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600-30-8-06.

Educational (1907) Department.

ORDINARY MS.

G.O., No. 547

DATED 21-8-07.

order
page no. 10

25

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12

INDEXED.

[Despatch Abstract.]

Books & Publications

Intimating to the Govt of India the number of copies to be furnished to this Govt of Major E. H. de V. Atkinson's reports on modern method of instruction in Art and Engineering and latest advances in photography.

BACK PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

FURTHER PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

[E.]
1,503-12-12

EDUCATIONAL DEPARTMENT.

CURRENT FILE.



CONTENTS.

From	Number.	Date.	Pages.

PAPERS PUT UP WITH CURRENT No.

Papers of the department to which the current belongs.

Number.	Date.	Original (=O) or spare copy (=S. C.).	Remarks. (In this column such of the papers as have been removed for copying, printing, &c., should be marked with a cross.)	Initials of Referencer with date in token of return to Reference department.

Papers of other departments.

Department.	Number.	Date.	Original (=O) or spare copy (=S. C.).	Despatcher to note the return of the papers to the departments concerned.

From

G. B. H. Fell, Esq.,

Deputy Secretary to the Government of India,

To

The Secretary to the Government of Madras,
Education Department.

Home Department.

(Education)

Sir,

Simla, the 25th June 1907

I am directed to forward for the information of the
Governor in Council a copy of a report by Major E.H. dev.
Atkinson, R.E., on (1) the most modern methods of tuition in
advanced engineering and technical institutions in England, and
(2) the latest advances in photography, photo mechanical and
lithographic work, and to request that the Government of India
may be informed whether any, and if so how many, copies of each of the
reports are required by the Government of Madras. The
report on engineering will probably be found useful in engineering
colleges and schools, and that on photography in the schools of
Art and scientific institutions.

I have the honour to be,

Sir,

Your most obedient servant,

G. B. H. Fell

Deputy Secretary to the Government of India.

NOTES.



From
G. B. S. Bell, Esq.,
Deputy Secretary to the Government of India,
Educational Department.
Home Department.
(Education)
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Government in Council a copy of a report of Mr. E. H. Bell,
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colleges and schools, and that on photography in the schools of
art and scientific institutions.
I have the honor to be,
Sir,
Your most obedient servant,
J. H. Bell
Deputy Secretary to the Government of India.

3
GOVERNMENT OF MADRAS.

C. No. 1586 Educational.

LETTER FROM THE GOVERNMENT OF INDIA,
HOME DEPARTMENT.

No. 479.

Dated 25th June 1907.

in original
Circulated for information to His Excellency the Governor.

the Hon'ble Mr. G. STOKES, C.S.I.

the Hon'ble Mr. G. S. FORBES, C.S.I.

H.D.T.
4-7-07.

9.7.07

11/7/07

Send us. to D.P.D. for remarks.
Copy the go to Res. - as the Survey Dept.
may be interested in the matter of
photography or photographic work

11/2

We have received only one copy of the enclosures.
May the file be therefore first sent up to the D.P.D.
for remarks, and on its receipt to the Rev. Secy.

Very well
11/7/07

35 N^o 1586-1

13-7-07

13/7



Gen N^o 1711

Regd 19-7-07

bp
18/7

No. 1711-1
19-7-07

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Lec.

Cas

12.7.7.

482

500 u.o.

137.07

E. O. N^o 86 Dated 17.7.7.

1. Report on the latest advances in
Photography, Photo mechanical & Lithographic
Works

2. Report on the most modern methods
of tuition in Advanced Engineering &
Technical Institutions in England

A copy of No 1 may be taken for each
of the following Institutions:-

School of Arts

Presidency College

College of Engineering

A copy of No 2 for each of the following:-

College of Engineering

School of Arts

Office of Insp^r of Technical Schools

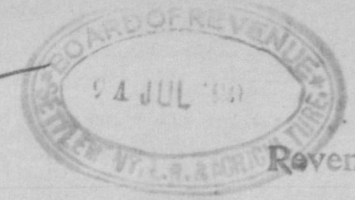
17.7.7

Rev. u.o for remarks as to whether any copies
are required for the Local & Municipal
& also know whether any separate
communication from India has been
received with the Rev Dept.

Rev. u.o

482
87/7

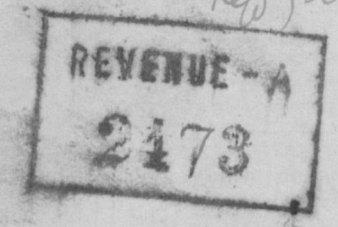
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7 5

Revenue Department

Rev
Rep 20-7-07



Is under Secy

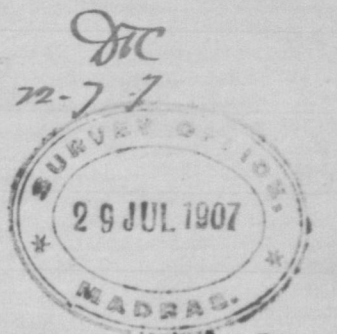
The papers may be sent. viz to the Director of Survey for remarks (through the Board of Rev.).

with an book.

KRM 20-7-07

Rev no 24734-1
22-7-07

Board of Revenue (Rev. Secy) no.

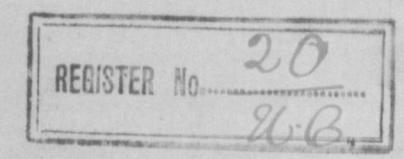


Secy

To the Director of Survey U.O.

U: Q: No 186
25-7-07

208
25-7-07



No 22 dated 6-8-07

I would like to have 3 copies of the report on the latest advances in Photography, Photo-mechanical and Lithographic work.

Su

6-8-07

To the Secy. Rev. Secy

mu.

The Director's request might be submitted to Govt. A copy of each of the Reports might be asked for for the Library of the Agricultural Dept under the Director of Agriculture. The Govt Botanist does a good deal of photography in the ...

to be sent at your request all
 the documents of interest to the Board of
 the Board of the Board

RECEIVED
 12

N.O. 201
 12.8.07

SECRETARY TO GOVERNMENT
 13 AUG. 1907
 REVENUE DEPARTMENT

LOCAL & MUNICIPAL
 15 AUG 1907
 SECRETARIAT

Rev No 2473M-2
 14-8-07
 15/8

45 3
 the course of his official work.

1083
 10807

I agree with the above note.
 J. N. Atkinson
 16.8.07

Secy to Govt, P.O., U.O.

Do under Secy

The request of the Director of
 Survey and the Board may be supported in
 this Dept and the file transferred to ^{Edl.} ~~Education~~
 On the whole the Board wants 4 copies of
 the report on the Latest Advances in
 Photography &c. and one copy of the report
 on the tuition of Advanced Engineering.

Edl. no ^{DK} 16.8.07
educational dept
 Draft to Govt
 15.8.07

The draft letter to India placed below is submitted for
 approval.

Sec.
 15.8.07 I suppose the copies in the
 file are exclusive of those now
 asked for, since he kept in the
 Secy
 16.8.07

65 9 1

are no additional copies required for the
Lee's Library?

17-8-07

Chief Sect no.

Chief Sect

A copy of each might be
obtained from the Sect. Library

19-8-07

Vol. no

Comptrolneral Dept

house

17-8-07

2-8-07

No 1711-2
19-8-07



77 71 77 77 77 77 190 .

C. No. 1586, From the Govt. of India, No. 479, dated 25-6-1907.

No. 547, dated 21-8-1907.

See

I am directed to acknowledge Mr. Felt's letter n^o. 479 d^y 25th June 1907 forwarding a copy of a report by Major E. H. Jeff. Atkinson R.E., on (1) the most modern methods of tuition in advanced engineering and technical institutions in England and (2) the latest advances in photography, photo-mechanics and lithographic work, and enquiring how many copies of each of the reports would be required by the Government.

2. In reply I am to say that this fool
man

21-807
94

2 8 11
 may be furnished with ^{five} ~~four~~ copies of
 the former and ^{eight} ~~seven~~ copies of the
 latter publication.
 15.8.07 I have &c.

15.8.07
 16.8.7.
 21.07

[Faint, mostly illegible handwriting in the top half of the left page, possibly bleed-through from the reverse side.]

[Faint handwriting in the bottom half of the left page, continuing from the top or as separate notes.]

[Small handwritten note or signature in the center of the left page.]

When given for copying _____
When copied _____ } 190 .
When examined _____
When signed _____

READ AGAIN G.O., No. _____, DATED
190 .

CURRENT No.

ENCLOSURES TO C. No.

ORDER OF GOVERNMENT A A A A A A A

LETTER OF GOVERNMENT.

STATEMENT WITH DITTO.

PAPERS NOT FILED UP, BEING MEANT FOR DESPATCH
IN ORIGINAL.

N.B.—

A = Copy in full.
B = Not to be copied.
P = Copy abstract only.
Q = Copy heading only.

Enclosure to Sp. 547 Ed 2

21-8-07

D. R.

Ed. Sept.

22-8

15

10



A

REPORT

ON THE MOST MODERN METHODS OF

TUITION IN ADVANCED ENGINEERING
AND
TECHNICAL INSTITUTIONS IN ENGLAND.

BY

MAJOR E. H. DEV. ATKINSON, R.E.,

PRINCIPAL, THOMASON CIVIL ENGINEERING COLLEGE, ROORKEE.

Photo-Mechl. and Litho. Dept., Thomason College, Roorkes—No. 1432-1-42.

A Report on English Technical Institutions.

The object of the various Technical Institutions I visited may be broadly summed up as an endeavour to provide instruction and training in the principles of science in their application to the Industrial arts, with a view to a right understanding of the foundations upon which these arts rest, and to promote their effective development.

There are many different grades of these Institutions, catering for every class of society, and offering technical education to every kind of student—from the workman to those who aim at holding the highest positions in the various industries.

The educational opportunities offered by these Institutions may be put into two distinct sections.

I. Engineering and other day courses for students who are willing to devote the whole of their time for several years to a thorough scientific training in one of the branches dealt with. These courses are designed to provide the scientific part of a professional training, and almost exclusively deal with Engineering in its various branches. The object is not only to prepare students to pass examination tests when found necessary, but to fit them to become competent workers and thinkers in the careers which they have chosen.

The question of the position in which Workshop practice should be placed in the training of Engineers is one which has been much discussed by both practising Engineers and those responsible for their education. It is on all hands admitted that the trade Workshop training can only be given in a commercial workshop, but that a valuable introduction to such training can be given in the educational Workshop and College. In some cases, depending on the age of the student, he may have already done several years in a commercial workshop before entering a Technical Institution, but it is usually found that in this case he has grown rusty in his school education, and finds it an effort to rub it up, at a time when he wants to devote all his energies and time to the application of his school knowledge to applied sciences. I find, therefore, that it is usually considered preferable that a student should come straight to the Technical Institution from his school studies, and after completing his course go to the workshop, draftsman's office, or other position in which he can learn the commercially practical side of his business.

It seems to be the general opinion that the necessity for a training similar to that which is offered in these Institutions is daily becoming more and more recognised in the Engineering trades, under the stress of actual, and still more of prospective, foreign competition.

It is now affirmed that the majority of men under 28 years of age who are at present in leading positions in Electrical Engineering works and in central stations in this country, have received an important part of their Engineering education in one of these Institutions in various parts of the country, and others are to be found now in all countries holding their own well against their competitors.

The older established Mechanical Engineering industry is rapidly following the lead set by its modern off-shoot, and in both industries the more advanced employers are making it a condition that all applicants for admission to their works, except perhaps those whose highest ambition is to be a "hand," shall have undergone some such training. It is universally recognised that Technical education can only produce the best results when it builds upon the sure foundation of at least a sound secondary education. The Institutions, therefore, in most cases

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have Entrance Examinations or preliminary tests varying in stiffness according to the class of Institution and the grade of out-put aimed at.

II. Trade Evening classes for imparting to actual workmen instruction in the scientific and theoretical sides of the various trades and manufacturing industries practised in the neighbourhood of each particular Institute. Only workmen actually employed in a trade are admitted for instruction in that trade.

The men and women who attend these classes are as a rule, those who are not content to be mere "hands" but wish to raise themselves to the highest rung of the ladder to which they can climb. It is, however, found that Trade Students are too ready to think that the only classes they should attend are those in subjects connected with their trades. It is on the face of it a mistake, as several of the pure and applied sciences bear very directly upon technical subjects, and cannot be omitted if it is desired to gain a thoroughly sound knowledge. Several of these subjects are necessary as an introduction to Technical Classes, as for example very little progress can be made in Engineering or Building Drawing without some knowledge of Practical Geometry, and the student who does not know something of Mensuration and Practical Mathematics will do little good in such subjects as Mechanics, Steam, Machine Design and Builder's Quantities.

Consequently in all Institutions, Trade Students are advised, and in some Institutions obliged, to take corresponding theoretical classes held on evenings other than those on which the practical classes meet.

As modern crafts employ in their processes so many methods derived from widely different sources, and use the principles developed in so many branches of natural science, scarcely a single trade can be found which does not demand from an intelligent craftsman or journeyman, if he is to understand his daily work, a clear knowledge of fundamental principles drawn from more than one science. Consequently, though the Evening classes are usually arranged under a few specific Trade heads, as many as a hundred different courses are generally sketched out to meet every possible case.

The Institutions generally lay down that the power of clear linguistic expression and the mastery of the Elements of Mathematics, Physics and Descriptive Geometry are held to be vital to a successful study of the applied sciences, and the chief aim of preparatory study should be the effective training of the thinking and observing faculties.

For the higher grade of students, it may be taken as a principle that mere interest in experiment, or in machinery in motion, and for all classes of students, evidence of manual skill and dexterity, without a firm grasp of fundamental principles, are of small avail if the purpose of the student be to attack serious problems in Engineering, Physics or Chemistry, and to fit himself for a position of Industrial responsibility in the present age.

The Technical education given in these Institutions is, as a rule, accomplished by means of lectures, laboratory and workshop exercises, together with scientific research directed to the solution of industrial problems. The essential aim of the instruction is generally held to be the training of the faculties through a systematic course of sound theoretical study and the development of resourcefulness, and habits of self-reliance by means of an exact, thorough and progressive, course of laboratory and workshop exercises.

It will be convenient, perhaps, to first describe some of the principal Institutions I visited, then to consider the different conditions underlying Technical Education in England and India, and finally to make a few deductions and suggestions which may be applicable to India.

The Institutions visited class themselves clearly into two groups. Those that only give the kind of instruction described in Class I., as day work, and those that combine Classes I. and II. Those in the first group, confine themselves to teaching

Engineering and its branches. This is natural, as Engineering is probably the only trade in which a sound practical training in College followed by an apprenticeship on works will lead to the highest positions in the profession. Engineering, of course, is taken as a general term for all branches of the profession, but it is a moot point whether the branch of Mechanical Engineering can be satisfactorily taught under this system.

Most other arts, crafts and trades require such continual and elaborate workshop practice, that it is only in the commercial workshop that sufficient dexterity can be obtained. As already pointed out this dexterity alone is not sufficient to enable a man to keep his place in the struggle for pre-eminence, and the theoretical and scientific application of Mathematics, Physics and Chemistry to each trade must be mastered.

The men, to whom this is a necessity, cannot as a rule afford to give their days to obtaining it, as they have to earn their living, consequently the second group of Institutions has been established to come to their assistance with Evening Trade Classes.

The Institutions are often known as Polytechnics, and their day courses, though carrying out the same aims as the Institutions in Group I., do not, as a rule, aim at such advanced instruction as imparted in Group I. Some Polytechnics confine themselves entirely to Trade instruction while others go in as well for Commercial and Domestic instruction. In some, the social feature of the combination of a Club and Technical Institute is a very pre-eminent feature (as in the Regent Street Polytechnic), while in others there is no social side (as in the City and Guilds Institute, Finsbury).

GROUP I.—The only two Institutions I had the opportunity of visiting were—

1. Cambridge University.
2. City and Guilds Central Institute, South Kensington.

Cambridge University Engineering Laboratory.

A student must become a member of the University, and consequently show that he has already obtained a general education by passing the Previous Examination.

In general, a student begins this course of study when he enters the University, and completes it at the end of his third year, by taking Part I. of the Mechanical Sciences Tripos Examination. This examination entitles a student who has resided for three years to obtain the degree of B.A. Occasionally a student continues in residence for a fourth year and takes Part II. of the same Tripos, or engages in research or other special work, but as a rule, he prefers to enter practical life at the end of his third year, by going into the workshops of a manufacturing firm or into the office of a Civil Engineer.

In the first year the ordinary subjects are—

1. Mathematics.
2. Mechanics.
3. Elementary principles of Mechanism.
4. Elementary Electricity.
5. Geometrical and Mechanical Drawing.
6. Mechanical and Electrical Laboratory Work.
7. Workshop Practice.
8. Surveying.

In the second and third years the student attends more advanced lectures on Mechanism and Applied Electricity, the theory of Heat engines and the Strength of Materials. His Engineering Laboratory work includes much testing of steam

and gas engines and pumps, measurements of the strength and elasticity of the materials used on construction, electrical measurements and tests of dynamos and motors, survey drawing office and workshop practice. There are 12 Professors and Lecturers as well as skilled instructors in each branch of workshop practice.

The Workshops include carpentry, pattern-making, fitting, turning and forging. The Laboratory buildings include (1), The Steam Laboratory, which contains about a dozen engines of various types arranged for experimental work; (2), The Electrical Laboratory, which is equipped with numerous dynamos and motors, including a very complete set of two-phase plant; (3), The Mechanical Laboratory in which there is a large number of pieces of apparatus designed for elementary experiments in Mechanics. Apparatus for experiments in Hydraulics is set up as a portion of the Elasticity Laboratory, while the design and manufacture of Petrol Motors receive a large amount of attention.

The fees payable by ordinary students depend on the precise courses of lectures and laboratories taken. For each lecture course, the fee is one guinea a term, for each laboratory course two guineas, and for the workshops three guineas.

The Tripos was started in 1892 when only 37 candidates presented themselves, and in 10 years the numbers rose to 211.

City and Guilds Central Technical College, South Kensington, London.

The object of this College is to give to London a College for higher technical education, in which advanced instruction shall be provided in those kinds of knowledge which bear upon the different branches of productive industry, whether Manufacture or Arts.

The main purpose of the instruction given in this College is to practically demonstrate the application of different branches of science to various industries.

Although the instruction is to so large an extent practical that it has enabled several students to obtain remunerative employment in engineering or manufacturing works on leaving the College, it is impressed on students that no school instruction can supersede the necessity of obtaining practical experience in the workshop and factory. A well-instructed student is expected, however, to be able to acquire this practical experience easily and rapidly after going through the course prescribed for students of the College. The ordinary way of doing this is by pupilage, but in the case of students a pupilage of one or two years should be sufficient.

This College, as a matter of fact, caters only for the higher grades of Civil, Electrical and Mechanical Engineering, and Chemistry, and the system is very similar to that employed at Roorkee.

The course is for three years and an entrance examination is required which is very like the Roorkee examination.

All students work together for the first year and specialise in the second or third year.

The fees for a complete course of instruction are £30 per Session.

I was informed that the Committee consider they had to provide £60 per Session for each student in addition to his fee.

The Diploma of Associate is awarded to matriculated students who go through a course with credit. Entrance age 16.

There are 36 Professors, Instructors and Demonstrators, many of whom are distinguished in the world of science, such as Professors Unwin, Henrici, Ayerton, and Armstrong, all Fellows of the Royal Society.

GROUP II.—Under this group I have taken one of the best equipped and most important Technical Schools, and given a brief sketch of its history and a detail examination of its methods.

For the other Schools, space prevents anything but a few brief remarks on any special points of organisation.

Manchester School of Technology.

It may be of interest to sketch briefly the events which lead up to the formation of the present magnificent School in Manchester, as in a remote manner they remind one of the conditions now obtaining in India, and are typical of Great Britain in general.

As a direct result of the great Educational Enactment of 1870 a Mechanics Institute was founded some years later, but despite the undoubtedly beneficial influence it exercised as a means of popular education, it was admitted that it failed to realise the chief object of its founders, namely, the technical instruction of the working classes in arts and industries.

This arose in the main from the utter inadequacy of the means and opportunities of elementary instruction, so that instead of the Institutes devoting themselves chiefly to instruction in science and art as applied to industry they were compelled to offer lessons in the merest rudiments of education to adults. The chief purpose of the Institutes remained, therefore, unachieved and impossible of achievement. About 1880 the beneficial results of the Education Act of 1870 began to be felt. The measures inaugurated for the establishment of a Department of Science and Art under the Committee of Council on Education, gradually called forth a new spirit, and awoke a more intense desire, with a view to increase our industrial efficiency, for a better understanding of science and art in their application to manufactures and commerce. It began also to be realised that foreign industrial and commercial competition was growing more effective, and could no longer with prudence be ignored.

Measures were immediately taken to enlarge the scope and to increase the means and efficiency of the Institute as a School of Technical Instruction, specialised courses of instruction for day students were organised in Chemistry, Engineering and in the textile industries. It is of interest to note that, at the same time and in the same Institution, the first serious attempt in this country was made to establish for boys between 13 and 14 years of age a department for Manual Training on the lines of the American Manual Training Schools. The advance in the means of Technical training would not, however, have been rapid but for the passing of the Technical Instruction Act of 1889 which gave Local authorities the power to rate their areas for the purposes of Technical instruction, or for the further even more influential Act of 1890 which placed at the disposal of Local authorities an Imperial grant of nearly £800,000 per annum in aid of the Act for the promotion of Technical education.

From this date the history of this School is one long record of local enterprise and private munificence.

In October, 1902, the present building was opened by the Prime Minister, magnificently equipped with every instrument and machine which could be required for the purposes in view.

The School is designed to accommodate the Mechanical, Electrical and Sanitary Engineering industries; the Chemical and Textile industries; Architecture and the Building trades; Printing and other trades and industries too numerous to name.

It is a serious attempt to place at the service of English Industry an Institution which shall be adequate to its needs and importance and comparable in respect of equipment with the great Institutions of the Continent and the United States.

The value of the sites, structures and equipment of the buildings amounts to upwards of £300,000.

The following quotation from the official calendar is well worth bearing in mind: "It cannot, however, be too strongly urged that the ultimate usefulness and the success of these Institutions rest entirely upon the complete organisation of a sound system of secondary education without which no adequate scientific, technical, and artistic training, especially for the leaders of our industries, is possible. It is gratifying to observe that the nation is at last persuaded that the organisation of efficient secondary education is a matter of serious and urgent concern, and that it is recognising with increasing conviction that successful industrial and commercial competition, and a high standard of manufacturing production, depend much more upon the adequate training of the leaders and managers of our industries and commerce than upon that of the workmen, whose efficient education and training for their respective occupations, according to their means and opportunities, must nevertheless receive the most careful provision and the most earnest encouragement."

Last year there were 368 day scholars while 5,400 attended the evening classes.

The staff consists of 65 Professors, Instructors and Demonstrators.

The Day Classes.

Students must not be less than 16 years of age. The course lasts three years.

There is an entrance examination in English, Mathematics, Drawing, Science and French, German or Latin.

All students take a first year's course in—

Mathematics.

English.

German.

Geometrical and Engineering Drawing.

Mechanics including Laboratory.

Physics including Laboratory.

Chemistry including Laboratory.

Wood-working Course.

For the next two years students may specialise in any of the following:—

Mechanical Engineering.

Electric Engineering and Technical Physics.

Municipal and Sanitary Engineering.

General and Industrial Chemistry.

(a). General Technical Chemistry.

(b). Bleaching, Dyeing and Printing of Textiles.

(c). Manufacture of Paper.

(d). Brewing.

(e). Metallurgy.

Manufacture of Textiles.

Photography and the Printing Crafts.

Civil Engineer's Apprentice Course.

Architectural Courses.

The fees for each Department are 15 guineas per Session.

In addition to the above day students there are—

1. A Manual Training Class for Teachers in Wood and Metal-working.

2. Theoretical and Practical Dress-making.

3. Special Training Classes for Teachers.

The Evening Trade Classes are, as is invariably the rule, for actual workmen, and include the following main headings, subdivided into numerous special branches.

1. Pure, Applied and Practical Mathematics.

2. Mechanical Engineering.

3. Architecture and Builder's work, Municipal and Sanitary Engineering.

4. Physics and Electrical Engineering.

5. Pure and Applied Chemistry.

6. Photography and the Printing Trades.

7. Textile Industries.

8. Dress-making, Millinery, Plain and Art Needle-work.

9. Natural Science.

They are arranged as Diploma and Certificate Courses, and extend for five and three years respectively, according as they are needful for industries requiring a high degree of scientific theory and training, extending over a considerable period; or as they are industries where handicraft skill, combined with an accurate knowledge of general principles, is the chief desideratum.

They are conceived from the point of view of laying a broad general foundation of sound Mathematics, Drawing and Science leading up to more specialised study, at a later stage, of those subjects which are of direct value and interest to the student.

They will prepare the student—assuming that he possesses the other conditions and qualities necessary in a manager—to take up a position of intelligent responsibility in industrial affairs, and enable him to develop on sound lines, the manufacturing business in which he may be engaged.

The five years' course, satisfactorily pursued, will entitle the student to the Diploma of the School with the title of Associate, and the three years' course to the Certificate of competency in the particular branch of study he has undertaken.

The cost of this School in 1904 was £36,800, of which £10,800 was recovered in fees, tests, sales of books, &c.

City and Guilds Technical College, Finsbury.

The scheme of this College is of an intermediate grade to the sister Institution at South Kensington. It occupies the position of a Finishing Technical School to those entering industrial life at an early age; of a supplementary Technical College, for those who, having had some industrial experience, desire to qualify themselves to become Foremen or Managers; and of an intermediate College in the educational scheme of the City and Guilds Institute leading up to the South Kensington Central College.

The College provides day courses of instruction in Electrical Engineering, Mechanical Engineering and Chemistry, and Evening classes for trade students.

These are at present limited to—

1. Mechanical Engineering.

2. Electrical Engineering and Instrument-making.

3. Manufacturing Chemistry and Industries involving the application of Chemistry.

4. The Art Industries, including cabinet-making and decoration in colour and in relief.

However every endeavour is made to meet the requirements of persons preparing for other occupations, as well as of apprentices, workmen and foremen engaged in other trades not comprised under these headings.

The Day classes are at present attended by some 200 students, from 15 to 19 years of age and the course is for two years.

The fee is £20 per Session.

Northampton Institute, Clerkenwell.

This Institute forms one branch of the City Polytechnic, and provides classes in technological and trade subjects.

Literary, Commercial and Science and Art subjects are provided for in the branches at the Birkbeck College, Chancery Lane and the City of London College, Moorfields.

This Institute divides its courses into day and night sections.

To enter the Day classes, students must be 14 years of age. The classes are—

1. Mechanical Engineering.
2. Electrical Engineering.
3. Watch-making and Horological Engineering.
4. Technical Optics.
5. Jeweller's and Goldsmith's work.

The courses in these mostly last for four years. The first year, which is to a great extent preliminary, is entirely passed at the Institute. The second and third year's work consists of six months' training at the Institute during the winter and two periods of approximately six months each passed in Commercial Workshops during the summer. The fourth year's work is entirely at the Institute.

The Evening Trade Classes are primarily devoted to the requirements of Clerkenwell. This district is thronged with small Workshops engaged in a great variety of trades, amongst which watch and clock-making stands out as the most prominent, though by no means the only important one. Mechanical and Electrical Engineering Workshops (including Electroplating and Electrotyping); Optical and Scientific Instrument-makers and Art Metal workers in a great variety also abound.

As many of the workshops are small, the need of an all-round training for the foremen and workmen in the principles and practice of the different sections of their trade, is more urgent than in large workshops where the work of production is very minutely subdivided. The courses are roughly divided into—

1. Mechanical Work.
2. Artistic Crafts.
3. Electrical Engineering and Applied Physics.
4. Technical Optics.
5. Electro-Chemistry.
6. Horology.
7. Miscellaneous Trades.

But as many as 106 specific courses have been arranged to meet every case.

Battersea Polytechnic.

This is a very successful Institution, divided as usual into day and evening

trade classes, the latter of which are far the most numerous attended and important. It primarily works for the districts of Battersea, Clapham and Wandsworth, and is provided with well-equipped workshops for Engineers, Smiths, Carpenters, Joiners, Pattern-makers, Plumbers, Bricklayers, Masons, Plasterers, Painters and House Decorators, and with laboratories for Engineering and Mechanics, Electrical Engineering, Physics, Chemistry and Natural Science, and with a well-fitted Art School, Cookery Schools, Laundry, Needle-work and Photographic rooms.

A great deal of attention is given to training chauffeurs in the design, repair and driving of motor cars.

Borough Polytechnic, Southwark, London, S.E.

This Institute has been in existence about 12 years and almost entirely devotes itself to evening trade classes.

The day departments are restricted to—

1. Technical Day School for Boys.
2. Domestic Economy School for Girls.
3. Trade School for Waistcoat-making for Girls.
4. Day School for Bakers and Confectioners.

The object of the Technical Day School is to provide a sound practical modern education at a low fee, and is not especially a Technical School.

The Day School for Bakers is the only one of its kind in the kingdom, and is essentially a trade class for Master Bakers' sons and apprentices.

The night Trades Classes are of the usual type including not only the trades of the neighbourhood, but every class of domestic, technical and commercial classes for both sexes.

The teaching staff numbers 70 and the annual cost is about £13,000 of which only about £1,500 is recovered in fees.

The Regent Street Polytechnic.

This Polytechnic has an enormous number of members but is very much more of a Social Club for the Industrial classes, combining with Technical education the object of attracting the attention of young men of the working classes to healthy aims and amusements. It is more or less unique of its kind but does not offer any other striking feature.

City of Liverpool.

Central Municipal Technical School.

This School is entirely devoted to evening classes for students of either sex over 14 years of age. If students wish to join, who cannot take full advantage of the instruction from a want of the necessary preliminary knowledge and training, there are Evening Continuation Schools which prepare for the more advanced and specialised classes at the Technical School. The courses are generally arranged in stages, students are expected to have passed successfully through the lower stage before entering a class in a higher stage of the same subject. Students joining practical classes must also attend the corresponding theoretical class unless they have previously passed the theoretical examination in the same.

The courses are—

1. For the Building Trades—
Masons, Bricklayers, Carpenters, Joiners, Plumbers, Painters, Decorators and Plasterers.
2. For the Engineering Trades—
Engineers, Boiler-makers, Engine and Ship-smiths, Hammermen and Pattern-makers.
3. Metal Plate Trades—
White-smiths, Tin-smiths, Copper-smiths, Boiler-makers.
4. Printing and Book Trades—
Printers, Lithographers, Book-binders.
5. Other Trades—
Tailors, Millers, Watch- and Clock-makers, Naval Architecture, Carriage Builders, Bread-making and Confectionery.
6. General Students.
7. Art Subjects.

City of Birmingham.

Municipal Technical School.

The scheme of this School is very much the same as that of the Liverpool School, with one important modification.

There are *afternoon* classes specially designed to meet the wants of Engineering apprentices and other employes of Engineering firms. These classes are held on three afternoons in the week, and admission is restricted to students actually engaged by Engineering firms, and recommended for admission by their employers. Fee £1 per Session.

There is also a Day School to give boys at the lowest possible fee, a general modern education, specially fitting them to take part in and to develop the manufactures and other industries of the towns.

In the description of the Manchester Technical School, I have already described the reasons which led to the formation of these schools. The direct stress of competition, the unwelcome fact that foreigners were assailing our supremacy in almost every branch of manufacture and industry, and by their attention to the scientific training of the men and the application of science and chemistry to manufacture were passing us in the ingenuity and economy of production, at last wakened the most responsible portion of the nation to action.

Day classes for the scientific training of youths and Evening trades classes for the scientific training of workmen were established in many magnificently equipped Institutes. Though each school may only number its day students in hundreds, they number their evening classes in thousands. Though not established very many years there seems no reason to doubt that the schools are doing an immense amount of good and fulfilling the intentions of their founders.

The great difference between these conditions and those existing in India is—

1. In England it is found necessary to give the scientific training to men engaged in established trades, to improve their manipulation of those trades and not to start new industries.
2. In England manufactures are confined as a rule to large towns, where the workers can be easily reached.
3. In England the standard of education reached now by the people is high enough to enable them to take advantage of scientific training

4. The men are willing to attend night classes.

5. England is a rich country and private munificence is an every-day occurrence, so that enormous sums are available for the thorough equipment of Workshops and Laboratories, the payment of a large and distinguished staff of teachers, and for the support of the schools, the expenses of which are very heavy and the fees charged to students very small.

1. India has chiefly an agricultural population, to a large extent just keeping body and soul together. The chief aim of Technical or Industrial education is to try and find some fresh outlets to which some at least of the natives could turn their energies. To some extent the want of sufficient education stands in the way, but this is a minor difficulty compared with that of the habits and temperament of the people. The ambition of those that are sufficiently educated is to become a clerk, a subordinate in the Public Works Department, or some other department of Government, or a pleader. There are not nearly enough vacancies, however, under Government, to supply a tithe of the applicants with the fulfilment of their ambition.

To the common artisan in his own particular style there is little to teach without the aid of machinery, and machinery means capital which he does not possess. There is capital, however, available if we could only show the right way to use it in industry and manufacture. The problem then is not so much giving scientific training in existing trades, though this is also very desirable, as showing the way in starting new industries.

It is, however, impossible to teach a tradesman in a school satisfactorily; and the only method seems to be to give as good an apprentice training as possible combined with theoretical training in a long School or College course and let experience and the aid of time do the rest.

The first start is sure to be discouraging for years, but perseverance seems the only road to ultimate success.

2. The immense distances in India are a great drawback to collecting the desirable material for experiment compared with the concentration and facilities of locomotion available in England.

3. Education is being taken in hand and will make progress it is hoped in the right direction, but it cannot be too earnestly borne in mind that no real useful technical education is possible without a sound general education.

If students in Industrial schools do not possess sufficient general education to avail themselves of the Technical instruction, the general education must be continued along with the Technical education, and it seems unlikely that any student will attend an Industrial School which refuses to continue his general education unless his attainments are already up to the required standard.

4. In India, except perhaps in a few large towns of which I have no practical knowledge, few workmen or boys will attend evening classes.

The reasons are well known and need not be discussed here.

5. The chief thing that struck me was the lavish magnificence of the workshops and laboratories in England. There is no doubt that in India Government has to stand the whole strain which is met in England by local rates and private munificence, but taking into consideration the importance of practical work in Technical schools it cannot be considered anything but money well spent to provide sufficiently large laboratories and workshops and an ample staff of professors and demonstrators.

The only novelty I noticed was—

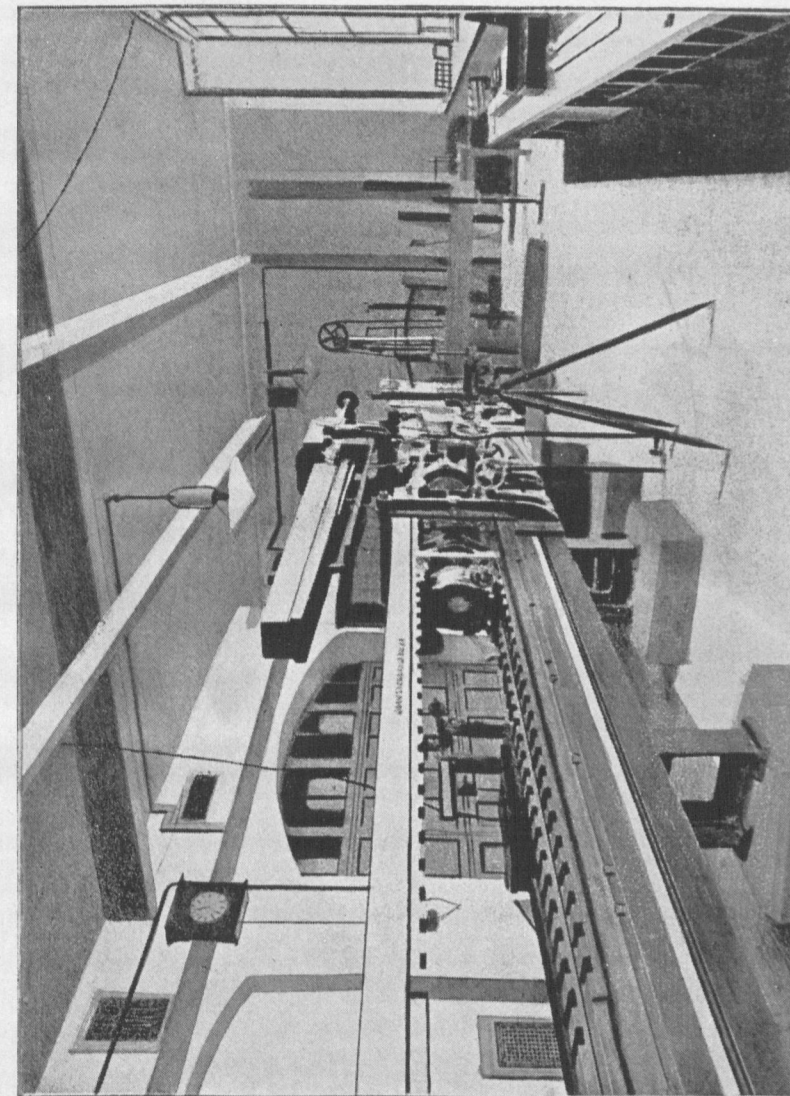
1. The teaching of Mechanics by Laboratory demonstration now universal

in England, which I started at Roorkee in 1904, but for which there is no room and very little apparatus.

2. The very great importance attached to the proper training of motor men, as this innovation has undoubtedly come to stay, and though now in its infancy will, in 10 or 20 years, be almost universal.

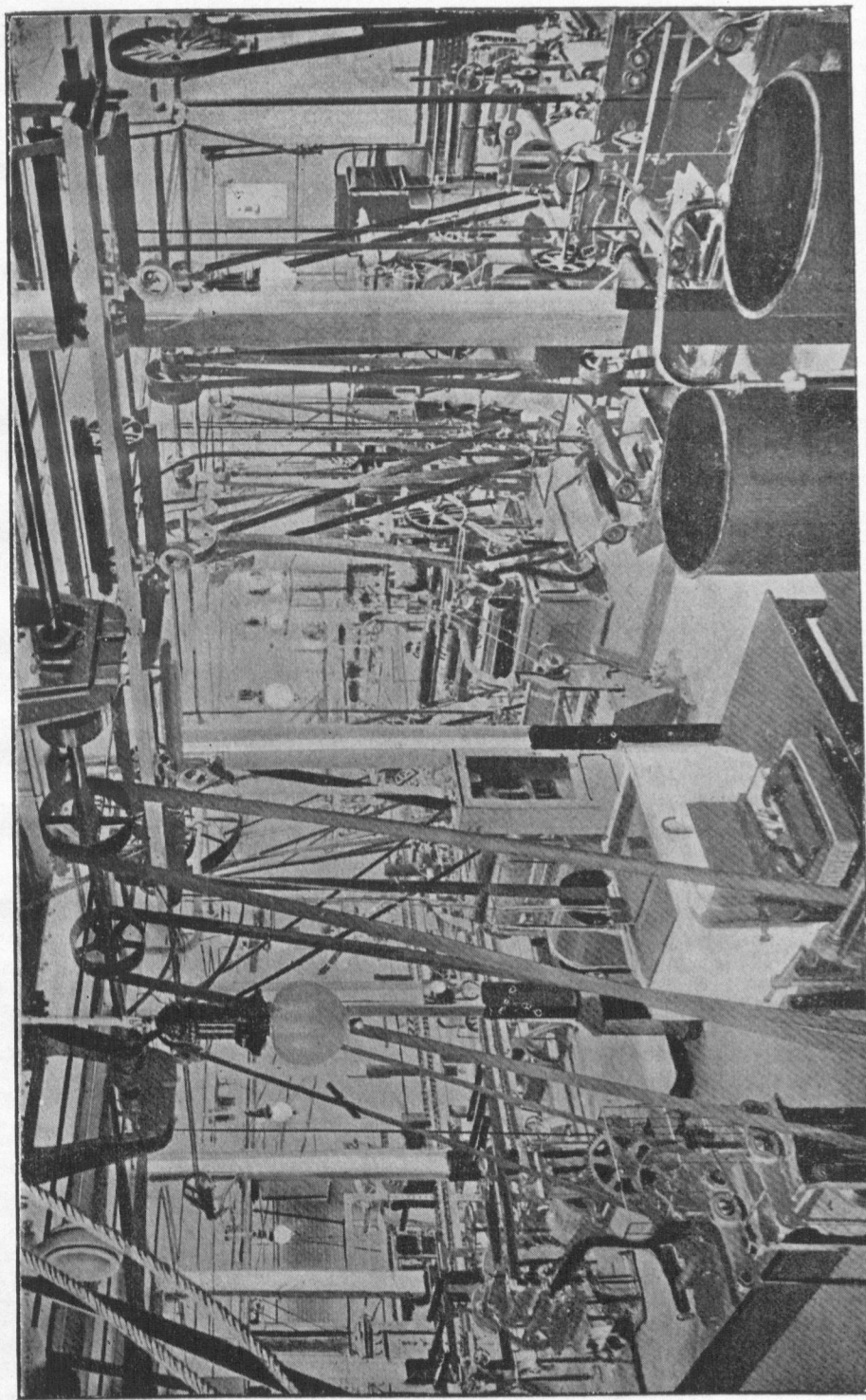
It may be noted that the average rates of receipts to expenditure in these schools are 1 to 3 or 4.

As regards Civil Engineering training I am of the opinion that the scheme of education and the work done at Roorkee is well up to, if not in advance of, any work I saw in England.

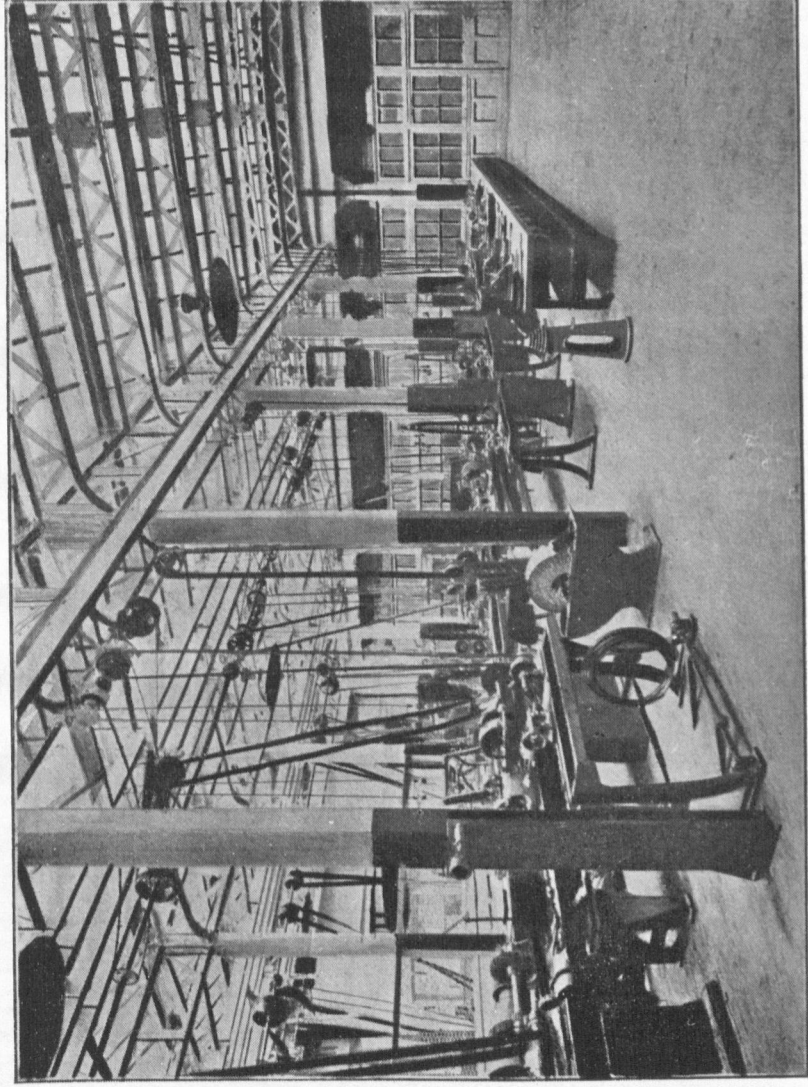


MANCHESTER SCHOOL OF TECHNOLOGY,
MATERIALS TESTING LABORATORY.

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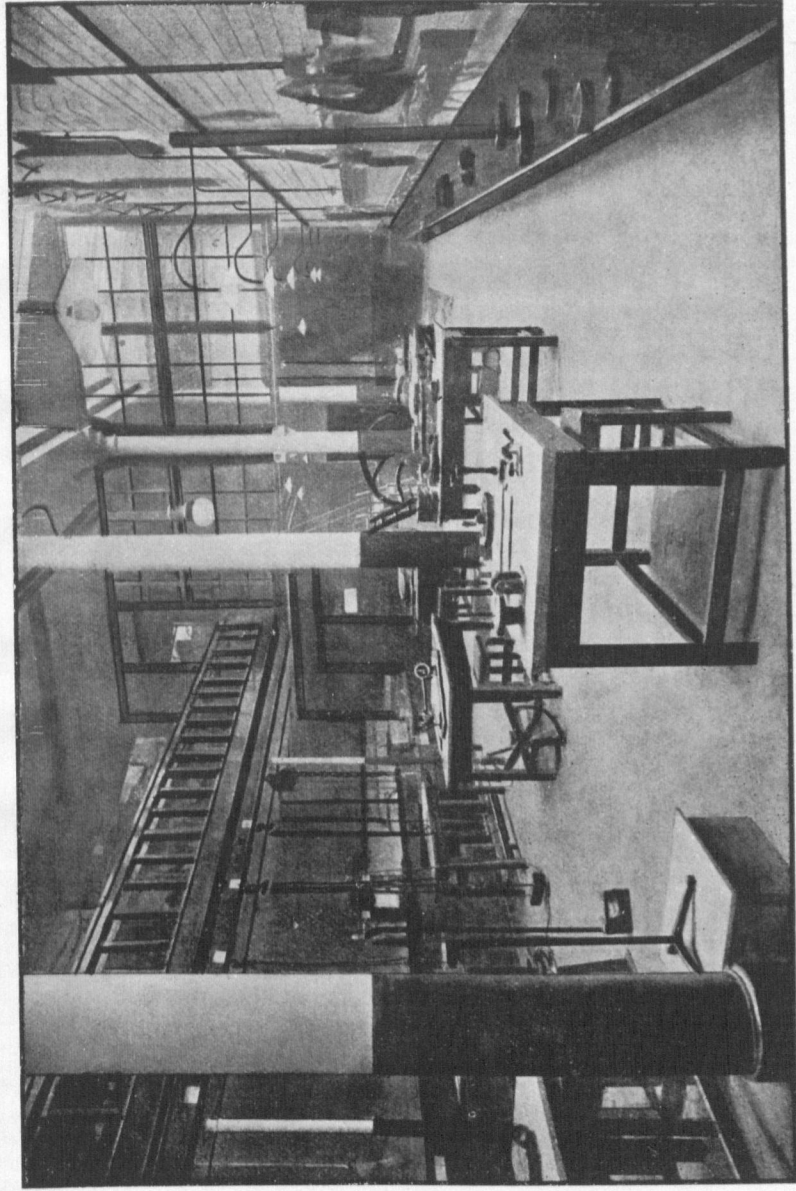


MANCHESTER SCHOOL OF TECHNOLOGY.
INTERIOR OF DYEHOUSE.

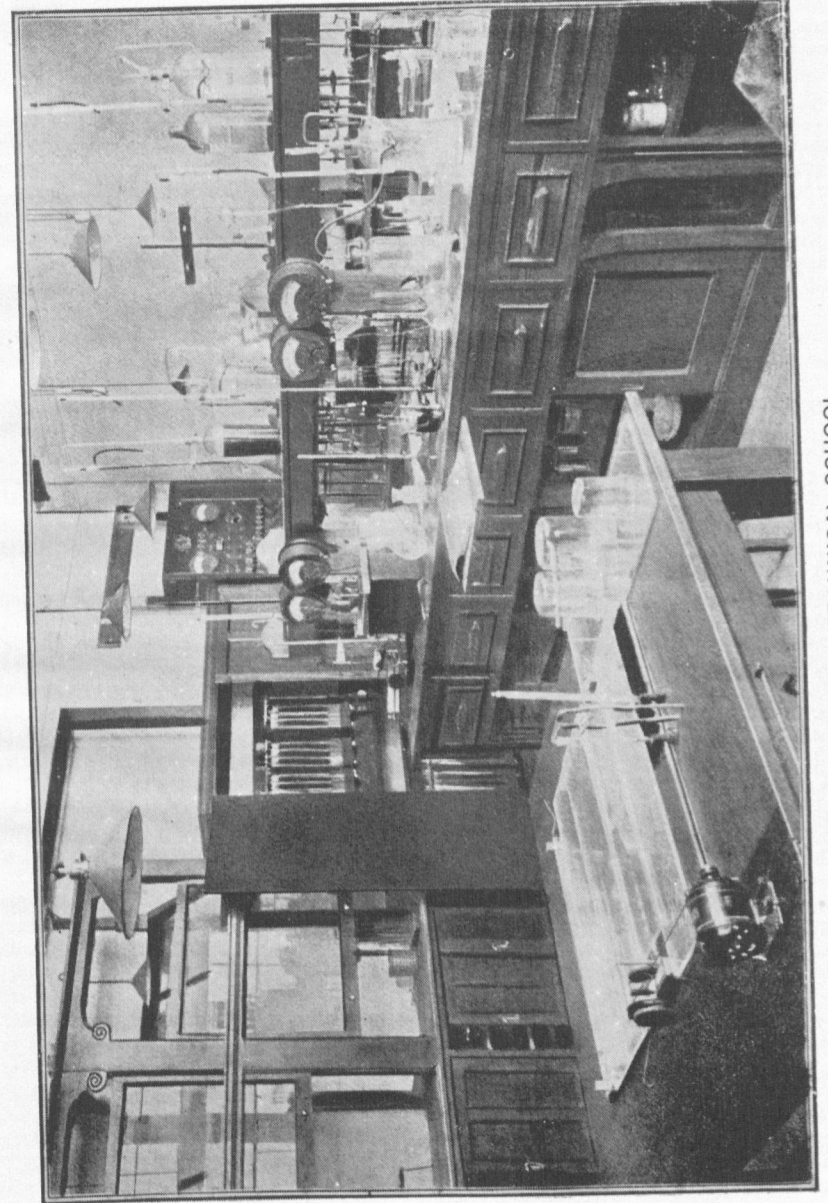


MANCHESTER SCHOOL OF TECHNOLOGY.
ENGINEERING WORKSHOP.

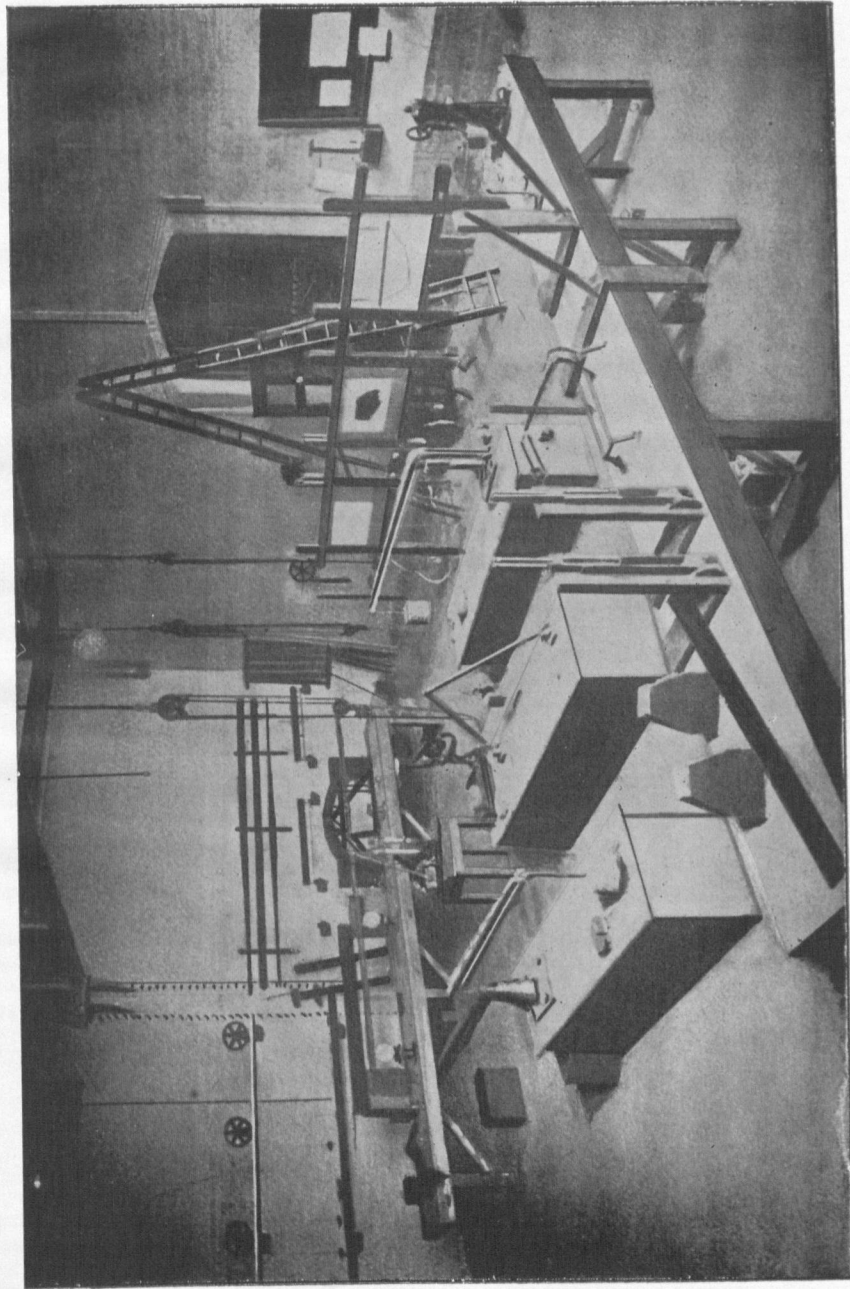
Photo. Mech. Dept., Thomson College, Roorkee.



THE BOROUGH POLYTECHNIC
MECHANICS' AND STEAM LABORATORY.



BIRMINGHAM TECHNICAL SCHOOL.
ELECTRO-CHEMICAL LABORATORY.



BIRMINGHAM TECHNICAL SCHOOL.
MECHANICAL LABORATORY.

Photo.- Mechl. Dept., Thomason College, Roopkee.

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A
REPORT

ON THE LATEST ADVANCES IN
PHOTOGRAPHY, PHOTO-MECHANICAL
AND
LITHOGRAPHIC WORK,

BY
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PRINCIPAL, THOMASON CIVIL ENGINEERING COLLEGE, ROORKEE.

4 - JUL 1907
SECRETARIAT.

Latest advances in Photography, Photo-Mechanical and Lithographic work.

The actual processes employed at Roorkee are mainly confined to Lithographic and Zincographic work, Half-tone or Process work and Heliogravure. The main principles on which these processes depend seem to be well established and perfected, and we seem to be well up to date in India in this respect. Any advances or improvements which may exist are chiefly in detail of manipulation, and it was impossible in the very limited time at my disposal to go into this in detail.

I visited the Schools of Photography, Bolt Court, Regent Street, and of about eight Technical Institutions. Unfortunately these were in vacations, all apparatus put away, and generally the rooms in the hands of repairers, so that I was unable to learn anything from these schools.

I was, however, fortunate enough to pick up several items of interest in visits to the following :—Survey of England, Southampton, Litho. Department ; War Office ; Autotype Companies' Works, Ealing ; Messrs. Hunter and Co., Poppin's Court ; Messrs. Penrose and Co., Farringdon Road, E.C. ; Strand Engraving Company, Strand ; Arc Engraving Company ; Anglo-Engraving Company.

Lithography.

The only new departure I noted was an invention by one of the foremen at the War Office of a system of permanent offsets for stone or zinc. Ordinarily, if corrections or additions have to be made on a map, a blue powder offset is taken on the stone or zinc to act as a guide, or if several colours have to be printed, blue impressions are taken on stone or zinc to guide in duffing out. This blue powder often brushes off under the friction of the arm and is hard to see. Under the new invention a permanent offset can be taken in any colour or colours which will not rub off and yet will not take up greasy ink in the printing. It can only be taken off the plate by grinding. This seems very useful, I was unable to get the details, but Major Close, in charge of the department, states that the details will be sent on application.

Zinc plates are very successfully used at Southampton, but the trade stick to stone a great deal. I am, however, informed that this conservatism is now being broken down, chiefly by the advent of rotary printing machines for which zinc is imperative. The trade now find that after a little practice they get as good results, if not better, off zinc as they did off stone. Aluminium has no apparent advantage and its price is prohibitive. I was surprised to see at Chatham the Field Lithographic units adhered to stone.

Even allowing for the sake of argument that you can get better work off stone than zinc, (which I do not believe) the Field establishments are not required to produce very high class work, and the number of zinc sheets which can be carried for the weight of one stone should I think be an unanswerable argument in the favour of zinc.

Heliozincography.

The only differences I noted in the manipulation of this process at Southampton to our methods at Roorkee were—

1. At Southampton they first treat the plate with a phosphoric etch to clean off all grease. This seems unnecessary if the plates are properly grained.

2. At Roorkee we sensitize the plate with equal parts of I. and II.

- | | |
|--|--|
| I. { Fish glue.
Bichromate of Ammonium.
Water. | II. { Sunlight Soap.
Ink dissolved in turpentine. |
|--|--|

The printing is then done from the negative.

At Southampton they sensitize the plate with—

Egg albumen.

Bichromate of Ammonium.

Water.

They then print from the negative and after printing ink-up with light Lithographic ink dissolved in turpentine.

Vandyke or Direct Zinc Printing.

In this process at Roorkee we sensitize with China glue, Bichromate of Ammonia and water mixed with a little Ivory black as a convenience to show up the ground.

At Southampton they sensitize with Fish glue and Bichromate, and after exposing dip the plate in a bath of aniline dye to show up the ground.

This is a very minor point, but it seems better to do the work in one operation if possible, than to use two.

At Southampton they find that by using a weak solution of Sulphuric Acid (3 per cent. solution) instead of the Hydrochloric Acid bath a very great improvement is noticed in the plate.

The Electric rotary fans used at Southampton were very efficient, though this is hardly necessary in India except in the rains.

I noticed at Southampton the use of Sach's pneumatic printing frames, in which a perfect contact is supposed to be obtained by pumping out the air and obtaining a vacuum. The operators, however, complained that they gave endless trouble owing to leaks.

Penrose and Co. state that an improved form of this printing frame has been introduced which is much more efficient. I should not, however, recommend this form of frame for India.

Graining Plates.

I feel no doubt that zinc plates grained by rotary troughs with glass marbles are much better and more quickly done than by the hand process.

At Southampton the hand process is still employed, but the reason I gather is the necessity for keeping it as a form of employment for spare hands when other work is slack.

The War Office have a stone-cleaning machine which seems very efficient. At this establishment a great deal of hand work seems to be done, and stone seems the favourite plate. The operator stated he much preferred aluminium to zinc, but I do not think this expensive preference on his part should be encouraged, as an examination of the zinc work done at Southampton will show that it is super-excellent.

Rollers.

I noted a pneumatic rubber roller invented by Mr. Turner, of the Survey of India. This is filled with air by a bicycle pump.

It has been very well received by the trade, and especially in process work it seems to pick up fine detail wonderfully well. It also has the advantage that it can be used for various colours as the rubber surface washes clean in a minute. It also always presents a level surface and can be made hard or soft as desired.

Printing Processes.

I saw some beautiful work turned out by the Autotype Company in "Auto-Pastel." This is a permanent process of Photographic Pigment Printing without transfer. It differs from "Gum Bichromate" in so much as the pigment coating, after exposure, becomes completely insoluble in hot or cold water and development of the latent image is achieved by abrasion, the film being indurated in varying degrees corresponding to the light and shade of the negative. Development is carried out with a camel-hair brush which gives enormous control over the picture. The paper can be procured in eight colours.

Collotype.

As this process depends on the varying amount of moisture absorbed by the different parts of a picture on a bichromated gelatine film printed under a negative, it has been found very unsatisfactory in India.

A new process called "Sinop" might however be tried in India.

The plates are supplied by the trades and are sensitized when required for use. After exposure under a reversed negative, when they show a positive image of a purplish brown colour, the plate is washed, drained and dried, then damped in a glycerine bath and is ready for fixing to the printing bed.

The results I saw were very good. The process can be applied to three-coloured work.

Half-tone or Process Work.

At Southampton this process is used for the reproduction of hills in small scale maps. The difficulty apparently lies in the fact that in half-tone blocks the whites still retain a stipple and this has to be got rid of by the tedious process of duffing out.

They are experimenting, however, with a process in which they will use a negative instead of a transparency, the whites will be black and the spots can be broken up easily. Details however were not to hand and can presumably be obtained on application.

I visited three commercial firms doing an immense amount of work. For commercial work which has to be done at great speed and in which no mistake can be allowed as time is an important factor, everything has to be cut and dried. Consequently all exposures are done by standard electric light (usually enclosed arc lamps), and the time can be fixed for various subjects. The originals, whether photographs or otherwise, are very carefully worked-up and fine etching is made use of to a very large extent. Each operation is confined to one set of operators who consequently are very proficient at their own work. Labour-saving apparatus (very often expensive machines) are used wherever possible, and naturally this method is very superior in its results to that which has to be observed when the work is carried out in a small way, viz., one operator carrying out the whole operation.

Three-Colour Process Work.

Very great advances seem to have been made in this, and though perfection has not been attained, the results, under certain conditions are very successful and promising. A large amount of experimental work however is still wanted in this line for India. The chief methods seem to be—

1. To use three gelatine plates, staining the emulsion to sensitize it for different parts of the spectrum, and making three blocks from screen negatives taken through blue, red and green filters. These are the lines we are experimenting on at Roorkee.

2. To use a collodion emulsion in which collodion is the vehicle for holding the sensitive salts instead of gelatine. The emulsion can be procured either in solution or powder. The sensitizing dyes need only be added when required for use. The development is done with hydroquinone or glycin and the fixing with hypo. Intensification and reduction are simple.

As however emulsion works best when kept below 60° Fahr., ice would have to be used in the hot weather in India.

The latter process is now worked commercially by many firms with striking success, and I saw a mass of work turned out speedily, and in many cases most artistically.

Heliogravure.

I saw some very perfect work done by the Autotype Company, the detail of manipulation seemed exactly the same as that employed at Roorkee, and perfection simply depends on the experience, judgment and skill of the operators.

The carbon tissue recommended by this firm was Burnt Sienna, this being a transparent colour shows up the image well, and is better than standard Brown or Red.

The carbon printing done by this firm was very fine.