving the cart "without the horse. You want to send the students "to an area where there are active mines and mines "of a very much better order than the small mines "at present in operation in India."

State scholarships in mining to be continued, subject to more stringent conditions of selection.

73. After carefully weighing the evidence laid before us, we consider that the policy of sending students to this country for the study of mining should not be abandoned; but there is a consensus of opinion that scholarships in this subject should only be granted to men who have had considerable practical experience in Indian mines. In the past too little attention appears to have been paid to

this point; some of the Government scholars have arrived in this country without ever having seen a mine, and therefore without the slightest idea as to the conditions of work underground. The result has been that after they have been here a short time, and have been down into the mines, they find that they do not like mining, and endeavour to change their course to geology or some other more congenial subject. If sanction to change the subject of study is refused, their interest is not in their work, with the result that they sometimes fail to get the mining diploma or degree, and have to return to India very little better qualified to take any responsible position than when they first arrived in this country.

Previous experience of work underground indispensable; a consensus of opinion.

74. It has been urged by all the experts in mining from whom we have taken evidence that at least one year's actual experience of work in Indian mines should be made a *sine quâ non* of the grant of Government Scholarships for the study of mining. In this connection we may quote the views of Professor Latham (Professor of Mining, Glasgow University), who said:—

"What I would recommend the Indian Govern-
" ment to do is to send these men to their own
" mines for, say, a year, and after they have proved
" their ability, to send them over here."

Again, Sir T. Holland said:—

"The first thing the student notices on going back is that the tips he has picked up in Europe are of no use to him in India. If he were a practical man beforehand, he would be able to turn those ideas to account; and in fact every lecture he attends he would be saying to himself, 'this just 'fits in with the conditions in my home or my 'village. Now I know exactly how to do my work 'a little better than I did before.' But without that previous practical training, it is quite hopeless for a student to apply his training in Europe at once to conditions in India."

Professor Cadman, of Birmingham University, who has had a considerable number of Government scholars under his charge, was equally emphatic. "The Indian scholars in mining find
" that they are unable to obtain employment in
" mining on their return to India. The reason
" is largely due to the defective system of
" selection. The students are recruited from
" candidates who are in no way associated with
" mining before leaving India, are not known to
" any mine owners or mine officials, and indeed, in
" many cases, have never seen or been connected
" with a mine before taking up the scholarship."
. . . . "It is my opinion that if the students
" were recruited from persons actually connected
" with Indian mining, there would be no difficulty
" in their obtaining re-employment on their
" return."

Effect of this test in eliminating the unfit.

75. The advantages of previous practical experience in India appear therefore to be—

(i) Students whose interests do not lie in mining or who are physically unfitted for work underground will be eliminated during the period of probation in India;

(ii) The students will be better able to adapt English methods to Indian conditions and to apply the knowledge they acquire here more readily on their return;

(iii) Having been in touch with Indian mine managers and owners, they should find less difficulty in securing employment on return, in the first instance in some subordinate capacity, for such period as may be necessary for qualifying for the mine manager's certificate under the Indian Mines Act.

Abundant facilities for practical training in English mines.

76. It should be added that the question of obtaining practical experience in mines in this country for scholarship-holders does not present serious difficulty, owing to the close relations which exist, at Birmingham and elsewhere, between the professors of mining and local mine owners and managers. Evidence was given by Government scholars, now under training at Birmingham University, that they had no difficulty in securing admission during vacations to as many mines as they wished, and that the miners themselves were helpful and friendly.

Further practical training needed, to supplement the University course.

77. It is recognised, however, that the period spent in mines during vacations is insufficient. A suggestion was made that Government scholars should spend a continuous period of at least 12 months in a mine in this country subsequent to their University training. This suggestion met with the approval of Mr. Redmayne, who thought that this arrangement would enable the student to learn the best possible underground mining practice. We were informed of an arrangement by which a student might be apprenticed to a mining engineer, and on payment of a premium be put through all branches of the mine. We consider that in some cases it may be desirable to extend the period of the scholarship in order to include a pupilage of this kind, but ordinarily we think it will be better for the scholar to obtain the practical part of his training in India.

Summary of recommendations in regard to mining scholars.

78. Our recommendations therefore in regard to the grant of scholarships in Mining, as distinguished from Geology, are—

(i). that they shall only be given to men who intend to become mine managers or mining engineers;

(ii). that in every case the candidate shall have actually worked for at least one year in an Indian mine—preferably in a paid position;

(iii). that a specially strict test of physical fitness shall be imposed on candidates before selection;

(iv). that the candidate shall have reached at least the Intermediate Science standard, and shall have a competent knowledge of physics, chemistry, and mathematics;

(v). that the period of the scholarship shall be extended, when the Professor under whom the student is working considers it desirable, so as to include a period of continuous practical training in an English mine.

Geology.

The mining geologist or prospector; general qualifications required and course of training outlined.

79. The above considerations apply only to the case of students intending to become mine managers or mining engineers. There is another quite distinct class of mining expert, namely, the mining geologist or prospector. The latter is described by Sir T. Holland as "the economic mineralogist who "wants to know enough of mining methods to "know whether a mineral can under certain "circumstances be worked with a fair prospect of "profit. He wants to know more than one mineral. "He is not like the mine manager who knows only "his one mineral and knows it thoroughly; the "mining geologist wants to know the habits and "economic problems of several minerals. He does "not want to handle fans, dynamos and every "other variety of mining machinery. He wants to "know just as much about mining methods as to "be able to put down his own prospect pits, to "size up the situation generally, and make his "own surveys with regard to new mining pro-"positions." . . . "The mining geologist "requires more of the so-called scientific training "and less familiarity with the actual methods of "mining. . . . His training can be given in "technological institutions supplemented by a "comparatively short experience in various types "of mines." We have it in evidence from Sir T. Holland that for the training of experts of this class better facilities exist at present in Europe than in India. It may be desirable, therefore, to make provision in the scholarship system for the training of mining geologists, but in this case the qualifications required are somewhat different, and consist of a knowledge of economic geology supplemented by some experience of surveying and general mining methods, such as might be obtained by a pupilage in the Department of the Geological Survey of India. Special arrangements are now being made for the training of such experts under Sir T. Holland at Manchester University.

Metallurgy.

Metallurgical industries; Professor Turner on the record of past scholars, and the facilities available at Birmingham.

80. The leading considerations as regards Indian students of Metallurgy are succinctly stated by Professor T. Turner, of Birmingham University, as follows:—

"The Indian students who have attended in the Metallurgical Department of the University of Birmingham have generally been quite satisfactory in regard to regularity, conduct, and progress. They are, however, generally rather below than above the average in strictly metallurgical work. In assaying, where careful routine work is necessary, Indian students are probably equal to the average.

The importance of physique and of previous connexion with some metal trade, however primitive.

But no native Indian student has yet headed an examination class list, or been chosen as a "shift leader" in the vacation practical courses. It is doubtful if the best type of man has been selected for the purpose. In England, as a rule, a metallurgical student has some family or other interest in metallurgy or the metal trades. This helps him in many ways. He has a pride in his subject and his future profession; he has the opportunity of visiting metallurgical works, and not unfrequently he has a definite position in view when his training is completed. The question of physique also is important in metallurgical industries. The managers must be prepared in many cases, when emergencies arise, to work for lengthened periods in heat or cold, and by their example lead and stimulate the men in their exertions. The power to do the right thing quickly may save expensive equipment or valuable lives. In this initiative and resource the native Indian student appears to be lacking. In practical courses he generally stands by and looks on as though it were all a demonstration prepared for his instruction, instead of a real thing in which he has to take part.

"The development of the metallurgical resources of India should come largely through British-trained Indian students. These students should be physically well developed, and, if possible, either connected with the industry in some way, or with a definite prospect of employment on their return to India. The training could then be somewhat modified, in their final year, so as to meet the needs of any special case. It is impossible to give a course of training which will equally well fit a man for an ironworks, a brass foundry, or a gold mine.

"Hitherto opportunity has been found for the Indian metallurgical students at Birmingham to supplement their University education by practical experience in large manufacturing establishments. It has been done by means of application from the Professor among his friends and acquaintances. As a number of English students have to be similarly provided for, such a system of gratuitous training cannot be indefinitely extended. Further, English students are preferred to Indian students, as they may ultimately enter the works. Doubtless, extended facilities could be obtained for Indian students if important firms were officially approached, and if a fee of, say, one guinea per week, were offered in approved cases."

Recommendations as regards scholarships in metallurgy.

81. It will be seen, therefore, that the same importance is attached as in the case of mining to previous experience of metal industries, and a knowledge of even primitive processes is of great assistance; students who have no previous experience of metallurgy should be sent for some months to metal works before the scholarship is granted to them.

Here also physique is of vital importance, and, if possible, an indication should be given of the branch of metallurgy which the student intends to take up on his return, in order that his course of training here may be specially modified to meet his

particular requirements. We also recommend that in special cases the scholarship should be extended for a fourth year, so as to allow a year of postgraduate specialised training. Whether the University course extends over three or four years, it should be supplemented by practical training in large manufacturing establishments; for such training arrangements must be made by the India Office with individual firms, as suggested by Professor Turner.

The Textile Industries.

The textile industries.

82. Of the 66 scholarships which had been granted by the Government of India up to 31st March 1912, 24 were awarded in the subject of textile manufacture.

The study of textile manufacture embraces not only the fundamental processes of spinning and weaving, but the further treatment of the fabric by bleaching, finishing, mercerising, dyeing, or printing. Some of the scholars have spent part of their time, and one or two the whole of their time, in studying the latter processes, whilst the majority have given all their time to the study of spinning and weaving.

All the Government scholars in textile manufacture, no matter in what branch, have carried on their studies in the Manchester School of Technology and devoted themselves, except in two instances, where silk manufacture was chosen, to the study of the manufacture and subsequent treatment of cotton goods.

Spinning and weaving; the admirable record of Indian Government scholars.

83. It will be convenient to deal first with the subject of spinning and weaving, in respect of which the Committee had the advantage of the written and oral evidence of Professor T. W. Fox, the head of the Textile Department of the Manchester School of Technology, who has been in close relations not only with the scholars sent by the Government of India, but also with a further considerable body of Indian students since 1903.

As a rule they have come to the spinning and weaving department with fairly good practical preparation; referring to the whole body of Indian students, 42 in number, including the Government scholars, who have come into the department since 1903, Professor Fox said: "Five have been first "class men, nine second class men, and eleven "third class men, the remainder being below the "average European student." Four of the first class men were Indian Government scholars, and one of them, Mr. P. N. Mehta of Bombay, "was "exceptionally good and was easily the best man "of his year" . . . . "His position was, "apart from his natural ability, due to a wide "experience gained in Indian mills before taking "up the Government Scholarship." "He was the "ablest Indian student who ever entered the textile "department of the Manchester School."

Mr. J. Hübner, the Director of the Department for Bleaching, Dyeing, Printing and Finishing, and Paper Manufacture in the Manchester School of Technology, said that among the Indian

scholars he had found "some very brilliant and "some very good students, together with some "poor ones," and Dr. E. Knecht, the Head of the Applied Chemistry Department, stated that his impression of the Indian students has been that "on the whole they are satisfactory students."

Importance of previous works experience; some examples of this among Government scholars.

84. The importance of previous practical experience before entering upon theoretical studies was strongly advocated by all the witnesses. Mr. T. Butterworth, of Messrs. Butterworth and Dickinson of Burnley, textile engineers, stated in his evidence that "these students would learn more during "their time in the school if they were sent to a "weaving shed in their own country first."

Mr. Sarabhai, mill-owner of Ahmedabad, gave it as his opinion that "it would be better if the "scholars came here (to England) after receiving "some practical training in India" . . . . "They should work for a couple of years in a "mill in India, and then come to England."

Mr. Gurjar, one of the present Indian Government scholars, said that before coming to England the student "should have some technical education "in India so that he will not come to this country "to learn the A.B.C. of technical subjects," and that he should have some practical knowledge of the industry, serving in the mill as apprentice.

The value of previous practical experience is well illustrated in the case of Mr. Gurjar now studying finishing processes as applied to cotton cloth, at the Manchester School. He was able to discern the fundamental difference between Indian and English cloth arising from the character of the staple, and to point out that the process applied to English goods would not produce a satisfactory finish in India. Being a man of marked ability he applied the knowledge of finishing processes which he has gained in the School to the special problems of Indian cloth.

Mr. Guha, another of the present Government scholars, further emphasised the importance of previous practical training, stating that "if a "student is to come here to learn textiles he "should have a previous training in mills in India "so that he can compare the conditions of the "industry in England with those of India, and "adapt the English system to Indian conditions, "because everything that is applicable in English "mills is not applicable to Indian mills."

Practice of German institutions.

85. Evidence was placed before the Committee that in the German Technical High Schools, notably Charlottenburg, it was now required that a student should have had at least a year's experience in a works before entering upon his technical studies.

Standard of general education and physical fitness prescribed.

86. The evidence offered throughout the inquiry emphasises the importance of a rigorous selection of the scholars in respect of the quality of their previous general education, which should at least reach the standard of Intermediate (in science) followed by a sufficient period of practical training in the industry concerned to test the mental and

physical fitness of the candidate, so that he may follow with advantage the course of theoretical and practical training he would enter upon in England.

The training given in the technological schools and universities of the United Kingdom; its practical character.

87. The provision made in the universities and technological schools of the United Kingdom for training in the textile industries is excellent. Spinning and weaving, and the bleaching, dyeing, finishing, and printing of cotton goods and the manufacture of silk fabrics are taught in Manchester, and the manufacture and subsequent treatment of woollen goods in Leeds. The plant in the Municipal School of Technology, Manchester, and at Leeds University (to mention only those institutions which we actually inspected) is on a works scale and the professors and instructors are in all cases themselves trained in the industries.

Professor R. Beaumont, head of the Textile Department at Leeds University, said, "In the first "place I have had quite a number of students "who pass from the University direct to the works "and take up some position there either in the "designing room or in the management of the "factory, and of course they have what I call a "living wage from the first. A number of these "have come direct from school to my department, "which shows that the department can qualify "that type of young fellow, who has a good training "and power of initiative."

Sir William Mather on the value of the practical training in technical school workshops.

88. Sir William Mather, whose experience as special Commissioner in the United States of America, Canada, and Russia in connection with the Royal Commission of 1883 on Technical Instruction, gives great weight to his opinion, said:—"It is necessary first to concentrate the "minds of these young people upon the subjects "from the theoretical side, with, of course, practice "in the shops of the technical school. There is "a considerable amount of practice there, so far "as hand work is concerned, which is very useful "to the students."

Need for subsequent works experience under business conditions, preferably in the United Kingdom.

89. The importance of further practical training, upon the completion of the theoretical and practical studies of the schools, by subsequent experience in mills for spinning and weaving, or in works for bleaching or dyeing and finishing or calico-printing, was the subject of much weighty evidence. Thus, Professor Fox said:—"They (the students) must "have practical experience in addition to the "education given in the textile department." Professor Knecht stated that:—"A student "going from a school into a works is of no "use to the works until he has been there for a "certain length of time." Again, Sir Frank Forbes Adam said:—"It is most important that a "man looking to his future career should have "practical experience and practical application of "what he has learnt theoretically at school

"and college." Sir F. Forbes Adam was unhesitatingly of opinion that "it would be to the "advantage of Indian students if a system could "be devised by which they could get some of their "practical experience here." . . . "The mill "would be run better here in every way." Indian students should have a standard before them and know how to apply it. "If they were long enough "in one of these mills and got impregnated with "the methods, they could go out there and apply "them."

Difficulty of securing admission of Indians to textile concerns in this country: the attitude of manufacturers—"Not a business proposition."

90. While some of the Government scholars have occasionally secured admission to mills or works for brief periods through the good offices of the authorities of the Manchester School, in general the difficulties of getting such training in textile mills or works are at present very great, especially in regard to the subsequent treatment of the fabric which makes it marketable. The attitude of English textile manufacturers is not altogether sympathetic. They realise that the effort to develop Indian industries cannot be stopped, but ordinarily they see no reason why they as manufacturers should be called upon to accelerate it. "It is not a business proposition," one manufacturer urged, "to come and ask me to teach somebody "at my place who is going to practise what he "learns in direct competition with me"; and the same gentleman said, "it is quite certain that none "of the manufacturers I represent would allow an "Indian student to come into their works to learn "what he can with the avowed intention as soon "as he got to India of practising what he had "learned in direct competition with them." It must however be remembered that this exclusiveness, which is not confined to Lancashire textile concerns only, but prevails everywhere in the textile industry, refers not merely to Indian students but affects English students as well. An Indian witness went so far as to say, "I think it is "more easy for us (*i.e.*, Indians), to get into an "English mill than for Englishmen themselves." This, however, was not the opinion of the manufacturers, for they mentioned as a secondary objection to the Indian student that he had no intention of remaining in the employ of the firm into whose works he proposed to enter.

Textile machine makers helpful.

91. It is possible to a limited extent to make arrangements through the agency of certain makers of textile machinery, for, as has been pointed out by Professor Fox, "Every textile machine-maker "can see in an Indian student a possible customer, "whilst every spinner and manufacturer can only "see a potential competitor." In one case, however, that of the firm of Butterworth and Dickinson, loom builders of Burnley, facilities have been offered not only for entering their engineering works but also for practical training in the weaving shed attached to the works, and advantage

has been taken of this privilege in several instances. There is some probability that the firm would accept a scholar for a full year on the completion of his studies at the School of Technology.

Facilities offered by German firms of doubtful utility.

92. It is very doubtful whether the privileges granted to Indian scholars by German firms (in all cases machine makers) were at all more advantageous than those granted by English machine makers, so far as actual work and experience in the mills were concerned. They had, in any case, the same purpose in view, namely, to familiarise the student with their machines with a view to their ultimate purchase. And still less is it certain that vacation visits to the German Colour Works have resulted in any real industrial advantage which the Indian textile scholars, who were interested in dyeing, could not have gained in the laboraratories of Universities or Technological Schools in this country.

Facilities for a limited number of picked men probably obtainable in the textile industry; some offers of co-operation already secured.

93. Since the number of Indian scholars sent each year to this country is, after all, but small, the Committee were encouraged by Sir Frank Forbes Adam, a large exporter of Lancashire cotton goods, and by other witnesses to believe that, on representations made by the India Office, duly accredited textile students, to the number of perhaps four a year, would be granted facilities by well-established firms in one or other department of the textile industry.

94. We have submitted to the India Office the names of the gentlemen who have volunteered to co-operate in securing practical training for at least the Government scholars, and we believe that, with their assistance, the officer who will carry on our work will find it possible to secure for Indian textile students the experience in mills and factories which is necessary to complete their training.

Recommendations as regards scholarships in spinning and weaving.

95. As regards the grant of future scholarships for the study of spinning and weaving we recommend:—

(i.) That the student should ordinarily have been educated up to the standard of the B.A. (on the Science side), or the B.Sc. Examination of an Indian University, or have gone through a complete course of training in an Indian Technical College and have obtained a diploma such as the L.T.M. (Licentiate of Textile Manufacture) of the Bombay Victoria Technical Institute.

(ii.) That the scholars should in all cases have had considerable experience in one or more Indian mills, preferably through having served in a paid position.

(iii.) That the period of the scholarship should be extended to cover an adequate course of practical training in an English mill, subsequent to the theoretical or college course, whenever it is found possible to provide such facilities.

Bleaching and Finishing.

Bleaching and finishing: college training not the primary qualification.

96. We were fortunate enough in the course of our inquiry to secure the advice of an expert who was able to give the Committee very valuable evidence as regards the training of Indian students of bleaching and finishing processes. In the first place it was pointed out that, unlike dyeing and calico printing where highly trained chemists are essential, bleaching has been built up largely on rule-of-thumb principles, and that therefore many years of actual experience, rather than a high scientific or chemical training, is the primary qualification of a really good bleacher. It was not, of course, contended that some training at a technical school was not beneficial, but it was argued that such training was a very long way from enabling a man to take a proper position in managing a bleaching business, and in support of this contention it was stated that many of the best bleachers in the trade had had no scientific training whatever.

No admittance as a rule to bleaching and finishing works in this country.

97. With regard to the possibility of gaining practical experience for Indian students, the Committee were given little hope that any proposal to admit scholars to cotton bleaching and finishing works in this country would be favourably received. It was pointed out that the Lancashire bleaching trade was becoming more and more dependent upon the Indian and China markets, and that those interested in it would strongly resist any proposal to allow an Indian student to get experience in any of the works controlled by them. Another difficulty arises from the effect of different conditions upon the bleached product. We learned that it was frequently found to be impossible to produce the same class of goods at two places in this country only a few miles apart, and that it must necessarily be even more difficult to apply in India the knowledge gained in any particular works here.

Recommendation as regards the grant of scholarships in the bleaching and finishing of cotton.

98. We are therefore compelled to recognise that in this branch of industry it is almost impossible for Indian students to obtain in this country anything more than the training given in Technological Colleges, and, in order that they may complete this by practical experience, efforts should be made to secure openings for a few carefully selected students in some of the more up-to-date bleach works now existing in India.

Some facilities procurable in the woollen industry.

99. With regard to woollens the case is somewhat different, and the difficulty of obtaining practical

experience is rather less acute. We have in fact received an offer from a firm of woollen dyers and finishers to take an Indian student for a year into their works, and if in the future it should be considered desirable to grant a scholarship for the study of dyeing and finishing of woollen cloth it is probable that arrangements could be made for a thoroughly practical course of training. It must, however, be remembered that this offer is, so far, an isolated one, and that the number of students for whom such facilities could be secured is probably very limited.

Dyeing.

Dyeing; experienced men selected as State scholars.

100. Several scholars have been awarded scholarships for the study of dyeing, usually in conjunction with some such co-ordinate subject as calico printing or bleaching. The men have, on the whole, been well selected in that they have in almost all cases had some experience of Indian conditions and methods.

The training of a dyer: theoretical instruction and practical experience alike necessary, the former readily procurable by students, but the latter, as a rule, not.

101. As regards the training in this country, we may quote Mr. Herbert Kitchen (a dyer of Leeds), as to the necessity of both theoretical and practical training: "All practice without theory is almost "useless, and all theory without practice, in my "opinion, is practically the same. Personally, I con- "sider that you require the two in dyeing, whatever "you may do in any other branch of trade." There is little difficulty in obtaining for our students the highest kind of theoretical training, but the problem of gaining admission to a dyeworks for the purpose of learning the practical side presents the usual difficulties. The dyers are a very conservative class, and are at great pains to guard jealously what they consider to be their secret methods. We may again quote the evidence of Mr. Kitchen to show the attitude of the dyeing trade on the point: "There are a lot of secrets in "dyeing . . . science has not solved every "question yet in the dyeing trade, and there are "many secret methods, secret recipes and secret "mixtures of colours, which, when a man has "found them out either by research or accident or "pure luck, he wants to reap the benefit of; he is "going to keep them to himself, and he is very "chary about whom he allows to come into his "dye-house."

Well-equipped laboratories in English institutions; special facilities at Bradford, Leeds, and Manchester.

102. The authorities of the technological institutions are now endeavouring to overcome to some extent this difficulty with regard to practical training, by equipping their laboratories with plant on an actual works scale, and at Leeds, Bradford, and Manchester facilities now exist for a practical training, which, although admittedly only a substitute for the greater advantage of working in actual dyeworks, are of considerable service to the student of dyeing. In the past, students have

frequently been sent to the volunteer laboratories of German colour-making firms, but there is a consensus of opinion that the experience to be thus gained is no greater than that available in the dye-houses attached to the best technical institutions in this country. We may quote the reply of Dr. Rée, a member of the Committee of the Manchester School of Technology, to a question as to the value of such training: "Without confining "myself at all to the question of the Indian "students, I should say, quite broadly, that the "benefits obtained are benefits to the particular "concern rather than to the individuals who go "there as volunteers. . . I do not see that there "is any advantage to be gained as compared with "the experience to be gained in a large technical "institution." The value of the practical training to be obtained in the experimental dye-house of the University or laboratory of the Technical Institution, organised as they now are, is well brought out by Professor Green of Leeds University, who said: "You must not forget that the student can "get a great deal of practical knowledge here in "the Institution. We have the practical machines "and we get practical men to teach. In many "cases our students, although we do not claim that "they are always able to do it, have left here and "have taken full command in a works straight "away. I have had many men who have done "that. They have had the whole charge of the "dyeing in large works put into their hands, and "have managed it well."

Fair prospect of securing works experience for well-qualified Indians; a generous offer noted.

103. There is evidence to show that the value of the training in chemistry given in the universities and technological schools as a preparation for practical work in the dyeing industry is gradually becoming more widely recognised, and we think there is reason to hope that the difficulties in the way of securing admission to dye works for a limited number of thoroughly well-qualified Indian students will not prove insuperable. We are confirmed in this view by the promise of co-operation which we received from Mr. Ivan Levinstein, the head of an important firm of aniline colour manufacturers of Manchester. We have already, in the preceding chapter, expressed our appreciation of the broad-minded view taken by Mr. Levinstein of the question in its general aspect, and it only remains to add that he supplemented his general observations by a generous offer to take into his works one or more properly qualified Indian students for practical training; it would be a condition of admission that such students should have obtained previously a thorough knowledge of chemistry by means of a full course at a university or technical school, lasting three or sometimes four years, and including, if possible, a certain amount of research work, and further, such students would be required to stay for at least two years in the works. Mr. Levinstein explained that there is

a large testing dye-house attached to his firm's works, in which all fibres and fabrics are dyed and in which also research work is carried on. We consider that a practical training in such a works would be extremely valuable.

Recommendations as regards scholarships in dyeing.

104. Our recommendations with regard to the grant of scholarships in dyeing are—

(i) that the candidate shall have had sufficient general scientific education in India to enable him to follow the specialised lectures here, *i.e.*, that he should have read up to the standard of the B.Sc. or B.A. with science in India;

(ii) that no scholarship shall be granted to a candidate who does not possess some knowledge of the dyeing industry as carried on in India;

(iii) that when it is found possible to secure admission for an Indian student to a good dye works, the period of the scholarship shall, if necessary, be extended up to five years in order to cover this practical experience.

Tanning.

Tanning; two types of student distinguished. Value in either case of technical training in the United Kingdom.

105. As regards students of tanning and leather industries, from the evidence of the experts whom we consulted it appears necessary to divide them into two classes, viz.—

(i) those who aim at becoming managers or owners of tanneries;

(ii) those who intend taking up scientific research as applied to leather industries.

There is ample evidence to show that both classes derive great benefit from a course of training in one of the technological institutions in this country which specialise in the subject. Thus Dr. Parker, Principal of the Leathersellers' Company's Technical College at Bermondsey, writes:—

"I consider that the custom of sending over State scholars to be trained in the technology of leather manufacture is excellent, and from my own experience I know that certain students who have gone through a course of training at Leeds or London have benefited materially, and that two or three have already made great progress and great improvements in the factories where they are now working in different parts of India."

(1) The man with "tanning in the blood."

106. For a student of the first class it is essential that he should have what has been figuratively described to us as "tanning in the blood," that is to say, hereditary connexion with the industry. Such a man would have considerable acquaintance with Indian methods of tanning, and would thus be enabled to reap the full benefit of his training in this country.

Previous working experience specially important as there is no system of apprenticeship, whether for English or Indian students.

107. This necessity for previous working experience is particularly emphasised by Dr. Parker: "Only one State scholar who has been through my "College has had any real practical training in "tanning before coming to this country. This is "a great drawback and delays their studies. It "would be most advantageous if they could have "some training in an Indian tanyard before being "sent over. I do not mean that they should "necessarily learn the business, but that they should "know the nature of the various skins—the difference "between the skin of a calf, a goat, an ox and "a cow, and so on; and that they should have "some elementary knowledge of the processes of "tanning." The ideal course for these students is, as indeed in most industries, a combination of theoretical training and practical experience, but we have to face the fact that in the leather industry there is no system of apprenticeship, such as exists in the engineering profession, and that ordinarily the owners of tanneries in this country are not prepared to afford students facilities for gaining practical experience of the industry.

This difficulty is not by any means confined to Indian students, but applies equally to English students.

Special advantages at the Leathersellers' Company's College, at Bermondsey.

108. In the past the difficulty has been overcome to some extent by sending scholars to the Leathersellers' Company's College where the training is of an eminently practical character. Of the course there Dr. Parker says: "We make a speciality of "technical work in a model tannery where we "turn out leather on more or less commercial lines. "We are always tanning 4,000*l.* or 5,000*l.* worth "of leather every year; therefore they do get a "practical training with me. I do not say that "that practical training is as good as they would "get in a works; it is on a smaller scale, but I "make the students take a pack of skins, bought "on the market in the hair—bought from India "or anywhere else in the world—and they have "to put those skins through on commercial "lines and cost every process right through. The "students work practically every morning from "9 till 1, and in the afternoon they are in the "laboratory doing the scientific work. We are "trying to work the two things—practice and "theory — hand in hand." Dr. Parker also explained how, in one respect at least, such a training had distinct advantages for Indian students over an apprenticeship in an English tannery. In the college experiments are encouraged, and conducted under expert supervision and criticism, *e.g.*, to quote Dr. Parker's evidence: "The student after going through the ordinary "training may point out to me, 'I could not do "'this in India, the temperature is too great,' then "I let him modify things to suit the conditions. "Or again, a student says he does so and so at "home and I say 'All right! do it here—let me "'see exactly how you do it in India.' I then "criticise it and find fault with it, and show how

" he can improve it. He would not be permitted " to carry out experiments in a tannery turning " out leather for the regular market." Moreover, the course in the college has been supplemented by visits to works and factories during vacations, which have proved very valuable to those students who have had previous experience of Indian tanneries, and who have acquired the necessary theoretical knowledge to enable them to follow intelligently the processes in use.

Practical training possible in Government leather factories in India.

109. In addition, it has been suggested that a period of practical training in an up-to-date Indian tannery, such as the Government factory at Cawnpore, would be an excellent method of completing the training of a Government of India leather scholar.

Recommendations as regards scholarships for hereditary tanners.

110. Our recommendations regarding the grant of scholarships to students of this class are—

(i) that hereditary connexion with the leather industry is desirable, and a knowledge of Indian methods is essential ;

(ii) that where these conditions are satisfied, high academic qualifications need not for the present be insisted upon ; a fair knowledge of chemistry and physics, and some knowledge of mathematics will suffice ;

(iii) that the scholarship shall be granted for three years at least, and should include visits to American and Continental tanneries, when recommended by the Professor.

If after inquiry the India Office is unable to arrange for practical training in this country, arrangements should be made for supplementing the training given here by a period of practical experience in one of the Government leather factories in India.

(2) Research chemists in the leather industry: an ideal course of training indicated.

111. The qualifications to be desired in candidates of the second type are very different. Hereditary connexion with the Indian leather industry, although of course advantageous, is by no means essential, but it is imperative that the candidate shall have received in India the highest scientific training possible, and also have shown considerable aptitude for research work. The ideal course for such a student would be a three-years' training at one of the best technical institutions in this country, followed by the practical training to be gained by holding a paid position as chemist in an up-to-date tannery. That the difficulty of obtaining such a post is not insuperable is proved by the fact that in certain cases Indian students have succeeded in overcoming it, and as first-class chemists are rare, a really good man of any nationality is likely to be given a trial. Should it be found impossible to gain admission to any tannery, a student of first-class ability and scientific training would greatly benefit by spending a fourth year on post-graduate research work in the laboratory of a technical institution. Our

recommendations with regard to this type of candidate are—

Recommendations as regards scholarships in chemistry as applied to tanning.

(i) that the scholarship shall only be granted after the student has received the highest scientific training in India ;

(ii) that he must have shown considerable aptitude for research work ;

(iii) that the scholarship shall be tenable for four years ; and

(iv) that if the scholar be successful in gaining a paid position in the laboratory of an English tannery, his right to a free passage back to India shall be extended for a further three years.

Scholars of the first type likely to predominate at present.

112. In concluding our remarks regarding the grant of scholarships in tanning we would point out that, owing to present conditions in India, students of the first type will necessarily predominate for some years to come, and will be by far the most useful in improving the industry in India ; but as the standard of education rises the highly scientific man, who is at present rare, will become more common, and as the industry improves his usefulness will increase.

Chemical Manufactures.

Chemical manufactures. Works do not take students, whether British or Indian, as apprentices.

113. As regards chemical manufactures generally, the difficulties in the way of obtaining practical experience were clearly stated by Dr. Beilby, F.R.S., of Glasgow. " A chemical manufacturer " is a person who by years of labour and painful " and expensive experience has found out a lot of " information which is valuable in his manufacture " and which can very easily be carried away by " anyone who has a little knowledge. I remember " a man who said 'in half an hour in walking " ' through a chemical works I could pick up what " ' has taken a life-time to find out.' Therefore " one cannot be surprised that a chemical manufacturer is extremely jealous. . . . Speaking " as a manufacturer, we have to be extremely " careful about the men we admit into our works. " . . . We recognise when a man comes in to " our chemical works, that, as a rule, once admitted " we must keep him. At least there are very few " men we would care to give a few months' " experience to." Dr. Beilby added that he did not know of any place in the United Kingdom or Germany where students studying applied chemistry could gain admission to works as apprentices ; the difficulty was not peculiar to Indians, but applied equally to British students.

Salaried employment as a means of securing works experience.

114. The only recognised method at the moment of obtaining practical experience was to enter a works as an employé, taking a post at some remuneration, however small, merely to make a

beginning. This view was confirmed by Professor Cohen of Leeds who said :—

"It is not quite so much the actual obtaining of positions but the sort of apprenticeship required which is the difficulty. I mean that where a man does not want to tie himself to remain on, but where he wants to get practical experience and go somewhere else when he has got it,—that is what the manufacturers do not like. They do not mind having a man in their employ whom perhaps they will have to train, provided they can get something back after he has got through his training; but they do object, and it is natural in a way, to take people on their premises who are merely coming to learn without any idea of giving anything back when they have learnt it."

We may also quote Professor Green of Leeds University :—

"As a rule our students on leaving here can easily get employment straight away, and at a very decent salary. Students who, if they offered themselves for nothing, would not be taken on, very often get taken on at a salary, because people do not want to be bothered by a man who is known not to be going to stay. They do not mind paying a salary to a man who ultimately may be of use to them, even if he is not of much use to them to begin with, and they anticipate that a young fellow will not be of very much assistance the first year or so. But they expect him to stay, and they pay him a living wage, at least, to start with."

Grant of scholarships to Indians for the study of chemical industries in the United Kingdom of doubtful utility; training in India recommended.

115. These opinions have also been confirmed by the experience of the single Government scholar who has so far come to this country for the study of alkali manufacture, for it has been found impossible to secure for him admission to any works. As regards theoretical training, we have evidence that there are ample facilities for obtaining the highest form of scientific training in this country, and from the extracts quoted above it will be seen that a student who has been through the University course is capable of filling a paid post in a works; but in view of the present dearth of chemical manufacturing works in India, it is very doubtful whether Indian industries will benefit sufficiently from the sending of students to this country for the study of chemical manufactures to justify the outlay necessary, and it is for consideration whether the Indian Institute of Science at Bangalore, and other institutions which may shortly be established in India, do not for the present afford sufficient facilities for the training of as many students as are likely to find employment in this branch of applied chemistry. In any case we consider that before any scholarship is granted for the study of a special branch of chemical manufacture, inquiry should be made as to the facilities available for giving the student a complete training in this country, and at the same time full particulars should be given of his qualifications and his prospects of obtaining suitable employment on return.

Conclusion :—The scholarship system has yielded good results, and may be made to yield even better results in future.

CONCLUSION.

116. Our general conclusion may be stated as follows :—The results attained so far justify the continuation of the system of Government Technical Scholarships, and, with the modifications which we have suggested, the system may be expected to yield even better results in the future, but this expensive form of training at public cost should only be given to a well chosen few who may reasonably be expected to help the industrial development of India. We recognise that the openings for such men are not at present numerous, and that the most urgent demand of Indian industry at present is for skilled mechanics, and we are in complete sympathy with the efforts now being made for giving in India a better training to men of that class. But the necessity for educating the artisan does not preclude the desirability of having a limited number of men with the highest technological training, capable of holding posts of control. Both classes are needed for the development of Indian industry, and opportunities for the improvement of both should be given simultaneously.

117. We wish to place on record our high appreciation of the services rendered to the Committee by our Secretary, Mr. P. H. Dumbell, and his assistant Mr. R. E. Field; our inquiry has thrown upon both of them a heavy burden of work which they have discharged with highly commendable despatch to our entire satisfaction.

(Signed) T. Morison.
K. G. Gupta.
J. H. Reynolds.
W. E. Dalby.

P. H. Dumbell (*Secretary*).
R. E. Field (*Assistant Secretary*).

18th October 1912.

APPENDICES.

APPENDIX I.

Correspondence between the Government of India and the Secretary of State.

No. 1.

DESPATCH from the Government of India (Home Department) to the Secretary of State for India, No. 8 (Education), dated 9th October 1912.

Simla,
My Lord, 9th October 1902.

We have the honour to advert to your Lordship's Despatch No. 105 Public (Educational), dated the 2nd August 1901, with which you forwarded a question asked in the House of Commons by Sir M. M. Bhownaggree, and the answer given thereto, on the subject of founding additional Government scholarships for natives of India who might desire to pursue technical studies in Great Britain or other countries of Europe.

Your Lordship at the same time expressed a wish to be informed of the result of our deliberations in the matter.

2. The question of the institution of State technical scholarships formed one of the subjects which came up for discussion before the Educational Conference held at Simla in September 1901, and the following resolution was then passed :—

"That it is desirable that the Government of India should institute a number of State technical scholarships, perhaps ten in number, with an approximate allowance of 100*l.* a year, in addition to travelling expenses and fees, to be awarded annually in fixed proportions by the Local Governments, subject to the sanction of the Government of India, to selected candidates, who should be sent abroad to undertake definite courses of study in subjects connected with industrial science or research. That these scholarships might be held for an average duration of two years."

3. In our letter* addressed to Local Governments and Administrations on the 20th November 1901, relating to the subject of practical and technical education, we informed them that the Government of India accepted the recommendation of the Conference as to the institution of ten State technical scholarships, and that they proposed to give two of them to the Madras Presidency, two to the Bombay Presidency, and two to Bengal, and to distribute the remaining four among the other provinces, where technical instruction had not yet advanced so far as in the three provinces mentioned. It was suggested that the selection of the students to hold these scholarships should be made by the Local Governments subject to the approval of the Government of India; that the Universities should have no power of nominating to them; and that no candidate should be considered qualified unless he had displayed in his educational career an aptitude for technical study. Subject to these conditions, it was considered that a wide discretion should be left to the Local Governments in selecting candidates for the award of these scholarships. We stated our opinion that in ordinary circumstances the period for which the scholarships might be held should be two years, but that in special cases it might be increased to a third year or even reduced below two years; and that the scholarships should be tenable in foreign countries as well as in Great Britain. The Local Governments and Administrations were asked to submit their views as to the details for working out the scheme.

* Extract enclosed.

4. The replies of the Local Governments and Administrations to our communication have received careful consideration at our hands, and we have now the honour to enclose a copy of them for your Lordship's information. It will be seen that the outlines of the scheme sketched out by us have been generally accepted, but that there is a divergence of views in connection with the details. The scholarships are to be given for the purpose of providing for natives of India the higher technical education which may qualify them to assist in promoting the improvement of existing native industries and the development of new industries, wherever this may be possible. Technical education for this purpose may be defined as (*a*) the study of the scientific methods and principles underlying the practice of any handicraft, industry, or profession, (*b*) the application of these methods and principles to the practice of the handicraft, industry, or profession in question. Law, Medicine, Forestry, and Veterinary science being already provided for, are not included among the subjects to be studied by the holders of these technical scholarships, and Agriculture does not fall within the scope of the present scheme. The scholarships will be awarded by the Government of India upon the recommendation of the Local Governments, and will for the present, as already stated, be distributed as follows:—Two annually to the Madras Presidency; two to the Bombay Presidency; two to Bengal, and the remaining four among other Local Governments and Administrations.

5. We do not propose to prescribe the particular industries for the encouragement of which particular provinces should give scholarships. The Local Government or Administration which is asked to recommend a candidate will consider what industries are of importance in the province, and which of them may best be encouraged by scholarships, taking care to connect the scholarship scheme with the system of technical and industrial education in the province. In determining the choice of an industry Local Governments should in our opinion obtain assistance from the mercantile and industrial public, and take all measures that appear to them to be possible and expedient for interesting the influential sections of that public in the scheme. Industries in which native capital and enterprise are engaged or likely to be engaged, will be particularly appropriate for selection. It should be borne in mind that men who have received an expensive European training can be employed only upon such industries as are susceptible of being organized upon a considerable scale.

6. In each case in which a Local Government recommends a scholarship, it will be necessary for it to support its selection by giving the Government of India some account of the state of the particular industry which it is intended to promote and some comparison with other industries which might be considered eligible for encouragement. In determining the industry to be studied and choosing the man recommended for the scholarship, the Local Governments and Administrations will be required to bear in mind the importance of ensuring that the returned scholar shall find scope for his skill and ability. It has been proposed on the one hand that such scholars before they are appointed should be placed under engagement to serve Government on their return. On the other hand it has been suggested that private firms should be asked to guarantee their employment, and that the scholars should be reciprocally bound by engagement to such firms. We consider that the holder of one of these scholarships should not be bound by any such engagements, but that the prospect of his chances of employment after the completion of his studies should be well weighed when he is selected, and that upon his return the choice of his career should be, in the first instance, determined by his own inclination. If the early results of the scheme are successful, we think that the services of the returned scholars are sure to be in good demand, and that, failing private employment, Government will be glad to turn their abilities to account as teachers in industrial schools, or in other capacities connected with the improvement of local industries.

7. It is our intention to make it a condition of the grant of these scholarships that no candidate is to be selected for recommendation to one of them

on the result of competitive examination either open or limited. It is desirable that, in selecting the industry to which they are to be directed, Local Governments should give the widest possible publicity, through such channels as they think fit, to their intention to nominate scholars, and that they should take such advice as they need from persons cognisant of the industry, and from officers and others connected with technical education. In making the selection they should bear in mind the fact that it will be necessary for the student to have a competent knowledge of English, or of the language of any other country to which he is to be sent; and they should also be guided by considerations of his capacity, intelligence, practical interest in the industry, and the assurance which they feel that he will continue to devote himself to it on his return to India. These are matters which cannot be decided by competition; and we intend that it should be made clear from the beginning that these scholarships are not to be regarded as prizes, for which everyone has a right to claim an equal opportunity of competing. It is not necessary to lay down more precise rules as to the kind of general education which the scholar is to have received. Governments will act on their own discretion, having regard to the above considerations. As a general rule a scholar before being nominated should have received the best technical education available in the province in the particular industry which he has to study. The standard of this education differs in different industries, and each may be considered on its own merits. Even if the standard of technical education in a particular industry in a province is low, the scholar may be nominated if he has availed himself of the best facilities obtainable, and shows an interest in the industry. No age limit will be laid down for scholars, and none should be generally laid down by the Governments; but an age limit may at the discretion of a Local Government be fixed for any particular scholarship for which they invite applications. The particular industry to be studied will, as is stated above, be specified by the Local Governments in nominating a scholar, but they will hardly be in a position to define minutely the course of study to be pursued, nor will they ordinarily be in possession of the most recent information as to the facilities for such studies existing in England and elsewhere. We are inclined to think therefore that the best plan will be to leave these matters to be settled by Your Lordship when the scholar arrives in England; and if this view is accepted we will arrange that timely information shall be submitted to you as to the probable date of each scholar's arrival and the subject which he is required to study. We propose that those scholars who study in England should be under Your Lordship's control, and we trust that in the case of those who elect to pursue their studies on the continent or in America Your Lordship may be able to make suitable arrangements for their supervision. The conditions under which they will hold their scholarships will be similar to those laid down for Government of India scholarships. Progress reports will be required upon them from time to time, and power will be retained to cancel a scholarship and to send the scholar back to India if his progress is not satisfactory.

8. Should the principles which we have advocated in connection with the institution of these technical scholarships meet with Your Lordship's acceptance, we trust the scheme for the establishment of ten scholarships of 100*l.* a year may receive Your Lordship's early sanction.

We have the honour to be,
My Lord,
Your Lordship's most obedient, humble Servants,
CURZON.
A. P. PALMER.
T. RALEIGH.
E. R. ELLES.
A. T. ARUNDEL.
E. F. G. LAW.
DENZIL IBBETSON.

ENCLOSURES.

Enclosure No. 1.

Extract paragraph 6 of a letter, No. 501–508, dated the 20th November 1901, from the Government of India to the Local Governments and Administrations, except the Chief Commissioner of Coorg and the Resident at Hyderabad.

* * * * *

The examination by the Conference of the subject of technical education terminated in a resolution recommending the institution of a number of State technical scholarships for the encouragement of the further studies of Indian students in the higher branches of technical education. This proposal is accepted by the Government of India. The existing State scholarships of 200*l.* a year are given in rotation to students from the different Universities, and are subject to the condition that the holders must proceed to England to study at one of the Universities there. The Government of India propose that the number of Technical State scholarships to be given should be ten a year, two of which should be distributed to the Madras Presidency, two to the Bombay Presidency, and two to Bengal, the remaining four being distributed among other Local Governments and Administrations, in whose territories technical instruction has not as yet made the same advance as in Madras, Bombay and Bengal. It is considered that the selection of the students to hold these scholarships should be made by the Local Governments subject to the approval of the Government of India; that the Universities should have no power of nominating to them, and that no candidate should be considered qualified unless he has displayed in his educational career an aptitude for technical study. Subject to these conditions, the Government of India would propose to leave a wide discretion to the Local Governments in selecting candidates for their approval. The course of instruction and the place at which a scholarship holder is required to study will have to be strictly laid down by the Local Government in the case of each selected candidate prior to his departure from India. In ordinary circumstances the period for which a scholarship might be held should be two years, but in special cases it might be necessary to extend the term to a third year, and in other cases even to reduce it below two years. In the opinion of the Government of India these scholarships should be tenable in foreign countries as well as in Great Britain. The Government of India are prepared to give to the holder of a Government technical scholarship 100*l.* a year, as well as to provide him with a second class passage to and from the place at which he will have to study, and to pay the fees at the institution where he is to be sent. I am directed to ask as to the details for working out this scheme.

Extract from the Resolutions passed at the Educational Conference held at Simla in September 1901.

V.—STATE SCHOLARSHIPS.

That it is desirable that the Government of India should institute a number of State technical scholarships, perhaps ten in number, with an approximate allowance of 100*l.* a year, in addition to travelling expenses and fees, to be awarded annually in fixed proportions by the Local Governments, subject to the sanction of the Government of India, to selected candidates, who should be sent abroad to undertake definite courses of study in subjects connected with industrial science or research. That these scholarships might be held for an average duration of two years.

Enclosure No. 2.

From M. Hammick, Esq., C.I.E., Secretary to the Government of Madras, Educational Department, to the Secretary to the Government of India, Home Department.

Dated Fort St. George, 13th March 1902.

Sir,

I am directed to reply to the 6th paragraph of Mr. Hewett's letter No. 501, dated 20th November 1901, on the subject of the institution of a number of technical scholarships. It is proposed to allot to Madras two of these scholarships of the annual value of 100*l.* each, and to leave to the local Government the selection of the students to hold them, the selection being subject to the approval of the Government of India. It is considered that the Universities should have no power of nominating any candidate, and that no one should be regarded as qualified for nomination unless he has displayed some aptitude for technical study.

2. I am to state that in the opinion of the Governor in Council these conditions are suitable. He considers that the scholarships should not be awarded to students at the termination of their college course, but only after they have spent at least two years at practical work of some kind and have gained some experience in the matters they wish to specially study abroad. The best means of giving effect to this decision appears to be to make the nominations at the conclusion of the college course and then employ the students on probation in the technological department (if it is formed) or in approved private workshops or manufactories, the scholarships being actually granted only when the applicant has clearly made up his mind as to what line of work he intends to pursue and with what object. If these meet with the approval of Government, the course of instruction and the place where a scholarship holder should study will then be determined. Periodical reports, say half-yearly, on the progress of the scholar may be insisted upon.

3. As matters stand at present, this Government is not in a position to give guarantees of subsequent employment, but it is possible that private firms and companies would be ready to make a conditional promise to take into their service such as intended to study industries in which the firms or companies are interested. If guarantees are given the students should be bound by agreement to continue in the service concerned for a term of years.

I have the honour to be,
Sir,
Your most obedient servant,
M. HAMMICK,
Secretary to Government.

Enclosure No. 3.

Extract paragraph 4 of a letter from the Government of Bombay, No. 855, dated the 8th May 1902.

In paragraph 6 of the letter under reply the opinion of this Government is invited as to the details of a scheme of technical scholarships proposed by the Government of India. As Mr. Burns has pointed out,* the absence of eligible candidates for these scholarships prevents the immediate realization of the scheme. When men combining high general education with special aptitude for technical study, and capable of utilizing the instruction they would receive in Europe, are forthcoming, as they doubtless will be hereafter, the scheme of scholarships proposed might be worked generally on the lines indicated by Mr. Burns in paragraphs 10 and 11 of his report.* In present circumstances it is impossible to formulate any precise scheme. It is understood that the report of the Industrial Schools Committee will

* *See* letter, dated 14th April 1902, overleaf.

indicate the industries for which men trained in Europe are specially required in each Presidency. After this is settled, it will be necessary to ascertain by inquiry in England what facilities exist for training students from India in those particular industries.

Annex.

Extract paragraphs IX., X., and XI. of a letter from C. L. Burns, Esq., Principal, Sir Jamsetjee Jejeebhoy School of Art, No. 362, dated the 14th April 1902, enclosure to above.

IX. With reference to paragraph 6 of Mr. Hewett's letter, it is to be presumed that the scholarships are intended for students who will specially study one of those industries which are at present depressed and are capable of revival or improvement by the introduction of modern technical methods. Such industries as handloom weaving in cotton and silk, hand-block printing, pottery, woodwork, jewellery, house-decorating, &c., and not for such crafts as engineering, powerloom weaving, machine printing, &c., which are all flourishing industries supporting large factories, works, and mills in India, in which students from such institutions as as the Victoria Technical Institute and the College of Science at Poona can gain all the practical experience necessary, and which require no assistance from Government. If this is the case, I have the honour to point out that the principal objection to the immediate despatch of men to England supported by the proposed scholarships of 100*l.* a year, is that among the craftsmen employed in those industries most requiring improvement there is, so far as I am aware, scarcely any who knows sufficient English to be able to make full use of the opportunity. On the other hand the well educated Natives (such as those from whom the Drawing Masters are chiefly enlisted) have as a rule no technical knowledge of the shortcomings of the present methods which would enable them to readily seize upon the points where improvement is possible.

Scholars capable of making the best use of such a desirable opportunity must be trained, and should the suggestions of the Sub-Committee appointed by the Government of Bombay be adopted, there is every reason to suppose that no lack of suitable candidates for such scholarships from among the scholars trained in the proposed Central Institution will be experienced.

X. Should two suitable men be found in Bombay at once, I beg to suggest that the following course be adopted :—

(*a*) That each scholarship holder should agree and be bound, so long as he holds the scholarship, to devote himself to the study of one special industry.

(*b*) That in place of spending his time in a college or technical school, he be placed in a factory where the industry he is studying is being carried on. In this case a premium of some sort will have to be paid to the manufacturer to enable the student to spend a certain time in several departments, so that he can obtain a working knowledge of all parts of the trade, for the value of the student's labour will be practically *nil* to the manufacturer.

(*c*) That the student be required to spend at least two of his evenings every week in the local technical institute to study those branches of his work which he cannot learn in the factory.

(*d*) That specimens of his work and his notes be forwarded every quarter to the Bombay Government to indicate his progress and that a report be asked for from the head of the factory and the technical institute.

(*e*) That instructions be sent from time to time to the student from Bombay directing his attention to such points in the technical methods at present in practice among the native workmen in the particular craft he is studying as may seem to the experts in India to require improvement.

XI. Keeping the student at practical work during the day in a factory will not only ensure his regular attendance at his studies, but will also give more assurance that, while he is in attendance, he will be working and will be under supervision. In this respect the attendance at a factory is in every way preferable to joining a technical school. In nearly all the technical schools in industrial centres the staff only attend during the evening when most of the students are able to be present. The school is consequently practically empty during the day, when perhaps only the Principal attends at his office. Little or no provision is therefore made for day pupils, any who attend being practically left to themselves. Again, the instruction in all technical institutes must to a great extent be theoretical and is intended to supplement the knowledge gained in the workshop, and not to supplant it. To make the best use of the institute training therefore, the student must do practical work during the day, and there is in my opinion the best prospect of both the Government and the student obtaining adequate value for the money expended by combining the two.

Enclosure No. 4.

No. 646, dated 7th February 1902.

From W. C. Macpherson, Esq., Indian Civil Service, Officiating Secretary to the Government of Bengal, General Department (Education), to the Secretary to the Government of India, Home Department.

In reference to paragraph 6 of your letter No. 503, dated 20th November 1901, asking for the views of this Government as to the details for working out the scheme for the award of State Technical Scholarships, I am directed to submit, for the information of the Government of India, the accompanying copy of a letter, No. 256 of the 10th January 1902, from the Director of Public Instruction, Bengal, and to say that the Lieutenant-Governor accepts in the main the suggestions put forward in paragraphs 4 and 5 of that letter. He doubts, however, whether it would at present serve any useful purpose to ask heads of technical schools to nominate students to the scholarships, since students of technical schools seldom possess that competent knowledge of English which the Director justly makes the first condition for nomination.

2. The Lieutenant-Governor also doubts whether it is really desirable that Government should retain a lien on the services of all scholars on their return from England as the Director suggests. There are no industries which are directly worked by Government and in connection with which the services of these scholars could be utilized, nor is the number of the higher inspecting posts sufficiently large to allow the entertainment of two scholars every year in those appointments. Sir John Woodburn is therefore of opinion that it would be best in the interests of the industries which it may be desirable to foster to make them a free gift of the scholars trained at Government expense. The expansion of technical education will no doubt give greater room some years hence for the employment of Government inspectors, but it seems sufficient that an occasional scholar should then be selected for the purpose and sent home in order to come back fully trained for the duties of an inspector.

Annex.

(Confidential.)

No. 256, dated the 10th January 1902.

From A. Pedler, Esq., F.R.S., C.I.E., Director of Public Instruction, Bengal, to the Secretary to the Government of Bengal, General Department.

I have now the honour to reply to paragraph 4 of your letter No. 364, dated 4th December 1901, in which you ask for an expression of my opinion on the proposal made by the Government of India to create certain scholarships to enable selected natives of India to proceed to Europe and other countries generally to study technical subjects there.

2. The proposal indicated in paragraph 6 of the letter of the Government of India, No. 503 of 28th November 1901, is to create about ten scholarships of the value of about 100*l.* a year, together with travelling expenses and fees at the institution at which the student will work, and which will usually be tenable for two years. Ordinarily two of such scholarships will be assigned to Bengal. The selection of the candidates is to rest with the Local Government and the Calcutta University is not to be consulted in the nomination, but the candidates are to have shown special aptitude for technical study.

3. The exact source of the funds for the payment of these scholarships is not indicated; but assuming that funds are available, the general scheme of such scholarships should undoubtedly meet with the full approval of the Government of Bengal. It will therefore only remain to roughly work out the details of the principles under which the scholars are to be selected and the rules under which the students will work while in Europe.

4. As regards the first of these two points, it is obvious that the selection must be confined to those who have shown a practical or scientific bent in their education, and who have shown ability for practical work in contradistinction to theoretical or book work. One method of securing candidates of this stamp would be for the Director of Public Instruction yearly, two or three months before an election for such scholarships is to take place, to address—

(1) the principals of technical colleges, such as the Sibpur Civil Engineering College, the Behar School of Engineering, the Dacca Engineerings School, and the Calcutta School of Art, and the heads of all technical schools in Bengal;
(2) the principals of all colleges in which science is taught practically; and
(3) to issue advertisements addressed to the various employers of industrial labour, such as those employing master-foremen of shops, &c., intelligent apprentices, &c., stating the qualifications required in the scholars to be selected to be sent to Europe and stating that they will be allowed to submit selected names.

These classes of officers would be asked to submit the names and all necessary particulars of any students who might seem to them to fulfil the necessary conditions, and specifying specially if such students have any hereditary interest in industry.

From the names thus received the Director of Public Instruction could suggest nominations to the Local Government, and in making his selection he would be guided (i) by the fact that it would be necessary for the student to have a competent knowledge of English, &c., to enable him to take full advantage of any course of study and instruction in Europe; (ii) by the interest and knowledge which such student had shown in practical work; (iii) by the history of the candidate showing whether he is likely to continue to follow industrial work after his training in Europe; (iv) by the capacity and intelligence of the candidate; and (v) by the desirability or necessity of fostering the branch of industry to which the candidate has directed his thoughts and attention. From the names so selected the Government of Bengal would make its nominations for the approval of the Government of India.

5. Then, as regards the work to be done by the scholar when in Europe, this would be to a certain extent decided on by the considerations (iv) and (v) given in paragraph 4, and on the appointment of such scholar a definite programme should be laid down for the scholar's work for the time he is to hold the scholarship, showing where it is intended he should work, the exact subject he would work at, &c. The programme would be drawn up by the Director of Public Instruction in consultation with the candidate and with local experts in the industry which is to be studied. While in Europe the scholar should be under the supervision of the Secretary of State in the same way as the Government scholars are at the present time, and a set of rules

somewhat like those for the present holders of Indian scholarships should be framed. These rules will be found in detail in pages 236–237 of the calendar for the Calcutta University for the year 1901. Somewhat similar rules also obtained in the case of the agricultural scholars who proceeded to Europe. Among the rules also should be included one which would make it incumbent for the student to have reports of his work submitted to the Director of Public Instruction as well as to the Political Aide-de-Camp to the Secretary of State.

6. On the return of such scholars from Europe to India the Local Governments should have the first claim on the services of such men and the Local Governments should employ them in posts or occupations calculated to foster the industry which the student has been deputed to Europe to study. They might be even made inspectors of schools devoted to such industries or might themselves superintend schools, &c.

7. At the present time it does not appear possible to give any more detailed indications of how the proposed scheme should be worked. It is, however, clear there would be no difficulty whatever in at once starting the scheme even from the year 1902–03, and there would, in my opinion, be every probability of such a scheme proving eminently successful.

Enclosure No. 5.

No. $\frac{589}{\text{XV.-318 A.}}$, dated the 30th December 1901.

From L. M. Thornton, Esq., I.C.S., Secretary to the Government of the North-Western Provinces and Oudh, Educational Department, to the Secretary to the Government of India, Home Department.

I am directed to reply to paragraph 6 of your letter No. 504, dated 20th November 1901, in which the Government of India ask the opinion of this Government as to the details for working out the scheme of Government technical scholarships. I am to submit, for the information of the Government of India, copy of a letter No. F. 1880, dated 30th November 1901, from the Director of Public Instruction, North-Western Provinces and Oudh, who was consulted on the subject, and to communicate the following remarks and suggestions.

2. It is understood from your letter that perhaps one State scholarship, of the value of 100*l.* per annum *plus* fees of the institution, and tenable as a rule for two years, would, under the scheme contemplated by the Government of India, be available each year in the North-Western Provinces and Oudh. His Excellency in Council desires that the Local Government shall award the scholarship, and shall prescribe on each occasion the branch of higher technical education which the holder is to study in Europe and also decide at what institution he is to study it. As regards the initial measure of giving due publicity to the intentions of Government beforehand, the Lieutenant-Governor and Chief Commissioner thinks that the proposals detailed in the letter of the Director of Public Instruction may be accepted. His Honour also concurs with Mr. Lewis in thinking that a really good knowledge of English is essential and that suitable candidates will not generally be forthcoming direct from school. The maximum age limit might be fixed at 25 years. As a preliminary, the Government will have to decide each year in what subject or branch of technical education the scholarship shall be given. At first it will no doubt be desirable to give the scholarship in one of the branches which are taught at the Thomason Civil Engineering College at Rurki. It appears to the Lieutenant-Governor that it will be expedient to adopt a system of limited competition. Applications would be received by the Education Department, and submitted, with the opinion of the Director, for the orders of Government, which would

make a selection from among the applicants. An examination of the selected candidates could then be held at Rurki.

3. I am to say, however, that the above suggestions are tentative only, and should be regarded as liable to revision in the light of experience. I am to add that a separate reply will, in due course, be submitted with regard to Industrial Schools (paragraphs 3 to 5 of your letter of 20th November 1901).

Annex.

No. 1880 F., dated 30th November 1901.

From. T. C. Lewis, Esq., Director of Public Instruction, North-Western Provinces and Oudh, to the Secretary to the Government of the North-Western Provinces and Oudh.

With reference to paragraph 6 of Government of India's No. 504, dated 20th November 1901, forwarded with your No. 546/XV. 318—A., dated 29th November 1901, in which the opinion of the Government of the North-Western Provinces and Oudh has been asked for as to the details for working out the scheme for the proposed State technical scholarships, I have the honour to reply that there are two points to be considered :—

(i.) How to give the widest publicity to the offer of scholarships.
(ii.) How to select the most suitable students to hold them.

As regards (i), announcements should be made in the Government Gazette, in all colleges affiliated to the University in Arts, Science, or Engineering, and also to important firms of manufacturers, more especially those under the management of natives of India, who might be likely to profit by the improvements in their manufacturing business, which a technical scholar deputed by them would be able to introduce after studying the best European or American methods for the period of two years.

With regard to (ii), the selection of the scholars from among the applicants, it is important to insist upon good attainments in English, beyond such as school boys are likely to possess; hence applications should not be expected from schools. As regards other subjects which the applicant may have studied, only so much proficiency should be required as is sufficient to show that he is ordinarily intelligent. Among students in Arts Colleges evidence of aptitude for technical study is not often to be found, nor, when found, easy to estimate at its right value; but it may sometimes be both forthcoming and convincing. Students attending Science and Engineering classes would find less difficulty in proffering such evidence in a satisfactory shape; and there would be no difficulty in the case of an employé of a manufacturing firm. Amongst candidates otherwise qualified the preference should be given to the one who appears to be most likely to be able to put his new knowledge or skill to practical use on his return to India, *i.e.*, generally to one who is directly connected with a business concern either by family relations with the managers or by being actually employed in it. The bringing out of technically educated men who are at a loss to know what to do with their technical education, and so are apt to be of no practical use to the country, is a possible evil that should be guarded against from the beginning.

Enclosure No. 6.

Extract paragraph 3 of a letter from the Government of the Punjab, No. 131, dated the 8th April 1902.

In paragraph 6 of letter No. 505 of 20th November 1901, the opinion of the Local Government is asked with regard to the establishment of Government technical scholarships of 100*l.* a year. The Government of India

propose to found ten scholarships a year, two each year to be given to Madras and the same number to the Bombay and Bengal Presidencies respectively, the remaining four to be distributed among other Local Governments and Administrations. It is also proposed that the selection of the students to hold these scholarships should be made by the Local Governments subject to the approval of the Government of India. The course of instruction and the place at which a scholarship-holder is required to study are to be strictly laid down by the Local Government in the case of each selected candidate prior to his departure from India. In ordinary circumstances the period for which the scholarship might be held is to be two years, but in special cases the term may be extended to a third year or reduced below two years. These scholarships are to be tenable in foreign countries as well as in Great Britain. The Government of India also propose to provide the scholarship-holder with a second class passage to and from the place at which he will have to study and to pay the fees at the institution to which he is to be sent.

These conditions seem to Sir Charles Rivaz very suitable, and he proposes to consult, when it is the turn for this Province to select a candidate, the local authorities and experts best fitted to judge of the qualifications of the candidates and to suggest appropriate courses and places of study: such experts would include the Principals of Colleges and of the School of Art, and officers of the Public Works Department and the Railways.

Enclosure No. 7.

No. 97-4-E.-1, dated Rangoon, the 2nd April 1902.

From the Secretary to the Government of Burma, General Department, to the Secretary to the Government of India, Home Department.

With reference to paragraph 6 of your letter No. 506, dated the 20th November 1901, relating to the establishment of Government Technical Scholarships, I am directed to say that the Lieutenant-Governor concurs generally in the proposals of the Government of India, but that his Honour is not prepared at present to make any detailed recommendations so far as this Province is concerned.

Enclosure No. 8.

Extract paragraph 4 of a letter from the Chief Commissioner, Central Provinces, No. 1793, dated the 1st April 1902.

In regard to the technical scholarships referred to in paragraph 6 of Mr. Hewett's letter under acknowledgment, I am to say that the Chief Commissioner does not at present think that he should press the claims of the Central Provinces to one of these scholarships.

Enclosure No. 9.

Extract paragraph 6 of a letter from the Chief Commissioner of Assam, No. $\frac{2621—P.I.}{262}$ G., dated the 11th January 1902.

With reference to paragraph 6 of your letter, I am to say that the Chief Commissioner does not consider it necessary for the present to bring Assam within the operation of the scheme for granting Government Technical Scholarships tenable in Great Britain and foreign countries for the encouragement of the further studies of Indian students in the higher branches of technical education.

No. 2.

DESPATCH from Secretary of State for India, No. 65 (Public), to His Excellency the Right Honourable the Governor-General of India in Council, dated 29th May 1903.

My Lord,

On receipt of the letter of Your Excellency in Council, No. 8 (Education), dated the 9th October last, in which you proposed the establishment of ten State technical scholarships, to be awarded annually to natives of India studying in Great Britain or other Western countries, I thought it desirable to obtain the opinion on the scheme of the Board of Education.

2. I enclose a copy of the letter addressed to the Board, and of their reply thereto.

3. It is not necessary for me to assure your Excellency that the principle of the scheme, which applies to India a system which has, I understand, proved very successful in the case of Japan, and more recently in that of Siam, meets with my full approval, and that I cordially sympathise with the desire of your Government to further the development of Indian industries by providing promising young men with the means of studying the progress which has been made in industries and arts in the most advanced countries of the West. It appears to me, however, that before the details of the scheme can be finally settled there are some points which call for further examination.

4. Your Excellency will observe that the Board of Education express a doubt, which I share, whether a scholarship of 100*l.* a year, in addition to fees and travelling expenses, will fully meet the expenses of a student in this country. I observe that in 1887, when dealing with the existing Government scholarships of 200*l.* a year, the Government of India found it necessary to issue a public warning* that "while the scholarship allowance "of 200*l.* a year is sufficient to cover the "necessary expenses of college life at Oxford or Cambridge, it is very "desirable, if not absolutely necessary, that the scholars should have some "small private resources of their own to meet expenses in the vacation and "other general expenses which are scarcely avoidable." And it appears to me that the holders of the proposed technical scholarships will be in the same case. I would therefore ask you to consider whether it is not necessary to fix some higher limit to the scholarship allowance.

* *See* Home Department Education Proceedings, March 1887, p. 60.

5. I observe from your fifth paragraph that it is proposed to connect the scholarship scheme with the system of technical and industrial education in the various Provinces, which will no doubt be established as the result of your deliberations on the report of the Industrial Schools Committee. I do not gather from the replies of the various Local Governments which you forward that there is any large supply of qualified candidates for the scholarships as yet forthcoming, at any rate in the two provinces which are believed to be industrially most advanced, Bombay and Bengal, and I should suppose that it would take some time to bring into existence a class of students, trained in properly equipped technical schools in India, who would be ready to take up the scholarships when established. Before, therefore, sanctioning any definite annual number of scholarships to be awarded, I think it would suffice to announce the readiness of Government to give a scholarship or scholarships if promising and well-qualified candidates present themselves in some particular branch of industry. In other words, it appears to me that the scheme should for the present be worked experimentally, its further development being left for consideration when your technical institutions in India have begun to produce a class of students who might be expected to profit by its extension.

6. I notice that you exclude from the scope of the scheme Law, Medicine, Forestry, and Veterinary Science, as being already provided for; and certainly there is no lack of Indian students who, without the inducement of a scholarship, visit this country in order to study the first two of these subjects. Engineering is not mentioned among the excluded subjects; you are, however, aware that Indian candidates present themselves in considerable numbers for entry to the Coopers Hill College, while the engineering Colleges in India are, I presume, capable of giving instruction of a high class in that subject.

7. I shall be ready, with the advice of the Board of Education, to undertake the selection of the course of technological study best fitted to the needs of any particular scholar. Your Excellency will observe that the Board, in the concluding paragraph of their letter, ask that they may, in any case in which their advice is desired, be furnished with full particulars as to the past educational experience and future requirements of each scholarship-holder. Should any student elect to pursue his studies on the Continent or in America, it would probably be found possible to obtain from the head of the institution where he is studying a periodical report on his progress and conduct; but no more extended supervision by this Office would in such a case be practicable, and I should hope that the persons selected for the scholarships would ordinarily be of such formed character and habits, and of such an age, that detailed tutelage would in their case be unnecessary.

I have the honour to be,
My Lord,
Your Lordship's most obedient humble Servant,
(Signed) GEORGE HAMILTON.

ENCLOSURES.

Enclosure No. 1.

India Office to Board of Education.

J. and P. 2392/02. India Office,
25th February 1903.

Sir,

I am directed by Lord George Hamilton to enclose, for the information of the Board of Education, a copy of a Despatch* which has been received from the Government of India, proposing the establishment of ten scholarships annually for natives of India who may desire to pursue technical studies in Great Britain or other European countries.

* No. 8, dated the 9th October 1902, with enclosures.

It will be seen that the Government of India, while contemplating that the particular industry to be studied by a scholarship holder shall be determined in India by the Local Government before he is nominated, propose to leave to this Office the prescription of a course of study, with reference to the facilities for such studies existing in England and elsewhere. They propose also that special arrangements should be made for the supervision of any students who may elect to pursue their studies on the Continent or in America. The value of the scholarships is fixed at 100*l.* a year, in addition to the fees payable to the institutions where the scholars will study, and travelling expenses.

Lord George Hamilton would be much obliged if the Board of Education would favour him with their advice on the proposed scheme, and in particular in regard to those points in it which are enumerated in the preceding paragraph. There is not at present in this Department any official who could be made responsible for selecting a course of study for an Indian holding a technical scholarship, and his Lordship hopes that if the scheme is brought into operation he may count on the assistance of the Board of Education especially in this respect.

It is understood that the system of deputing students to Europe for technical study has been adopted with much success by the Government

of Japan, and more recently by that of Siam; and it is probable that the experience gained in these cases (if known to the Board of Education) would afford some criterion of the results which may be expected from the establishment of a similar scheme for natives of India.

Lord George Hamilton would be glad to learn whether, in the opinion of the Board, an allowance of 100*l.* annually (in addition to fees and travelling expenses) is likely to suffice for the support of an Indian in this country while undergoing a course of study.

I have, &c.,
HORACE WALPOLE.

The Secretary,
Board of Education.

Enclosure No. 2.

Board of Education to India Office.

Whitehall, London, S.W.,
21st April 1903.

Sir,

In reply to Sir H. Walpole's letter of February 25th, I am directed by the Board of Education to state that they regard the proposed establishment of ten annual travelling scholarships for natives of India who shall pursue technological studies in Great Britain or some other Western country as likely to prove of benefit to Indian industry and education.

The Board note that the Government of India in their Despatch of October 1902 contemplate cases in which the scholar will elect to pursue his studies in America, while in your letter of 25th February last the sphere of study is limited to Great Britain or other European countries. If this discrepancy is due to inadvertence, the Board would take this opportunity of saying that in their opinion some of the scholars might derive special advantage from a course of study in America supplementing a period of residence in Europe.

If requested by the Secretary of State for India, the Board of Education, though unable to undertake responsibility for the personal supervision of the students, will be happy to give such advice as is within their competence, from time to time, as to the course of technological study best fitted to the needs of any particular scholar.

In reply to the question of the Secretary of State as to the sufficiency of the proposed annual allowance, the Board are of opinion that 100*l.* annually (in addition to fees and travelling expenses) would not be adequate to the student's needs, and they believe that this view is confirmed by the experience of those who have organised similar scholarship-systems for the Governments of Japan and Siam, but, of course, much would depend on the social status of the scholars and on the country to which they were sent.

In this connection the Board of Education would be glad to receive more precise information as to the exact educational standing of the proposed scholarship holders. The Board are at present not clear whether it is contemplated that these scholars should pursue technical studies of the highest grade, or of an intermediate character, or whether they might even be of artizan rank; but it is presumed that the reference is to the needs of the first two classes. In any case in which the Board might be called upon to advise with regard to any student they would desire to be furnished with a statement of his past educational experience and future requirements.

I have, &c.,
ROBERT L. MORANT.

The Under Secretary of State
for India.

No. 3.

Extract from Despatch from Government of India to Secretary of State, No. 18, dated 11th August 1904.

We have the honour to refer to the correspondence ending with the Despatch No. 65 (Public), dated the 29th May 1903, in which your predecessor intimated his general approval of the proposals made by the Government of Lord Curzon to award State technical scholarships to qualified natives of India who might desire to pursue technical studies connected with some particular branch of industry in Great Britain or other Western countries.

2. After considering Lord George Hamilton's Despatch, Lord Curzon's Government published a copy of the correspondence for general information. At the same time they explained to Local Governments the conditions under which they desired to introduce the scheme; they intimated that the textile industry in Bombay and the mining industry in Bengal appeared to offer the most favourable fields for the initiation of the experiment; and they stated that they would be glad to consider any suggestion which the Local Governments might have to offer for the establishment of a technical scholarship in any other branch of industry which could thereby be developed, if a suitable candidate could be found. In view of the doubts expressed by the Board of Education and your predecessor as to the adequacy of the scholarships of 100*l.* originally proposed, the Government of Lord Curzon raised their value to 150*l.* a year, exclusive of the fees payable at the institutions at which the scholars might study, and of travelling expenses.

Enclosure to Government of India Despatch No. 18, dated 11th August 1904.

Circular Letter from Government of India to Local Governments, Nos. 565–570, dated 21st September 1903.

I am directed to forward, for the information of the Governments of Madras, Bombay, &c., a copy of the papers noted on the margin,* regarding the institution of State technical scholarships to enable natives of India to pursue a course of study in Great Britain or other Western countries.

* Despatch to the Secretary of State, No. 8, dated the 9th October 1902.
Despatch from the Secretary of State, No. 65, dated the 29th May 1903, and enclosure.

2. In view of the doubts expressed by the Board of Education and the Secretary of State as to the sufficiency of the proposed amount of the scholarships, the Government of India think that it would be well to fix their value at 150*l.* a year. As has been pointed out, however, the question depends largely upon the status of the scholar, and on the country to which he proceeds for study: and if in any particular case the Local Government regards the sum now named as insufficient, the Governor-General in Council will be prepared to consider proposals for increasing it.

3. Instead of announcing the intention to award a definite number of scholarships annually, the Government of India agree with the Secretary of State that it will for the present suffice to intimate the readiness of Government to give a scholarship or scholarships if promising and well-qualified candidates present themselves in some particular branch of industry. They further accept His Lordship's suggestion that engineering should be excluded from the scope of the proposals.

4. Subject to the foregoing modifications, the Despatch of 9th October 1902 to the Secretary of State indicates the conditions under which the Government of India desire to introduce experimentally a scheme of technical scholarships. The information now before them suggests that the textile industry in Bombay and the mining industry in Bengal will be found to offer the most favourable fields for the initiation of the experiment,

The Government of India will, however, be glad to consider any suggestions which the Governments of Madras, Bombay, &c., may have to offer for the establishment of a technical scholarship in any other branch of industry which can thereby be developed, if a suitable candidate can be found.

No. 4.

Despatch from the Secretary of State for India, No. 138 (Public), to His Excellency the Right Honourable the Governor-General of India in Council, dated 8th October 1909.

MY LORD,

I desire to address Your Excellency in Council on the question of the employment on their return to India of young Indians who have been granted technical scholarships by Your Excellency's Government for the study of various branches of technical education in this country. My attention has been called to the general question by the particular case of Mr. Asok Bose, a copy of correspondence* with whom I forward for the information and consideration of your Government; but there have been four other cases in which students who have received scholarships for the study of mining have applied for appointment under Government on the termination of the scholarship. The names of the four applicants are N. D. Daru, H. C. Read, A. M. Sen, and C. Fox; the first-named alone received an appointment, namely, in the Geological Survey.

* Letter from Mr. A. Bose, dated 25th July 1909.
Letter to ditto, dated 19th August 1909.
(Not printed.)

2. Other cases of holders of technical scholarships have also occurred in which the student has appeared to think that the fact that he has been assisted by Government in obtaining technical instruction, constitutes a reason why Government should provide him with employment on his return to India.

3. The notification issued by the Government of Bengal, of which a copy was sent to me with your Despatch No. 18, dated 11th August 1904, announcing the grant of these scholarships, for one of whieh Mr. Bose was selected, deals with the subject of returned scholars in paragraph 11, and is so worded as to leave the scholar under the impression that if he fails to secure suitable private employ, Government would be glad of his services. It is plainly impossible to find Government employment for all such returned scholars, and I commend it to your consideration whether these notifications should not make clear to such scholars that they must generally depend upon their own exertions to make their living on their return to India, and must not ordinarily expect to be taken into Government service.

4. If this is not done, there appears to be a risk that a sense of grievance may be created, and that the expenditure involved in the grant of these scholarships may prove to be unprofitable.

I have the honour to be,
My Lord,
Your Lordship's most obedient humble Servant,
(Signed) MORLEY OF BLACKBURN.

No. 5.

Extract from Despatch from Government of India to Secretary of State, No. 18, dated 26th May 1910.

We have the honour to forward for Your Lordship's information a copy of the papers noted in the attached list of enclosures regarding the grant of State technical scholarships to certain candidates in the United Provinces.

2. With regard to the subjects mentioned in paragraph 2 of the letter from the Government of the United Provinces, dated the 12th April 1910, we have already asked Your Lordship for information as to the facilities available in certain countries for instruction in these subjects in our Educational Despatch No. 4, dated the 24th February 1910.

3. The Government of the United Provinces has also raised the question whether mechanical engineering should be excluded from the scope of the proposals for technical scholarships. Engineering was originally so excluded for the reasons stated in paragraph 6 of Lord George Hamilton's Despatch No. 65 (Public), dated the 29th May 1903. But having regard to the reference to Coopers Hill College in that despatch, it would appear that the intention was merely to exclude civil engineering, a subject for the teaching of which there was then and is now ample provision in India. In view of the representation now submitted by the United Provinces Government we are disposed to think that electrical and mechanical engineering should be considered as falling within the scope of the technical scholarship scheme. Provision for instruction in these subjects is not so advanced in India as in the case of civil engineering, while the demand for qualified electrical and mechanical engineers to take charge of factories and works is steadily on the increase. We have already, as intimated in our Educational Despatch No. 16, dated the 10th June 1909, awarded a scholarship in electrical engineering to a candidate from the Bombay Presidency, and we see no objection to the grant of scholarships in mechanical engineering to the two candidates who are now recommended by the United Provinces Government.

Extract from Letter from the Government of the United Provinces to the Government of India (Home Department), No. 368, dated 12th April 1910 (Enclosure 1 to Government of India Despatch No. 18, dated 26th May 1910).

With reference to Mr. Fell's Letter No. 1003, dated the 30th November 1907, I am directed to forward the recommendations of the Lieutenant-Governor for the grant of technical scholarships in the year 1910–11 to enable candidates to study a selected industry in England.

2. In accordance with the usual practice the Upper India Chamber of Commerce and Commissioners of Divisions were consulted as to the industries to be selected, and on a consideration of the replies received applications were invited by advertisement in the papers for scholarships in the following subjects :—

(i) extraction of alkalis;
(ii) manufacture of cane sugar by machinery;
(iii) manufacture of vegetable oils;
(iv) wool dyeing;
(v) mechanical engineering.

The Lieutenant-Governor was advised, however, that a candidate could not obtain the full benefit of instruction in the technology of sugar by studying in England. A reference was therefore made to the Government of India in my Letter No. 1730, dated the 16th November 1909, enquiring whether scholarships could be made tenable in Java, and as the question is still under the consideration of the Secretary of State it is clear that the grant of a scholarship in this subject must be held over for the present; the result is one which His Honour regrets as the industry is one of the greatest importance in this province, and a study of improved methods is urgently required. He hopes, however, to be permitted to nominate a candidate next year. In the same letter enquiry was made also whether a course of instruction would be available in extraction of alkalis, manufacture of vegetable oils, and wool dyeing; a reply to this enquiry has not yet been received, and His Honour would therefore have some hesitation in recommending the grant of a scholarship in any of these subjects. Apart from

this, however, having considered both the merits of the candidates who have applied and the relative importance of the subjects they have selected, he is of opinion that his nominations should be given to men who are desirous of taking up mechanical engineering. He is not certain, I am to say, what are the intentions of the Government of India as regards scholarships in this subject, since it was intimated in Mr. Marris's Letter No. 566, dated the 21st September 1903, that they had accepted the suggestion of the Secretary of State that engineering should be excluded from the scope of the proposals for technical scholarships. He understands, however, that a scholarship in electrical and mechanical engineering was sanctioned last year in the Bombay Presidency, and he desires strongly to urge the need for similar scholarships in this province. A new spirit of industrial enterprise is showing itself among the people, and various factories and works are being started in which large sums of capital are invested. But the promoters labour under the disadvantage that they can find among their own people no one equipped with the expert knowledge that is necessary for the running of a large concern, such as a spinning mill, and they have to employ outsiders. The province, indeed, appears to be singularly weak in mechanical engineering, so much so that when the executive committee of the United Provinces Exhibition desired to get a mechanical engineer they were unable to do so. It is true, no doubt, that civil engineering is amply provided for in India, but instruction in electrical and mechanical engineering is not equally satisfactory. It would be of the greatest advantage to the nascent industries of this province to have men who belong to the province and who would naturally seek their career in it, trained in the latest practice in this subject at home; a good supply of engineers may, indeed, be considered a preliminary essential to any industrial advance since there is scarcely an industry in which their services are not required, and His Honour believes that next to sugar mechanical engineering is the most important branch of study that needs encouragement at the present time.

APPENDIX II.

EXTRACTS from Fifth Quinquennial Review of the Progress of Education in India, 1902–7.

The following extract from the reply of the Madras Chamber of Commerce indicates the nature of the difficulties which they detected :—"The Chamber "understands that manufacturing industries are what Government have "chiefly in mind, and if it is only in that direction that encouragement "by the grant of scholarships is proposed, the Chamber fears that the "difficulty you mention of attracting suitable native candidates for them "will prove insurmountable. The reasons are that practically all manu- "facturing industries in India are at present run by Europeans, and "they, when requiring men with expert knowledge for responsible posts "(such as an ex-scholarship holder would naturally aspire to), would almost "certainly prefer to employ a European, whose capacity and general reliability "they could better form an opinion of. Natives doubtless realise this, so "those of a class and with the education, ability and energy to qualify for "technical scholarships are scarcely likely to care to enter on a career with "no very promising or assured prospects for them in it."

The Chamber of Commerce for Upper India appointed a Committee and arrived at negative conclusions, which are expressed in the following remarks :—

"The Committee have been assisted in their deliberations with the views held by a comprehensive range of industries, and, though diversity of opinion was to be expected in regard to a question possessing such different bearings when viewed from the standpoint of the various classes of producers, the Committee feel that certain well-defined objections to the Government of India's proposals are shared by the great majority of those interested in production on a large scale by means of extensive labour-saving machinery. I am to represent in the first place, that so far as the organised industries of these provinces are concerned, it is not thought that specially trained scholars, who have undergone such a course of studies as is contemplated by the Government of India's scheme, would be of any material value. These students would presumably expect to be installed in positions of trust and importance, and as it is not considered that it would be possible for them in the time at their disposal to gain more than a limited and circumscribed acquaintance with the practical details of the particular industries they had selected for their studies, it would be extremely doubtful that the heads of important concerns would regard them as qualified to replace European experts, possessing years of practical experience, in the more responsible appointments. On the other hand, the very fact of their being favoured by such special selection at the hands of Government as is indicated in the memorandum under consideration would be calculated to render them unfitted in their own estimation for the more subordinate positions in mills and factories.

"As to the value of such students as instructors in technical schools, the Committee does not feel itself competent to pronounce an opinion: but in the case of what may be termed the major industries, the knowledge gained by a thorough training in a factory working under Eastern conditions would seem to provide a very much more useful preparatory course than the superficial instruction which a scholar would be likely to receive in foreign countries. In the present position of the local manufacturing industries it is not experts or highly qualified men with a knowledge of the technique of their trades that are difficult to obtain, but a more plentiful supply of the crude material from which to select the ordinary rank and file of operatives and the improvement of the standard of intelligence and manual skill amongst those operatives."

The Governments, however, persevered in giving effect to the scheme. In Madras it was reported that there were a large number of native industries, but very few of them were appropriate for selection, as the majority were not susceptible of being organised on a considerable scale. Amongst others which were passed in review were the trade in gold lace, which is imported up to the value of 10 or 15 lakhs per annum from France; metal plate work; pottery and brick manufacture; textile industries, including cotton spinning, dyeing, machine loom weaving, and hand weaving; mining which, however, except for mica in Nellore is entirely in the hands of European syndicates; glass making; and the manufacture of sulphuric acid, the demand for which in the Madras Presidency was said to average about 90 tons per annum. After careful consideration the Government came to the conclusion that first scholarships might be most advantageously assigned in connection with the study of industrial chemistry in one or more of its branches, and with the tanning industry. Government therefore invited applications in January 1906 for scholarships in these subjects. Although industrial chemistry and tanning represented the deliberate choice of the Madras Government, before suitable candidates could be found in these, an opportunity occurred to nominate a scholar to study weaving, and this was accordingly the subject of the first State technical scholarship instituted in Madras. A scholar 39 years of age, who was weaving master in the Coimbatore jail, was sent to Manchester to study the various types of hand looms for dealing with silk, cotton, and other fibres, and the means to be employed to secure the best preparation of warps for hand looms. The occupation of cotton weaving, spinning, and dyeing maintains about 1¼ million persons in Madras, and a hand loom factory for the teaching of improved methods has recently been started by the Government of Madras at Salem.

In Bombay, it was the unanimous opinion of the authorities consulted that the first scholarships ought to be given in connection with the textile industry. Contrary to the experience in some other provinces, it was found that a European firm, that of Messrs. Wallace & Co., Bombay, had shown sufficient faith in the technical training of Indian employés to send home a Hindu, employed at their mill at Sholapur, to go through the textile industry course at the Manchester School of Technology. It was settled that one of the State technical scholarships should be awarded to a candidate who was willing to go through the course of textile industry at Manchester, Leeds, or Bradford. There was some difference of opinion as to the precise direction which it would be best to give to the second scholarship. Hand block printing had been suggested as the subject of study, and it seemed that there was a considerable opening for the improvement of this industry, if developed on proper and scientific lines, in Gujerat; but it was doubtful whether a scholar could obtain training in it in Europe. It was agreed, however, that if a student were trained as a textile chemist he would acquire knowledge which might enable the hand-printers of this country to regain the position they once held as producers of printed fabrics with colours of exceptional brilliancy and endurance. The Government of Bombay therefore decided that the second scholarship should be offered for a course of textile study, with special reference to chemistry in its application to textile requirements, and especially to the printing of textile fabrics, with the special object of improving the hand methods now followed in the villages and towns of the Bombay Presidency.

Of the candidates who applied for the scholarships, five were found to be fully qualified, and it was decided to award three scholarships instead of two. The three scholars sailed for England in May 1905 and were entered at the Municipal School of Technology at Manchester.

In Bengal the proposal that mining should be the subject of the first scholarships was received with general consent; and the Indian Mining Association added the suggestion that electrical engineering should form one of the subjects to be taken up by the mining students. The need for a further supply of trained men to be employed in connection with mines has been recognised by the publication of rules under the Indian Mines Act, 1901. The scholarships were widely advertised, and of the applicants four were chosen and sailed to England in September 1904 to enter upon a

course for the diploma in mining at the Birmingham University. The course there is three years, and the scholarships were to be capable of extension to three years if satisfactory progress was made. In the next year, 1905, two more scholars were selected in a similar way for the course in mining at the Birmingham University.

In the United Provinces, where the Chamber of Commerce held the unfavourable opinion already quoted as to the prospects of the scholarship scheme, the Government made very full enquiries, which, however, turned out to be fruitless, for an industry for the support of which a scholarship might suitably be given. The first suggestions tentatively made were that the indigenous industries which might be helped by a scholarship were:—(1) ghee and butter making, (2) sugar refining, (3) brass work. As regards the first of these, it was reported that although there might be a good deal of scope for a man who devoted his life to the chemical investigation of fatty matters to improve the ghee industry, it was unlikely either that the necessary training could be obtained out of India, or that ghee factories on a large scale would be established. Butter making was considered an unsuitable industry in which to train an expert, because of the monopoly of this trade by the Military Department. Sugar refining was also reported to be an industry in which it was unlikely that large factories would be started with the aid of local capital. Inquiries with the brass-work trade did not reveal sufficient positive grounds for expecting that the institution of a scholarship in it would be a success. The proposal to institute technical scholarships in the United Provinces was therefore postponed. In the year 1906 two natives of Benares asked for scholarships to enable them to continue technical training which they had already begun, one in the subject of silk weaving, and the other in that of glass making. An exception was made to the rules which require that the subject in which the scholarship is to be given is to be selected by the local Governments, and that applications for candidates are to be invited with the widest publicity, and scholarships were promised to these two men.

In the Punjab many suggestions were made by those whom the Government consulted. Some of these pointed to existing industries carried on by natives and capable of improvement by an application of more scientific methods, while others pointed to trades which might be called into existence if the necessary capital and knowledge were forthcoming. Prominence was given to the fact that many hides are exported from the Punjab, and re-imported when tanned and dyed; and it was stated that of the natives who are engaged in the trade in hides some are possessed of large capital. Pottery was also recommended as an industry to be encouraged by a scholarship. Mr. Percy Brown, the Principal of the Mayo School of Art, Lahore, calling attention to the passage in the report of Colonel Clibborn's Committee on Industrial Schools, in which they recommended the establishment of an institute for pottery at Delhi, and remarked upon the bad quality of Indian pottery owing to the ignorance of the most suitable clays, and the imperfect kilns in use, and the prevailing ignorance of the use of glazes, wrote:—"The above indicates mainly that an experimental "institute is required; but it also points out the important fact that an "industry employing a large number of workpeople is waiting to be "improved by the introduction of an expert. Delhi is shown as being the "centre of the craft, but Mooltan has been omitted, and here some of the "finest glazing of the country is made. The preparation of tiles, plain "and glazed, for walls and floor, is also an industry of the future, and, in "fact, there is no limit to the list of useful and artistic articles which may "be made of terra-cotta. I think it may be accepted that pottery chinaware "will well repay development in the Punjab. As an ancient art, it must "have employed many thousands of hands; the remains of the mosaic tile "work and terra-cotta decoration on old buildings all over the province testify "to this, and with encouragement there is every possibility of it becoming "an important craft of the future."

Metal in various forms was also mentioned as an industry likely to be improved by the increase of expert knowledge. Under this heading were mentioned the trade in despatch boxes at Sialkot and Mooltan, surgical instruments at Sialkot, cutlery and steel work generally; the manufacture of

brass and bell-metal utensils, and iron foundries. It was stated that inferior metal was in use, and that the bazaar methods of casting and moulding were very crude and the instruments very primitive; and there was room for more or less improvement in every branch of this important craft.

Other subjects mentioned were glassware, manufacture of articles from the bones of animals (*e.g.* buttons), boiler-making, calico printing, dyeing and bleaching, sugar industry, cotton and flour mills.

The Local Government decided that of all the industries mentioned, those which might be developed with advantage by the help of scholarships were tanning, metal work, and pottery.

Two scholarships were allotted to the Punjab, and the Local Government decided to invite applications for scholarships in tanning and metal work. The best of the candidates for the tanning scholarship had received no instruction in science, his school career having extended only as far as the middle school examination. Inquiries were made in England whether it would be useful for such a candidate to proceed there for the purpose of technical training, but the reply was unfavourable. Consequently no scholarship for tanning was awarded in the Punjab. A suitable candidate was found for the study of metal work, and a scholarship was awarded to him.

Burma saw no opening for the technical scholars and no means of obtaining a suitable candidate. The Local Government considered whether a scholarship might be offered for training an analytic chemist for the purposes of the petroleum industry, but came to the conclusion that a native of the province so trained would be unlikely to obtain remunerative employment in Burma.

In the Central Provinces, where the prospectors for minerals have been active and successful, the promised growth of the coal, iron and manganese industries were sufficient to justify a demand for a technical scholarship. The other industries examined were the culture and manufacture of tussah silk, dyeing, tanning, hand weaving, oil pressing, mining. Tussah silk and dyeing were set on one side because the Local Government considered that they were in a primitive condition, which called, not for the moderate amount of expert knowledge which a technical scholar might be expected to apply, but for an original investigator of high scientific training and faculty. Tanning, hand weaving and oil pressing, on the other hand, were not pursued in any one place upon a large enough scale to give prospect of the profitable employment of a scholar.

Assam saw no opening for the award of a technical scholarship.

APPENDIX III.

STATEMENT showing the various Subjects for the study of which Government Technical Scholarships have been awarded, together with the Universities or other Institutions at which the training has been, or is now being, carried out.

Place of Training.	SUBJECT OF STUDY.										Totals.
	Textile Industries, &c.	Electrical and Mechanical Engineering.	Mining and Mining Engineering.	Metallurgy.	Manufacture of Alkalis.	Leather Industry.	Soap-making and Chemistry of Oils, Fats, &c.	Sugar Industry.	Pottery.	Engineering and Sanitary Science.	
Manchester University	–	–	2	–	–	–	–	–	–	–	2
Manchester School of Technology	24*	2	–	–	–	–	–	1	–	–	27
Birmingham University	–	1	16	2	–	–	–	–	–	–	19
Leeds University	–	–	–	–	–	2	–	–	–	–	2
Liverpool University	–	–	–	–	1	–	–	–	–	1†	2
Berlin University	–	–	–	1	–	–	–	–	–	–	1
City and Guilds (Engineering) College	–	1	–	–	–	–	–	–	–	–	1
London School of Mines	–	–	1	–	–	–	–	–	–	–	1
Leathersellers Company's College	–	–	–	–	–	3	–	–	–	–	3
Faraday House	–	3	–	–	–	–	–	–	–	–	3
Battersea Polytechnic	–	–	–	–	–	–	1	–	–	–	1
Dr. Lewkowitsch's Laboratory	–	–	–	–	–	–	1	–	–	–	1
West Indies	–	–	–	–	–	–	–	1	–	–	1
Pilkinton's Tile and Pottery Company	–	–	–	–	–	–	–	–	1	–	1
Totals	24	7	19	3	1	5	2	2	1	1	65‡

* One of these students was transferred to l'École Supérieure de Lyons at the expiration of the first year of his scholarship.
† This student afterwards spent one year at London University studying Sanitary Science.
‡ Mr. Darn, who was sent to Canada for the study of Mineral Prospecting, is not included in this total.

APPENDIX IV.

INDIAN GOVERNMENT TECHNICAL SCHOLARS.

Expenditure on	Year ending 31st March.							
	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Stipends	292 14 1	1,124 15 2	1,631 19 6	2,732 1 9	3,471 5 2	4,289 13 1	4,397 17 4	4,165 5 4
Travelling expenses	18 9 8	38 13 6	101 17 3	96 9 10	138 9 6	517 7 0	426 16 1	403 16 6
Passages to India	—	—	—	140 16 0	99 11 0	209 0 0	367 9 4	322 6 0
University and college fees, &c.	8 0 0	169 15 0	320 19 6	680 11 2	882 9 7	1,131 11 3‡	942 7 10§	758 15 7
Fees for practical work	—	10 10 0	28 17 0	40 5 0	20 5 0	71 9 0	85 5 1	401 13 0
Other expenditure	—	—	—	40 0 0*	20 0 0†	1 5 0	1 5 0	68 7 0‖
Total expenditure	319 3 9	1,353 13 8	2,083 13 3	3,730 3 9	4,632 0 3	6,220 5 4	6,221 0 8	6,120 3 5
Number of scholars	4	10	14	25	30	35	41	39
Average expenditure per scholar £	79 15 11	135 7 4	148 16 8	149 4 2	154 8 0	177 14 5	151 14 8	156 18 6

N.B.—It will be noted that, although the stipend payable to each student is 150*l.* per annum, the average cost per student (including expenses of journeys, fees for practical training, &c.), seldom rises above that figure. This is because in certain cases (when the scholarship is about to expire soon after the beginning of a financial year, or has only just been granted towards the end of it) the payments shown in this statement include only one or two, instead of the full four, quarterly instalments of the stipend.

* { Grant to Mr. I. K. Kaul for drawing instruments = 5*l.*
{ Grant to Mr. Abdul Hafiz for purchase of microscope = 35*l.*

† Grant to Mr. Abdul Hafiz towards cost of publishing thesis for D.Sc. degree = 20*l.*

‡ Includes 137*l.* 16*s.* 3*d.* paid to Dr. Lewkowitsch on account of Mr. Menon.

§ Includes 91*l.* 17*s.* 6*d.* paid to Dr. Lewkowitsch on account of Mr. Menon.

‖ Includes a special grant of 50*l.* to Mr. Obaidullah to enable him to remain at Birmingham till the end of the Session in order to take his M.Sc. degree.

APPENDIX V.

Statement relating to Government of India Technical Scholars (1904—1912).

APPENDIX V.

Statement relating to Government of India Technical Scholars (1904-1912).

Name, Age Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.).	Practical Training. Premium, &c.	Total.
1. Mehta, P. N. 27 years. Bombay. 1904.	Parsi. Native of Navsari in Gaekwar's territory Bombay Presidency. Father was a Weaving Master in the New Great Eastern Spinning and Weaving Mills, Byculla. Applied in response to a Government notification. Selected by the Director of Public Instruction.	Educated at Bombay Victoria Jubilee Technical Institute; L.T.M. (Licentiate of Textile Manufacture) of Bombay and Lord Reay Gold Medallist. Held 1st Class City and Guilds Certificate in Cotton Weaving and Spinning. Had been engaged in Indian weaving mills for several years, and was employed in the Colaba Land and Mills Company as Weaving Master on Rs. 250 at time of nomination.	Textile industry - Two years. Manchester School of Technology.	Visited works of Meister Lucius and Bruning at Hochst on Main and other Continental works during two vacations.	Obtained the Certificate of the University of Manchester and the Diploma of the School of Technology. Since return to India has conducted an inquiry and issued a report for Government on certain aspects of the handloom industry; is now an agent for bleaching machinery materials, yarns, and sizing materials, at Bombay.	£ s. d. 358 19 3	£ s. d. 45 2 0	£ s. d. 76 19 5	£ s. d. Nil.	£ s. d. 481 0 8
2. Pathak, V. T. 28 years. Bombay. 1904.	Caste—Brahman. Native of Sanganner, District Ahmednagar. Applied in response to a Government notification. Selected by the Director of Public Instruction.	L.T.M. and Gold Medallist of Bombay Institute. Had been engaged in textile industry in India for some years, and was employed as Weaving Master on Rs. 125 in the Pulgaon Mills at time of nomination.	Textile study with special reference to chemistry in its application to textile requirements. Two years; extended to three. Manchester School of Technology.	- - -	Did not take the Diploma course. Is now Manager of Serampore Mills.	450 0 0	64 11 0	38 12 4	Nil.	543 3 4
3. Hoogewerf, E. 29 years. Bombay. 1904.	Domiciled European. A native of Belgaum. Father—E. H. Hoogewerf, Headmaster, Sirdar's High School, Belgaum. Applied in response to a Government notification. Selected by the Director of Public Instruction.	L.T.M. and L.M.E. of Bombay Technical Institute, and held 2nd Class Certificate under the Boilers Act. Considerable experience in Indian mills, and was Assistant and Mercantile Traveller on Rs. 250 and travelling expenses to Messrs. Greaves, Cotton, & Co., textile machinery agents, at time of omination.	Textile industry - Two years. Manchester School of Technology.	Spent two months in the works of Messrs. Hattersley and Sons, Loom Machinists, &c., Keighley.	Obtained the Certificate of the University of Manchester and the Diploma of the School of Technology. Is now Principal of Serampore Weaving Institute.	360 10 3	44 11 0	6 2 6	Nil.	411 3 9

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.).	Practical Training. Premium, &c.	Total.
4.						£ s. d.	£ c. d.	£ s. d.	£ s. d.	£ s. d.
Read, H. C. - - 24 years. Bengal. 1904.	A statutory native of India Applied in response to a Government notification published in the Calcutta Gazette, and circulated to the Chambers of Commerce, the Managers of important mines, and others connected with the industry.	Was educated at St. Paul's School, Darjeeling, and passed F.A. examination of Calcutta University. Had been employed since 1899 in Messrs. Bird & Co.'s collieries, and held the post of Assistant-in-Charge of the Kantapahari Colliery at time of nomination.	Mining - - Two years; extended to three. Birmingham University.	Spent three months in various mines, during Degree course.	B.Sc. (Mining) 1907 Manager, Bhuskojori Colliery, Asansole.	447 0 5	56 14 6	5 17 2	Nil.	509 12 1
5.										
De, S. C. - - 23 years. Bengal. 1904.	- - - - Applied in response to a Government notification published in the Calcutta Gazette, and circulated to the Chambers of Commerce, the Managers of important mines, and others connected with the industry.	Passed Entrance examination of Calcutta University, and was trained at the Bihar School of Engineering, where he obtained a Survey Standard Certificate. Entered the service of the Birbhum Coal Company as Mining Surveyor in 1901; and was employed in similar capacity by the Nandi Coal Company at time of nomination.	Mining - - Two years; extended to three. Birmingham University.	Spent three months in various mines, during Degree course.	B.Sc. (Mining) 1907 Is now a Consulting Mining Engineer.	450 0 0	57 4 6	15 5 6	3 3 0	525 13 0
6.										
Bose, Asok - - 20 years. Bengal. 1904.	Father—P. N. Bose, late of the Geological Survey of India, and owner of the West Baraboni Coal Company's Mine. Applied in response to a Government notification published in the Calcutta Gazette, and circulated to the Chambers of Commerce, the Managers of important mines, and others connected with the industry.	Passed F.A. examination of Calcutta University, and was studying for B.Sc. degree at the Presidency College at time of nomination. Had received some practical and theoretical training in mining at his father's mine.	Mining - - Two years; extended to three. Birmingham University.	Spent three months in various mines, during Degree course.	B.Sc. (Mining) 1908 Investigated the mineral resources and made a geological survey of the Tippera State under the supervision of his father. Now deceased.	450 0 0	56 14 6	19 16 4	15 2 0	541 12 10
7.										
Mazumdar, P.H. - 25 years. Bengal. 1904.	- - - Applied in response to a Government notification published in the Calcutta Gazette, and circulated to the Chambers of Commerce, the Managers of important mines, and others connected with the industry.	Passed Entrance examination of Calcutta University. Was reported to have gained some knowledge of mining by superintending the working of several mica mines for five years.	Mining - - Two years. Birmingham University.	- - -	Joined the Bar -	298 13 3	23 9 6	7 11 8	2 2 0	331 16 5

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.)	Practical Training. Premium, &c.	Total.
8.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Daru, N. D. - Bombay. 1905.	- - - - Applied through the Secretary of State.	- - -	Prospecting for minerals in Canada, under Geological Survey of Canada.	- - -	Assistant Superintendent, Geological Survey of India.	No particulars available.				
9.										
Fox, C. - - 19 years. Bengal. 1905.	Father—Superintendent of Jails, Jaipur. Recommended by the Principal of Sibpur College.	Sibpur College, 1901–05 - Stood first for four successive years in the annual examination of the Apprentice Department of the Civil Engineering College, Sibpur.	Mining - - Two years; extended nine months. Birmingham University.	Spent one year in a coal mine as Assistant Manager, Overman, and Surveyor.	Diploma of Mining, 1907. B.Sc. (Mining), 1908. Held appointment as Mining Lecturer at Birmingham University. Is now an Assistant Superintendent, Geological Survey of India.	412 10 0	101 5 0	8 11 10	11 5 0	533 11 10
10.										
Sen, A. M. - 25 years. Bengal. 1905.	Father—B. M. Sen, retired Headmaster of Dacca Collegiate School, Government Pensioner. Recommended by the Principal of Sibpur College.	Sibpur College, 1897–1902. Passed F.A. examination of Calcutta University and first examination in Engineering of Sibpur College. Had gone through a complete course of Analysis of Coal under Professor Tate; also trained in Practical Mineralogy and Field Geology under Professor Brühl.	Mining - - Two years; extended nine months. Birmingham University.	Had three months' practical training in various mines during vacations.	B.Sc. and M.Sc. (Mining), A.M.I.M.E. Now employed in the Mysore Geological Survey.	412 10 0	84 9 6	11 14 5	16 3 0	525 6 11
11.										
Mokadam, B. P. - 25 years. Central Provinces. 1905.	- - - - Selected on the recommendation of the Manager of the Warora Government Colliery.	Matriculated Calcutta University, 1900. Passed examination under Bombay Steam Boilers Act, 1904. Served as Engineering apprentice in Warora Government Colliery; also as Engineer in cotton ginning factory in Berar.	Mining - - Two years; extended to three. Birmingham University.	Spent two months in various mines whilst reading for Diploma.	Mining Diploma, 1910. Is now an Assistant in the Ballarpur Colliery, Central Provinces.	450 0 0	89 6 6	2 16 8	6 13 0	548 16 2

Name, Age Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.)	Practical Training. Premium, &c.	Total.
12.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Dewal, G. N. - 39 years. Madras. 1906.	Born a Brahmo, now a Brahmo. Applied through the Government of Madras. Recommended by the Superintendent of Coimbatore Jail.	Studied for the Matriculation Examination of Bombay University, but abandoned his studies in order to enter upon his profession. Served as Weaving Master at Coimbatore Jail for eight years. Previously worked for eight years in Bombay mills as a jobber, sizer, and finisher.	Textile industry - - Two years; extended to three. Manchester School of Technology.	Visited various works in England, Scotland, and Ireland, and spent one vacation in the works of Meister Lucius and Bruning at Hochst - on-Main.	Did not take Diploma course. No information available as to present employment.	475 0 0	66 13 6	58 17 1	Nil.	600 10 7
13.										
Saklatvala, B. D. - 25 years. Bombay. 1906.	Caste—Parsi - Applied through the Government of Bombay. Recommended by the Principal of St. Xavier's College, Bombay.	Educated at St. Xavier's College, Bombay, where he obtained the degree of B.Sc. Was studying Metallurgy at the Royal Polytechnic at Charlottenburg in Berlin at the time of nomination.	Metallurgy - - Two years. Berlin University.	- - -	Andrew Carnegie Research Scholar, 1907. D.Sc. (Berlin). Not yet returned to India. Employed by the Vanadium Metal Co., Ltd., of U.S.A.	300 0 0	37 16 0	15 13 0	Nil.	353 9 0
14.										
Ray, M. K. - 23 years. Bengal. 1906.	- - - - - Applied in response to a Government notification published in the Calcutta Gazette and other papers.	B.Sc. (Calcutta) - - Had acted as Assistant in the Laboratory of the Presidency College, and was employed as Assistant to the Superintendent of the Apprentice Department of the Civil Engineering College, Sibpur, at the time of nomination.	Mining - - Two years; extended to three and a half. Birmingham University.	Three months' practical training in various mines in England and Sweden during vacations.	B.Sc. (Mining), Birmingham, First Division. Is now Geologist on the staff of the Assam Oil Company, Limited.	525 12 3	159 12 6	26 16 6	18 13 0	730 14 3
15.										
Ashcroft, C. E. - 25 years. Bengal. 1906.	- - - - - Applied in response to a Government notification published in the Calcutta Gazette and other papers.	Educated at La Martinière College. Had been engaged at various collieries.	Mining - - Two years; extended for six months. Birmingham University.	Spent two months in various mines during vacations.	Mining diploma. Was employed on return at the Murilidi Colliery, Mahoda, *viâ* Katras. Has since become a mine manager.	375 12 4	81 6 9	16 7 8	5 5 0	478 11 9
16.										
Chand, L. - - 23 years. Benares, United Provinces. 1906.	Member of Agarwala family; connected with leading silk merchants and bankers. Applied in response to an advertisement in the United Provinces Gazette. Recommended by the Collector of Benares.	Educated at Queen's College, Benares, and Government College, Benares. B.A. (Allahabad), 1902. M.A. (Allahabad), 1904. Had worked for some months with a Weaver.	Silk Weaving - - Two years; extended to three. Manchester School of Technology.	Vacation work in England, Germany, and France. Visited the works of the Bayer Company at Elberfeld; Meister Lucius and Bruning at Hochst - on - Main; and the Berlin Aniline Co. at Berlin.	B.Sc. (Tech.), 1909. M.Sc. (Tech.), for research work. Invented electro-gilding machine. Appointed Principal, Technical Institute, Brindaban, United Provinces.	450 0 0	80 3 0	155 0 10	13 13 0	698 16 10

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.)	Practical Training. Premium, &c.	Total.
						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
17.										
Kaul, I. K. - - 26 years. Punjab. 1906.	- - - - Applied in answer to an advertisement in the Punjab Government Gazette.	Educated at Bombay Victoria Technical Institute. L.E.E. and L.M.E. (Bombay). Studied up to B.A. standard (Science side). Was Headmaster of Victoria Diamond Jubilee Technical Institute, Lahore, at time of nomination.	Engineering and Sanitary Science (originally metal work). Two years, extended to three. Liverpool, two years. London, one year.	- - -	B.Eng., 1909 - Passed Certificate Examination in Sanitary Science of Royal Sanitary Institute. Assistant to the Sanitary Engineer under Punjab Government.	470 19 2	244 6 6	17 5 11	Nil.	732 11 7
18.										
Hafiz, A. - - Punjab. 1906.	Member of a respectable family owning land in the Hoshiarpur District. Applied through the Secretary of State. Recommended by the Vice-Principal of Birmingham University.	Educated at the M.A.O. College, Aligarh. Had taken a two years' course at Birmingham University before scholarship was granted.	Mining. Two years, extended to three. Birmingham University.	Had three months' experience in mines during vacations.	B.Sc. (Mining), 1907 M.Sc. (Mining), 1908. Thesis for D.Sc. not accepted. Now studying for the Ph.D. degree in Science (Mining) at the University of Leipzig.	450 0 0	157 16 0*	10 4 1	11 11 0	629 11 1
19.										
Joshi, G. L. - 21 years. Central Provinces. 1906.	A native of Khapa, Central Provinces. Selected on the recommendation of the Director of Public Instruction.	Educated at Bombay School of Art and Victoria Technical Institute. L.T.M. (Bombay), 1905. Obtained first class certificate in cotton spinning, City and Guilds Institute, 1905. Had served as Weaving and Dyeing Master in the Swadeshi Mills, Nagpur.	Practical Chemistry in connection with textile fabrics and weaving and dyeing. Two years, extended to three. Manchester School of Technology.	Visited works in Ireland and on the Continent; also had some practical training with Messrs. Butterworth and Dickinson, of Burnley. Returned to India *viâ* Japan, in order to study stencil printing.	Did not take Diploma course. First class certificates of City and Guilds Institute in cotton dyeing, and in cotton and linen bleaching and finishing. Is now employed as Superintendent of the Weaving, Dyeing, and Bleaching Departments at the Pulgaon Cotton Mills.	450 0 0	68 6 6	75 15 10	Nil.	594 2 4

* Includes 35*l.* for microscope and 20*l.* towards cost of thesis for D.Sc. degree.

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship, College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.)	Practical Training. Premium, &c.	Total.
20.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Paniker, M. A. R. - 21 years. Madras. 1907.	Native of Malabar, and a Nayar by caste. Member of a well-to-do family of good social position. Father—V. D. Paniker, retired Sub-Registrar, and a Bench Magistrate at Palghat. Brother is Adikari, or headman of a village in one of the taluks of South Malabar. Recommended by the Government of Madras.	M.A. (Madras), Science side - Educated at Victoria College, Palghat, from 1900–02, and at Presidency College, Madras, from 1903–06. Worked for 12 months at a native tannery at Kodambakam, near Madras.	Leather industry. Two years; extended to three. Leeds University. Granted special extra scholarship of 75*l.* a year for three years, for the purpose of gaining practical experience.	Was employed at a salary of 3*l.* per week by the Nance Tannage, Ltd., Surrey. Is now employed by Messrs. Rohm & Haas, of Darmstadt.	M.Sc. degree of Leeds University in Leather Industry, 1910. Also diploma. Not yet returned to India, but states that he has succeeded in raising a capital of Rs. 2,50,000 to start a leather factory in Madras when he returns.	563 18 9	113 2 0	95 2 4	Nil.	772 3 1
21.										
Patwardhan, A. P. - 24 years. Bombay. 1907.	Resident of the Ratnagiri District, Bombay. Scholarship was advertised in the Government Gazette. Selection made by Director of Public Instruction.	L.T.M. of Bombay - - Assistant Weaving Master at Pulgaon Mills, Bombay.	Dyeing and bleaching. Two years; extended for two months. Manchester School of Technology.	Visited textile and colour works in England and Germany. Spent 5 weeks in the works of Meister Lucius and Bruning, at Hochst-on-Main.	Did not take Diploma course. Weaving Master, Rai Saheb Reckchand Mohta Spinning and Weaving Mill, Hinganghat.	325 0 0	44 2 0	56 16 6	Nil.	425 18 6
22										
Bhatt, K. J. - 27 years. Bombay. 1907.	A native of Rander, Surat District. Applied through the Director of Public Instruction, Bombay.	L.T.M. of Bombay - - Had been employed as Spinning Master in Ramdyal Cotton Mills, Howrah.	Cotton weaving and designing, with textile colouring and calico printing. Two years, extended to three. Manchester School of Technology.	Practical work on the Continent during vacations. Gained admission as "Volunteer" to dye-works and lace works in Germany. Spent 5 weeks in the works of Meister Lucius and Bruning, at Hochst-on-Main.	Did not take Diploma course. Now employed in a mill at Broach.	450 0 0	65 2 0	30 5 4	Nil.	545 7 4
23.										
Brühl, P. T. - - 17 years. Bengal. 1907.	Father—Professor Brühl, of Civil Engineering College, Sibpur. Applied through Secretary to the Government of India, Home Department.	Educated at St. Joseph's College, Darjeeling, and Sibpur Engineering College.	Engineering and Metallurgy. Two years, extended to three. Birmingham University.	Spent 1909 vacation at Elliott's Metal Co., Ltd., Selly Oak.	M.Sc. (Metallurgy, Birmingham. Not yet returned to India. Is at present in the employ of the Prestea Block A. Gold Mining Company of West Africa, at a salary of 370*l.* per annum.	450 0 0	114 0 6	11 17 11	7 0 0	582 18 5

Name, Age, Province and Year of Nomination.	Status or Caste, Father's name and Profession (if known). How Selected.	Particulars of Indian Education (including practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.).	Practical Training. Premium, &c.	Total.
24.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Obaidulla, M. - 21 years. Bengal. 1907.	Native of Noakhali - Applied through the Government of Bengal. Recommended by Principal of Sibpur College.	Educated at Barisal Zilla School and Sibpur Engineering College. Obtained Upper Subordinate Certificate in Civil Engineering, Mechanical Engineering, and Surveying. Also Mining Diploma. Spent two months in Sodepur Colliery, Jerriah, and was Assistant to the Professor of Mining at Sibpur for the six months previous to obtaining the Scholarship.	Mining - - Two years, extended to three, and permitted to remain in England till July 1912 with special grant of 50*l*. Birmingham University.	Practical work with: Sandwell Park Colliery two months, Holywell Lead Mine one week, Laxey Lead Mine one week, Madeley Coal Mine three weeks.	B.Sc. (Birmingham), 1911. Entered for M. Sc. in Geology, but failed. Not yet returned to India.	500 0 0*	123 6 0	18 19 6	8 16 0	651 1 6
25.										
Mitra, H. M. - 28 years. Eastern Bengal and Assam. 1907.	A native of Dacca. Father —Ram Mohan Mitra, Kayestha, Head Master of Comilla Government School at Rs. 200 per mensem. Applied in response to an advertisement. Selected by Director of Public Instruction.	Educated at Muir College, Allahabad University. B.Sc. (Honours in Mathematics and Physics) and M.A. of Calcutta University. No practical training in India; was working for D.Sc. degree at time of gaining scholarship.	Electrical Engineering - Two years; extended to three. Birmingham University.	Worked in Sandycroft Foundry electrical shops.	B. Sc. (Engineering), 1909. Now Assistant in the Loom Factory of Messrs. Tata & Co., Central Provinces.	419 11 9	112 0 0	2 4 6	Nil.	533 16 3
26.										
Dandekar, P. V. - Central Provinces. 1907.	- - - Recommended by the Principal, Victoria Technical Institute, Bombay.	L.M.E. of Bombay - - Holder of First Class Certificate under Bombay Boiler Inspection Act. Had done no mining work but had had a good deal of experience in the management of machinery during three years spent in various mills.	Mining - - Two years, extended to three. Birmingham University.	Allowed to remain in England for two years more to gain practical experience without forfeiting his right to return passage to India. Has spent last 18 months in Birmingham Electrical Supply Company's Works.	Mining Diploma, 1910. Not yet returned to India.	450 0 0	106 10 6	17 14 10	18 10 0	592 15 4
27.										
Kurup, M. N. P. - 29 years. Central Provinces. 1907.	- - - Recommended by the Chief Commissioner, Central Provinces.	Educated at Bombay Victoria Technical Institute. L.M.E. of Bombay, 1902. Served over a year under Messrs. Tata and Sons in their mining prospecting works; also employed in copper works of Messrs. Burn & Co., at Sleemanabad.	Mining - - Two years; extended to three. Birmingham University.	Practical training in various mines for three months during vacancies.	Failed Mining Diploma, 1909. Now engaged as Prospecting Engineer at the Digboi Oil Fields.	450 0 0	125 10 6	9 7 4	15 10 0	600 7 10

* Includes special grant of 50*l*. (*see* column 4).

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.).	Practical Training. Premium, &c.	Total.
28.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Nair, V. G. - - 23 years. Madras. 1908.	Member of "Valliyil" family of Malabar. Applied in response to a Government notification published in the Fort St. George Gazette. Recommended by the Fibre Expert to the Government of Eastern Bengal and Assam.	B.A. (Madras) in advanced Chemistry. Worked during spare time in Laboratory of Fibre Expert to Government of Eastern Bengal and Assam; was clerk in the office of the Director, Agricultural Research Institute, Pusa, at time of nomination.	Textile chemistry as applied to the dyeing, bleaching, finishing, and printing of textile fabrics. Two years; extended to three; fourth year refused. Manchester School of Technology.	Spent 4 months in dyeing and finishing works of Messrs. J. C. Taylor & Co., Pendleton; also visited the works of the Bayer Company at Elbenfeld; Meister Lucius and Bruning, at Hochst - on - Main; and the Berlin Aniline Company at Berlin.	M.Sc. (Tech.) - B.Sc. (Tech.) Hons. Is now employed in the Calico Mills, Ltd., Ahmedabad.	450 3 8	83 18 0	66 11 11	Nil.	600 13 7
29.										
Rele, G. R. - - 28 years. Bombay. 1908.	- - - Applied in response to a Government notification. Selected by the Director of Public Instruction.	Educated at Victoria Technical Institute, Bombay. L.T.M. of Bombay. Seven years service in a dyeing and finishing works in India.	Bleaching, dyeing, and printing in mills. Two years; extended to three. Manchester School of Technology.	Gained admission to bleaching and finishing works of Messrs. Heinrich Wolffsohn & Co., Grunsu, Berlin; also visited the works of the Badische Com- at Offenbach- on - Main, the Berlin Aniline Company, and Meister Lucius and Bruning.	Obtained Certificate of Manchester University, and Diploma of the School of Technology. Appointed Weaving Master, Morarjee Gokuldas' Spinning and Weaving Mills, Bombay.	390 0 0	59 0 6	107 12 4	28 9 1	585 1 11
30.										
Gupta, M. N. Sen. - 21 years. Bengal. 1908.	"A native of Faridpur" - Father a lawyer. Applied in response to an advertisement in the Calcutta Gazette. Recommended by Mr. Hayden of the Geological Survey of India.	M.A. Calcutta (Geology, first on list). Was Assistant to Curator of the Geological Museum at Calcutta.	Mining - - Two years; extended to three. Birmingham University.	Practical training at:— Sandwell Park, 6 weeks. Laxey Lead Mine, 2 weeks. Bagholt Coal Mine, 7 weeks. Glasdir Copper Mine, 3 weeks. Madelay Coal Mine, 3 weeks. Visited leather works in United Kingdom during vacations.	Failed B.Sc. (Mining), 1911. Failed B.Sc. (Mining), 1912. Not yet returned to India.	450 0 0	131 15 0	7 18 5	25 10 0	615 3 5
31.										
Rout, R T. - - 28 years. Bengal. 1908.	Uriya Christian - - Father—J. S. Rout, Sarishtadar to Commissioner of Orissa Division. Applied in answer to notification published in the Calcutta Gazette.	Had attended Madras School of Art and read up to F.A. standard of Calcutta University. Had been engaged in leather tanning industry in India.	Leather tanning - - Two years; extended for nine months. Leatherseller's Company's College.	Obtained City and Guilds Second Honours Certificate in leather dyeing; First Ordinary Certificate in leather tanning, and Second Ordinary Certificate in dressing skins. Also First Class pass in Leatherseller's College examination in tanning of heavy leathers. No information available as to present employment.		423 13 11	124 2 0	29 5 0	Nil.	577 0 11

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32.										
Srivastava, J. P. - 19 years. United Provinces. 1908.	Kayasth - - - Father — Munshi Janki Prasad (now deceased), Tahsildar. Applied in response to a Government notification. Recommended by the authorities of the Muir Central College.	Educated at Allahabad University; a third year student in B.Sc. class of Muir College at time of nomination.	Cloth dyeing and printing. Two years; extended to three. Fourth year refused. Manchester School of Technology.	Spent six months in the Bleaching and Finishing Departments of Messrs. J. C. Taylor & Co., Pendleton; also one month with Meister Lucius and Bruning, and one month with the Berlin Aniline Company.	M.Sc. (Tech.) - B.Sc. (Tech.), Honours. Appointed Assistant Chemist, Technological Institute, Cawnpore, on Rs. 300 per mensem, from 1st April 1912, for five years.	£ s. d. 487 10 0	£ s. d. 92 18 0	£ s. d. 124 16 3	£ s. d. 50 0 0	£ s. d. 755 4 3
33.										
Yusuf, S. M. - - 21 years. United Provinces. 1908.	Mussulman - - Father—S. Y. Hasan, Resident of Muhalla Shah Wilayat, Saharanpur. Father owns a flour mill, and had owned a cotton factory which had to be closed down owing to want of an expert. Has promised to revive the industry when Yusuf returns. Applied in response to a Government notification.	Educated at Anglo-Oriental College, Aligarh, and Thomason Civil Engineering College, Roorkee. Passed F.A. examination of Allahabad University.	Cloth dyeing and printing. Two years; extended to three. Manchester School of Technology.	Practical work on the Continent during vacations. Spent 2 months in the works of Messrs. Cassella & Co., at Frankfort.	B.Sc. (Tech.), 1910 M.Sc. (Tech.), for research work, 1911. No information available as to present employment.	450 0 0	85 1 6	27 18 9	Nil.	563 0 3
34.										
Amin, M. - - 23 years. Punjab. 1908.	Member of Gora family of Kasur Khojas for many generations engaged in textile industry. Scholarship was advertised in the Punjab Government Gazette. Applied through the Commissioner, Lahore Division.	Educated at Forman Christian College, Lahore. Matriculated in 1902, and passed Inter. Arts, Punjab University, in 1904. Manager of a cotton factory for three years.	Textile industry. Two years. Extension refused owing to ill-health. Manchester School of Technology.	Worked for four weeks in a cotton mill, and two weeks in works of Platt Bros., Ltd., Oldham.	Did not take diploma course. Proprietor and manager of a cotton factory at Kasur (Punjab).	300 0 0	44 2 0	1 8 4	5 0 0	350 10 4
35.										
Parshad, Sheo - 27 years. Punjab. 1908.	- - - Applied in response to Government notification in the Punjab Gazette. Recommended by the Punjab Chamber of Commerce.	Educated at St. Stephen's College, Delhi. Inter. Arts 1899. Failed B.A. 1901. Had been engaged in Indian textile industry for 4½ years.	Textile industry. Two years; extended to three. Manchester School of Technology.	Practical work on the Continent. Gained admission to textile mills of Messrs. Butterworth and Dickinson, of Burnley.	Obtained diploma of the School of Technology. Now Textile Assistant to the Director of Industries, Punjab.	450 0 0	58 17 0	67 15 2	6 10 0	583 2 2

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Name, Age, Province, and Year of Nomination.	Status or Caste, Father's name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.).	Practical Training. Premium, &c.	Total.
36.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Nag, D. C. - - Eastern Bengal and Assam. 1908.	Native of Baradi - - Brother—N. C. Nag, Professor, Agra College, and Fellow of Allahabad University. Several relatives in Government Service. Applied in response to a Government notification.	Attended Poona College of Science. L.C.E. of Bombay University. Seven months experience as a draftsman in the Public Works Department.	Mining Engineering - Two years; extended to three. Birmingham University.	Had 3 months training in various mines during vacations, also visited mines near Dresden on way back to India.	B.Sc. (Mining), 1911. Now engaged at the Assam Oilfields as Assistant Engineer.	450 0 0	130 9 6	46 13 9	17 17 0	645 0 3
37.										
Naidu, C. S. B. - 28 years. Central Provinces. 1908.	Hindu - - Father—C. S. Naidu, retired Inspector of Police, Raipur, Central Provinces. Applied in response to a notification published in the Central Provinces Gazette.	Attended Bombay Victoria Technical Institute L.T.M. of Bombay. For several years engaged in Indian mills as Spinning Master. Was Assistant Weaving Master at the Pulgaon Mills at the time of nomination.	Textile industry - - Two years; extended for three months. Manchester School of Technology.	Visited works in Switzerland, and spent eight weeks in laceworks of Mr. A. Sourci, Arbon, Switzerland.	Not yet returned to India.	337 10 0	44 2 0	38 17 0	Nil.	420 9 0
38.										
Menon, A. K. - 22 years. Madras. 1909.	Native of Cochin - Scholarship was advertised in the Fort St. George Gazette. Selected candidate withdrew his application; Mr. Menon recommended as "next most suitable."	B.A. (Madras), fourth place in second class of advanced Chemistry (December 1909).	Chemistry of soap-making and use of native oils. Two years; extended for nine months. One year and six months in private laboratory of Dr. Lewkowitsch, Priory Road, Kilburn.	One year in works of Messrs. D. and W. Gibbs at Wapping. Three months visiting other works in United Kingdom.	Not yet returned to India.	382 7 11	232 3 9	7 8 9	105 0 0	727 0 5
39.										
Gurjar, R. V. - 29 years. Bombay. 1909.	- - - Applied in response to a Government notification. Selected by the Director of Public Instruction.	Educated at Bombay Victoria Technical Institute and in Poona Science College Workshops. L.T.M. of Bombay Institute. Five years experience of Indian textile mill work.	Bleaching, dyeing, and printing in mills. Two years; extended to three. Manchester School of Technology.	Spent 1 month in works of Meister Lucius and Bruning.	Obtained the certificate of Manchester University and the Diploma of School of Technology. Not yet returned to to India	388 1 0	71 11 0	31 2 3	Nil.	490 14 3

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Name, Age, Province, and Year of Nomination.	Status or Caste, Father's name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training,	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.).	Practical Training. Premium, &c.	Total.
40.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Pradhan, B. B. - 21 years. Bombay. 1909.	Somawaushi-Kshatriya - Member of an agricultural Hindu community ("middle class and backward"). Applied in response to a Government notification. Selected by the Director of Public Instruction.	Educated at Bombay Victoria Technical Institute. L.E.E. of Bombay; also Fellow and Gold Medallist.	Electrical and Mechanical Engineering. Two years; extended to three. Manchester School of Technology.	Practical work on Continent during vacations; visited electrical works in Germany and Switzerland. Is at present receiving practical training in the works of Callenders Cable and Construction Co., Ltd., at Birmingham.	B.Sc. (Tech.) in Electrical Engineering, 1911. M.Sc. (Tech.), 1912. Not yet returned to India.	388 1 0	78 4 6	63 7 2	Nil.	529 12 3
41.										
Bysack, M. N. - 28 years. Bengal. 1909.	"Member of respectable family of Calcutta." Applied in response to a Government notification.	Attended Bombay Victoria Technical Institute. L.T.M. of Bombay. Educated up to F.A. standard of Calcutta University. Some experience of Indian weaving industry.	Textile chemistry, with special reference to the dyeing, printing, and bleaching of textile fabrics. Two years; extended to three. Manchester School of Technology.	Practical work on Continent during vacations. Spent one month in works of Meister Lucius and Bruning; and one month with the firm of Christian Kirchoff, at Ashe, in Bohemia.	Obtained certificate of Manchester University and diploma of School of Technology. Not yet returned to India.	381 17 8	82 1 0	49 13 10	Nil.	513 12 6
42.										
Nawab(-ud-din), M. - 32 years. Punjab. 1909.	Khatik - - - Belongs to a well-to-do family of hereditary tanners and dyers. Applied in answer to an advertisement in the Punjab Government Gazette.	Educated at Government High School, Amritsar. Had had four years' practical experience of the leather industry.	Tanning - - Two years; extended to three. Leathersellers' Company's College.	Practical work with Messrs. Popp and Becker, at Frankfort (2 weeks); Messrs. Doerr Rheinhardt, of Worms (one week); the Turner Machine Co., of Offenbach (one week); and the Moenus Tanners Machine Co., Offenbach (one week); also spent two months in America, where he visited over a dozen factories.	First Class Ordinary Certificate of City and Guilds' Institute in Leather Tanning and Leather Dyeing. First Class pass in Heavy Leather Tanning and third Class pass in Applied Chemistry at Leathersellers' College examinations. Is now a member of the firm of Shams-ud Din Nawab-ud-din, Leather Manufacturers and Dealers in hides, skins, &c., of Amritsar.	342 6 6	97 6 8	76 13 11	Nil.	516 7 1
43.										
Thukral, L. K. F. - 23 years. Punjab. 1909.	Brother—L. M. Chand, Public Prosecutor of Sialkot. Applied in response to a notification in the Punjab Gazette. Recommended by the Deputy Commissioner, Sialkot.	Passed Inter. Sc. examination of Punjab University and graduated as B.A. of Allahabad. Had been working with handlooms under the style of K. T. Thukral & Co., Sialkot City, Punjab.	Textile industry - - Two years. Manchester School of Technology.	Visited filatures in Italy.	Managing own business in Lahore (Textile Engineers' Agents, and Merchants.)	300 0 0	45 15 6	22 12 7	Nil	368 8 1

0 4

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.
44 Thein, Maung Po - 23 years. Burma. 1909.	Christian - - - Applied in response to a Government notification.	Educated at St. Paul's High School, Rangoon; St. Xavier's College, Calcutta; and Government College, Rangoon. B.A., Calcutta (Chemistry and Physics).	Mining engineering - Two years; extended to three. London School of Mines.
45. Bardaloye, S. G. C. - 23 years. Eastern Bengal and Assam. 1909.	"Member of a family of some wealth and consideration." Applied in response to a Government notification.	B.A. of Calcutta. Had undergone a three months' course of practical training under a Colliery Superintendent on the Margherita Coalfields.	Mining engineering - Two years; extended to three. Birmingham University.
46. Faiz-ud-din, S. - 22 years. Central Provinces. 1909.	Mussalman. Son of a farmer of Ellichpur; nephew of Assistant Agricultural Chemist in Agricultural College, Nagpur. Uncle intends, with help of grandfather-in-law, to incorporate a sufficiently large company in any suitable district of the Central Provinces or Berar to tan the local hides and to manufacture them into finished marketable articles. Was nominated by a Selection Committee.	Educated at Amraoti High School. Served as apprentice of mechanical engineering in ginning factories in Berar and mills in Nagpur; also worked for two months in Government Chrome Tannery, Madras.	Leather industry - - Two years; extended to three. Leeds University.
47. Narke, G. G. - 25 years. Central Provinces. 1909.	Brahmin (Mahratta). Son of G. R. Narke (deceased), clerk in a native bank at Umrer. Applied through the Director of Public Instruction, Central Provinces. Selected on the recommendation of the Director of the Geological Survey of India (Sir T. Holland).	M.A. (Calcutta), Science side. Educated at Free Church Institute, Nagpur, Hislop College, and Morris College. Some practical work in India during recess periods.	Mining - - Two years; extended to three. Manchester University.

Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.).	Practical Training. Premium, &c.	Total.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Visited Foxdale Lead Mine.	Not yet returned to India, but two firms — Messrs. Finlay, Fleming, & Co., and the Burma Mines, Ltd.—have offered to employ Mr. Thein on his return.	382 7 11	148 18 4	6 17 6	16 16 0	554 19 9
Practical work at Great Rock Iron Mine, 1 month. Hanwood Coal Mine, 3 weeks. Glasdir Copper Mine, 3 weeks.	Not yet returned to India.	379 10 5	125 14 0	13 13 6	12 12 0	531 9 11
Studied boot and shoe manufacture at Leeds Technical School during summer vacation, 1911.	Obtained Leeds University Diploma in Leather Industries, 1912. Not yet returned to India.	382 7 11	84 16 6	1 8 5	5 0 0	473 12 10
Practical work at Sandwell Park Colliery and Francis, Son, and Bower Colliery.	B.Sc. (Tech.) in Mining, First Class Honours. M.Sc. (Tech.) in Mining, 1912. Not yet returned to India.	379 2 2	80 2 6	11 12 8	21 0 0	491 17 4

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.).	Practical Training. Premium, &c.	Total.
48.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Nair, T. K. - 24 years. Madras. 1910.	Member of a respectable family in the district of Malabar. Father—A. P. Nair, retired Senior Grade Hospital Assistant. Applied in answer to a Government notification published in Fort St. George Gazette and three leading Madras newspapers.	Educated at St. Joseph's and S. P. G. Colleges, Trichinopoly. B.A. of Madras in Physics and Inorganic Chemistry.	Metallurgy - - Two years. Birmingham University.	Spent six weeks during the 1911 vacation at Sheepbridge (Derbyshire) Iron and Coal Company's Works; and is spending one month of the 1912 vacation with the Frodingham (Lincolnshire) Iron and Steel Co., Ltd.	Not yet returned to India.	232 16 2	85 16 0	3 15 3	6 6 0	328 13 5
49										
Ba Tin, M. - 22 years. Burma. 1910.	Native of Burma - Father—Maung Kyaw Nyein, A. T. M., Additional District Judge, Henzada. Applied in answer to an advertisement in the Rangoon Times.	Educated at St. Paul's High School and Rangoon College; passed entrance examination of Calcutta University; and was working for Inter. Arts Examination at time of nomination.	Pottery. Two years.	Under training at Messrs. Pilkington's Tile and Pottery Company, Clifton Junction, near Manchester.	Not yet returned to India.	232 7 11	9 6 0	1 6 2	37 10 0	280 10 1
50.										
Patel, A. C. - 21 years. Bombay. 1910.	Father—Deputy Educational Inspector in Panch Mahals and Rewa Kantha Sub-Division. Applied in response to a Government notification. Selected by the Director of Public Instruction.	L.C.E. of Bombay - -	Electrical Engineering - Two years. City and Guilds (Engineering) College.	Practical work at Rugby and in Sweden during vacations.	Not yet returned to India.	237 14 9	85 0 0	17 18 6	Nil.	340 13 3
51.										
Sahasrabuddhe, G. N. 24 years. Bombay. 1910.	Maharashta Brahmin - Applied in response to a Government notification. Selected by the Director of Public Instruction.	L.Agric. of Bombay - - Had served in the Agricultural Department of the Government of India.	Sugar refining. Two years. Sent to Barbados under Commissioner of Agriculture. Allowed to visit Cambridge, Glasgow, and Edinburgh to study scientific agriculture.	- - -	Not yet returned to India.	241 0 6	Nil.	62 10 1	Nil.	303 10 7
52.										
Guha, A. - 26 years. Bengal. 1910.	Native of Bikrampur, near Dacca. Father was Educational Clerk in the District Board Office. Applied in answer to an advertisement. Recommended by the Manager of the Empress Mills, Nagpur.	B.A. (Calcutta), and read some Science for the M.A. Served as assistant in Weaving Department of Empress Mills at Nagpur for three years.	Textile industry - Two years; extended to three. Manchester School of Technology.	Visited Turin and handloom districts in Ireland during vacations.	Not yet returned to India.	232 16 2	47 9 0	13 1 0	Nil.	293 6 2

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name, and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.)	Practical Training. Premium, &c.	Total.
53.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Mookerjee, H. K. - 20 years. Bengal. 1910.	Member of respectable Hindu family of Calcutta. Applied in response to a Government notification published in the Calcutta Gazette. Recommended by the Principal, Government Weaving Institute, Serampore. Selected by the Director of Public Instruction.	Passed entrance examination and studied up to Inter. Arts standard. Received instruction at Government Weaving Institute, Serampore. Practical training at Bengal Luxmi Cotton Mills, Ltd.	Power loom weaving, finishing, and dyeing. Two years; extended to three. Manchester School of Technology.	Spent summer vacation 1911 in mills of Messrs. R. Haworth and Sons, Salford. Is arranging with Messrs. N. Bothwell and Sons, of Walken, for a five weeks' course in their Mill during 1912 vacation.	Not yet returned to India.	238 13 0	47 9 0	13 1 0	Nil.	299 3 0
54.										
Chaudhuri, P. C - 23 years. Eastern Bengal and Assam. 1910.	Father—D. K. Achariya (deceased), brother by adoption of Raja Jagat Kishore Acharjya Chaudhuri of Muktagacha. Scholarship was advertised by Director of Public Instruction who also made the selections.	Passed F.A. examination and read up to B.Sc. standard of Calcutta University. Practical training at Government Weaving School at Serampur; had also been engaged in silk industry in India.	Silk weaving and dyeing. Two years; extended to three. Sent to Manchester School of Technology for one year, and then transferred to Ecole Supérieure de Lyons.	Practical work during vacations. Proposes to visit various Continental works during third year.	Not yet returned to India.	238 13 0	69 13 11	7 12 10	Nil.	315 19 9
55.										
Yadav, A. P. S. - 22 years. Bombay. 1910.	Hindu Rajput - - Father—Director in various cotton factories. Applied in response to a Government notification. Recommended by the Head of the Textile Department, Bombay, Victoria Technical Institute.	Attended Bombay Victoria Technical Institute. L.T.M. of Bombay Institute. Bronze Medallist of City and Guilds Institute. Some practical experience as apprentice engineer in Indian mills.	Mechanical Engineering - Two years. Manchester School of Technology for one year.	Now working as a fitter in Messrs. Asa Lees & Co.'s Cotton Spinning Machinery Works, Oldham.	Did not take Diploma course. Not yet returned to India.	232 8 0	47 9 0	1 3 10	Nil.	281 0 10
56.										
Newson, H. J. - - 27 years. United Provinces. 1910.	Eurasian - - - Born at Allahabad. Applied from England. Recommended by Sir T. Holland and the Professor of Engineering, Manchester University.	Educated at La Martinière College, Lucknow. Began three years' course at Manchester University at own expense. Specialised in Applied Geology. Obtained B.Sc. (Hons.) Degree of Manchester before nomination.	Mechanical Engineering - Two years. Manchester University.	One year with Messrs. Thornycroft at Southampton; also visited various works in England and on the Continent.	M.Sc. in Engineering of Manchester University. Obtained Certificate of Proficiency in Electrical, Civil, and Mechanical Engineering. Not yet returned to India.	245 19 2	43 0 6	18 14 9	115 0 0	422 14 5

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name, and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship, College or University selected.
57. Rai, H. 23 years. Punjab. 1910.		Educated at Government College, Lahore. B.A., M.Sc.	Manufacture of Alkalis. Two years. Liverpool.
58. Sitaraman, M. C. 23 years. Madras. 1911.	Member of the weaving community of Sourashtras of Madura. ("Backward in education.") Father-in-law building a spinning mill at Madura. Applied in response to an advertisement in the Fort St. George Gazette.	Attended Presidency College, Madras. B.A., Madras.	Weaving. Two years. Manchester School of Technology.
59. Rao, H. S. 28 years. Madras. 1911.	Saraswat Brahmin. Father—Dr. H. Rangappa. Selected on recommendation of the Principal of the Manchester School of Technology.	Educated at Presidency College, Madras. B.A. (Madras). Applied from England; had taken a two years' course at School of Technology previously. B.Sc. (Tech.) of Manchester before scholarship granted.	Spinning and weaving. Two years. Manchester School of Technology.
60. Bennett, H. D. 22 years. Bengal. 1911.	Father served in Bengal Pilot Service for 25 years. Applications were invited in the Calcutta Gazette. Selections made by Director of Public Instruction.	Educated at La Martinière College, Calcutta, and Sibpur Engineering College.	Mechanical and Electrical Engineering. Two years. Faraday House.
61. Roy, P. B. Bengal. 1911.	Father—Dr. T. C. Roy, of Plantara. Uncle—M. N. Roy, Vakil of High Court, Calcutta, and Fellow of Calcutta University. Applications were invited in the Calcutta Gazette. Selections made by Director of Public Instruction.	Attended Sibpur Engineering College. Was a student Engineer in the P.W.D. at time of nomination.	Mechanical and Electrical Engineering. Two years. Faraday House.

Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912.* Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.)	Practical Training. Premium, &c.	Total.
Visited Heidelburg for two months in order to learn German; but has so far been unable to obtain admission to an Alkali Works.	Not yet returned to India.	£ s. d. 212 1 4	£ s. d. 41 19 6	£ s. d. 8 18 2	£ s. d. 1 7 0	£ s. d. 264 6 0
Spending five weeks of summer vacation, 1912, with Messrs. Butterworth and Dickinson, of Burnley.	Not yet returned to India.	82 16 2	24 10 0	1 15 6	Nil.	109 1 8
- - -	Not yet returned to India.	82 16 2	23 4 0	2 0 4	Nil.	108 0 6
Practical training with the British Westinghouse Electric and Manufacturing Company, Ltd.	Not yet returned to India.	75 8 2	23 6 8	0 17 3	Nil.	99 12 1
Practical training with Messrs. Clarke, Chapman, & Co., Ltd., Gateshead-on-Tyne.	Not yet returned to India.	75 8 2	34 6 8	0 12 9	Nil.	110 7 7

Name, Age, Province, and Year of Nomination.	Status or Caste, Father's Name and Profession (if known). How selected.	Particulars of Indian Education (including Practical Training, if any).	Subject and Period of Scholarship. College or University selected.	Particulars of Practical Training.	Distinctions acquired, and Occupation on return to India.	Expenditure incurred up to 31st March 1912. Stipends.	Theoretical Training.	Practical Training. Travelling Expenses (including Journeys to and from Universities, &c.)	Practical Training. Premium, &c.	Total.
62.						£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Srivastava, R. C. - 20 years. United Provinces. 1911.	Kayasth - - Father — Munshi Janki Prasad (deceased), Tehsildar. Present guardian—Uncle, M. T. Prasad, landowner. Applied in response to an advertisement in the newspapers. Recommended by the Directors of the Basti Sugar Works, Ltd.	Educated at Christ Church Collegiate School, Cawnpore, and Muir College, Allahabad. B.Sc. and B.A. (Allahabad).	Manufacture of sugar - Two years. Manchester School of Technology for one year.	Is to enter the Glasgow Works of the Harvey Engineering Co. (Sugar Machinery Manufacturers) in September 1912; part of each week to be spent in the Works and the remainder at the Royal Technical College.	Not yet returned to India.	82 7 11	25 11 0	2 1 4	Nil.	110 0 3
63.										
Datta, A. C. - - 23 years. Eastern Bengal and Assam. 1911.	Father—A. E. Datta, B.A. (Cantab), Senior Professor of Rajshahi College. Applied in response to a Government notification.	Educated at Rajshahi College and Sibpur Engineering College.	Silk weaving, dyeing, and finishing. Two years. Manchester School of Technology.	- - -	Not yet returned to India.	83 4 4	24 5 0	1 14 4	Nil.	109 3 8
64.										
Muhammadi, M. G. - 29 years. Central Provinces. 1911.	Muhammadan. Resident of Ellichpur in Berar. Father serving in Government of India Agricultural Department. Applied in response to an advertisement in the Central Provinces Gazette.	B.A. and Fellow of Bombay University. Was Assistant Lecturer at Agricultural College at Nagpur at time of nomination.	Manufacture of oils, fats, and their products. Two years. Battersea Polytechnic.	Now in Messrs. D. & W. Gibbs' Soap Works at Wapping.	Not yet returned to India.	83 4 4	22 0 6	Nil.	Nil.	105 4 10
65.										
Muttannah, K. - 25 years. Coorg. 1911.	Member of a respectable Coorg family. Scholarship was advertised in the Coorg District Gazette. Selected by the Chief Commissioner.	Attended Bombay Victoria Technical Institute and obtained complete Technological Certificate of second class. Was an apprentice in Kolar Gold Fields at Rs. 75 per mensem at time of nomination.	Mechanical and Electrical Engineering. Two years. Faraday House.	Practical training with the British Westinghouse Electric and Manufacturing Company, Ltd.	Not yet returned to India.	82 16 2	34 1 8	0 17 1	Nil.	117 14 11
66.										
Mehd, P. V. - 23 years. Bombay. 1911.	Nagar Brahmin - Father and many other relatives have been in Government service. Applied in response to a Government notification.	Educated at St. Xavier's College M.A. and B.Sc. of Bombay. Was Assistant Professor of Chemistry, St. Xavier's College, at time of nomination.	Manufacture of tanning extracts, &c. Two years. Leathersellers Company's College.	Is spending one month of 1912 vacation with Messrs. J. Hall and Sons (Leather Machinery makers), of Leeds; and one month with Messrs. Blair, Campbell, and McLean (Makers of Tanning extract apparatus, &c.) of Glasgow.	Not yet returned to India.	82 16 2	44 0 0	Nil.	Nil.	126 16 2

APPENDIX VI.

STATEMENT showing what the Students of the Association for the Advancement of Scientific and Industrial Education of Indians, who have returned to India, are doing. [*Extracted from the Report of the Association for* 1912].

1. Mr. G. C. Sen, M.A., F.C.S., returned after a distinguished University career in England and after learning the manufacture of dyes and the allied industries of calico-printing, colour-making, and paint-making in Leeds and Germany. He stood first in the Competitive Examination of the City and Guilds, London. He was elected a Fellow of the Chemical Society, London, and was selected, while in the University, for research work and investigations in connection with Tussah silk. He worked upon Rhea fibre in degumming, bleaching, and dyeing, and attained conspicuous success. He has been engaged as Chemist, Calcutta Paint, Colour, and Varnish Works, Limited.

2. Mr. R. N. Sen, M.A., obtained the Diploma in Dyeing of the Leeds University, stood first and got first class honours both in cotton dyeing and wool dyeing in the City and Guilds Examinations. He worked as a voluntary student in the dye-houses of two very big and well-known colour works of Germany, and pursued a course of research work under Professor Green of the Leeds University. He has been appointed as a Professor in the Imperial Service for Industrial Chemistry in the Sibpur Engineering College.

3. Mr. K. C. Nandi, B.A., B.E., A.M.I.M.E., returned after distinguishing himself in Glasgow in mechanical and electrical engineering. He was elected a Research Student of the Glasgow University and a Member of the Society of Mechanical Engineers, London, which in itself was a great honour. He has been engaged as the Chief Engineer of the Cooch Behar State on a salary of Rs. 550 per month.

4. Mr. J. K. Das Gupta, B.Sc., A.M.I.C.E., A.M.I.M.E., joined the University of Glasgow where he stood first in the B.Sc. Examination, distinguished himself in mechanical and electrical engineering, and secured several splendid certificates from his professors and the engineering firms where he worked. He also got certificates from the Weaving College. He, on his return, has been engaged as a Deputy Surveyor of the Calcutta Municipality on a salary of Rs. 300 per month.

5. Mr. I. B. Mojumdar, B.A., M.Sc., obtained the Master's Degree in Agriculture of the Cornell University in New York, U.S.A., and has been appointed on his return by the Cooch Behar State in their tobacco firm on a salary of Rs. 300 per month.

6. Mr. B. A. Taher, B.A., returned after fully qualifying himself as a leather expert after training in America and England. There is not a branch of leather industry which he did not learn. He has been engaged by the Boot and Equipment Factory Company, Limited, Agra.

7. Mr. A. K. Sen, B.A., B.Sc. (Manchester University), joined the Municipal School of Technology, Manchester University, where he applied himself to the study of bleaching, dyeing, calico printing and finishing. He appeared in the City and Guilds of London Institute Examinations in cotton and linen bleaching and finishing, and cotton dyeing. He got first class in both the subjects, and in the former he stood first and got the Institute's first prize and medal. He appeared in the same Institute's Examinations in Honours "Dyeing," "Calico Printing," and "Alkali and Acid Manufacture," and in all the three subjects he got first class. He also attended a special course of lectures on "Oils and Fats." He obtained degrees (Manchester University)

ı Applied Chemistry and Chemical Technology, the Diploma of the Munipal School of Technology with the title of Associate of the School. While ı England Mr. Sen had many occasions to visit works where the above ıdustries are carried on and to study their working conditions. In Germany ɜ joined and worked in a big dyeing and calico-printing works. He has ɜen, on his return, engaged as dyeing expert in the Banga Lakshmi Cotton ills on a salary of Rs. 250 per month.

8. Mr. P. C. Ganguly, B.Sc., joined the University of Glasgow, passed ıe final B.Sc. Examination in Mechanical Engineering, and got special stinction in Electricity, pure and applied. He has been, on his return, ıgaged as a Professor of Mechanical and Electrical Engineering in the engal Technical Institute on a salary of Rs. 250 per month.

9. Mr. A. Ahmed, B.A., having acquired sufficient theoretical knowledge leather industry in the University of Leeds, joined the Herold's Institute, ɔndon, for practical training, and obtained certificate at the completion of s course. He also appeared in the City and Guilds of London Institute xamination and got first class certificates in tanning. He has been ɑployed in the National Tannery, Calcutta.

10. Mr. M. Ismail, M.Sc., returned after passing the M.Sc. Examination Leather Chemistry of the Leeds University with distinction. Before his turn he also worked in a big tannery for practical training. He has been ɑployed in the Utkal Tannery, Cuttack.

11. Mr. S. C. Basu, M.A., returned after obtaining the Degree of Master Arts from the University of Nebraska in Political Economy and Commerce. ɜ paid equal attention to theoretical as well as to applied economics, and s special subject of investigation was corporation finance, and industrial nking and insurance. He was highly spoken of by his professor. He s been employed as a Professor in the Victoria College, Cooch Behar.

12. Mr. J. C. Nag, B.S., returned after passing the B.S. Examination in griculture from the California University, U.S.A., with great distinction. ɜ has been employed as a Professor of Botany and Chemistry in the ishnanath College, Berhampur.

13. Dr. W. N. Chowdhury, Ph.D., returned after passing the final ɛamination of the Cothen Polytechnic in Ceramics and obtaining the Ph.D. ɜgree of the Basel University in Geology. Before his return he worked in veral porcelain factories in Austria and Germany, and also worked as an sistant of the Director of the Mineralogical and Geological Institute, then. He has been employed as a Geologist by the Singhbhum Mining d Prospecting Syndicate.

14. Mr. A. Dutt, B.A., M.Sc., returned after passing the M.Sc. Examition in Agriculture of the Cornell University, U.S.A. He also worked in big tobacco firm for practical training. He has been employed as a ttlement Officer by the Cooch Behar State.

15. Mr. N. Chakrabutty, B.A., B.Sc., returned after passing the B.Sc. amination in Agriculture of the Ohio State University, U.S.A. He has rted an agricultural firm near Kanchrapara.

16. Mr. K. C. Bharatkar, M.A., M.S.A., M.A.S., studied sericulture and riculture in the Imperial University, Tokyo, and got the Imperial ploma in Agriculture and Certificate in Sericulture. In the third year ss he secured a research work and discovered a new compound which was med "Kanirin." He also studied the technology of sugar. He has been ployed as Superintendent of Sericulture in the Mourbhanj State.

17. Mr. J. C. Das, B.Sc., got a Diploma from the leading Commercial llege of the Pacific Coast in higher accounts, including factory management d banking accounts. He also obtained B.Sc. Degree in Economics and mmerce of the California University. He has been engaged in the ɑdusthan Co-operative Insurance, and also as Professor of Banking and mmerce in the Government Commercial Institute, Calcutta.

18. Mr. S. Deb, M.C.E., had been sent to Japan by the Society of Theists and latterly got a scholarship from the Association. He returned after a complete course of study in colleges and factories for the manufacture of porcelain. He has been engaged in the Calcutta Pottery Works on a salary of Rs. 200 per month.

19. Mr. M. C. Roy returned after passing all the examinations and securing Certificates in Sericulture of the Imperial Agricultural College, Tokyo. He has been appointed by the Honourable Maharaja Manindra Chandra Nundy Bahadur, of Cossimbazar, in his sericultural firm on a salary of Rs. 200 per month.

20. Mr. P. C. Roy -
21. Mr. A. P. Ghose

Returned after learning the industry of match manufacturing in Japan, Germany, and England. Mr. Roy has been employed in the Bande Mataram Match Factory, started by Dr. Rashbehari Ghose, on a salary of Rs. 150 per month and certain percentage on profits. Mr. Ghose has been appointed on a salary of Rs. 250 per month in the Irrawady Match Factory, Mandalay.

22. Mr. J. P. Bose, M.C.E., returned from Japan after learning the manufacture of printing ink. He has been engaged in the Calcutta Printing Ink Works on a salary of Rs. 150 per month and certain percentage on profits.

23. Mr. M. M. Chuckerbutty
24. Mr. M. N. De - -
25. Mr. J. Chowdhury -

Returned after passing all the examinations and obtaining Certificates in Sericulture of the Imperial Agricultural College, Tokyo. Mr. Chuckerbutty has been engaged as Superintendent of Sericulture by the Eastern Bengal and Assam Government on a salary of Rs. 150 per month; Mr. De, as Sericulture Assistant of the Pusa Agricultural College; and Mr. Chowdhury, as Sericultural Expert by the Tippera State.

26. Mr. A. Mitter returned from Japan after learning the manufacture of biscuit, and has started the Raj Lakhsmi Biscuit Factory in Calcutta on his own account.

27. Mr. N. N. Mojumdar returned from Japan after learning the manufacture of pencil and candle, and has started the Manorama Candle Factory at Dinajpur on his own account.

28. Mr. M. N. Ghose, M.C.E., M.R.A.S., London, returned after learning the manufacture of celluloid and celluloid articles, *e.g.*, buttons, combs, handles of umbrella, and sticks, &c., in Osaka, Japan. He also learnt the manufacture of camphor, including the cultivation of camphor plants. He has been employed by "The Jessore Comb, Button, and Mat Manufacturing Company, Limited," and has been doing excellent work there.

29. Mr. A. M. Ghose, M.C.S., Chemical Engineer, returned after having attended the Part Institute, New York. He mastered the technology of oils, fats, and soaps, by entering the world-renowned Colgate and other soap works. He was elected a Member of the American Chemical Society, and was the first Indian honoured with that distinction. On his way home, *viâ* Japan, he was appointed Chemist and Supervisor of a big soap factory in Tokyo. His book entitled "Chemical Technology of Oils, Fats, and Manufactured Products" earned for him much reputation in America, where a large number of copies were sold. He has been employed in the Bengal Soap Factory, and has also started on his own account a soap factory under the name of Vegetable Soapery.

30. Mr. J. N. Sahai, T.E., graduated in Textile Engineering from the Higher Technological Institute, Tokyo. He had also practical training in

spinning, weaving, dyeing, in short, everything in connection with the weaving and spinning industry, by working in several factories in Nagasaki and Osaka. At the recommendation of the College Authorities he had the good fortune of working in both weaving and spinning sections of the Osaka Cotton Mill, the largest Mill in Japan. The President of the Mill was highly satisfied with his work, and recommended him to any mill he may desire to join. He, on his return, worked as Spinning Master of the Krishna Mill, Bewar, on a salary of Rs. 150 per month. He is now working as Manager of the Gorakhpur Weaving and Dyeing Works.

31. Mr. B. C. Das joined the Royal Sanitary Institute, London, passed therefrom and was appointed an Associate of the same Institute. He has been, on his return, employed by the Dacca Municipality on a salary of Rs. 150 per month.

32. Mr. S. P. Gupta, graduated in Ceramics from the Higher Technological Institute, Tokyo, and worked in several factories for the manufacture of cement and fire-bricks. He also learnt the manufacture of pencil. He has, on his return, started a pencil factory in Calcutta on his own account.

33. Mr. A. B. Sircar, M.A.C.S., took Chemistry and Bacteriology in the Stanford University, U.S.A. After that he learnt can-making and canning and preserving of fruits, vegetables and other food products in several canneries in California. He obtained the Diploma of the National Canners' Laboratory in Pennsylvania. He was also elected a Member of the American Chemical Society. He has been, on his return, appointed by the Bengal Preserving Company, Mozaffarpur.

34. Mr. H. N. Mukherjee returned after learning the art of tanning in all its branches in several factories in different places of America. He has been employed by the Berhampur Leather Manufacturing Company.

35. Mr. A. C. Ghose, M.A.S. (Japan), M.R.A.S. (London), returned after graduating in tobacco curing and the manufacture of cigar and cigarettes from the Government Tobacco Monopoly Bureau's Manufactory in Tokyo. The Director of the Bureau spoke very highly of his attainments and recommended him to the tobacco works of the Anglo-American Tobacco Company in America and England. He was the first foreigner who was granted a Graduation Certificate by the Imperial Government Monopoly Bureau of Japan. He was also elected a Member of the Royal Agricultural Society, London. He has been employed as Manager of the Gopalkheria Cigarette Company, Lucknow, on a salary of Rs. 250 per month.

36. Mr. D. C. Mojumder, after graduating from the Ceramic Department of the Government Higher Technical Institute of Tokyo, worked in one of the most up-to-date pottery works in Japan. He also qualified himself thoroughly in clay analysis, body and glaze-making, mould-making, furnace-building, firing and in all other different aspects of pottery industries. He has been engaged as Ceramic Engineer by the Gwalior State on a salary of Rs. 200 per month.

37. Mr. B. K. Sen returned after learning sheet metal works and electroplating from a big factory in Osaka, Japan. He has been employed in the Calcutta Sheet Metal Works.

38. Mr. I. B. Vidyanta, T.E., graduation in textile engineering from the Higher Technical Institute, Tokyo, with honours and obtained prizes and proficiency certificates. This was the first instance of an Indian student being admitted as a regular student in that Institution. He fully qualified himself in the seven courses of pattern analysis and designing, mechanism of textile machinery, mechanical engineering, weaving, dyeing, factory construction and industrial economy and obtained special certificates from the Director of the Institution. He has been employed by Messrs. Andrew Yule & Co., in their Bengal Mills.

39. Mr. L. Barathakur, M.A.S., returned after graduating in agriculture from the Imperial Agricultural College, Sapporo, Japan. He worked as Assistant Manager of the Sankhomten Sugar Mill, Hainan, Formosa, and visited many sugar factories, including the Government Sugar Experimental

Station in Japan. He has started a firm for producing sugar cane preliminary to his starting a sugar factory at Tinsukiah.

40. Mr. A. C. Sen returned after passing the intermediate B. Sc. Examination in Tanning of the Leeds University. While in England he joined and worked in a big tanning factory. He also visited several factories both in England and Germany. He has been engaged in the Nadia Tannery.

41. Mr. R. N. Tagore, B.S. - Mr. N. N. Ganguly, B.S. - returned after graduating in Agriculture from the University of Illinois, U.S.A. They have started an agricultural firm and also Agriculture Bank at Silaidaha.

42. Kumar Amindronarain returned from Japan after learning the manufacture of pencil. His services were lent for some time to the Bimlipatan Pencil Manufacturing Co., Madras. During that short time he made several substantial improvements in the factory and manufactured pencils in no way inferior to the foreign ones. He is now working in the pencil factory of the Small Industries Development Company.

43. Mr. P. C. Bose, M.E., joined the Mechanical Engineering Department in the Imperial University, Kyoto, and got M.E. Degree. For practical training in ship-building he worked in the dockyard of Kobe. He has been employed as an assistant engineer in the Bilimorn, Sara Line (Baroda State Railway) on a salary of Rs. 300 per month.

44. Mr. S. C. Bannerjee returned after learning pharmacy in Japan. He has been employed by the Russa Pharmaceutical Works, Ltd.

45. Mr. K. T. Achaya returned after training in sericulture both in Japan and France. He has been employed in the sericulture farm of the Salvation Army in Aligarh on a salary of Rs. 200 per month.

46. Mr. J. C. Gossain, II., joined the testing department of the General Electric Company, New York. The director of the firm was highly pleased with his work and appointed him as an engineer in the hydro-electric plant which the Company undertook in Nepal. He is now working in the Calcutta Electric Supply Corporation.

47. Mr. J. C. Maitra returned after learning electrical engineering in London. He has been employed by Electric Supply Corporation, Calcutta.

48. Mr. J. L. Sen, M.B., I.M.S., returned after passing the I.M.S. Examination and taking course in bacteriology in the London Polytechnic. He has been appointed a civil surgeon of Lucknow.

49. Mr. C. C. Sen, L.C.E., returned after training in mechanical and electrical engineering, both in England and America. He had been engaged as an assistant engineer by the E.B.S. Railway.

50. Mr. P. D. Pande, B.S. returned after obtaining B.S. Degree of the Oregon Agricultural College, U.S.A. He has been appointed as Assistant Director of Sericulture in Kashmir State.

51. Mr. L. M. Sen, B.Sc. (Glasgow), returned after passing the final B.Sc. Examination in Mechanical Engineering of the Glasgow University with special distinction. He has been employed by Messrs. Jessop & Co., in their big engineering firm in Calcutta on a salary of Rs. 250 per month.

52. Mr. R. Dutt, B.A. returned after fully qualifying himself in the manufacture of soap and essential oil after theoretical and practical training in France, Germany and England. He has been employed as a professor in the Bengal Technical Institute.

53. Mr. J. C. Sen, A.B., returned after obtaining the A.B. Degree in Economics of the Harvard University, U.S.A. Before his return he worked in the National Bank of Commerce, one of the largest banks of Boston.

54. Mr. D. K. Roy. B.A., A.Sc., passed B.Sc. Examination in Chemistry of the Edinburgh University and worked in the firm of a pharmaceutical chemist for practical training. He has only just returned.

55. Mr. S. S. Sinha studied agriculture for two years in the Ontario Agricultural College, Canada, and obtained B.S. Degree in Agriculture of the University of Illinois. He was also elected Member of the American Society of Agronomy and Royal Agricultural Society of England. He has only just returned.

56. Mr. S. C. Roy, L.M.E., learnt enamelling and worked at the British Westinghouse Electric and Manufacturing Company, Manchester, and stood second in the sufficiency test. He was highly spoken of by the general manager of the works. He has only just returned.

57. Mr. S. C. Bose, B.A., returned after learning automobile in England.

58. Mr. L. Das returned after obtaining Diploma in Sericulture of the Superior National Agricultural School, Montpellier, France, and studying tropical agriculture in the Superior National Colonial Agricultural School, Paris. He worked for some time as a professor of the Pusa Agricultural College on a salary of Rs. 150 per month, which post he has resigned.

59. Mr. S. K. Dutt Gupta returned after learning the manufacture of buttons from Japan, and started the Bengal Button Factory in Calcutta on his own account.

60. Mr. B. M. Chatterjee returned after graduating in textile from the University of Leeds. He also obtained first class certificates in cotton and linen bleaching and finishing of the City and Guilds of London Institute Examinations. He, for practical training, worked in a big cotton mill in Manchester and visited several factories.

61. Mr. S. N. Bose, M.A.S., returned after graduating in agriculture from the Imperial Agricultural College, Sapporo. He also worked in a big firm for practical training.

62. Mr. B. B. Banerjee returned after learning the manufacture of umbrellas and scientific instruments such as telescope, compass, vacuum gauze, &c., from the Tokyo Meter Manufactory.

63. Mr. M. C. Sen returned after learning the manufacture of shell buttons in a big factory in Kobe, Japan. He has started a shell button factory on his own account.

64. Mr. R. R. Ghose, M.S.A. 65. Mr. P. K. Mitter, M.S.A. Returned after brilliant career and obtained high certificates of merit and golden opinions of the Professors of the Sericultural Department of the Imperial University, Tokyo. They also learnt the practical side of the work in the Government Experimental Station at Nishigahara.

66. Mr. S. N. Bose returned after fully qualifying himself as a leather expert after training in Japan and England.

67. Mr. N. C. Guha M.D. - 68. Mr. G. C. Das, M.D. - Returned after passing the M.D. Examination of the Hahneman Medical College, Chicago, U.S.A., and also learning Mechanical Dentistry.

69. Mr. J. Dutt returned after learning Ceramics in the Kato Porcelain Factory, Tokyo.

70. Mr. S. Roy. - 71. Mr. H. C. Dutt. Returned after passing the Final Examination of the Royal Sanitary Institute, London, and qualifying themselves as municipal engineers from the University College, London. Mr. Dutt is working as an engineer in the firm of Messrs. Incell and Silk.

73. Mr. P. C. Pramanic returned after learning umbrella making in all its branches in the Iwasaki umbrella manufactory, and electro-plating in a firm in Tokyo.

74. Mr. P. K. Biswas returned after obtaining Ph.D. Degree of the Imperial Agriculture College, Sapporo, Japan.

75. Mr. K. D. Mitter returned after learning litho printing, and in a factory in Tokyo, Japan.

76. Mr. B. B. Bose got himself admitted in the Keyosu-shoten Tin Printing Factory, Tokyo, and learnt litho printing, tin printing, and can-making. To give a finishing touch to his education, he went to America. He has just returned.

77. Mr. B. N. Das returned after learning the manufacture of shell buttons in a big factory in Tokyo, and leatherette in Osaka.

78. Mr. A. Mitter returned after learning the manufacture of paints in Germany.

79. Mr. J. Hazra returned after learning shoe-making in the Universal Machinery Co., Ltd., Northampton, England.

80. Mr. B. C. Ukil returned after learning electro-plating and the manufacture of glass beads at Osaka, Japan. Before his return he was employed in starting the Bunraj Glass Beads Factory at Osaka. He will soon start a glass beads factory in Calcutta.

APPENDIX VII.

In view of the difference of opinion prevailing among experts as to the training of a mining engineer, we print here the written evidence submitted to us by Professor J. Cadman, D.Sc., and Sir T. H. Holland, K.C.I.E.

Written evidence submitted by Professor John Cadman, D.Sc., M.Inst.C.E., F.G.S. (Certificated Colliery Manager, late H.M. Inspector of Mines under the Home Office and Colonial Office, Professor of Mining in the University of Birmingham; also Consulting Engineer to a group of Collieries in the Midlands, and Mining Adviser to the Colonial Office for West Indian Colonies).

For a period of three-and-a-half years I was in charge of the Mines Inspection Department in Trinidad, and came in contact with a large number of Indians. I have also been in India and Burma, and have some knowledge of the conditions existing there.

I have been in charge of the Mining Department in the University of Birmingham during the past four years, during which time the following Indian scholars have passed through the department.

No.	Name.	Experience in Mining prior to obtaining Scholarship.	Occupation before gaining Scholarship.	Attending University.	Passed Degree or Diploma.	Work obtained on return to India.	If work obtained in England other than during vacations.
1	Hafiz, A.	No.	(?)	5 years.	B.Sc., M.Sc.	(?)	No.
2	Fox, C. S.	No.	(?)	3 years and returned 1 year as lecturer.	B.Sc.	Mining Branch of Geological Survey.	Assistant Manager, Overman, and Surveyor in Coal Mine 1 year.
3	Mokadam, B. P.	Yes.	Mining.	3 years.	Diploma.	Employment in Mines.	Yes; worked in Mines for a year.
4	Sen, A. M.	No.	Civil Engineering.	4 years.	B.Sc., M.Sc.	Mysore Geological Survey.	Yes; investigation of S. Staffs. Coalfield. Worked at several Mines.
5	Ashcroft, C. E.	Yes.	Mining.	3 years.	Diploma.	At a Coal Mine. Since become a Manager.	No.
6	Ray, M. K.	No.	Chemist.	4 years.	B.Sc.	Geologist, Rajputana.	No.
7	Dandekar, P.	No.	Electrical work.	3 years.	Diploma.	Not yet returned.	Working in the Birmingham Corporation Power Station.
8	Kurup, M. N. P.	No.	Oil Boring and Prospecting.	3 years.	Failed.	Boring, Digboi Oilfields.	No.
9	Obaidullah, M.	No, but took a course at Calcutta.	Engineering and Mining at Calcutta University.	5 years.	B.Sc.	Not yet returned,	No.
10	Nag, D. C.	No.	Civil Engineering.	3 years.	B.Sc.	Assam Oilfields.	No.
11	Sen-Gupta, M. N.	No.	Geology.	4 years.	(?)	Not yet returned.	No.
12	Bardaloye, G. C.	Three months preparing for scholarship.	Calcutta University.	3 years.	(?)	Not yet returned.	No.
13	Rao, S. R.	Yes.	Civil Engineering.	2 years.	Qualified for B.Sc. degree.	Mining work Geological Survey of Mysore.	No.

My experience of these scholars leads me to state emphatically that with a few exceptions the men are very badly selected for the profession they are undertaking. The above list will show that out of 13 students, only three had previous experience in mining, or, indeed, had any intention or ambition to follow the profession of mining engineer, prior to obtaining the scholarship.

There has been no difficulty whatever in obtaining ample opportunity at mines for Indian scholars to obtain practical experience. The general arrangement is that a small fee is usually charged to students, amounting to about the rate of 10*s.* to 1*l.* per week for short periods, or 4*l.* to 5*l.* for the long vacation. It is obligatory on all students to work in the mines for two months during the three years they are reading for the degree. My department obtains a form signed by the manager of the mine at which the student has been employed, stating the exact nature of the employment during the period.

The Indian scholars in mining find that they are unable to obtain employment in mining on their return to India. The reason is largely due to the defective system of selection. The students are recruited from candidates who are in no way associated with mining before leaving India, are not known to any mine owners or mine officials, and indeed, in many cases, have never seen or been connected with a mine before taking up the scholarship. A student in these circumstances has no direct connection with Indian mining, and has no friends or employers who would be prepared to obtain his services on his return.

It is my opinion that if the students were recruited from persons actually connected with Indian mining, there would be no difficulty in their obtaining re-employment on their return. From the list above it will be seen that of all the candidates, only those who have been actually associated with mines before taking up the course have obtained direct employment in mines on their return.

No doubt you have obtained evidence from Sir Thomas Holland, and if he has expressed himself as he did in a speech recently delivered on the education of Indian scholars, I should like to allude to his suggestions, as I am directly opposed to such views.

I attach a press cutting on this subject.

Report of a speech by Sir T. Holland K.C.I.E., at the 3rd Annual Dinner of the Indian Mining and Geological Club. (Extracted from the "Colliery Guardian.")

"Sir Thomas Holland, who was warmly received, after a few much appreciated humorous remarks, alluded to the appointment of a committee by the Secretary of State for India to investigate the question of State technical scholarships. It would be out of place to discuss the matter in detail; but there was one criticism that ought to be made now or never. The committee was composed of recognised educational authorities, who had a sympathetic attitude towards the difficulties of technical students, as well as the industrial needs of India. But it seemed to him that, in summing up the evidence which it would collect, such a committee ought to be influenced by members with practical experience of Indian industrial and commercial affairs—such a man, for instance, as Sir Percy Ashton, or their honoured guest Sir Dorabji Tata. The committee would also, he hoped, discover that the solution of the problem would not be found in evidence collected in this country, but in India itself, where we wanted, above all things, an army of efficient technical workers trained under Indian conditions to deal with Indian material. There was a related question of more direct interest to most of them—namely, the proposal to found a school of mines at Asansol, on the Raniganj coalfield. They knew that the existing facilities to study the principles of mining were the chair of mining at the Civil Engineering College, Sibpur, near Calcutta, and evening classes at different centres on the coalfield for the assistance of young mine apprentices, preparing for the manager's certificate examination under the Indian Mines Act of 1901. While the classes on the fields had been singularly successful, those at Sibpur College had attracted very few students. In this country we had exactly the same contrast. The evening classes in mining at the colliery centres were generally successful; the University classes were generally failures. It seemed to him that this contrast must always exist in a subject like mining; and he hoped the reason would be examined carefully by the University authorities, who appeared to think that the modern University was not up to date without a brave show of technical education. A mine manager, like a master mariner, was made only by a long, and often painful, practical apprenticeship. The University life of freedom made a serious inroad on the unrelenting force of discipline which was essential for every man responsible for the lives of his subordinates. Although he was a University professor in a flourishing mining district, he had no hesitation in confessing that they ought not, and could not, compete with the evening classes of technical schools. The Government of Bengal would come to this conclusion also, if they attempted to build a school of mines at Asansol, or anywhere else. The out-of-shift classes would flourish so long as the mining industry lasted; only few, and he feared not the best, students would take what corresponded to our B.Sc.Tech. in mining. Yet there was a very necessary member of the mining community who could be trained only in institutions of University rank, and that was the mining geologist. While the training of the mine manager should be about nine parts of mining methods with one part of the scientific principles, in the mining geologist the proportion of these ingredients should be almost inverted. One was a technical man; the other a technologist. One was trained on the mine supplemented by evening classes; the other was trained at the University supplemented by sufficient experience at more than one kind of mine. Unfortunately, in our English Universities we were attempting to turn out men who were qualified either as mine managers or as academic so-called pure geologists. Neither understood the other, and both consequently were of less use in the world than they might be. It was with the idea of getting these two to run comfortably in double harness that Mr. Pickering and he joined in founding their institute. His advice to the Bengal Government would be not to found a school of mines, but to strengthen the evening classes on the coalfields, and to add a professor of geology at Sibpur. The latter should remain a residential college wherever it went, and whatever was done, its individuality should not be destroyed; it should be given a chance of maintaining a continuous history—of building up traditions which would give its students some excuse for an *esprit de corps*."

Whilst I am disposed to agree generally that it may be necessary to strengthen the Mining School in the Calcutta University, and that it is important that sound evening instruction should be given in the coalfields, I am entirely opposed to the view that efficient mine managers and mining engineers can be trained by evening instruction alone. Evening classes are, in my opinion, only suited, and indeed are eminently suited, for the instruction of subordinate officials, overmen, firemen, and deputies. Mine managers of the future must possess a sound technical training in all the branches of science applied to mining, which cannot be satisfactorily obtained at evening classes during the time the students are working daily in the mine. After a hard day's work in the mine, it is idle to suppose that instruction can be given of the quality and quantity necessary for the complete education of a mining engineer.

I entirely and emphatically disagree with Sir Thomas that "a mine manager, like a master "mariner, is made only by a long and often painful "practical experience," and Universities "ought not, "and could not, compete with evening classes of "technical schools."

My experience has been entirely in mining in different localities in this country, and in many countries abroad. I have managed mines, and am still connected with the direct management of mines, and I say with absolute confidence that the successful mine manager and mining engineer of the future is the man who has a sound University education, together with a sound practical training. The Government of this country has seen the need for this, and has now given facilities by its legislation to enable this combination to be followed.

I would strongly advise the Indian Government to insist upon part of the training of mine managers and engineers being acquired at day classes at a University or college of equal standing.

India has to develop enormous fields of minerals; the geologist will locate these fields, but the efficient and economic development can only be undertaken by a body of engineers, trained in a modern school, swept of those rule-of-thumb principles inherent to the class of men trained entirely in the school of bitter experience. Sound principles of science are as necessary to the successful management and development of the mine as they are to the efficient geological survey of a country, and I advise the Committee to beware of the mining geologist or expert. Both the geologist and the mining engineer, properly and efficiently trained, are indispensable and essential for the successful development of India.

In my opinion it is imperative that carefully selected Indian mining students should be sent to this country for instruction, particularly until such time as Indian mining is more fully developed. The selection of candidates would be well placed either in the hands of a committee composed of the two inspectors of mines, two members of the Indian Mining and Geological Society, and two colliery managers, or in the hands of the Examination Board under the Indian Mines Act. The present system of mining scholarships has entirely failed to meet the object the Indian Government had in view, and as the failure can be traced to the selection of unsuitable candidates, a remedy is at hand which I venture to suggest would ultimately produce efficient and capable mining engineers fully prepared to meet the policy the Indian Government formulated in promoting its scholarship scheme.

Note by Sir Thomas H. Holland, K.C.I.E., F.R.S. (Professor of Geology, and Director of the Department of Geology and Mining, Manchester University, and sometime Director of Geological Survey of India), on the Indian State Technical Scholarships.

In assuming that Indian students at present do not derive the maximum benefit possible from their training at British Universities and Technological Institutions, my conclusions are based on personal acquaintance mainly with students who have been sent to England for training in mining. In view of the fact that mining is already a well-established industry in India, offering abundant room for the employment of suitable men, it is fair to conclude that the results obtained for this subject have a wider application, bearing on the general question of the present system of sending technical scholars to Europe.

Of the mining students that I know personally, only one had had practical experience at Indian mines before being granted a scholarship, and he is among the small number, so far, who can be regarded as a success, as he is now holding a good position as an assistant manager in Bengal. He, however, like the others, was an anxious candidate for Government employment immediately after completing his course at the Birmingham University.

In drawing an inference from the consideration of mining students, it is important to remember that there are two distinct classes of so-called mining experts (the mine manager and the mining geologist or prospector), and that so far the scholarships have been utilised in a way intended to lead to the preparation of one class only, namely, the expert whose ultimate aim is to be a mine manager. So far as I know, only one scholarship has been utilised in a way which would tend to qualify the scholar to be a prospector or mining geologist, and that scholar is now completing his training at the Manchester University. As there is little doubt about his being a success, the utilisation of public funds for his assistance can be regarded as a reasonable investment on behalf of India.

Taking the failures first, it is easy to show why and how it is unwise to send raw students to England in the hope that the ordinary training at an English University will qualify them to be mine managers. Mine managers, to be qualified under the Indian Mines Act of 1901, are required to show evidence of practical experience in positions of responsibility underground, and to pass an examination in the principles of mining. Unless a student is apprenticed at a mine for some years, he is unable to take full advantage of training similar to that given in English Universities; it is possible for him to obtain a certain amount of familiarity with mining terms and with the machinery employed, but no University training can take the place of actual familiarity with the special conditions underground. A raw student, therefore, does not form a true mental appreciation of the principles of mining taught at a University, and, after obtaining his degree, he is too old, and is otherwise generally unfitted, to go through the heavy drudgery required of the ordinary apprentice. Most of the students who have returned to India with the B.Sc. in mining show an obvious awkwardness in practical affairs; they are unfitted to take charge of subordinates, and cannot be entrusted with responsible work, in which a mistake may mean the loss of lives as well as of property. In one case a returned scholar, with the B.Sc. in mining, failed to pass even the theoretical examination in India for the second class certificate. This last case illustrates my contention that even the principles of mining do not become a permanent part of the mental fibre of a student who has not had actual practical experience before coming home; for it must be remembered that, so far as the University examinations were concerned, this student was marked as successful.

The ordinary youth who is compelled to earn his living at mining cannot afford, as a rule, to cut out three years of his practical experience in order to go through the course for a University degree. He must obtain his knowledge of the principles underlying his practice by training at evening or out-of-shift classes; and, consequently, if the Government of India wish to recruit mine managers from Indians they must maintain in the country evening classes of the kind that we have in England. I conclude, therefore, that the present system of sending State technical scholars to Europe will never result in the production of mine managers.

My general knowledge of other industries leads me to a similar conclusion, modified, however, in some cases by the fact that managers of other industrial works have not the same responsibility

regarding the lives of their subordinates, and, consequently, require a less rigid training in matters of discipline. Nevertheless, it will be found as a rule that managers of industrial works obtain the necessary qualifications only by a long and uninterrupted practical experience. To such men, who have to be themselves expert workmen, the University and Technological Institution of University rank can ordinarily give little assistance; what they want, in addition to experience in works, is training of a kind given in purely technical and industrial schools.

In this class, however, there will be found a small proportion of individuals who are capable of obtaining benefit from the so-called higher training in science and technology. It should be possible, therefore, to find in India industrial workers who might be benefitted by a special course of training in Europe, either in technological institutions, or at works where the methods are, from a scientific and technological point of view, in advance of those in India. Such men will almost always be comparatively senior, certainly older than the average University student. They will benefit by their training in Europe because, having an intimate practical acquaintance with their industries in India, they will be continually forming, during their European experience, mental pictures of the way in which their newly-acquired ideas may be turned to account under Indian conditions; being also more matured they will be less distracted by the new life in English cities. This last point is one of the most important to consider, for I feel sure that our raw Indian students are seriously handicapped on coming to Europe by the enormous number of distractions put in their way. The methods of teaching now common in our Universities and Technological Institutions in themselves destroy all mental discipline: the students are provided with most expensive apparatus and are given illustrations by lantern slides, diagrams and lectures so carefully prepared that the only faculty brought into play is memory, and even that is largely destroyed by the quantity and variety of illustrations. In addition to the regular lectures and demonstrations, following one another at a rapid rate and in bewildering variety, the Indian student finds new distractions in the endless students' clubs, social entertainments and debating societies. Immediately outside the University walls he finds every possible form of inducement to forget the lessons of the day in the form of halfpenny papers, music halls, and cinematograph shows. It seems to me that it is unreasonable to expect a young Indian student, with no practical knowledge of the industry that he is supposed to study, and accustomed only to the simple life of an Indian village, to qualify as a disciplined expert after three years of such entertainment at the expense of Government. The English public school boy is not so easily distracted by University life, and knows how to keep the various forms of relaxation offered duly subordinated to the real object before him, while most of the English students who are dependent on scholarships are too poor to take advantage of these temptations to relaxation.

The object with which the Government of India instituted these scholarships will be more certainly attained by the development in the country of technical and technological schools. It should be easy to maintain a large variety of technical and industrial schools, but it may not be possible at present to provide in higher technological institutions in India every form of training required to assist existing and possible industries. It will be desirable, therefore, for some years to come to send a few select technical scholars to Europe for special training; but I think that in all cases these should be experienced and matured men, never raw, inexperienced young students.

This leads me to a consideration of the other class of mining students to which I have referred already, namely, the class of prospectors of minin geologists. For the training of this class bette facilities exist at present in Europe; but even in this matter it would be comparatively easy to make India independent. The mining geologist requires more of the so-called scientific training and less familiarity with the actual methods of mining—he is more of a mineralogist than an engineer, but it is still necessary for him to have a clear appreciation of the methods of mining, both for metalliferous minerals and coal. His training can be given in technological institutions supplemented by a comparatively short experience in various types of mines, and the mining scholar to whom I referred above is being trained at Manchester on the distinct understanding that, while he will never be suitable as the manager of a large mine, he will be useful to a mining company which requires a more precise knowledge of its mineral-bearing lands, or is anxious to have an accurate survey of new concessions. For the assistance of Indian students likely to join this class, I admitted to my department, when Director of the Geological Survey, a certain number of young science graduates for training in economic geology, and if I had remained in India I should have attempted to develop this practice into a regular system, granting diplomas to those who showed the requisite proficiency; for I am convinced that it is the duty of the scientific and technical departments of Government in India to undertake their appropriate share of technical education. In this way numbers of private workers as well as useful assistants can be trained in the country to take the place of the more expensive imported expert; it is the duty of the officials to turn to the fullest account possible in the public interest the people as well as the raw materials. There has been a tendency hitherto for the educational department in India to be an institution apart, attempting to teach all forms of science and technology, while the scientific departments occupy themselves with their technological work without considering it a part of their duties to undertake a share of the work of teaching. As a result, the products of the education department are not often fit for employment, while other departments are undesirably dependent on recruits from Europe.

The second question offered by the Committee regarding the possibility of admitting Indian students to English works will presumably be answered by other witnesses; but is is obvious that it will always be difficult to persuade owners of works that it is to their advantage to admit immature strangers whose object is to assist competitors in their principal market. In any case, owners of works will not be bothered with casual students, while they will readily accept regular apprentices; and this brings us to the same conclusion, namely, that Indian students must go through the ordinary practical apprenticeship like the average English boy: managers of industrial works cannot be manufactured out of raw students by two or three years of free living at English Universities.

If my estimate of the situation be correct, namely, that mature workers only can fully benefit by these scholarships from India, it follows that the subjects selected will be only those directly related to existing industries in India. My reasons fall into two classes:—

(1) Only experienced practical men can fully appreciate the meaning of technological science as an aid to industrial development; and

(2) Only such students can find suitable employment on their return to India; for new industries cannot be inaugurated without capital expenditure, and financiers will not put their money on students with nothing more than the ordinary B.Sc. Tech.

As the technical scholarships were instituted with a view of assisting the industrial development of India, it is necessary briefly to consider the main

features of those industries which European technological science might assist. They fall into two main classes:—

(1) Distinctly new industries and those which can now be worked profitably only on a large scale and on European lines like most of the metallurgical industries; and

(2) Those now existing under conditions that might be improved without an immediate expenditure of additional capital on any considerable scale.

For the first class European experts will be necessary, some or all being ultimately replaced by Indians, who will be either trained entirely on the works, assisted by evening classes, as in the case of furnace men, refiners, and founders, or obtained from technological colleges, as in the case of chemists and surveyors. The Indian assistants at such works can thus all be trained in India.

For the second class of industries the chief requirement of the assistant is familiarity with present methods and local conditions. The methods and conditions may be improved (1) by research work in Indian technological institutions, such as that now established at Bangalore and that proposed for Cawnpore; (2) the direct utilisation of ideas obtained from more progressive works elsewhere; but only experienced men are capable of recognising those among foreign methods which are capable of advantageous application to Indian industries.

In my opinion the principal present educational needs of industrial India of a kind that Government could appropriately finance are:—

(1) A large number of elementary industrial and purely technical schools, with evening classes in the main industrial centres.

(2) A first-class technological college for each large province or appropriate group of small provinces, provided with staff and equipment for research work on local existing or obviously possible industries.

(3) An Imperial industrial exhibition every year, held at the larger cities in rotation, in addition to the smaller local shows.

(4) Scholarships tenable in Europe and America for the assistance mainly of (*a*) those who intend to return as teachers to the technical schools, and (*b*) those who could not otherwise leave their industrial employments for higher training.

Supplementary Note by Sir Thomas H. Holland on the Indian State Technical Scholars.

In accordance with the wishes of the Committee, I have examined the Statement supplied regarding the State technical scholarships granted between 1904 and 1912, and this Statement enables me to distinguish these scholars from other Indian students who have come to England for training. As before, I confine my remarks to the subject of mining, but my knowledge of students in other departments forces me to the conclusion that the inferences drawn with regard to mining are capable of very wide application.

Of the 18 students who have been granted scholarships in mining, seven may be classed fairly as non-successes. Of the remainder, four are still undergoing training, three are students unknown to me, and four I know to be successful. Of these four successful students, three were selected and recommended by myself for appointments in India.

The expenditure on these 18 students between 1904 and 1912 amounts to just over 10,000*l*. It seems to me that the results are of far less value to the Indian mining industry than those obtained during approximately the same period for an expenditure probably not in excess of this sum on mining education in Bengal.

In Bengal mining education has been undertaken since 1904 along two principal lines: (*a*) lectures under the control of local committees at four centres on the coalfields of Raniganj and Jherria, and (*b*) a mining department in the Civil Engineering College at Sibpur. For the classes on the coalfields I have figures only for 1908 to 1910. In 1908, 417 students were enrolled up to the end of the year, and the average attendance at each lecture was 80. In 1909 the students registered up to the end of the year numbered 230, the average attendance at lectures being 28. In 1910 the students enrolled numbered 325, the average attendance at lectures being 20.

Up to the end of 1909, of the 105 persons who had been granted certificates of competency as managers after examination, 88 had been students at these evening classes; and it is important to remember that, in addition to those who thus obtained the manager's certificate, the remaining students, who either did not compete or were unsuccessful, were nevertheless better workers on account of their training; the advantage to the industry secured by local classes is thus greater than that indicated by the mere number of certificates granted.

At the Sibpur Engineering College, five students obtained diplomas in 1908, one in 1909, and six in 1910. Of these 12, 11 secured good appointments on the coalfields, and, in addition to these, other students who failed to obtain the diploma found satisfactory employment.

Of the State technical scholars in mining who have returned to India, I can find only two who have obtained the mine manager's certificate; these are, H. C. Read, who is now one of the four lecturers at evening classes on the Raniganj coalfields, and C. E. Ashcroft, who obtained the second-class certificate by examination on the 20th December 1909, followed by the first-class certificate on re-examination on 30th March 1910. I have no complete statement regarding the number of certificates granted to Sibpur students since the class was started, but, in the lists of certificates published annually by the chief inspector of mines, I recognise the names of several Sibpur students whom I met before leaving India in 1909. The Sibpur College shows a record distinctly better than that due to the 16 scholars who were sent to the Birmingham University; for the Sibpur College has not only a long list of practical successes as tested by the Government examination for competency, but numbers of other students less successful have turned out to be useful workers in the mining community. Another fair test is the membership of the Mining and Geological Institute of India, to which only one State scholar, namely, H. C. Read, appears to have been admitted.

It will be noticed that the evening classes on the coalfields and the full-time mining class at Sibpur show a relationship as regards numbers of students somewhat similar to that between the evening classes in this country and the University departments in mining. The evening classes more perfectly suit the conditions required by those who intend to be ordinary managers; the classes of University standard more fully meet the requirements of the smaller number of students who become mining geologists or prospectors. The contrast between the results obtained in Bengal with those due to the maintenance of scholars in Europe is accentuated by the fact that the technical scholars, who get stipends larger than anything known among English scholars, were, or ought to have been, picked men. The experiment, however, is complicated by the circumstance that 16 of the 18 mining students were sent to Birmingham, the other two having not yet returned to India. Of these two students, one is now at the Royal School of Mines, and the other has just been granted the M.Sc. after a course of great distinction at Manchester. This student was selected by me in India, and will be offered a lucrative post under one of the mining companies after his return to India.

Whilst better results might have been obtained by more careful selection of the scholars, and by training in other mining schools, I feel sure that, so far as mining is concerned, the education of Indian students could have been more efficiently and

economically undertaken in India itself. The Sibpur College, being residential and controlled by thoroughly practical men, gives a far more satisfactory training for Indian students than is obtainable at any of our younger Universities in this country. The disadvantages due to students' life in Calcutta, where the larger colleges are non-residential, and to an even greater extent in our northern cities, do not exist at Sibpur; and I think the Government would be wise in supporting that and other institutions of its kind rather than in spending money on sending technical students to Europe. It is a mistake to encourage the idea that Indian institutions are necessarily inferior to those in this country. There are various kinds in each country, and colleges like that at Sibpur might be turned to much more valuable account if they were supported in such a way that the students themselves could look upon the institutions with pride.

I understand that some witnesses considered that research work could be better undertaken in English institutions so far as the immediate requirements of science are concerned. This may be true; but, if research work be undertaken with a view of improving Indian technical industries, and of training Indian students for practical work under Indian conditions, there is not the slightest doubt that the research work should be undertaken in India itself. Even gauged by the output of pure science, research work on Indian material would be more productive in India than in Europe, if the college professors were not forced by the present absurd system to give as many as three lectures a day to various classes of students. This system not only bars absolutely any attempt to undertake research work, but it results in a serious degeneration in the quality of the lectures given, while the students, being over-lectured and over-tutored, become absolutely incapable of independent thought. That research work of the highest quality can be done in India is shown from the results of the Geological Survey Department, and by the scientific sections of the agricultural department. The organisation of the Indian Institute of Science at Bangalore has been drawn up with a view of avoiding the old evils which characterise the colleges, and I have no doubt that research work of the highest quality will be conducted there both by the professors and students.

My views regarding the subjects other than mining are not based on mere casual observation, for I have had to consider many questions outside geology and mining as Dean of the Faculty of Science in the Calcutta University, as a Member of the Board of Scientific Advice, and as a member of various committees of inquiry, including the Conference at Naini Tal in 1907, when the general question of technical education in its relationship to the industries of India were very thoroughly discussed by widely representative authorities. The end result of my consideration of the whole question points, as before stated, to the great advantage of completing the average student's education in India itself, modifying and extending local institutions to meet this end. At the same time I agree that in a small number of subjects, for which regular and continuous training cannot be provided in India, a certain number of carefully selected, and almost always senior students might be sent as scholars to Europe. The inquiries that should be instituted before a student is selected for training in Europe should extend well beyond those that determine his scientific qualifications and ability, for it is important to remember that the Indian student has generally family obligations and encumbrances of a kind that are unknown to the English youth. Technical efficiency will be dearly bought if it incurs serious disturbances of domestic and social customs regarded as sacred by the people. Modification of these, like all other delicately adjusted systems, can be made but slowly.

Whilst I think that it is difficult to counterbalance the advantages of training in India, I should be always glad to receive Indian students at Manchester, and to use my influence in securing for them afterwards suitable posts in India. I receive many more applications for students than I can satisfy from my own classes, and many of these applications are of a kind that I consider could be most efficiently met by the appointment of qualified Indians. We are making special arrangements now in our University work to absorb the mining into the geological department with a view of turning out mining geologists rather than mine managers. Such men will be useful to companies wishing to extend their operations over new areas; they will also be suitable for appointment to the Geological Survey and to educational posts. We consider at Manchester that a mistake has been made in keeping the mining and geological departments distinct, the result being the out-turn of students of pure science and mining men who are trained more especially in engineering methods without knowledge of the questions of mineral economics so essential to officers of the Geological Survey and prospectors for mineral companies.

APPENDIX VIII.

LIST OF REPORTS AND PAPERS LAID BEFORE THE COMMITTEE.

Reports of the Royal Commission on Technical Instruction, appointed 1882 (first Report presented to Parliament in 1882, C. 3171 of 1882; second Report presented to Parliament in 1884, C. 3981 of 1884).

"The Training of Engineers in the United States," a paper, written in 1903 for the Institution of Naval Architects, by Professor W. E. Dalby, M.A., B.Sc., with discussion by Mr. A. F. Yarrow, Sir Nathaniel Barnaby, K.C.B., Mr. Archibald Denny, Mr. Hans Renold, Dr. William Garnett, Sir William White, K.C.B., F.R.S., Professor A. Barr, Mr. James Rowan, Professor C. J. Lambert, Mr. C. E. Stromeyer, Professor R. L. Weighton, Mr. H. G. Morse, and Professor D. S. Capper. (*Reprinted as Appendix IX.*).

Report of the Indian Industrial Schools Committee, and Resolution of the Government of India thereon, No. 31 (Home Department), dated 14th January 1904.

Report of a Committee appointed by the Institution of Civil Engineers in 1903 to inquire into the subject of the training of Engineers. (Printed in the Minutes of Proceedings of the Institution of Civil Engineers, Vol. CLXVI., 1905–6, Part V.).

"The relation of Science to Industry and Commerce," a paper read before the British Association by Mr. R. Blair, M.A., B.Sc., 5th September 1910. (Printed in the *Educational Times*, October—November 1910).

Report of "the Recess Committee" on the Establishment of a Department of Agriculture and Industries for Ireland (first published in 1896; republished 1906).

"Technical Education in Ireland," a paper read before the Society of Arts by Mr. George Fletcher, F.G.S., on 24th April 1912. (Printed in the *Journal of the Society of Arts*, Vol. LX., No. 3101, 26th April 1912.)

"Education for Industrial Purposes," by the Superintendent of Education for Ontario; printed at Toronto, 1910. (A study of the experience of Great Britain, France, Germany, Switzerland, and the United States of America.)

"Industrial Education in the United States," being the subject of the Twenty-fifth Annual Report of the Commissioner of Labour. Washington, 1911.

Address by Mr. D. Home Morton, M.Inst.C.E. (of Messrs. D. and A. Home Morton, Civil Engineers, Glasgow), as President of the Glasgow Association of Students of the Institution of Civil Engineers, dated 21st November 1911. (Printed by McCorquodale & Co., Limited, Glasgow.)

"Report on the Inquiry to bring Technical Institutions into closer touch and more practical relations with the Employers of Labour in India," by Lieutenant-Colonel E. H. de V. Atkinson, R.E., and Tom S. Dawson, Esq. (Printed by the Government of India, 1912.)

Regulations for the admission of pupils to the works of Messrs. Yarrow & Co., Limited, 26th March 1903. (Reprinted in Appendix IX., page 151.)

The British Westinghouse Electric and Manufacturing Company, Limited, Trafford Park, Manchester. Scheme of apprenticeship courses.

Messrs. Hans Renold, Limited, Manchester. Rules for the admission of apprentices.

Messrs. Vickers, Sons, and Maxim, Limited. Scheme for regulating the admission of apprentices to the Engineering and Ordnance Departments.

The Daimler Company, Limited, Coventry. System of Engineering Scholarships and regulations for works pupils.

APPENDIX IX.

THE TRAINING OF ENGINEERS IN THE UNITED STATES.

By Professor W. E. DALBY, M.A., B.Sc., Associate.

[Read at the Spring Meeting of the Forty-fourth Session of the Institution of Naval Architects, 2nd April 1903; the Right Hon. the Earl of GLASGOW, G.C.M.G., LL.D., President, in the Chair.]

The object of my paper is to place before you a few facts with regard to the training of engineers in the United States—facts obtained during a visit last year to investigate and report on the subject to Mr. Yarrow.

I may state at the outset that the general opinion in the United States is that an engineering training must include a College course, and the apprenticeship rules are in general framed in full recognition of this principle, and the College-trained men pass without difficulty from the College to the works.

The subject naturally divides itself into two parts:—

(I.) The nature of the technical education given in the best Colleges.

(II.) The relation between the employers and the technically trained men graduating from the Colleges and Universities.

PART I.

TECHNICAL EDUCATION.

To fully understand the technical courses, it should be realised that the primary and secondary education in the United States provide a much better groundwork for technical training than is the case with us. Students at the leading Technical Colleges start their technical course with an advantage in this respect over our own students. The educational codes and regulations for primary and secondary education are as many as there are different States. There is, however, a general similarity in principle, and a good idea can be formed of their peculiarities by the consideration of the Educational Code in one of the older States. Some of the regulations from the education laws of the State of Massachusetts are given in Appendix I.

In addition to these State schools, there are, of course, many private schools and Colleges.

At the present time there is a widespread distribution of technical schools and Colleges, ranging in character from the evening schools where mechanical drawing is taught, to the great technical Universities like Cornell and the Massachusetts Institute of Technology. Technical education in America originated largely from the Land Act of 1862, the title of which runs:—"An Act donating public lands to the several States and Territories "which may provide Colleges for the benefit of agriculture and the mechanic "arts."

The amount of land given to each State was fixed at 30,000 acres for each senator or representative in Congress. New York State, for instance, became entitled to 990,000 acres. There were certain conditions attached to the grant, the most important being that the land thus granted to any State must be located in that State alone, and not in any other State. A State in which there were no public lands left would have been in a quandary had the Act not provided that in such cases an equivalent in land scrip should be issued

by the Secretary of the Interior to the States so circumstanced. In this way each State became possessed of a large amount of public land, or an equivalent in land scrip. Both the land and the scrip had to be sold by the terms of the Act, and the proceeds invested at 5 per cent. per annum, the income so derived being devoted to the maintenance of at least one College, "where "the leading object shall be, without excluding other scientific and classical "studies, and including military tactics, to teach such branches of learning "as are related to agriculture and the mechanic arts."

The income derived from this Act must be applied to the payment of teachers' salaries and to the purchase of scientific apparatus only. Every other item of expenditure, the erection and maintenance of buildings, general office staff, &c., must be otherwise provided for, thus leaving a wide field for municipal grants and private munificence.

Further assistance was given to technical education by the Federal Government through the Morrill Act of 1890, entitled "An Act to apply a "portion of the proceeds of the public lands to the more complete endow-"ment and support of Colleges for the benefit of agriculture and the "mechanic arts established under the previous Acts of Congress approved "2nd July 1862." By this Act the United States Treasury was directed to pay 3,000*l.* to each State and Territory in 1890, and to increase the amount annually by 200*l.*, until a maximum of 5,000*l.* was reached in 1900, after which the grant was to remain constant at 5,000*l.* per annum. The total grant from the Treasury under this Act in 1901 was 240,000*l.* distributed between forty-eight States and Territories.

This grant is to be applied "only to instruction in agriculture, the "mechanic arts, the English language, and the various branches of "mathematical, physical, natural, and economic sciences."

It is noteworthy that the Act specially directs that none of the money is to be granted to any College where a distinction of race or colour is made.

These two Acts indicate the attitude of Congress towards technical education, and specify the help that has been, and is being, given by the Federal Government. The provision of funds for the erection and maintenance of buildings, and for the establishment and endowment of all branches of technical education outside "agriculture and the mechanic arts" falls upon the States themselves, and upon private individuals.

The States themselves have independently passed measures affecting technical education in their own Legislatures. Municipalities have also the power under their State Law to appropriate money for technical education. A Technical College may receive external aid, therefore, from three distinct sources:—(1) The United States Legislature under the two Acts quoted; (2) State and municipal appropriations; (3) Private gifts.

STATISTICS CONCERNING HIGHER EDUCATION OF THE UNIVERSITY TYPE AND INCLUDING HIGHER TECHNICAL EDUCATION.—YEAR 1900.

There are 480 Universities and Colleges in America with power to grant degrees to persons of both sexes; 141 Colleges for women, and 43 technical schools. The majority of these have come into existence during the last thirty years.

For the year 1900 the number of students receiving instruction in these Colleges in Engineering subjects is given below, the column on the right giving the numbers of the total in the Agricultural and Mechanical Colleges, that is, in those Colleges receiving grants under the Land and Morrill Acts:—

	In all the Colleges.	In the Agricultural and Mechanical Colleges alone.
Mechanical Engineering	4,459	3,938
Civil Engineering	3,140	1,964
Electrical Engineering	2,555	1,617
Mining Engineering	1,261	822
Architecture	459	292

The gross income of all these institutions for the year 1900 was 5,711,693*l.*, made up as follows :—

	£
U.S. Federal Government	596,836
State and Municipal Grants	892,881
Tuition Fees	2,234,225
From Endowments	1,409,096
Other sources	578,655
Total	5,711,693

The gifts from private individuals during the year amounted to 2,399,093*l.*

The total property possessed by these institutions amounted to the value of 72,118,919*l.* Of this, 33,238,706*l.* represents endowment funds, the rest representing the value of the grounds, buildings, &c., used for education and research.

Table I. indicates the financial position of a few of the leading Colleges in the United States.

The numbers of students are also given, and these numbers include both undergraduate and post-graduate students.

TABLE I.

Income derived from	Harvard.	Yale.	Columbia.	Cornell.	Mass. Inst.
	£	£	£	£	£
Federal Government	—	—	—	7,700	1,665
States and municipalities	—	—	—	—	5,000
Invested funds	108,314	51,194	100,217	77,188	20,702
Tuition fees	133,733	97,404	83,942	46,899	41,423
Other sources	33,287	5,321	10,428	935	723
Total	275,334	153,919	194,587	132,722	69,515
Gifts for 1901	167,020	128,245	194,783	27,870	92,595
Number of men students	4,090	2,343	2,450	1,930	1,125
Number of women students	—	43	—	369	53
		2,386		2,299	1,178
Percentage of total income represented by tuition fees.	48 per cent.	63 per cent.	43 per cent.	35 per cent.	59 per cent.
	£	£	£	£	£
Tuition fees for undergraduate course.	30	30	40	25	40
Tuition fee calculated from numbers of students given above, and the amount received from such fees.	33	41	35	20	35
Cost of education per student calculated from number of students given above, and total income.	67	64	79	58	59

The figures in the Table refer, of course, to all branches of higher education. What proportion of income is derived from technical students I am unable to say. In the case of the Massachusetts Institute of Technology (right-hand column) all the students are "technical." It is interesting to note that at this famous Institute the cost per student is 59*l.*, of which each student pays on an average only 35*l.*, although the actual charge for undergraduate instruction is 40*l.*

The progress of professional education during the last ten years in the older Universities and the two modern schools of engineering which have won such a standing for themselves in America, namely, Sibley College of Cornell University and the Massachusetts Institute of Technology, is indicated in the following Table.

TABLE II.

SHOWING NUMBERS OF STUDENTS IN ENGINEERING IN THE COLLEGES STATED.

—	HARVARD. Civil, Mechanical, and Electrical Students in the Lawrence Scientific School.	YALE. Civil, Mechanical, Electrical, Mining, and Sanitary Eng. Students in the Sheffield Scientific School.	CORNELL. Civil, Mechanical, and Electrical Students.	MASS. INST. Civil, Mechanical, Electrical, and Mining Students.
1890–91	—	118	—	297
1891–92	31	127	640	310
1892–93	—	168	684	313
1893–94	—	186	687	338
1894–95	—	202	623	355
1895–96	—	209	617	357
1896–97	—	174	623	352
1897–98	—	153	645	356
1898–99	—	166	686	347
1899–00	—	162	774	356
1900–01	200	163	844	372

The above figures give a good idea of the work that has been going on in the States with regard to the training of engineers. So far as I can ascertain, these institutions stand highest in the regard of the profession, though there are many more of almost equal standing from a purely technical point of view.

COURSES OF STUDY AT HARVARD, YALE, CORNELL, MASSACHUSETTS INSTITUTE OF TECHNOLOGY (BOSTON), AND MCGILL (MONTREAL).

The undergraduate courses of study are very exactly laid down, and a student selecting his particular branch of work is put through a definite course. The principle underlying the arrangement of these courses is that the first two or three years shall be spent in the study of scientific principles, and the fourth year devoted to some specialised subject. Often, therefore, men may be going to qualify in very diverse special subjects, and yet work through precisely the same general course for three parts of their time. Considering the courses of the chief Universities in order, Harvard stands more or less alone in allowing much more freedom of choice than the more modern schools. A course is recommended for engineers, but a student can vary this course within wide limits, subject to the approval of the Professor.

At Yale the work in the Sheffield Scientific School is more exactly laid down. For the first two years of their three years' course the work is practically the same for all scientific and technical students, but in the third year a student can continue his work in any one of the subjects shown in the middle column of Table III. All these courses lead to the degree of

Bachelor of Philosophy (Ph.B.). Two years more of post-graduate study leads to the degree of Civil Engineer (C.E.), or Mechanical Engineer (M.E.), or in the less technical studies Master of Science (M.Sc.), or Doctor of Philosophy (Ph.D.). The complete course in engineering is, therefore, five years, the student having considerable latitude in his post-graduate work.

TABLE III.

COURSES OF STUDY AT YALE.

First and Second Years.	Third Year.	Fourth and Fifth Years.
Common Studies.	Engineering in preparation for Mining. Sanitary Engineering. Civil Engineering. Mechanical Engineering. Electrical Engineering. Chemistry. Chemistry in preparation for Metallurgy. Natural History. Mineralogy in preparation for Geology Biology in preparation for Medical Studies. Agriculture. Studies in preparation for Forestry.	Post Graduate Work.

At Cornell the undergraduate course of study is four years. Students of Mechanical Engineering and the allied branches do their work at Sibley College, a fine building on the Campus. There is a separate building for Civil Engineering and Architecture. The Sibley College Courses are identical during the first three years, except in the case of Naval Architecture, where specialisation begins to a certain extent in the third year. In the fourth year a student may specialise in any one of the following courses :— Railway Mechanical Engineering, Mechanical Engineering, Electrical Engineering, Marine Engineering, Naval Architecture. All these courses lead to the degree of Mechanical Engineer (M.E.). At Cornell a six years' course has been arranged, so that a student may take the academical course jointly with the engineering course, the conjoint course leading to the two degrees (A.B., M.E.), that is, Bachelor of Arts and Mechanical Engineer.

There is a four years' course leading to the degree of Civil Engineer (C.E.), and a six years' course leading to the two degrees A.B. and C.E.

At the Massachusetts Institute of Technology all first year students take practically the same course. There are certain divergencies in the second and third years, though all have to take French, German, political economy, and business law. In the fourth year there are fourteen specialised professional courses, each course containing within itself options of even narrower specialisation.

A general plan of the courses is shown in Table IV. on the succeeding page, the column on the right containing the "options" allowed in the fourth year. Options are also allowed in the second and third years in some courses. In order not to narrow the men too much, the courses are so arranged that one-twelfth of the time for the first three years is occupied in literary studies. This proportion of the time does not include French and German. All the courses lead to the one degree of Bachelor of Science (Sc.B.). All the first year students work on one definite course, and are not required to make their choice of subject until their second year at College. The total number of men at the College during this session was 1,415.

There is a tendency in the College to increase the time devoted to literary studies, and to decrease the time given to the workshops.

TABLE IV.

COURSES OF STUDY AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

First Year.	Second Year.	Third Year.	Fourth Year.	Options.
Common Studies.			Civil Engineering	Civil Engineering. Highways and Railroads. Geodesy and Topography.
			Mechanical Engineering.	Marine Engineering. Locomotive Engineering. Mill Engineering. Heating and Ventilation.
			Mining Engineering.	Quantitative Analysis. Engineering Lab.
Chemistry -	Physics -	Physical Lab.	Architecture -	Architectural Design. Construction for strength.
Mathematics	Mathematics	French -	Chemistry -	Engine Design. Technical Analysis.
Drawing -	Drawing -	German	Electrical Engineering.	Railroad Signals. Electric Waves.
French or German.	German or French.	Political Economy.	Biology -	Municipal Sanitation. Structural and Chemical Geology.
English -	Literature and History.	Business Law.	Physics -	Organic Chemistry. Analytical Mechanics. Electro-Chemistry.
Military Science.			General Studies	This course is about to be changed to a General Science course.
			Chemical Engineering.	Hydraulic Motors. Applied Chemistry.
			Sanitary Engineering.	
			Geology -	Mining Engineering. Geology (experimental).
			Naval Architecture.	
			Naval Architecture for Students from Annapolis.	Just organised.

At the McGill University there are six subjects of undergraduate study in the Applied Science Department, each leading to the degree of B.Sc. after four years' study. The first year course is practically the same for all students in this department. Small differences appear in the second year; the third and fourth become highly specialised. The six courses are: Architecture, Civil Engineering, Electrical Engineering, Mechanical Engineering, Mining Engineering, Practical Chemistry.

In all the Colleges I visited, degrees are not given on the result of an examination at the end of the course, but on the gradually accumulated results of terminal and sessional examinations, and a thesis at the end of the course on a subject usually suggested by the Professor. There are no external examiners in the sense that we have them, and there is only one class of degree, and not, as with us, an Ordinary and an Honours degree.

ENTRANCE EXAMINATIONS.

The standard for entry is about that of a high school education, and is gradually being raised. The subjects demanded by the Colleges under consideration are shown in Appendix II.

DIVISION OF THE WHOLE COURSE BETWEEN THE DIFFERENT SUBJECTS OF UNDERGRADUATE STUDY IN THE MECHANICAL ENGINEERING DIVISION.

In order to give some idea of the relative importance attached to the subjects forming the Mechanical Engineering course at the different colleges under consideration, I have estimated in Table V., on the following page,

as near as possible the total hours of instruction given during the whole course, grouping the subjects as far as possible in the way we do in this country. The computation is based on a college year of 30 working weeks. This Table is only to be regarded as approximately correct, but the figures given are sufficiently accurate to bring out the peculiarities of the several courses.

TABLE V.

SHOWING THE TOTAL NUMBER OF HOURS OF INSTRUCTION GIVEN IN THE MECHANICAL ENGINEERING COURSE AT THE FIVE COLLEGES STATED.

—	Harvard.	Yale.	Cornell.	Mass. Inst.	McGill.
Mathematics	225	330	150	232	540
Physics	270	120	225	150	435
Chemistry	135	135	210	195	150
Freehand	—	90	—	45	180
German	90	270	90	90	—
French	—	—	—	180	—
English	150	60	—	135	60
Applied mechanics	285	120	285	210	210
Mechanism	45	60	—*	105	270
Steam engine	135	165	165	172	180
Machine design (including drawing and descriptive geometry).	540	330	600†	675	930
Engineering laboratory	390	—	255	150	720
Electrical engineering	80	—	60	60	60
Workshops	360‡	30§	900	405	720
Business law	—	—	—	15	—
Political economy	—	—	—	45	—
Total	2,705	1,710	2,940	2,864	4,455
Duration of course	4 years	3 years	4 years	4 years	4 years
Average instruction hours per year.	676	570	735	716	1,114
Average hours per week	23	19	24	24	37

* Mechanism included in applied mechanics.
† Includes freehand drawing.
‡ Taken during the summer months at the neighbouring Rindge Manual Training School.
§ Chiefly "workshop visiting."

In comparing the total number of hours of instruction forming the courses, it is noteworthy that whilst Harvard, Cornell, and the Massachusetts Institute each give about 2,800 hours of lectures, recitations, laboratories, and workshops during the four years, McGill gives 4,455. A large amount of private study is always necessary if a student is to keep up with his lectures, and all this has to be done in addition to the hours given in the table.

At the Massachusetts Institute the courses are so arranged that a student can do his work in 48 hours per week. Half this time is given to lectures, &c., at the College, the other half is assumed to be spent in private study. The same method appears to be in operation at Cornell and Harvard and Yale.

I think this basis of arranging the work at a college is a very good one. A student overloaded with lectures, &c., has little time left to keep abreast of his work if much more than 24 hours a week are taken up in purely college work. A good man will take more, of course, but the average man gets behind and gets discouraged.

A very striking feature in the Cornell course is the large amount of time devoted to the workshops.

Considering the above Table, an average course for a mechanical engineer may be taken to consist of 3,000 hours' instruction, distributed in the following way :—

	Per cent.
Mathematics	10
Chemistry and physics	15
English	4
French or German	3
Applied mechanics, mechanism, steam engine	17
Electrical engineering	2
Mechanical drawing	20
Engineering laboratories	10
Workshops	16
Freehand drawing	3
	100

It will be seen from the foregoing analysis of courses that what is understood by a technical education in the States is really four years of continuous hard work at a College equipped with engineering laboratories and workshops, and with all the educational apparatus necessary for giving a scientific education.

INSTRUCTION IN NAVAL ARCHITECTURE.

There have been courses in Naval Architecture and Marine Engineering at Cornell University since 1891. These are organised in connection with the Mechanical Engineering course at Sibley College. In fact, they are the same as the mechanical engineering with specialisation in the third and fourth years. A student may choose a course in Marine Engineering, taking the lectures on Naval Architecture, Shipbuilding and Marine Engineering, or he may choose the course arranged for those about to become Naval Architects, taking the lectures in Naval Architecture, Shipbuilding, and Ship Design. Men who have graduated at other colleges are allowed to come and take a post-graduate course at Cornell in these subjects. In connection with this department there is an experimental tank about 400 ft. long, complete with travelling gantry and all the necessary apparatus for making towing experiments, though at present it is arranged for making experiments on propellers.

The course which has been provided at the Massachusetts Institute of Technology since 1891 provides instruction for those who expect to enter the profession of shipbuilders and designers. There are thirty-nine students in the course at the present time. The Boston Navy Yard mould loft has been placed at the disposal of the College for teaching purposes, and instruction is given there to all third year students in Naval Architecture.

The Massachusetts Institute have very recently organised a post-graduate course in Naval Architecture in addition to the above, for the training of men from the Government College at Annapolis.

Courses of Naval Architecture have just been established at Columbia University, Lehigh University, and at Michigan University.

PART II.

RELATION BETWEEN EMPLOYERS AND TECHNICALLY TRAINED MEN GRADUATING FROM THE COLLEGES AND UNIVERSITIES.

It is generally recognised by employers in America that a man with technical training makes a better apprentice, and develops into a better officer than a man with only an ordinary education.

The present trend of opinion amongst employers concerning College graduates is well illustrated by the apprenticeship rules in operation at the Motive Power Department of the Pennsylvania Railroad Company, and at the large private concern in Philadephia, Baldwin's Locomotive Works.

Considering the Pennsylvania rules first, they distinguish two classes of apprentices :—

(1) Regular apprentices. These are young men who have received a common school education, and are about seventeen years of age. They go through the regular course in the shops, and eventually become journeymen.

(2) Special apprentices. These are, as a rule, College graduates entering between twenty-one and twenty-three years of age, who after working through the regular course frequently become officers.

The rates of pay per week are as follows :—

	1st Year.	2nd Year.	3rd Year.	4th Year.
Regular apprentices -	12*s.*	17*s.*	22*s.*	34*s.*
Special apprentices -	34*s.*	38*s.*	43*s.*	48*s.*

The General Manager of the Railroad informed me that :—" College graduates, except with regard to their wages and the departmental work required of them, are received on the same terms as other employees. The Company recognise by the increased rates of pay the fact that they have already spent some time in acquiring knowledge, which, while of little use to the Company during their apprenticeship, makes them of more value than the regular apprentices."

The rules in operation at Baldwin's works are more elaborate, though in principle they are the same. A College graduate is taken on at the end of his College course pays no premium, and receives enough to maintain himself. They have three classes of apprentices, the division being made on differences of educational attainment alone. There is no way into their works except through one or other of these three classes.

The First Class includes boys seventeen years of age who have had a good common school education, and who who will bind themselves by indentures to serve for four years, and to attend, during the first three years of their apprenticeship, evening schools at which elementary algebra and geometry and mechanical drawing are taught.

The Second Class includes boys eighteen years of age who have received a high school training, in which they have taken the mathematical course, and who will bind themselves to serve for three years, and to attend evening schools for the study of mechanical drawing.

The Third Class includes graduates of Colleges or technical schools, over twenty-one years of age, who have taken courses covering the higher mathematics and the sciences, and who desire to secure shop training. They are bound for two years.

The weekly rates of pay of the different classes are as follows :—

	1st Year.	2nd Year.	3rd Year.	4th Year.
First Class - -	12*s.*	17*s.*	22*s.*	27*s.*
Second Class - -	17*s.*	22*s.*	27*s.*	—
Third Class - -	31*s.*	38*s.*	—	—

At the end of his apprenticeship each youth in the first class receives a bonus of 25*l.*, and in the second class 20*l.*

The apprentices in Classes 1 and 2 are usually put through the machine shops, fitting shops, and erecting shops. The college graduates in Class 3 are allowed to work in any department they may select. Thus a man can choose three months respectively in the pattern shop, the foundry, the forge, the erecting shop, the machine shop, and the fitting shop, filling in the remainder of his time in any shop he prefers.

At the present time there are 215 apprentices in the first class, 68 in the second, and 35 in the third class. There are a good many more apprentices in the works than these, but they were taken on before the present rules came into force two years ago. A superintendent has been appointed to look after the apprentices and administer the rules relating to them, one of which is that no youth is to be kept more than 90 days on any one job or machine. This affects those in Classes 1 and 2 more particularly, because men in Class 3 can go to the superintendent at any time and get what shifts they want.

VACATION APPRENTICES.

The students at the Technical Colleges have no difficulty in finding employment during their vacations. Baldwin's receive them freely, in fact they encourage them to come by allowing any vacation time to their credit if they subsequently come to them in Class 3, that is, after they have taken their degree at their respective Colleges.

They also take them at Altoona, in the Pennsylvania Railroad Company's shops, but they rather object to the practice because in some respects it is inconvenient to them in the operation of their shops. On the other hand, the Baltimore and Ohio Railroad wrote to the Massachusetts Institute of Technology this summer asking them to send some engineering students to work in their shops during the vacation with a view to receiving appointments after graduation.

The Central Railroad of New Jersey has now four students from Cornell and two from Purdue University working their summer vacations in their shops, and they pay them 15 cents per hour (equivalent to 36s. per week). They take college graduates as regular apprentices, starting them at any age between 21 and 26, paying them about 42s. per week to start.

A special point with regard to apprentices in the States is that no premiums are charged and substantial pay is given at once. As a consequence the " gentleman apprentice " or " pupil," as we understand the term, appears to be unknown in America; the only qualification required is a sound technical education.

Another point in which the American practice is remarkably different from ours is that age is no limit to a man who wants to get practical work in the shops, providing he is a college graduate. I am not sure if they would take on an apprentice after 21 years of age if he were not a graduate. College graduates in America never find that, whilst learning the scientific principles of their profession, they have grown too old to enter the workshops to learn the practical part. The general opinion seems to be that the educated man picks up his practice much quicker and more intelligently than the younger man with only an ordinary education. Generally speaking, the attitude of the American employer towards the college graduate is one of distinct encouragement, and of advantage to both. The employer gets the advantage of a trained intellect, the employee gets the advantage of his employer's shops and business experience. The American employer keeps an " open door " for the technically trained man, whilst with us in England the door is too often closed by rules regarding age and the like, and by the would-be apprentice not having sufficient means to pay a premium in addition to the amount he has already paid for his education. In cases where college graduates are taken on in England they are, as a rule, expected to go through the same course in the shops as a boy entering straight from school. The Americans are more yielding in this respect, and do not insist upon the drudgery of the first few years.

Whether the American system would succeed with us is an open question. The conditions in this country are somewhat different. I venture to think, however, that if employers would carefully consider the question in relation to the future of engineering in this country, there would result a greater co-operation between them and our technical colleges. The rules of apprenticeship would be altered so that the technically trained man would find an opening, and in this way employers would provide the opportunity without which the best man has no chance of showing his genius. In conclusion, I should like to take this opportunity of thanking my many friends in America for their patient assistance, always most kindly and courteously given.

APPENDIX I.

PRIMARY AND SECONDARY EDUCATION IN THE STATE OF MASSACHUSETTS.

The primary authority for the management of educational affairs in the State is vested in a Board consisting of the Governor and Lieutenant-Governor of the State and eight persons appointed by the Governor.

Every town in the State appoints a school committee at its annual meeting, which committee has general charge of the public schools in the town. Each member of the committee is paid. The committee has to appoint teachers and generally administer the Educational Code in their town. Thus every year the committee is elected on educational questions alone, and the people have, through their committee, complete control of their schools.

Some of the provisions of the Code are as follows:—

All children between the ages of eight and fourteen must attend school, otherwise their parents are fined.

No child under thirteen may be employed in any workshop or factory or mercantile establishment.

Instruction must be given on the effects of alcohol and narcotics.

Every town must provide schools giving a good English education, including, amongst other things, algebra, music, agriculture, physiology, hygiene. The Bible shall be read without comment.

Every town containing 500 householders must provide a high school in which general history, book-keeping, surveying, geometry, natural philosophy, chemistry, botany, and Latin shall be taught in addition to the ordinary subjects, and if the town contains 4,000 inhabitants the teachers must be competent to give instruction in Greek, French, astronomy, geology, rhetoric, logic, intellectual and moral science, and political economy.

Every town of 20,000 inhabitants shall maintain as part of the high school system the teaching of manual training.

Every town of 10,000 inhabitants shall maintain evening schools for the instruction of persons over twelve years of age.

Every town of 50,000 inhabitants shall maintain an evening high school.

Every town of 10,000 inhabitants must make provision for giving free instruction in mechanical drawing to persons over fifteen years of age in either day or evening schools.

The several towns are bound to maintain proper school buildings. The funds for the maintenance and working of these schools are derived partly from interest from the Massachusetts School Fund, and partly by taxation levied and collected by the several town committees. The capital amount of the School Fund is about 800,000*l*. The interest from this is distributed by the State authority in different proportions to the various towns, the grant being contingent upon the proper fulfilment of the State Code by the town.

APPENDIX II.

ENTRANCE EXAMINATIONS.

A cross, thus "×," in a column signifies that the corresponding subject is required.

	Harvard.	Yale.	Cornell.	Mass. Inst.	McGill.
1. English Grammar	×	×	×	×	×
2. American History		× or 5			
3. European History			× or 2 or 5 or 4		
4. English History	×	×		×	×
5. Ancient History					
6. Latin		×			× or 7 or 8 or 9
7. Greek					
8. French	×	× or 9	× or 9		
9. German	×				
10. Algebra	×	×	×	×	×
11. Plane Geometry	×	×	×	×	Euclid to Book VI.
12. Solid Geometry	×	×	×	×	
13. Trigonometry		×	×		×
14. Chemistry	× or 15	× or 15 or 19	×		
15. Physics			×		
16. Physiography	Any two of 16, 17, 18, 19, 20.			Any one of 6, 8, 9, 14, 15, or 1 and 4 additional papers or Mechanical Drawing or Mechanic Arts.	Any one of 16, 19, 14, 15, or a Language.
17. Anatomy					
18. Zoology					
19. Botany					
20. Astronomy					
Age at Entry	?	16	16	17	?
Duration of Examination	6 days	6 days	5 days	5 days	5 days

The subjects specified for Harvard and Yale respectively are those required for admission to the Lawrence and Sheffield Scientific Schools, the respective scientific departments of the Universities.

The examinations usually take place in June and September, so that a man failing in June may have another chance in September. Cornell, however, has only one examination (in September) for the Sibley College students.

Under certain conditions, school certificates are accepted in lieu of some of the subjects of examination.

DISCUSSION.

Mr. A. F. YARROW (Vice-President): My Lord and Gentlemen, I think we must all admit that we are under a very great obligation to Professor Dalby, in the first place, for bringing this very important subject before us, and, secondly, for taking such an enormous amount of trouble in collecting all these particulars and putting them before us in a form we can so easily grasp. I venture to think that we may, with advantage, consider whether the information he has, at so much trouble, put before us can be turned to profitable account for ourselves. One marked difference between the system of apprenticeship in the United States and that adopted by many firms here is that, in order to get into workshops in America, young men have only to show that they come up to a certain standard of knowledge, while in England, on the other hand, poor men's sons, although clever, are in many cases shut

out from getting a thorough practical training either from want of influence or on account of the premium demanded. This narrows the field of selection from which to draw for our future leaders. The premium system in this country is very much the same now as it was fifty years ago. It seems to be a plan drawn up apparently with the object of keeping out of the profession men who have brains but have no money. A young man, to be brought up as an engineer, is supposed to serve five years in the workshops, and an insufficient provision is made for scientific instruction. Although public opinion seems to demand what is called "technical education," whatever that may mean, there seems to be no definite view as to how science and practice are to be combined to the best advantage. I think this is due principally to the want of appreciation of the value of this combination by firms, most of whom seem to take but little interest in this subject. Sometimes in discussing this matter with the heads of firms of the highest standing, one is met by the statement that they do not see the object of scientific instruction at all, and that they have got on very well without it. The self-evident answer is that when they were brought up there was practically little scientific knowledge, and that if they were to start in life at the present time with no better training than they had in former years, and in competition with firms in this country and abroad controlled by men combining scientific knowledge with practical experience, they would find themselves at a serious disadvantage. Although one must admit that by actual experience with practical work, an engineer will gain the most valuable part of his professional education; nevertheless, in the present day, both scientific and practical knowledge must form the mental equipment of every engineer who aims at a high position in his profession. Again, it is often pointed out that the great men of the world have sprung from the working classes, and that they had no means of getting any proper training; therefore, it is argued, education is not necessary for success. The fact is, that the comparative poverty of such men involved a struggle for existence and to overcome difficulties, which developed their character, and this, combined with their genius, enabled them to fight their way to the top. Nevertheless, they themselves fully realised that their want of education was a serious handicap. Again, it is urged that many young men who have passed through a University or Technical College do not make competent engineers. Of course, their success at college only indicates that they made good students. It does not in the least degree prove that they have any aptitude for the engineering profession, that they are clever with their hands, that they have the power to control men, or that they have any inventive faculty. It does not follow that a scientific man will make an engineer; but, nowadays, to occupy an important post, an engineer must be a scientific man. It often happens that the training at our public schools is not such as to develop the thinking powers of young men, which should be the first object in view; and, in dealing with this subject recently in the *Nineteenth Century*, it has been well said that "the natural thinking power and common sense of students are "often crowded out of existence by the absorption of a huge store of book-"learning involved in cramming to prepare for an examination." The education to be obtained in this country in our large public schools deserves careful attention, so that the best foundation may be laid for the Technical Colleges to build upon, and above all, the training should be such as to develop the thinking powers of the students. The cramming process of working up for an examination is, to the mind, what the taking of a lot of indigestible food is to the body. Not only does one not get the benefit that is desired from its assimilation, but it occupies a space which might otherwise be filled with good wholesome nourishment. Assuming that a suitable public school education is available, together with a course in a Technical College or University, combined with practical work in a workshop, I submit that that training will produce the best men for occupying high positions in the engineering profession. Leaders of industry cannot devote too much attention to this subject, as the future prosperity of their business depends upon their training up a suitable number of first-class men from whom to select the members of their staff; and I would venture to say that it is the neglect of this in the past that has caused so many firms of eminence to sink

into obscurity. Now the question arises, how can this combination of scientific and practical knowledge be best arrived at? Some young men, after leaving public schools, go direct into the workshops, where they remain, say, five years, during which time it is often found—I found it so in my case—that they forget much that was taught them at school and, above all, they seem to lose the power of study. It is sometimes said that scientific training can be continued by evening classes; but it must be admitted that if a young man starts work at six in the morning and leaves off at five, he is not fit for much serious mental exertion in the evening. Again, if with a view to study in the evening, a lad starts work after breakfast at nine, that also is bad. It tends to disturb workshop discipline, and it certainly does not gain for him the respect of the men. Often he will find himself shut out from the most instructive and profitable work, because no foreman likes to see a machine or job standing idle. There is another alternative, that is, to go to the University or Technical College immediately after leaving school, for, say, a three years' course. In that case, a lad afterwards enters the workshop, and then often finds, when it is too late, that he is not adapted to the profession of engineering. As I have said before, success in college life only indicates that a young man is a student, and not that he is fit to become an engineer. There is a third alternative, and that is the one that has been adopted in Scotland to a limited extent, and it is substantially in accord with the method that for many years has been carried out by the Admiralty, of working in the shops in the summer and in the college during the winter. This plan, in the opinion of many leading authorities, offers the best combination. The two classes of study go on more or less simultaneously, which is very desirable, having in view the fact that the one is so dependent on the other, workshop practice enabling a student to better appreciate the value of the college course. To express it in the words of a friend: "It involves a proper "simultaneous education in the properties of materials, the use and capacity "of tools, and the development of the intellect in abstract matters applicable "to the profession." Again, those whose home is in London, and who, perhaps, would gain their practical knowledge in factories on the Clyde or the Tyne, would have the great advantage of returning home during one half of each year and thus retaining the influence of home life by not being away for lengthened periods. Further, it enables a young man who is not suited for the profession, to be made aware of the fact as soon as possible. From the point of view of health, it would certainly be beneficial for anyone who is continuously studying during six months in the winter to have physical exercise during the remainder of the year, and, without giving offence to my athletic friends, I would venture to suggest that bodily exercise obtained in the workshops is as good as football or cricket, and possibly, at the same time more instructive. Again, this system gives the professors an opportunity of doing private work, which is necessary for them, if they are to keep in touch with modern progress and be always abreast of the times, and research work can be carried on during the summer months. By this system the professors are enabled to devote their undivided attention to their pupils during the winter, and it also gives a favourable opportunity to students to do post-graduate work. Should the system be considered the best to adopt, it only rests with the educational bodies and the heads of firms to work in harmony, in order to carry it out to a successful issue. When discussing this point the question is often raised whether firms will be found to take young men for, say, six years in alternating periods of six months; but I apprehend no serious difficulty on that score when the object in view is pointed out. Out of about twelve eminent firms whom I have consulted about such a scheme, at least eight have most readily fallen in with it, and among them I may mention Messrs. Humphrys and Tennant, of Deptford; Messrs. Wigham, Richardson, & Co., of Newcastle; Messrs. Rowan, of Glasgow; Messrs. Ferranti, of Hollinwood; and Mr. Hans Renold, of Manchester. It is also gratifying to find that some of the leading locomotive superintendents have already started schemes to secure for their lads a combination of scientific and practical training. If this alternating plan is considered superior to any other, my firm conviction is, knowing what the custom is in the United States, in Germany, and in Switzerland, that if it were generally adopted in this country in combination

with good public school training, we should have a system superior to that available in any other part of the world. In conclusion, in order to spread our net to the widest extent, we must give the sons of workmen, as far as practicable, the same educational advantages as are enjoyed by those who are better off, and there should be some well-thought-out scheme for the advancement of the cleverest lads. The importance of this is self-evident when we consider that the inventors and creators of industry have mostly come from the working classes: such men, for example, as Arkwright, a barber, the first cotton manufacturer; George Stephenson, a pitman; Faraday, a bookbinder, and others. Therefore, whatever plan is adopted, the fundamental principle we should have in view is to widen the field of selection, and give the same educational advantages to all, irrespective of wealth or influence.

Sir NATHANIEL BARNABY, K.C.B. (Vice-President): My Lord and Gentlemen, I rise to follow Mr. Yarrow, because I wish to end my few remarks with a proposal which will place before us some of Mr. Yarrow's views in a more complete form than he has given them to us this morning. Having been in correspondence with Mr. Yarrow, by his favour, for some months on this matter, I have been greatly impressed with the importance of the report which Professor Dalby has brought us from the United States, and of which he has given us the result this morning. I feel that the plan which is proposed by Mr. Yarrow, in order to give effect to this, is one which is bound to give us in our industries an advance such as we have not had for a good many years. No doubt it would seem at first as if this is a provision for putting into our industries highly educated persons at the expense of those who are apprentices, and who are looking forward to higher places. To a certain extent this is true, but one must remember that we have amongst us here men who have been thus let down, as it were, from above into our industries, and who have made a very great success of their work. I may mention, for instance, the cases of Sir William White and Mr. Watts, both of whom may be said to be men who have been, so to speak, let down from above, to the great advantage of the industrial world in general and the Admiralty in particular. The plan of training engineers in one way and training artificers in another, and letting down the engineer, as it were, from above, and lifting the artificer from below is a plan which seems to work well in the Navy. I was present with some gentlemen who are also here at a complimentary dinner recently given to Sir William White, and I was very much struck with the fact that he was surrounded by a number of men representing different departments of natural science and mechanical arts. Among the Chief Constructors of the Navy whom I have personally known there was one who, 60 years ago, was an exceedingly able sailor, and not only an able sailor, but who also had a great deal of mechanical skill, and for some years held the post of Chief Constructor of the Royal Navy, although with the title of Surveyor of the Navy. I remember very well then (60 years ago) that he was greatly opposed to the proposal which a civil engineer was pressing on the Admiralty to put a screw propeller into a ship of war; but facts eventually overcame the resistance of the Surveyor of the Navy—and the civil engineer was asked to go to the Dockyard and fit one of Her Majesty's ships with a screw. That engineer was Mr. Isambard Kingdom Brunel, and a very great success we know it was. But fancy Sir William Symonds, the gentleman of whom I am speaking, looking into that assembly the other night. He would have seen men round his successor, the Chief Constructor of the Navy of to-day, representing all kinds of science with which he has to be more or less familiar, and it is for this reason that it seems to me to be of extreme importance that we should get, as far as we can, something like what the Americans are getting in the direction of introducing as much of the general knowledge of natural science and mechanical arts as we can into our mechanical industries. In carrying out, or attempting to carry out, the proposal with which Professor Dalby concludes his paper, Mr. Yarrow has actually prepared, and prepared with very great care and consideration, a scheme which I am quite sure you will feel embodies in a very excellent manner the best of the plans which we have had before us this morning.

Therefore, my Lord, I propose, if this meets with your approval, that Mr. Yarrow should be asked to let the meeting have the proposals to which I refer, which are brief and extremely important. I cannot say how deeply I feel the value of the report and of Mr. Yarrow's action in the matter, and I should like to propose our hearty thanks to Professor Dalby and to Mr. Yarrow for it.

Mr. ARCHIBALD DENNY (Member of Council): My Lord and Gentlemen, I am extremely glad that Mr. Yarrow and Professor Dalby had the thought to go over to America and bring back this quintessence of all that is being done there. I share the late Cecil Rhodes' idea that in education there should be frequent communication between the two countries. I think that students of both nations would learn much from rubbing shoulders with one another, both in work and play. Now, with regard to this question, Professor Dalby has wisely divided his paper into two parts, and he has also wisely stopped at considering the training of those who are to be the captains of industry. The training for those men is naturally quite different from the training of a man who will be a hewer of wood and a drawer of water all his days. The present system here means that nearly always in engineering, and generally in shipbuilding, a lad goes through precisely the same mill as the ordinary apprentices. He is expected to keep even better time than they are, and the dirtier his face and hands the more he seems to be respected and thought highly of. Now, I cannot help thinking that, while this system is still largely the rule, and is still applied by many men for whose opinions I have the greatest respect, it is not quite the one for training our captains of industry, and I have the very warmest appreciation of Mr. Yarrow's proposed scheme. Coming back for a moment to Professor Dalby's paper on American training, I had lately to consider the American system in reference to a young man in whom I am deeply interested, and I got the programmes of the four Universities mentioned—Harvard, Yale, Cornell, and the Massachusetts Institute of Technology. Harvard and Yale, for naval architects, do not seem to me so desirable as Cornell or the Massachusetts Institute, and, after the most careful thought, I came to the conclusion that the Massachusetts Institute was the better of the two. It has, however, one defect in my eyes, namely, that it is not a residential college. I think that a residential college is one of the best training grounds for young men. As to the course at the Institute I thought that the specialisation began somewhat earlier than the fourth year. I notice that Professor Dalby has modified that statement in the latter part of his paper, but I rather thought that naval architecture was introduced into the course for naval architects in the second term of the second year.

Professor DALBY: Yes, it begins then.

Mr. ARCHIBALD DENNY: Now, in the Scotch system of College education, the University course is from five and a half to six months long, and it could only be under those circumstances, I think, that Mr. Yarrow's scheme would fit in, or the University course, if longer than that, would require to be shortened, and, personally, I think that five years' apprenticeship on the system that Mr. Yarrow mentions would be excellent. At present, in Scotland, the course is usually of four years' duration, but I think that five years would be better and less crowded. Mr. Yarrow did not include us among the eminent firms in his invitation to discuss this matter, but perhaps I can give some information as to what we have been doing, which may be of interest. I will deal with the yard. The drawing office is recruited as largely as possible from the sons of our own workmen or others, who enter the works as ordinary apprentices. There is an examination held from time to time under the guidance of Professor Lambert, of the Royal Naval College, who sets the papers and examines the work. If there are not a sufficient number of applicants from the yard then outsiders can also sit; but if a boy enters the drawing office from the yard he is allowed one year off, or four years' apprenticeship in the drawing office. If he comes fresh from school he has to go through five years, and he does not get any yard training. I induced my firm eleven or twelve years ago to take advantage of bursaries, which belong to the Burgh Academy at Dumbarton, and my two firms—

engineers and shipbuilders—agreed that any boy who took the bursary at the Glasgow University examination would be allowed to work six months during the winter in the College, and six months during the summer in the yard, the time he was working in the College counting as part of his five years' apprenticeship. This, I think, is precisely the system that Mr. Yarrow is advocating. We have passed through that course some five or six lads with great advantage. Not only are the bursaries direct from the academy, but there are also bursaries belonging to the School of Science and Art, and any young man who gains one of those bursaries can go either to the Glasgow University or to the West of Scotland Technical College, and in this case also we give him the privilege of working in the yard during the summer and taking his course in the winter. So that I think, perhaps, I might be able to assist Mr. Yarrow by giving him accurate results of the system which he is advocating. I think the old system of making a growing lad, who has not been accustomed to it, get up at six o'clock in the morning, brew himself a cup of tea over the gas, and eat a hard biscuit as he runs to the yard to escape being quartered, is certainly not the best system. With six months in the yard or the engine works and six months training in College, the boy would profit much more than by being two or three years in the yard after he had been three or four years at the College. I do not like the idea of taking the College first or afterwards; I think they ought to be combined right through the training.

Mr. HANS RENOLD (Visitor): My Lord and Gentlemen, the few remarks I have to make must begin with the excuse that I am here, not as a member of your Institution, but as a mechanical engineer upon the invitation of my friend Mr. Yarrow. This paper upon the training of engineers by Professor Dalby touches upon a very important problem; in fact, no weightier subject can be brought before an English engineering society at the present time. Some years ago, having visited, in company with the Principal of the Manchester School of Technology, most of the American institutions to which Professor Dalby has alluded, I can fully endorse almost all he says about the splendid opportunities young American engineers have for making themselves fit to deal with those mighty engineering problems we so often meet with in America. I am so convinced of the superiority of the American engineer's training that to-day my eldest son, twenty years of age, is studying at the Cornell Technological Institute. Whilst, in England, great efforts have been made during the last few years to bring our Technical Schools into a more efficient state, many years yet will be required to make them what the American and a great many Continental Schools are. At the present day our English Technical Schools lack two things before they can prosper as these foreign schools do. First, they lack students already provided with a general education before they can think of starting them on the study of special subjects, such as engineering, architecture, &c,; and, secondly, until very recently, few masters and managers of our large engineering works could see that it is to their advantage to have in their concerns, as leading men, past students of Technical Colleges. Machine building upon the old rule of thumb method did not require technically trained young men, but works which mean to keep abreast of go-ahead American and Continental concerns can no longer do without them. Now I have long felt that our want of efficient young engineers in England was not caused by the scarcity or inefficiency of most of our so-called Technical Schools, but by the unsympathetic reception given by most of our works owners and managers to young men who have given the necessary time and spent their money in Technical Colleges to prepare themselves for an engineer's career. Professor Ewing and Professor Stuart, late of the Engineering School in Cambridge, can confirm how hard it sometimes was to find places for their students when leaving College. Up to very recently there was almost no demand for such men, and if a few could find places, such miserable remuneration was offered, that it practically "did not pay" to go to a Technical College. I am glad to see signs, and know of efforts being made by several heads of large engineering works to put an end to this state of things, and Professor Dalby's paper and Mr. Yarrow's newly framed pupil regulations are most welcome steps in the right direction. By approving

and adopting a more liberal treatment of young beginners in our engineering works, such as Mr. Yarrow has sketched, this society of masters will take the first and by far the most important step towards introducing an effective system for the better training of engineers. Where there is a demand the supply will soon spring up. I feel sure that a nation which, only fifty years ago, had a Nasmyth, a Whitworth, and a Fairbairn, men who, although unschooled, produced such engineering masterpieces as they did, will again come to the front as soon as its youths can get the benefit of a nationally organised and well co-ordinated technical education. I am glad that Professor Dalby, in his paper, was careful to point out that it is not the training of the workman, but that of the foremen and leaders in our engineering industries that he is particularly concerned with. Anybody who is at all familiar with the management of our large engineering works will know how great is the want of able foremen, head draughtsmen, and works managers; and when one comes to realise what these men in a wide-awake concern are called upon to do, one cannot but wonder that we have so many able and resourceful men, under the present unsystematic and unorganised training of our young beginners. We sometimes accuse the workmne's Trade Unions of having rules which restrict the number of apprentices; but what are the masters doing to create a larger supply of able young foremen, draughtsmen, and works managers? Have they not for years demanded in ever so many large works a high premium, which made it possible for only rich men's sons to enter the higher walks of the engineering profession. I could never understand this foolish limitation put upon our supply of leading men, and I am very thankful to Professor Dalby that he has not omitted to mention in his paper that such system is totally unknown in America, and we have to thank Mr. Yarrow for having decided to adopt in his works more liberal conditions for young engineers, and for giving a substantial advantage to those with a Technical College education. Mr. Yarrow will not repent thus enabling College students to find work readily, and at a salary upon which they can at least keep themselves. In my experience this again is only what one finds to be the general rule in the States, and it pains me to think that with us it is rather the exception. The idea of making a little profit here and there by paying apprentices poorly, levying premiums on pupils, and paying low salaries to gifted young men is, unfortunately, far too often the case, especially in older engineering concerns. We all like to get money—so-called philanthropy has no place in business—nor should short-sightedness be allowed to have a place. But the economic results are far greater when the head of a firm aims at making money by turning out work with the help of an able, well-paid, and, therefore, contented staff, and not by paring the salaries of his leading men and those of his workmen. This question of paying our leading staff better than is the general rule has as much to do with obtaining more efficiently trained young engineers in the future as the establishment of more numerous Technical Colleges. If the masters demand better men and are ready to pay them, heads of Technical Colleges will not be slow to supply the market, and the members of an Institution like this are the very men to create such a demand, now that Professor Dalby and Mr. Yarrow have clearly shown the way.

Dr. WILLIAM GARNETT (Visitor): My Lord and Gentlemen, I thank you most sincerly for the opportunity you have given me of listening to this very valuable paper by Professor Dalby, and to the equally valuable discussion to which it has given rise, and I hope that both the paper and the discussion will bear useful fruit in the future development of engineering education in London as well as in other parts of the country. During my own educational career I have noticed two classes of students among genuine, earnest hard workers. I have noticed those who, having gone through the course of an ordinary public school are capable of studying engineering or some other technical subject to advantage without actually commencing to practice—of profiting by a three years' course in a Technical Institution or in a University, and afterwards of going into the shops and making real use of the instruction which they have previously received. The system by which advantages in engineering works are offered, especially in America, to the students who have passed through such a University course meets the needs of this class

of earnest hard workers. But I have noticed another class of students equally hard working, equally earnest, equally serious in their desire to profit, who, somehow or other, can never study a technical subject apart from the actual practice of the work. I have noticed in Cambridge among the students under Professor Stuart, who was just now referred to, men who utterly failed in University examinations so long as they were expected to learn from text-books and lectures; but when they got into what might, perhaps, be considered by many of you to be only a toy workshop, and came into actual contact with mechanical appliances, they brightened up immensely, and, after failing utterly in the University examination for a degree in applied mechanics, six months later obtained a first-class in the same examination. Now, how are we to deal with these students, who waste their time—not through their own fault, but through their constitution—unless they can combine this system of workshop practice and University instruction carried on almost simultaneously? I agree with almost every word spoken by Mr. Yarrow just now. Many attempts have been made to solve this problem, but I think by far the most hopeful attempt is that which Mr. Denny has referred to, which was adopted on a small scale by Sir Joseph Whitworth many years ago, and which has been carried on for many years past in Bristol in connection with the University College, and in some of the great engineering works in that district, namely, the system of combining six months' work in the summer in the workshops with six months' technical and professional training in academic institutions in the winter. When I first went to Newcastle I found myself in an institution which had been established very largely through the influence of the North of England Institute of Mining and Mechanical Engineers. Those engineers had come to the conclusion that they had responsibilities towards their pupils for training them, not only in the everyday practice of mining work, but in the scientific principles upon which their profession rested; but they were of opinion that they could discharge those responsibilities better by united action and by contributing towards the establishment of a Technical College, than by endeavouring to give the theoretical instruction in their own offices, and thus the College of Science in Newcastle-upon-Tyne was established, not exclusively by them, but largely by their help and influence, with the intention of allowing students to work for a certain time, say three days a week, in the mines in the immediate neighbourhood of Newcastle, and attending the remaining three days a week in the College. That, I believe, would have grown into a great educational system, but for certain difficulties, which I need not now refer to, arising especially from the Mines Regulation Act, which requires that students should work for the whole of five years "in or about a mine," and it was held by many that the work done in the College was not being carried on "in or about a mine." Happily, in naval architecture and in mechanical and electrical engineering, we are free from the restrictions to which I have referred. Now I have been asked to say a word or two about the work which is going on in connection with engineering education in London. We have, as you know, that splendidly equipped Central Technical College of the City and Guilds of London Institute at South Kensington. Then there are the mechanical and the electrical engineering departments at University College. There are similar departments of mechanical and electrical engineering at King's College, and stepping perhaps a little below the line of the schools and the University, we have institutions closely associated with the University of London. There is the Finsbury Technical College, over the engineering department of which Professor Dalby so ably presides. There are the engineering departments in the great London Polytechnics, the Northampton Institute, the Regent Street Polytechnic, the South-Western Polytechnic, the Northern Polytechnic, the Battersea Polytechnic, the Woolwich Polytechnic, and a number of other similar institutions, and in addition to those, the Technical Education Board of the London County Council is now expending something like 30,000*l.* in erecting an institute in Poplar, which is to be specially devoted to naval architecture and to marine and other branches of mechanical engineering. Another engineering school is being erected by the same body at Paddington. Now I hope that with all these schools of training we may come very closely into contact with the manufacturing, mechanical, and electrical engineers and with the shipbuilders of London, and I hope that these institutions, heartily supported as I trust they will be by the engineers, will do something towards developing the shipbuilding and marine engineering of this, the greatest port in the world, and the port which ought to be the greatest shipbuilding centre in the world. If I were asked how we can best co-operate, I think I would say by such a system as Mr. Yarrow and others have foreshadowed, by which boys who have had a good secondary education shall be encouraged and helped to spend six months in each year in engineering works or in the shipbuilding yard, and the remaining six months in the institutions to which I have referred. I think that the engineers and shipbuilders of London will find in the London County Council and in its Technical Education Board men who are only too anxious to co-operate with them in every possible way for the development of these great London industries.

The PRESIDENT (the Right Hon. the Earl of Glasgow, G.C.M.G., LL.D.): I think, gentlemen, I ought to ask Mr. Yarrow to answer the question put to him by Sir Nathaniel Barnaby.

Mr. YARROW: My Lord and Gentlemen, Sir Nathaniel Barnaby has asked me to place before you the regulations which we have framed in concert with a number of our friends, after considering, among other things, the information that Professor Dalby has given, and I want it to be clearly understood that these regulations are based upon sound business principles, that is, we believe they will ultimately pay.

Poplar, March 26, 1903.

REGULATIONS FOR THE ADMISSION OF PUPILS TO THE WORKS OF MESSRS. YARROW & CO., LTD.

Scheme A. Candidates who have obtained first-class Certificates after a complete course of instruction, extending over at least three years, at an approved Technical Engineering College or who have a first-class Honours degree or its equivalent in an approved Engineering course at a University, may be admitted. They will receive pay at the rate of 20*s.* weekly on entry, with an annual increase of 5*s.* per week. Candidates who have received a similar training, but have obtained lower class certificates, may submit their names to the firm for admittance if they can be strongly recommended by the Professors; but, in any case, those who have obtained the highest honours will have the preference. The time to be served will be three years, the third year being spent in the Drawing Office if the workshop record has been satisfactory.

Scheme B. Candidates who have not obtained University or Technical College Certificates must be between the ages of 16 and 19. They must be examined before entry by a competent examiner chosen by the Firm, in the following subjects:—

Arithmetic and Mensuration.
Algebra to Quadratic Equations.
Geometry, up to the standard of the first four and the sixth book of Euclid.
Theory and use of Logarithms.
Trigonometry to the solution of Triangles.
Elementary Theoretical Mechanics, Heat, and Electricity.
Freehand and Mechanical Drawing.

The Matriculation examination of an approved University or the "School Leaving Certificate" of the University of London will be accepted in so far as the subjects above have been covered. Any candidate who has a more advanced knowledge of mathematics or science above the standard indicated by the foregoing list will be at liberty to submit a statement of the additional subjects in which he might desire to be examined. The rate of pay will be 10*s.* a week on entry, with an annual increase of 5*s.* a week. Recognising that a scientific education is an essential factor in a young engineer's

training, every facility will be given to pupils entering under Scheme B for attending evening classes, and it is required that at least two evenings a week shall be devoted to study. The time to be served will be four years, the fourth year, if the workshop record has been satisfactory, being spent in the drawing office.

Scheme C. It being the firm's strong conviction that the best course of training for engineer pupils consists in spending the winter months at a University or Technical College and the summer months on practical work in the shops, they are in consequence desirous of giving every facility for carrying this system into effect in the case of pupils entering under the conditions of Scheme B, if a complete and satisfactory continuous course, occupying six to seven months during the winter in each year, can be arranged at an approved Technical Engineering College. Under this scheme work in the shops may be combined with a University or Technical College course. The rate of pay while in the shops will commence at 10s. per week, rising gradually to 30s. per week. This scheme may be extended to pupils who are doing post graduate work, having entered the workshop under Scheme A.

General. No premium is required under any of the above schemes. Candidates under Schemes A, B, and C, must give proof that their school and college career has been satisfactory as regards diligence, punctuality, and general conduct, and they should give an account of any prizes or other distinctions they may have obtained. Pupils will be required to serve three months on probation. All pupils will be required to start work at 6 a.m., and to conform to the regulations of the establishment; they may be dismissed at any time if their conduct is not deemed satisfactory. It is desirable that pupils should reside within a two-mile radius of the works. All pupils must enter into an undertaking jointly with their parents or guardians to remain the full term specified, in the event of the firm desiring to retain them, and their admission depends upon there being vacancies. The firm reserve to themselves the right to ask any pupil to retire from the works should he not be considered by them suitable for the profession of an engineer, or should he be irregular in his attendance, or have indifferent health. It being very desirable that pupils should visit manufactories, works in progress, &c., every facility will be given to take an afternoon off, not, however, more frequently than once a month, with this object in view. The firm reserve to themselves the power to modify these schemes in exceptional cases, at their discretion, but no personal influence will in any case be allowed to affect their decision.

Summary. Assuming a lad's school training terminates prior to his arriving at the age of 18, under Scheme A he can get his college qualification at 21 and finish his workshop experience at 24; under Scheme B he can complete his workshop time at 22; under Scheme C he can finish his technical and workshop experience at 23.

Scheme A is adapted to young men who go through a University course after leaving school. It is based upon the American system. We believe that young men who have distinguished themselves at college have thus shown that they have perseverance, industry and intelligence; but whether they will turn out engineers or not remains to be seen; but as a rule, they are worth more than those who have not passed successfully through a college course. Under Scheme A, candidates have three years in the college first and then three years at our works. Scheme B is for a less well-educated class. Under Scheme B, one object throughout is that the last part of the time shall be spent in the drawing office, so that the firm, if they desire it, can retain the services of those who are most efficient. And there is also Scheme C. As to when a lad will finish his time, that depends upon what age he leaves school with sufficient knowledge; but, assuming he starts between 17 and 18, under Scheme A he ought to finish up with the two courses at 24 years of age; under Scheme B he ought to manage it at 22; under Scheme C he should manage it at 23; and at the end of Scheme C he ought to know as much as at the end of Scheme A. But it will be seen he saves a year by Scheme C, because at the University he only works about eight months in the year; so that four out of twelve months are lost: thus by Scheme C he saves three periods of four months. I think it very desirable that some competent member of the staff should, among his other duties, keep a watchful eye on pupils and apprentices; he should keep in touch with them, look after them, and give them what advice they want. This would enable him to pick out the brighter lads quite apart from any kind of examination. As to the time of starting work, or the wages paid, and so on, we have decided upon what we think suitable; but that is quite distinct from the alternating system of work and study which I find receives very general approval. I should like to take this opportunity of thanking many of my friends who have kindly assisted me in the preparation of these schemes—Sir Nathaniel Barnaby, Sir William White, and many others. With regard to the mechanics' sons who enter the factory to be brought up to a special trade, care must be taken not to let them be shut out from any advantage if they are specially bright. The scheme for the admission of those lads is this:—Those who at any time can pass the examination required by Scheme B would come under the regulations for pupils, so that the smartest lads who enter the works merely to be brought up as mechanics can be thus selected and transferred to the other class, and reap the advantages of a more extended system of training.

Sir WILLIAM WHITE, K.C.B., LL.D., Sc.D,, F.R.S. (Vice-President): My Lord Glasgow and Gentlemen, it is well known that I have taken a great personal interest in this matter of the technical training of engineers for a very long time. In season and out of season I have maintained the view, which Mr. Yarrow endorses, that concurrent, or as nearly as possible concurrent, practical and technical scientific training is the best solution of this question. Mr. Yarrow has incidentally referred to what the Admiralty has done: Admiralty experience extends over nearly forty years' continuous working, and is eminently satisfactory in its results. It cannot be supposed, therefore, that in proposing a general adoption of that system, as Mr. Yarrow does, any great experiment is to be made or any great risk run. The Admiralty founded the Royal School of Naval Architecture and Marine Engineering on the recommendation of this Institution in 1864. In 1873 it was transferred to the Naval College at Greenwich, becoming a section of that establishment; so that, as I have said, for nearly forty years there has been continuous working and absolute proof of the success of the system. I do not say it is perfect, but its distinctive features are worth consideration. Before being admitted to the higher course of training, students have to satisfy certain conditions as to preliminary mathematical and technical training. The course of study extends over three years, and students are alternately employed at the college and in the dockyards. There are, no doubt, some difficulties in the way of the absolute and general application of that system; but if employers will do their part, I feel confident that there will be little, if any, difficulty on the part of the Technical Colleges and the Universities. It seems to me that the attitude of employers towards this matter is the determining factor at the present time. Employers are not wanting in intelligent appreciation of what makes for their interest, and I have every hope that many of them will give the suggested system a trial. The movement which has been going on for many years in favour of technical education has involved much expenditure, has been exceedingly well meant, and is a recognition of the importance of proper training. In such a new departure it was natural that there should be unwise things done at first and some waste. But now, taking matters as they stand, there is no doubt that we are recognising more clearly the necessity of distinguishing between two systems of training, both of which are wanted. Personally, I sympathise most thoroughly with what Mr. Yarrow has said, and I trust that nothing will ever be done in this country to shut out from the chance of the highest advancement those who happen to be born in the working classes. On the other hand, no one can doubt that there ought to be provision for the proper education of those

who are in better circumstances; and I think the scheme of pupilage, of which Mr. Yarrow has given us particulars, provides for both those conditions. In the national interests it is necessary to get the best brain, wherever it may happen to exist, and to give it full chance of benefiting itself and serving the country. We owe to Professor Dalby a great debt for so clearly setting out the distinguishing features of the American system—the better preparation for technical training, the more moderate cost to the students, the longer period of training, and last, but by no means least, the attitude of the employers towards the men when they are trained. I feel strongly that there is a great need in this country for imitation of what prevails so largely in the United States; that is, the benevolent support, by those who have the means, of institutions for training engineers. I notice on page 3 of this paper that whereas the gross income of the institutions in America is shown to be about $5\frac{3}{4}$ millions, only $1\frac{1}{2}$ millions come from the State or municipal funds. It would be very interesting if we could have the corresponding figures for the revenues of British institutions. Perhaps Professor Dalby can give them. It is quite clear, however, that the cost to the student—and that is the point I wish to make—will be kept down when private generosity as well as State aid supply so much financial help. It is not only in the United States that this is true. It is true also in Germany and other countries. We do not want to discuss Continental systems to-day, but it is a very important fact that engineering students can obtain their technical training abroad at much less cost than in this country. This question of expense has probably had to do with the fact that some British students have gone to Germany to study naval architecture, and it also accounts in part for the larger number of students in foreign institutions. For instance, in Berlin a few months ago I was informed that there were about 350 to 400 students of naval architecture and marine engineering in the Technical High School at Charlottenburg. What is the total number of students of naval architecture and marine engineering in corresponding institutions in this country at the present day? Students do not merely attend in greater numbers, but they remain longer, because the cost is so much less. If the institutions which afford training for engineers in this country can reduce their fees, there will obviously be a greater chance of drawing in all the classes that we wish to help. I think, sir, that if this discussion has the effect of enlisting on the one side the active support of employers, so as to give facilities for carrying out this idea of alternate study and practical experience, and if, on the other hand, it should lead to the discovery of pious founders who are prepared to do for English institutions something like what has been done in America, we shall all have great reason for gratitude to Mr. Yarrow for suggesting to Professor Dalby that he should ascertain the facts and place them before us, and to Professor Dalby for the manner in which he has carried out that task.

Professor A. BARR (Associate): My Lord and Gentlemen, I have personally to thank Professor Dalby and Mr. Yarrow for bringing this important matter before the Institution of Naval Architects. As Professor Dalby has said in the last paragraph of his paper, it is a question of national importance. I believe it is also one having a direct bearing on the future success of individual firms, but that is, of course, a narrower aspect of the subject. There is only one point in Professor Dalby's excellent paper upon which I should like to say a word in other terms than complete approval, and that is as to the use of the word "technical." I share the view held, I believe, by most engineers, that, properly speaking, the function of the College or University is to give a scientific training, and that the "technical" training in the proper sense of the word can only be acquired in the workshop. It is, perhaps, merely a question of words; but sometimes words help to clear or confuse our ideas. In the Scottish Universities, keeping this point in view, we have set ourselves against giving degrees in "engineering." We do not give such degrees as "Mechanical Engineer" or "Civil Engineer," referred to in the paper, only degrees of Bachelor and Doctor of Science. A great deal that professors have said upon the training of engineers has been disconnected, and perhaps properly so. As Mr. Renold remarked, this

is largely a master's question, and I am indeed glad to hear it discussed as such in this room. The old idea in this country was that a boy had to begin at fourteen or fifteen and go through the mill, with no time for a thorough study of the scientific basis of his work. Undoubtedly, most of the engineers of to-day have done so; but I think, if you look into the history of our profession, you will find that it is much less so in regard to the men who have made the profession what it now is than most people suppose. To take one example only; if you study the history of iron and steel manufacture from 150 years ago up to to-day, you will find a very remarkable fact, viz., that not one single *great* improvement has been made by a man who has been trained in the usual way to that trade or profession from an early age. Take Huntsman, Cort, Mushet, Bessemer, Siemens, Thomas, and Gilchrist, and many others one could mention; there is not one of those men who was trained in the usual way to iron or steel manufacture. On the other hand, you will find that every one of them had studied the science on which his practice must be founded. The case is similar also with regard to many of the great engineers of past times. Mr. Renold has instanced George Stephenson as a man who had no scientific training. He was a student of science all the same, and, recognising his own difficulties, he sent his son Robert to Edinburgh University to study there. And that brings up another aspect of the case. One important reason why Robert Stephenson was sent to Edinburgh appears to have been because the cost of education was too great in most other places. Professor Dalby has properly pointed out that the cost of education in America is not at all met by the fees. Neither is it, I believe, in any institution in this country. America has looked at this question in a different way from that in which it has been looked upon here, and the American Ambassador, a few years ago, speaking in London, made the remarkable statement that "the greatest industry of America is education." There is more truth in that, I think, than one is usually apt to suppose. Now, in the University with which I am connected, the fees are much less than any that have been mentioned here to-day. A student takes his University course at Glasgow, paying something like 12*l.* or 14*l.* or up to 16*l.* a session, and about 55*l.* will cover the class and matriculation fees for the whole course; and for Scottish students who require such aid and can pass the preliminary examination, the whole of the fees are paid from the funds of the Carnegie Trust. Sir William White has referred to the forty years' experience at the Admiralty of the "sandwich" system of training engineers. I think I may say that in Glasgow we can appeal to sixty-three years of similar experience. For the whole time that the chair of engineering has been in existence the session has only been one of six months, and in this room to-day I have seen quite a number of men who have had scientific training there under that system. It is, therefore, not one that has not been well tried, and I think we at least will not think of going back upon it. And I may also say that I do not know a case in recent years of a student who desired to get into works on the six months' basis failing to find an opportunity of doing so. Something like 80 or 90 per cent. of our students take their course on the "sandwich" system. I am very glad indeed that Mr. Yarrow has taken this subject up. His position gives his words and his actions the greatest weight, and I know also that the appreciation in which he is held will be a strong incentive for others to follow where he is so kindly and so ably leading.

Mr. JAMES ROWAN (Member): My Lord and Gentlemen, I should just like to refer to a proposal which we are drawing up in connection with our works to forward and develop a scheme such as Mr. Yarrow has proposed. Our proposal is that every apprentice should be given the opportunity of attending the University or Technical College for three or four sessions whilst he is serving his apprenticeship. He will require to work in the workshop for at least a year. There will be an examination, which will be equivalent in value to some standard examination, and selected by a Professor to meet our requirements. If the boy passes this he will be allowed to attend the University for three sessions, which will be included in the time of his apprenticeship of five years. If he takes four years to pass his final examination he will require to serve an apprenticeship of six years. The

boys who pass the examination will be given a substantial increase of wages. If necessary their wages will be paid them while attending the University, and every encouragement will be given to these boys. Entrance to our drawing office will be as at present, viz., a boy must have been for at least two and a half years in the workshop, and have kept to within two and a half per cent. of perfect time-keeping. Entrance is then gained by competitive standard examination, and a substantial increase of wages is given to those lads who pass this examination. The parents of one of the last 50 apprentices we have given employment to are in a position to give the lad a University education. The parents of about three or four would, with some assistance, be able to give their sons a University education. The other 45 are boys who have left school at about fourteen years of age, commenced their apprenticeship when about sixteen years of age, and, during these two years have all, without exception, been working. Not one of them had attended evening classes during this period. The bright and clever lads will come to the top under any circumstances, but there are quite a number of those we have in our employment who can be greatly assisted, and who, with a little encouragement, will be vastly better for a University education. I wish to emphasise the fact very strongly that we are decidedly of opinion that the best we can do to assist young men is to enable them to attend the University in winter and to work in summer. We have come to this decision after a good deal of discussion with those on our staff who are well able to speak from their own experience.

Professor C. J. LAMBERT (Associate): My Lord and Gentlemen, I should not have ventured to come forward here except that I have been asked to do so, as I fancy it may appear that the professorial element has been already sufficiently in evidence. It is natural that we teachers should be looked upon with a certain amount of suspicion when we come to talk about matters connected with the education of engineers. I had the pleasure and advantage of consulting with Professor Dalby on the subject of his paper, and I must confess that I was very much struck with the contrast of the American practice with what has been for so long the custom here in England. It seems to me that when an American employer desires an addition to his staff, he simply writes to Cornell or one of the other Technical Colleges and asks for a college man. They appear to keep the article in stock, and they send on a theoretically trained and likely man at once. I understand he is supplied immediately with a living wage, and although, of course, it is not all those thus sent who turn out great successes in practice, yet the employers find it pays them to go to this expense with the hope—the certainty in fact—of ultimately getting good men by this means. I am glad to see that the masters are waking up, and, indeed, our own Government also. As you know, the Admiralty has gone so far as to appoint the very best professor of theoretical engineering they can find, a man, I may say, pre-eminent as a teacher and authority on all branches of scientific engineering. They have dignified him with a title exceeding that held by his predecessors at the Royal Naval College, he is to be called the Director-General of Naval Education. I think it shows that our leaders are beginning to feel that the question of scientific engineering education is vital to the country as a nation. The contrast provided by the American system seems to me very great in view of the obstinate adherence to the belief in the omnipotence of pure handicraft, and of the contempt for scientific teaching which has hitherto been so prevalent among the masters in England. My chief object in addressing you is to raise a point which has not been alluded to to-day (possibly because there is plenty to talk about), and that is, the question of the proper supply of instructors. My own impression is that it is harder to make a good teacher than to make a good engineer. A really successful teacher is a *rara avis*, and I think that, when once he is discovered, he should be encouraged and retained. The existing practice in all the Technical Colleges, and, I am afraid, also in many places of general education is, it seems to me, to appoint almost any one to teach, without first knowing whether he has that very rare and important gift. Now, speaking from long experience, I am sure that our boys do not get that accurate and sound teaching in elementary

mechanical laws at the Technical Colleges which they ought to receive from the junior staff, and I think it is for this reason: the instructors are appointed at a low salary and have no prospects to encourage them to make teaching their profession. A young, and probably clever, student, thus appointed, may be, and often is, utterly incapable of imparting his knowledge, and he does not find it worth his while to devote himself to the labour of learning how to teach. Now, this is all wrong. You may say, of course, that we cannot afford to do anything else. Then I say, gentlemen, if you make a scheme for technical scientific education, a very necessary part of it is that you should provide the proper tools with which to carry it out. I have heard a successful and eminent engineer say that he does not care in the least what a tool costs him, provided it is ten per cent. better than the one he will have to replace and throw upon the scrap heap. If that is the case, why do we practise this very serious false economy in the matter of the supply of good teachers. I am not speaking for myself or for others who, like myself, have no reason to complain of their position; but I am speaking more of the junior assistants at the Colleges who, after all, do the bulk of the teaching. I think you ought to pay them much better, and ought to give them encouragement to stay on to learn their profession of teaching, and not, after they have had some practice with their pupils and have learned to a certain extent how to teach them, allow them to go away in search of a better salary. That, I take it, is a very crying evil, and the cause of many educational failures. A thirty years' connection with the teaching profession convinces me of the urgency of reform in this direction, and I think the matter is worthy of serious consideration. With regard to the proposed system of "sandwiching," as it is called, the scientific and the practical education, I may say that I am heartily in favour of Mr. Yarrow's third scheme. I have some experience of the others, and the question as to whether you should first send a boy to the Technical College and afterwards for three years to the shops, or whether you should invert the order and put the shop training first, is very much debated. My own opinion is that neither method is right. I think, if you send a boy to a Technical College and let him study for three years, he will by that time, perhaps, have contracted a certain distaste for the practical roughness of the workshop and for the associations he would there have to make. And if, on the other hand, you send him to the workshop first, he may, in his three or four years there, lose all his student habits and the desire for study. I believe it is very common for both of those experiences to occur. I do not believe for one moment in the other plan of sending a boy to the workshops and encouraging or forcing him to try to acquire all the necessary scientific education in evening classes. I speak from an experience gained both as a teacher and a father, and know how difficult it is to get a boy, who has to get up at a quarter past five in the morning and work till five o'clock in the evening, to settle down to scientific thought after that time. It is as much as you can do to keep him awake. It seems to me that Mr. Yarrow's third scheme solves the difficulty entirely. I quite believe that the six o'clock attendance at the workshops is necessary, because I think it very important that a pupil in the works should go through exactly the same experiences for a considerable period as the workman whom he hopes to command in after years. I think that can be very well done in the six summer months, and that the six winter months should be devoted to scientific technical study. May I revert to the question of the provision of an efficient instructing staff, and express the hope that most of you may think as I do of the extreme importance of first carefully choosing your teachers and then giving them the opportunity to learn their work, and to adopt it as a profession (with sufficient leisure, of course, to enable them to keep in touch with modern progress), instead of encouraging them by actual need of a better income to go elsewhere.

Mr. C. E. STROMEYER (Member of Council): My Lord and Gentlemen, I need hardly add any words to those which have already been said, not only as to the value of the paper, but also as to Mr. Yarrow's proposals. The interesting discussion we have listened to shows the importance of the paper, and I think it would be very advantageous if this discussion could be printed and attached to the separate copies, for I believe that in this

particular case the discussion has been quite as valuable as the paper itself. I wish to make a few remarks about some points of the paper before dealing with the question of education generally. Our American cousins have several advantages over us in regard to technical education. First, their workmen are quite reconciled to the idea of automatic and labour-saving machinery, and, although it is perhaps not quite fair to say that the American engineer is more a machine tender than an engineer, I think to a very large extent that is the case. In England, engineers have to learn manipulation, but in America this is not so necessary. In some respects their conditions are similar to those in chemical works. If anything goes wrong with a process, a furnace, or a retort, or anything else, it is the manager or the sub-manager who is applied to for instructions, he being the one who knows all about it; but in an engineering works here one would hardly go to the manager for information about, say, a forging. The smith who manipulates iron all the year round is expected to know, and generally does know, more about forging than the manager, and there are hundreds of other operations in English engineering shops about which the men, through their intimate knowledge of the materials and of the work that has to be done, know far more than the manager himself, and the managers are, therefore, in England, at a disadvantage. But in America, where there is so much work done by automatic machinery, the managers themselves really have the control of the business. In that respect I think it is very much easier in America to draft men with scientific college training direct into the shops than is possible here in England. I do not believe that British students drafted into the works would acquire that command of the men which they do in America. There, a thorough knowledge of the latest devices is essential to a manager, so that he may be in a position to instruct his—often untrained—men; here the men won't be bothered with novelties. Now there is one point that has been referred to by Professor Lambert with regard to the teaching staff. I do think that every endeavour should be made to increase the salaries of the teaching staff, and thereby attract men who really know not only the scientific side of the question but also the practical side. It is quite impossible to get men who have had any real practical experience to go to Universities and Colleges and give the results of their practical experience in combination with theory to their students unless they are exceedingly well paid. If a man has a good combination of both theory and practice, he is worth ten times more in a shop than any salary that he can command at any College. I see by the paper that the fees paid by students in America are between 40*l.* and 50*l.* per annum, and in Scotland I understand they are now reduced to nothing. I studied in Germany, and, as far as I can remember, the fees which I paid for sixty hours of lectures and drawing, per week, were about 6*l.* for the whole year of three terms. As far as my memory serves me, the average fee was 2*s.* per hour per week for the three terms. My technical education in Germany, combined with town living, was much cheaper than the school education of my brother, who was six years younger than I, and who was at a public school there. On an average, my expenses for three years amounted to 120*l.* in Aix-la-Chapelle, and this, being a fashionable watering town, was naturally very much dearer to live in than most other towns in Germany. Scholarships are hardly known in Germany. There are a few, but nobody boasts of enjoying them. In my opinion, scholarships, especially the really valuable ones, tend to cause cramming, and this simply means learning by heart, which is fatal to the thinking powers. Boys who have the power of remembering words, win scholarships easily, whereas those who have the power of thinking, and who, more often than not, have only medium memories—the very boys we all wish to make engineers of—have no chance of doing so. These scholarships, in the case of engineering sciences, really encourage a class of boys who are unfit for that particular branch, or who become unfit through cramming. I fear that our English education tends very strongly to exaggerate our memories and, at the same time, to kill the thinking powers. The whole system of English preliminary education seems to be a thoroughly classical one. Consequently, only boys with good memories get on well at school. Those with common-sense thinking powers, if not crippled at school, get on in after life. The headmasters of our

schools are almost all classical scholars, and it is quite natural that these men, who are doing their best for the boys, will teach them what they think is best, and what they have always been taught to look upon as best for themselves, viz., Latin, Greek, and Euclid, which means learning by heart and how to live by rule, with less and less thinking requirements. To be successful at examinations the boys must know what is expected to be in the examination papers. The system requires that the memory should be trained, and, therefore, does not allow the boys to think for themselves. Such training, I think, kills all but the most exceptional faculties in a boy. The recent discussion about the engineers in the Navy has brought to the front a question which really hinged on their social position, and I for one thoroughly welcome the recent Admiralty scheme in which it seems that these matters may be altered for the better. If you compare the various professions, you will find, for instance, that lawyers and others who have to study the classics never come into intimate contact with workmen. This is true even of chemists and medical men, whereas engineers, if they are going to be successful, must go through the shops at an early age. I do not mean to say that a boy there is actually learning how to handle men, but he comes in contact with them, and in after life he knows how to deal with them better than does a youth who has been at College till he is twenty-two or twenty-three, and is then put into works. Now I come to this question, about the difficulty of engineers being both good engineers and gentlemen. Their contact with the workmen militates against them. Well-to-do boys (of, say, fourteen to sixteen years of age), going through the works, will have previously received what might be called a classical education. They know Latin and Greek and Euclid. These accomplishments make no impression on the men, but the knowledge that the men possess, their ability to forge and hammer and chip, to file, saw, plane, turn, &c., appeals to the instinct of young boys, and they very soon look up to their fellow workmen as being vastly superior to the schoolmasters who have been teaching them what now appear to be useless subjects. That admiration for the workmen's abilities will, in a comparatively short time, ripen into a feeling of admiration for the men themselves, to such an extent that their language and their manners will be copied, and by and by, if the contact continues, these well-to-do boys will be proud of being what they call "rough diamonds." I think it would be far better for boys going to shops at an early age that their education should have been such that when they go there, they should have knowledge which is superior to that of the men in their own particular line. Give them a little knowledge of physics and chemistry and mechanics—they need not know much, because the workman does not know much—they would then be able to estimate the workmen at their true worth, and would be able to see that these men do not know as much as would be thought by other boys fed on classics only, and the boys would not acquire that admiration for them which they do at present.

Professor R. L. WEIGHTON (Member): My Lord and Gentlemen, the subject which is before us at present is one which, to my mind, cannot be exceeded in importance for an institution such as this, raising as it does the whole question of the training of those who have to carry on engineering and its allied industries in the future. In discussing this matter, it has always seemed to me to be very important indeed to begin my making sure as to what classes we are to educate. With outsiders—in newspapers, and popularly—there is a great confusion of ideas between apprentices and those who are something more than mere apprentices. One might distinguish as between "apprentices" and "pupils," for instance; meaning by the former the young artisan or workman, the young rank and file of the engineering army, and meaning by the latter, the pupils, the young officers of the engineering army, the draughtsmen, the managers, the employers, and others who are to direct the labour and prepare the designs on which the others work. This point has already been emphasised to some extent, but I think we cannot emphasise it too much or too often, and I should therefore begin by observing that what I have to say refers entirely to the education of the latter class, the pupils. That class, I take it, is the only one referred to in the very interesting and instructive paper of Professor Dalby. I think it is

indisputable, and granted on all hands, that this country is vastly behind our great competitors, America and Germany, in the education of the pupil class, the officer class, in engineering—and in engineering I include naval architecture, of course. As regards the artisan—the British artisan—those who are generally considered to speak with authority tell us that he is second to none in the world, and my experience certainly bears it out. So long as he works, his work is very efficient. With regard to his education, important as it is, I think we need not trouble ourselves at this meeting. There is already sufficient provision in existence for his education. His five years' apprenticeship in the works, coupled with attendance at such evening classes as are to be found at any one of the very many efficient schools, polytechnics or colleges which have evening classes, will provide sufficient equipment for the efficient discharge of his duties; but when we come to the other and higher class, the pupils, then we come into a field in which, we must all admit, this country is lagging sadly behind. And this leads one to inquire why this should be. Why should the education in this country of the pupil engineer who is to direct others, who is to design and to scheme and to think, be behind that of other countries such as Germany and America? To my mind this question finds an answer in the second part of Professor Dalby's paper, and this is a point that I wish to emphasise, although I have been to some extent anticipated by Sir William White. He said something which, to my mind, has all along applied with very great force. I think an examination of this question will show that the reason we in this country have lagged so much behind in the higher technical education is due almost entirely to the general attitude of the employers towards the college-trained man in engineering. I do not say this as a reflection upon the employers. I think it is natural, in the history of engineering in this country, that such a state of things should have come about, but we have now reached a stage at which we ought to set about putting our house in order. If we do not do so, we shall certainly suffer in the immediate future, and ultimately we shall suffer very seriously indeed. There is, I think, no doubt about that. Professor Dalby has very well shown in his paper that in America—and I think the same thing may be said with regard to Germany—the employers look upon a thorough college training, obtained by an organised course of instruction in day classes, as essential to an engineering education, and, furthermore, that they are prepared to give privileges in the shape of access to the different departments of their workshops, and increased pay to young men who have had that training, thereby providing the best of all inducements for them to equip themselves in that way. Now what do we have in this country? Speaking with some experience both in the workshop and as a teacher of engineering and naval architecture, we find as a rule the very reverse. I am very pleased, however, to notice that this spirit is fast leaving the employers of this country. Since I came here this morning two or three cases have been prominently brought forward in which employers have changed their system, and are now prepared to look at college-trained men in quite a different light; but one swallow does not make a summer, and I fear that the great majority of our employers have still got the notion that a young man who has gone through an engineering curriculum at college is no better as a pupil than another who has come direct from school. That is absolutely the case with a great number of our employers, and they will therefore give no additional privileges or consideration to the man who has gone through a college training. Now it seems to me that this is the crux of the whole problem, and if we could only persuade engineering employers to offer inducements either similar to those offered in America, or other equivalent ones, we would have no lack of thoroughly qualified young men. It is not to be supposed that a young man should voluntarily undergo for three or four years' severe mental exertion such as is entailed by a University course in engineering science, or that he should deny himself many pleasures during his pupilage all for nothing, or when, at any rate in the immediate future, he can see no benefit. We cannot expect that, unless there is some direct and immediate inducement offered. That to my mind is at the bottom of the whole problem. The question then arises, how can we so arrange matters that this will not be so in the future? And that naturally leads us to the very instructive and

suggestive regulations which have just been presented by Mr. Yarrow. I do not think there is any one who has considered this question broadly, but will agree that those regulations, or something similar to them, are a very good solution of the question, and if we could only persuade engineers to adopt them, the problem would practically be solved. If employers say that it will not pay them to offer these inducements in the shape of increased remuneration to a college-bred student just because he has acquired a University education in engineering or naval architecture, that it will not pay them to allow him to absent himself to attend college, thereby to some extent disorganising the workshop, my answer to that argument would be, try it. If the Americans have found that it pays, I do not see why we should not, and Mr. Yarrow has told us that he at least has deliberately framed those regulations from the point of view of £ *s. d.* He considers they will pay. I should say it is one of the best investments that an employer could make. By and by (I should say within five or ten years) the return will come in the shape of a greater available number of well-qualified young men, capable of taking up the higher branches of engineering and naval architecture. My Lord, I should also like to mention, with regard to the regulations which Mr. Yarrow has presented, and which it seems to me, focus the whole of the matter presented to us by Professor Dalby, that they have been brought before several of the employers on the North-East coast of England, and I am authorised to mention that there are about half a dozen at least of the firms there who have already intimated that they are wishful of adopting regulations somewhat similar to these. Before sitting down I should just like to say, because I feel it very personally indeed, how much indebted I think the profession, and, indeed, the country generally, is to Mr. Yarrow for his disinterested initiative in this matter.

Mr. H. G. MORSE (Member): My Lord, not having heard the paper read or discussed, I am taken somewhat at a disadvantage, but I am much interested in the subject. For many years I have had under my direction a large number of engineers, and have naturally arrived at fixed conclusions as to the training best adapted to bring about results satisfactory both to the employer and to the engineer. The advantages of having an engineer with an education partly technical and partly practical are that his services become valuable sooner, he does not require excessive coaching by superior officers, and he rises to responsible positions at an earlier age, when information is more easily acquired. On the other hand, the time taken for practical training leaves less time available for theoretical education, and, consequently, the recipient is not prepared to reach eventually as high a position as others who have a more thorough theoretical training; for it must be admitted that only in exceptional cases does an engineer advance much in theoretical knowledge after leaving the Technical School. The advantage of spending the whole period of technical training in acquiring theoretical knowledge is that one is much better prepared to investigate and reduce to practical results whatever problems may present themselves, and no engineer can foresee in just what field he may have to work in the future. "A little knowledge is a dangerous thing," and the young man just out of the University is liable to think he knows much more than is credited to him by his employer. If his education has been purely theoretical, he soon has his conceit rudely destroyed, and only then is he in a position to acquire practical knowledge. Having had a thorough grounding in theory, he acquires practical knowledge rapidly; and, in the course of a few years, outstrips the engineer with a mixed education, and is prepared to go far beyond him. The conclusion I have arrived at is that the best results to the employer as well as to the engineer (and their interests are identical) comes from a purely theoretical training. The usual method pursued in the United States is to take on each year a number of young engineers and give them the opportunity of absorbing practical knowledge through supervision of and contact with those who are more experienced. The object sought for is not so much to get back the immediate value of their salaries as to push them along as rapidly as they can master their tasks, in order to get young men with energy and ambition into important positions. Such men may be

assumed to have courage, and this, coupled with confidence and a well-grounded education, brings success; and when success comes early in life, it lasts longer. The New York Shipbuilding Company built a large plant, organised the management, and was in full operation with four thousand men employed, all in three years. The problem, therefore, was different from the usual one, as we had not time to gradually train our engineers. We organised our corps with men selected as best we could to fill each grade, and made our promotion much more rapidly than usual, owing to lack of suitability of many of the men selected. It was deemed advisable to partially organise our yard with men of technical experience. We therefore selected about twenty of our best draughtsmen, and placed them in charge of various departments as assistants to superintendents and foremen of practical experience; the result has been very gratifying, although only in operation one year.

Professor D. S. CAPPER, M.A. (Visitor): My Lord, I should like at the outset to add an expression of my own personal sense of gratitude to Professor Dalby for the succinct way in which he has put before us the system of training engineers which obtains in the United States, and I should equally like to thank Mr. Yarrow for the most excellent remarks which he has made as to the lines on which he feels that we want to amend our system of training in his country. In saying this I should like to take exception to one word which Professor Weighton let fall. I do not believe for one moment that Mr. Yarrow's motive in this is disinterested. I believe Mr. Yarrow appreciates the true interests of the nation, and that he identifies his own interests, in their highest sense, with those of the nation in suggesting this movement. You have had a good many professors speaking to you to-day. I should like to speak to you as a practical man, for, after all, an engineering professor ought to be a practical man, and if he is not a practical man he cannot rightly fulfil the functions of a professor. My experience—both from the practical and from the teaching side—is this. There are three orders in which you can train engineers. They have been referred to before, but I may perhaps put them in my own words. First of all, you may take a boy fourteen or fifteen years of age, trained in the sort of haphazard way which, I am afraid, passes for education in too many of our public schools. Then you send him into the shops and you give him five years in the works, where you expect him to pick up his information as best he can—and he does pick up a good deal of information and comes out at the age of nineteen or twenty with a training which is unsurpassed in its own way; for it gives a lad his professional training, or rather his trade training, if I may say so, as a native language, in a way which no other system can. He assimilates knowledge of the works' methods instinctively. But he is limited in this way, that he has never had to really think of the basis upon which his trade training has been erected, and, consequently, he has had no real mental training in the scientific basis of the profession which he is going to follow. He makes an excellent workman; he makes, probably, a pretty fair foreman, and possibly may make a very good foreman in exceptional cases. But I should like to emphasise the point that it is the exceptional cases that have made our great manufacturing industries. In the exceptional cases, under such a system as I have described, you get men of exceptional ability, who rise to positions of eminence by their own intrinsic merit, which those who are less gifted, though trained in a more efficient way, may perhaps, never reach. It is those men who have founded our manufactures, and, consequently, there has grown up the idea that the training they received is all that is necessary for the purpose of producing men capable of carrying out our industrial processes to the best profit. Now, we are confronted with foreign nations—I do not like to use the word "foreign" in regard to the United States, because it hardly seems to apply somehow—but we have, at any rate, other nations which have been trained in a different way, and with whom we have to compete. Our manufactories are far more numerous than they were in the past, and we cannot trust to intrinsic genius, but must train up men who will be able to lead on the industrial progress which we hope to make in competition with other nations. The defect for this purpose of the method of training I have described is that when at works a boy forgets his school training. It is, moreover, very difficult to get a lad to go to college afterwards. If he has gone through the factory first, he falls under the notice of his employer, and he may get an appointment offered to him which is attractive at the time, and which he accepts. It is, therefore, only a small percentage of those who are trained in that way, and then only those who are least prominent, that return to the scientific college training, and then you spend the first year in reminding them of the knowledge they possessed before they went to the works. If you take the other order, and let a lad go to college straight from school, then the difficulty arises which has been referred to more than once, that he is, for the full college period of three years out of touch with the works, and he gets to think the training he is going through in the college is all the training required; and when he comes out first in the examinations, he thinks he is brilliant engineer, whereas we all know he has not begun to be an engineer, but has simply learned the scientific facts on which he can base his engineering knowledge and training. Then, when he goes to the works, he learns his mistake and is disheartened, and his employer and those above him treat him as a man who thinks he has knowledge that he has not really got. In order to correct that error, the only possible way, as far as I can see, is to combine the two and work them together. If you can only take the student and let him have six months—or say a portion of each year—in the college and a portion in the works, you get the two trainings blended together, and you do not run the risk of the man either losing touch with practice or losing his school knowledge, and you do not let him suffer from what has been called a "swelled head." I should also like to urge the same course from another point of view. I think one of the most important persons you have to train is the teacher. He wants training as much as, or more than, the pupils do. For training a teacher the system, or want of system, under which too many work here is very bad. A nine months' course is arranged in which the laboratories are filled with students every hour of the day. You expect your teacher to keep in touch with all the modern developments which are so rapidly taking place in his profession (for without such contact he cannot remain a practical man), and yet you do not give him one moment for original work nor for keeping himself in touch with those developments. He is kept hard at it all the time and is paid a salary—I am not speaking of the chief teachers but rather of the junior teachers and assistants—which is totally inadequate to keep him without his trying to do additional work of some kind or another to add to his pay, and he has neither time nor opportunity for doing work of the right kind which is essential to him to keep his teaching vigorous and active. The result is that too often a man who starts as a good practical teacher stays away from the practical and becomes a mere drudge. Under a system of six months in college and six months in the works, a teacher has an opportunity during the time his students are at the works of keeping himself in touch with his profession, and of working out original experiments which are so rightly considered as essential to the re-invigoration of a teacher. Anybody who has tried to make a research experiment in engineering knows that an hour here and an hour there in a laboratory full of students is an absolutely impossible arrangement for carrying through such continuous experimental research as is requisite for adding to our knowledge. At the same time, a six months' alternating system will give employers an opportunity during the six months when the pupils are in their works, of suggesting to them: "Why "should you not find out such and such a piece of information which is "needed in our works, and on which no data are available?" You also give the student the opportunity by a post-graduate course of helping the employer to solve problems which he has no other means of solving. One is apt to wax enthusiastic when one finds what one has always looked upon as ideals which could never be reached, and which one has had diffidence in urging, because they are so clearly beneficial to teachers, now being urged from the employers' side. I feel that it is tremendously to the teacher's interest that this system should be adopted, but I believe with Mr. Yarrow that it is equally to the employer's interest also. In the north, they have had this alternating system in the colleges and universities for many years,

as we have heard from Professor Barr and others. Here, in the south, one great difficulty has been the rigidity with which employers have exacted premiums. I constantly have students who cannot afford premiums, who are able and who ought to rise to the top. They come to us, perhaps, with scholarships. Very often I have found that two or three out of the best five men in a class are students who are not able to afford to come to college unless they have obtained scholarships. Those men never can get their practical training as engineers, because employers in London want premiums, and they have to go without the practical training which would enable them to rise without great difficulty to leading positions. We are ready at King's College, as elsewhere, to adopt this alternating system; but the requirements to make the change a real success are these: we want, in the first place, to get employers to encourage college training by receiving qualified students into their works without premiums. Secondly, we want to enlist the sympathy of some of the teachers; and, thirdly, we want, and perhaps you will forgive my alluding to it, the means to enable the London colleges to carry out the change without further financial strain. The people of this country have not realised that we cannot have real educational establishments unless they are properly supported. If one compares them with those in the United States, and thinks of the endowments, and gifts, and so on, made to those teaching establishments as compared with ours, one is apt to become envious and to almost desire to cross the water.

Professor W. E. DALBY, M.A., B.Sc.: My Lord and Gentlemen, anything in the nature of a reply is, I think, unnecessary. I should like to thank the speakers very much for the kind things they have said about my paper. The discussion it has caused is of considerably more value than the paper itself. The speakers are in general agreement that a change which would bring the employers and the Colleges into co-ordination is necessary, and that the proposed alternating six months' system is one way in which this change might be brought about. Mr. Yarrow has included this system in the Rules of Apprenticeship he has arranged for his works and which he has laid before the meeting. Beyond thanking you for the encouraging interest you have taken in my paper, I will not take up any more of your time.

The CHAIRMAN (Sir Nathaniel Barnaby, K.C.B., Vice-President): Gentlemen, I am sure I may again, in your name, heartily thank Professor Dalby for raising this most serious and interesting question and Mr. Yarrow for the effort he has made to strike a new note in our national industries.

APPENDIX X.

SYNOPSIS OF REPORT AND SUMMARY OF RECOMMENDATIONS.

[The Numbers refer to paragraphs of the Report.]

INTRODUCTION.

(1.) Constitution of the Committee; terms of reference.—(2.) Preliminary meeting in London.—(3.) Proceedings at Glasgow.—(4.) At Leeds.—(5.) At Manchester.—(6.) At Birmingham.—(7.) Summary of Provincial inquiries.—(8.) Proceedings in London.—(9.) Further investigation necessary.

Chapter I.

HISTORY OF THE TECHNICAL SCHOLARSHIP SYSTEM.

(10.) Origin of the State scholarship system; the Simla Conference of 1901.

(11.) The Government of India's scheme of 1902. [*See also* Appendix I.]

(12 and 13.) Despatch from the Secretary of State (Lord George Hamilton) in 1903. [*See also* Appendix I.]

(14.) Subsequent modifications of the scheme. [*See also* Appendix I.]

(15.) Initiation of the scheme in India. [*See also* Appendix II.]

(16.) Subjects studied by State technical scholars, and institutions which they have attended. [*See also* Appendix III.]—(17.) Summary of expenditure. [*See also* Appendix IV.]—(18.) Working of the system summarised. [*See also* Appendix V.]—(19). Recent development of technical education in India. Influx of Indian students to centres of technical instruction in the United Kingdom.

Chapter II.

REVIEW OF THE WORKING OF THE SCHOLARSHP SYSTEM.

(20.) Three main questions for consideration:—

(i.) How do Indian students acquit themselves at British universities and technological schools?

(ii.) Is practical experience in workshops and manufacturing concerns an essential part of industrial training? If so, are Indian students able to get it?

(iii.) Do Indian technological students succeed in finding employment on their return to India?

(21.)—(i.) Indian students at British Universities and technical institutions generally successful. Some failures and the harm they do.—(22.) Creditable record of the Government of India scholars, and of other picked students.—(23.) Question of the sufficiency of the Indian students' preliminary training in India.—(24.) Need for improving the teaching of drawing in Indian schools and colleges.—(25.) Paramount importance of previous Works experience.—(26.) Views of the engineering profession as formulated by the Institution of Civil Engineers (1903–05).—(27.) The same principle recognised in metallurgical and textile industries, and in tanning, dyeing, and mining.—(28.) Success of Indian textile students.—(29.) Failure of Indian mining students.—(30.) Contrast between Indian textile and mining scholars illustrates the signal importance of previous familiarity with the industry.—(31.) The leather industry; two distinct types of student:—The man "with tanning in the blood"; and (32.) the research chemist in the leather industry.—(33.) Good relations between Indian students and their British class-fellows.—(34.) Summary of conclusions on the question "How do Indian students acquit themselves at British universities and technical schools?"

(35.)—(ii.) "Is practical experience in workshops and manufacturing concerns an essential part of industrial training?" Professors and men of business unanimous that it is.—(36.) Indian students recognise the vital importance of Works experience.—(37.) Extension of scholarship period necessary, so as to allow for whole-time apprenticeship.—(38.) Works experience for Indian students generally obtainable by organised effort, and the co-operation of broad-minded employers.—(39.) Summary of conclusions on the question, "Is practical experience in workshops and manufacturing concerns an essential part of industrial training? And if so, can Indian students get it?"

(40.)—(iii.) "How far have Indian technical students found employment upon their return to India?" Complete information not available. Immediate results not the true test of success.—(41.) After-careers of returned Government scholars. [*See also* Appendix V., column 6.]—(42.) Government scholars who stay on in Europe or America; a contingency to be provided for.—(43.) After-careers of scholars of the Calcutta "Association for the Advancement of Scientific and Industrial Education of Indians." [*See also* Appendix VI.]—(44.) Difficulties of the trained man on his return to India; some signs of progress.—(45.) Views of students now under training; prospects on the whole not bad; small concerns offer opportunities; "pioneering" of vast industries by returned scholars an impossibility.—(46.) Summary as regards prospect of employment for returned scholars.

Chapter III.

GENERAL RECOMMENDATIONS FOR IMPROVING THE SCHOLARSHIP SYSTEM.

(47.) General recommendations.—(48.) A standard of general education on the Science side laid down.—(49.) Preliminary practical experience important in all industries, essential in mining.—(50.) Elasticity in the system of selection desirable; the principle of choosing the man rather than the industry.—(51.) Scholarships to be awarded after consultation with business men and Employers' Associations in India.—(52.) Training after selection; period to be extended so as to include Works experience.—(53.) Method of securing Works experience for Indian scholars; a matter of organisation, and dependent on the continued co-operation of British employers.—(54.) Responsibilities of firms holding contracts from the India Office.—(55.) Due notice to be given by the authorities in India of the grant of scholarships.—(56.) Question of reducing the scholarship allowance.—(57.) Revision of the rules for Government scholarships; obedience to the India Office, and to employers and foremen

during Works training, to be strictly enforced.—(58.) Return to India within a specified period to be required, security being taken before the scholarship is awarded.—(59.) Measures for assisting returned scholars to secure employment; existing Advisory Committees to act as Appointments Boards in India.—(60.) Record to be kept of the after-careers of Government scholars, and regular reports to be sent to the India Office.—(61.) Financial effect of recommendations; the ideal training for an industrial career long and costly; only the *élite* to be trained at the public expense.

Chapter IV.

RECOMMENDATIONS REGARDING PARTICULAR INDUSTRIES.

(63.) *Engineering:* General Summary.—(64.) The ideal training for an engineer, as formulated by the Institution of Civil Engineers, 1903–05.—(65.) Training of Indian students must follow the approved practice of the profession in the United Kingdom.—(66.) Preliminary workshop course in India recommended.—The college course; a higher standard maintained in English and Scottish universities as compared with colleges in India. A thorough grounding in specified subjects (viz., mathematics, physics, chemistry, mechanical drawing, and descriptive geometry), to be given before the scholar leaves India. Works experience as an integral part of an engineer's training; the practice in this country:—

Mechanical and electrical engineers; three classes distinguished:—(1) Apprentices; (2) Premium apprentices; (3) Pupils.

Civil Engineering, "the pupil system."

(67.) Application of the system to Indian students:—Mechanical Engineering; list to be kept by India Office of firms willing to train Indian students as apprentices, and to arrange, if necessary, for their college courses. (68.) Electrical Engineering; the same system applicable, but a more advanced knowledge of mathematics essential. (69.) Civil Engineering; better opportunities for practical training exist in India, especially on State railways; engineers in the Public Works Department might take premium-paying pupils. Sanitary and municipal engineering; special facilities available in England.

(70.) *Mining:* controversy as to the comparative merits of University training and evening classes in mining centres.—(71.) Opinion of His Majesty's Chief Inspector of Mines.—(72.) Opinion of Professor Cadman.—(73.) State scholarships in mining to be continued, subject to more stringent conditions of selection.—(74.) Previous experience of work underground indispensable; a consensus of opinion.—(75.) The effect of this test in eliminating the unfit.—(76.) Abundant facilities for practical training in English mines.—(77.) Further practical training needed to supplement the University course.—(78.) Summary of recommendations in regard to mining scholarships.

(79.) *The Mining Geologist* or Prospector: general qualifications required, and course of training outlined by Sir Thomas Holland.—(80.) *Metallurgical Industries:* Professor Turner on the record of past scholars, and the facilities available at Birmingham; the importance of physique and of previous connexion with some metal trade, however primitive.

(81.) Recommendations as regards scholarships in metallurgy.

(82.) *The Textile Industries:* definition of the term as including not merely spinning and weaving but the further treatment of the fabric that makes it marketable (*e.g.*, bleaching, finishing, mercerising, dyeing, printing).

(83.) *Spinning and Weaving:* the admirable record of Indian Government scholars.—(84.) Importance of previous Works experience; some examples of this among Government scholars.—(85.) Practice of German institutions.—(86.) Standard of general education and physical fitness prescribed.—(87.) The training given in Technological Schools and Universities of the United Kingdom; its practical character.—(88.) Sir William Mather on the value of the practical training given in technical school workshops.—(89.) Need for subsequent Works experience under business conditions, preferably in the United Kingdom.—(90.) Difficulty of securing admission of Indians to textile concerns in this country; the attitude of manufacturers—"Not a business proposition."—(91.) Textile machine makers helpful.—(92.) Facilities offered by German firms of doubtful utility.—(93 and 94.) Facilities for a limited number of picked men probably obtainable in the textile industry; some offers of co-operation already secured.

(95.) Recommendations as regards scholarships in spinning and weaving.

(96.) *Bleaching and Finishing:* college training not the primary qualification.—(97.) No admittance, as a rule, to bleaching and finishing works in this country.—(98.) Conclusion as regards the grant of scholarships in the bleaching and finishing of cotton.

(99.) Some facilities procurable in the woollen industry.

(100.) *Dyeing:* experienced men selected as State scholars.—(101.) The training of a dyer; theoretical instruction and practical experience alike necessary; the former readily procurable by students, but the latter, as a rule, not.—(102). Well-equipped laboratories in English institutions; special facilities at Bradford, Leeds, and Manchester.—(103.) Fair prospect of securing Works experience for well qualified Indians; a generous offer noted.

(104.) Recommendations as regards scholarships in dyeing.

(105.) *Tanning:* two types of student distinguished. Value in either case of technical training in the United Kingdom.

(106.) Firstly, the man with "tanning in the blood."

(107.) Previous working experience specially important, as there is no system of apprenticeship whether for English or for Indian students.—(108). Special advantages at the Leathersellers' Company's College, Bermondsey.—(109.) Practical training possible in Government leather factories in India.—(110.) Recommendations as regards scholarships for hereditary tanners.

(111). Secondly, research chemists in the leather industry; an ideal course of training indicated. Recommendations as regards scholarships in chemistry as applied to tanning.

(112.) Scholars of the first type above-mentioned likely to predominate at present.

(113.) *Chemical Manufactures:* Works do not take students, whether British or Indian, as apprentices.—(114.) Salaried employment as a means of securing Works experience.

(115.) Grant of scholarships to Indians for the study of chemical industries in the United Kingdom of doubtful utility; training in India suggested.

CONCLUSION.

(116.) The scholarship system has yielded good results, and may be made to yield even better results in the future.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.

The main conclusions suggested by the working of the scholarship system may be summarised as follows:—

I. On the question "How do Indian students acquit themselves at British Universities and technological schools?" the Committee find that Indian students generally get on well at such institutions; that they are quite up to the average capacity of their classes; if they have read Science in India up to the standard of the B.A. or B. Sc. they are rather better equipped on the theoretical side than most of their class-fellows; if they have read up to the Intermediate standard on the Science side they can with hard work keep up with their classes; those who have only passed the Intermediate on the Arts side or the Matriculation examination of an Indian University cannot take full advantage of the instruction given. As a rule students who have had practical experience of an industry derive great benefit from the teaching given in this country and do well, while those who have had no previous acquaintance with an industry do badly; Indian students of engineering are handicapped by their general ignorance of machinery and by the inadequacy of the training in drawing which they have received in India (paragraphs 21–34).

II. On the question "Is practical experience "in workshops and manufacturing concerns an "essential part of industrial training, and if so, "can Indian students get it?" the Committee find that practical experience in works is indispensable for a complete industrial training; that the period for which Indian students stay in this country is usually too short to permit them to take full advantage of such practical training as is open to them; that in those industries in which apprenticeship is the custom Indian students are accepted along with British students; that there are industries to which they are unable to get admission as apprentices by their own unaided efforts, but that a careful inquiry conducted by the India Office would probably disclose the names of some firms in almost every industry ready to offer to a certain number of selected Indians facilities for obtaining the requisite practical experience (paragraphs 35–39).

III. On the question "Do Indian technological students succeed in finding employment on their return to India?" the Committee could only secure scanty evidence; but from this it would appear that Indian technical students, provided they are properly selected and trained, usually do find employment in India sooner or later; and although the pioneering of large industries by inexperienced students is not to be expected, small concerns are springing up which do afford opportunities to returned scholars and which are likely to perform a very useful function in the industrial development of India (paragraphs 40–46).

The following are the detailed suggestions made by the Committee:—

General recommendations:—

(1.) That students sent to this country should ordinarily have read in India up to the standard of the B.Sc degree, or the B.A. degree in Science subjects, or have obtained an equivalent diploma; but that exceptions may be made in favour of men who have an hereditary connexion with a particular industry, provided that they know enough English to follow lectures in this country (paragraph 48).

(2.) That previous practical experience of an industry should be recognised as an ordinary condition of the grant of a State scholarship, and that this rule should be relaxed only when it can be proved that such preliminary experience is unnecessary. In the case of mining at least a year's work underground should be regarded as a *sine quâ non* (paragraph 49).

(3.) That as regards the system of selection the principle of choosing the man rather than the industry to encourage should occasionally be followed (paragraph 50).

(4.) That men of business, directors of industry, and Employers' Associations in India should be consulted as to the selection of candidates for scholarships (paragraph 51).

(5.) That practical training under business conditions be regarded as an integral part of the technical scholars' education, and that the period for which the scholarship is tenable be extended (up to five years if necessary) so as to include a spell of continuous works experience (paragraph 52).

(6.) That the present method of securing practical training for Indian technical scholars needs to be more thoroughly organised, and that it should be the duty of a special officer or Department of the India Office to invite the assistance of British employers (paragraph 53).

(7.) That in this way a list of firms willing on patriotic grounds to co-operate with the India Office should be prepared and kept up to date; but that if sufficient facilities cannot be thus obtained it may be possible to apply to firms holding contracts from the India Office (paragraph 54).

(8.) That notice of all scholarships awarded should be sent to the India Office at as early a date as possible by the authorities in India, and that in the case of an industry in which no Indian student has yet been trained, no scholarship should be awarded until it has been ascertained, by special inquiry, that facilities exist for giving a complete training in that branch of industry (paragraph 55).

(9.) That the amount of the scholarship allowance remain as at present (150*l.* a year), but that power be taken to reduce the amount during works-training, if the employer recommends this (paragraph 56).

(10.) That the "Rules for Government scholars" be revised, and that obedience to the India Office, and to employers and foremen during works training, be strictly enforced (paragraph 57).

(11.) That Government scholars should be required to give an undertaking to repay the value of the scholarship if they fail to return to India within three years of its expiry (paragraph 58).

(12.) That local manufacturers and employers should be asked to serve on the Provincial Advisory Committees in India which might perform the functions of Appointments Boards and assist returned scholars to find employment (paragraph 59).

(13.) That regular reports be sent to the India Office as to the technical scholars who have returned to India, showing how they are employed and what salaries they are drawing (paragraph 60).

(14.) That only men of quite exceptional capacity should receive industrial training at the public expense, but that when the best available men have been chosen they should be given the very best training (paragraph 61).

Recommendations regarding Particular Industries.

Engineering:—

(i). That the training of Indian engineers should follow the approved practice of the profession in the United Kingdom, and comprise:

(1.) An introductory workshop course of at least one year in mechanical engineering workshops for

all students, including those who intend ultimately to specialise in mining, electrical engineering, civil engineering, and, in fact, every branch of engineering; during this introductory course the student should be treated as an ordinary apprentice and should keep regular hours, be subject to discipline and be paid wages.

(2.) A college course of normally three sessions; stress being laid upon the necessity of a sound and and extensive knowledge of mathematics in all branches of engineering.

(3.) Two or three years' practical training, subsequent to the college course, in workshops, or on works, or in mines; it being particularly desirable that part of the time should be spent in the drawing office (paragraphs 63–65).

(ii.) That all Indian engineering students of whatever branch should receive a year's preliminary workshop course in a mechanical engineer's shop in India (paragraph 66).

(iii.) That Indians who come to the United Kingdom for their college course should have received in India a training in mathematics, physics, chemistry and engineering-drawing, of a sufficiently advanced character to enable them to join a second-year class at once; special instruction in mechanical drawing and descriptive geometry is required, and should be given in India (paragraph 66).

(iv.) That as regards practical training in mechanical engineering, a list be kept by the India Office of firms willing to train Indian students as apprentices, and to arrange if necessary for their attendance at college courses (paragraph 67).

(v.) That in electrical engineering a similar system (apprenticeship by a firm which allows the apprentice to take a college course) should be adopted, and that the scholarship be extended so as to be tenable for five years or such other period as the apprenticeship lasts (paragraph 69).

(vi.) That in civil engineering opportunities for practical training should be sought in India rather than in the United Kingdom, and that it is for consideration whether greater facilities might not be provided by Government in India; in particular engineers in the Indian Public Works Department might be allowed to take premium-paying pupils (paragraph 69).

Mining:—

(i.) That scholarships in Mining (as distinguished from Geology, for which *see below*) shall only be given to men who intend to become mine managers or mining engineers.

(ii.) That in every case the candidate shall have actually worked for at least one year in an Indian mine—preferably in a paid position.

(iii.) That a specially strict test of physical fitness shall be imposed on candidates before selection.

(iv.) That the candidate shall have reached at least the Intermediate Science standard, and shall have a competent knowledge of physics, chemistry, and mathematics.

(v.) That the period of the scholarship shall be extended, when the Professor under whom the student is working considers it desirable, so as to include a period of continuous practical training in an English mine (paragraphs 70–78).

Mining Geology:—

That provision might be made in the scholarship system for the training in the United Kingdom of mining geologists, candidates being required to possess a knowledge of economic geology and some experience of surveying and mining methods (paragraph 79).

Metallurgy:—

(i.) That scholarships be granted only to men who have had previous experience of metal industries, a knowledge even of primitive processes being valuable; and that candidates who lack such experience should be sent for some months to metal works in India before coming to this country for their training.

(ii.) That scholars should be physically well developed.

(iii.) That if possible notice be given beforehand of the branch of metallurgy that the scholar intends to take up on his return to India.

(iv.) That in special cases the scholarship be extended for a fourth year so as to allow a year of postgraduate specialised training.

(v.) That, whether the University course extend over three or four years, it should be supplemented by a period of practical training in large manufacturing establishments (paragraphs 80–81).

The Textile Industries.

Spinning and Weaving:—

(i.) That the scholars should ordinarily have been educated up to the standard of the B.A. (on the Science side), or the B.Sc. Examination of an Indian University, or have gone through a complete course of training in an Indian Technical College and have obtained a diploma such as the L.T.M. (Licentiate of Textile Manufacture) of the Bombay Victoria Technical Institute.

(ii.) That the scholars should in all cases have had considerable experience in one or more Indian mills, preferably through having served in a paid position.

(iii.) That the period of the scholarship should be extended to cover an adequate course of practical training in an English mill, subsequent to the theoretical or college course, whenever it is found possible to provide such facilities (paragraphs 83–95).

Bleaching and Finishing:—

That as regards the bleaching and finishing of cotton it is almost impossible for Indian students to obtain in this country anything more than the training given in technological colleges, and, in order that they may complete this by practical experience, efforts should be made to secure openings for a few carefully selected men in up-to-date bleaching establishments in India; but that in the woollen industry facilities for practical training are procurable to a limited extent in this country (paragraphs 96–99).

Dyeing:—

(i.) That the candidate should have had sufficient general scientific education in India to enable him to follow the specialised lectures here, *i.e.*, that he should have read up to the standard of the B.Sc. or B.A. with science in India.

(ii.) That no scholarship be granted to a candidate who does not possess some knowledge of the dyeing industry as carried on in India.

(iii.) That when it is found possible to secure admission for an Indian student to a good dye works, the period of the scholarship should, if necessary, be extended up to five years in order to cover this practical experience (paragraphs 100–104).

Tanning:—

That students who aim at becoming managers or owners of tanneries must be distinguished from those who intend to take up scientific research as applied to leather industries. As regards the former class the Committee find:

(i.) That hereditary connexion with the leather industry is desirable, and a knowledge of Indian methods is essential.

(ii.) That where these conditions are satisfied, high academic qualifications need not for the present be insisted upon; a fair knowledge of chemistry, physics, and some knowledge of mathematics will suffice.

(iii.) That the scholarship should be granted for three years at least, and should include visits to American and Continental tanneries, when recommended by the Professor.

(iv.) That if, after inquiry, the India Office is unable to arrange for practical training in this country, arrangements should be made for supplementing the training given here by a period of practical experience in one of the Government leather factories in India.

As regards the latter class, the Committee recommend:

(i.) That the scholarship shall only be granted after the student has received the highest scientific training in India.

(ii.) That he must have shown considerable aptitude for research work.

(iii.) That the scholarship shall be tenable for four years; and

(iv.) That if the scholar be successful in gaining a paid position in the laboratory of an English tannery, his right to a free passage back to India shall be extended for a further three years (paragraphs 105–112).

Chemical Manufactures:—

That the grant of scholarships for the study of chemical industries in the United Kingdom is of doubtful utility; that training in India would be preferable, and that, before any such scholarship is granted, inquiry should be made as to the possibility of providing in this country a complete training in the special branch of industry concerned, full particulars being furnished to the India Office as to candidates' qualifications and prospects of finding employment on their return to India (paragraphs 113–115).