1887

# Report Presented to The Council of the Dublin Technical School : Kevin Street

William Robert Maguire
*Corporation of Dublin*

T. R. Scott
*Corporation of Dublin*

# REPORT

PRESENTED TO

## The Council of the Dublin Technical School,

KEVIN-STREET,

*Acting as a Sub-Committee of the Public Libraries Committee of the Corporation of Dublin,*

BY

A DEPUTATION (MESSRS. WILLIAM ROBERT MAGUIRE AND T. R. SCOTT)

*Named to visit Technical Schools and Science and Art Schools in England, and advise as to what branches of Science and Art could be most effectively and economically introduced in the Kevin-street Schools.*

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DOLLARD, PRINTINGHOUSE, DUBLIN.

1887.

# REPORT.

To the Council of the Dublin Technical School, Kevin-street, acting as a Sub-Committee of the Public Libraries Committee of the Corporation of Dublin

*May 20th*, 1887.

Gentlemen,

In presenting herewith the detailed Report of our visit as a Deputation to Technical Schools and Science and Art Schools, &c., in England, we wish to explain that as the Corporation are supporting a Science and Art School in connection with a Technical School in Kevin-street, and as a similarly combined system of Education is very generally followed in English Technical Schools, we considered that we would equally meet the views of the Libraries Committee and the Council by describing the two systems in combination, as we found them in practice.

We have to express our great regret that we were deprived of the advantage of the assistance of the Honorary Secretary, Mr. Arnold F. Graves, owing to unforeseen pressure of business detaining him in Dublin.

We found the Technical School system generally combined with Science and Art Classes spreading rapidly in England, through the private exertions and munificence of manufacturers and merchants, and also we found evidences of a determination to urge upon the Government the duty of providing State aid.

This Jubilee year in England has been used in many towns for the purpose of inducing a special exertion of liberality in establishing and extending Technical Schools.

At Bolton, public meetings have been held, and a memorial to take the form of a Technical School on a large scale has been determined on.

At Rochdale, £10,000 is the estimated sum required, towards which three subscriptions of £500 each, five of £250, one of £200, two of £150, and ten of £100 each, in all £4,500, were promised at the public meeting.

At Blackburn, it has been decided to expend £25,000 on Technical Schools for the Borough; the Mayor heading the list with £500, followed by ten other subscriptions of £500 each, six of £250 each, and others making a total of £8,500 to begin with.

At Stockport, the Mayor has promised to supply all the machinery, and a friend of the Mayor's will provide the building for a Technical School.

At Dewsbury, £10,000 has been adopted as the proper amount to allocate; while at Burnley, and also at Bingley, a small town near Bradford, £2,000 have been subscribed at one meeting.

At Wakefield, the working-men themselves are raising £1,000, and large sums coming in also from other sources.

At Huddersfield, £11,600 has been subscribed for an extension of the existing Technical School.

In all these, and in many other English towns, Technical Schools are being promoted this Jubilee year; and we are strongly of opinion that if moneys are collected in Ireland for this purpose they could not be more profitably invested for the benefit of the whole community than in the establishment of Technical Schools.

Very much larger sums than those named have been expended on Technical Schools which we visited. In London, £200,000; Nottingham, £70,000; Bradford, £40,000; Manchester, £20,000; Birmingham, £80,000, &c.; and besides these are many others which our time did not allow us to inspect, such as Huddersfield, £21,000; Leeds, £125,000; Sheffield, £15,000; Keighley, £30,000; Bristol, £12,000; Glasgow, £25,000; Edinburgh, £12,000; while on the Continent and in America far larger amounts are willingly devoted to this purpose.

We mention this financial aspect of the question specially to impress the fact that money must be forthcoming if we are to establish suitable Technical Schools in Dublin. We ask and require £2,500 to establish, and £1,000 a-year to maintain Technical Trade Schools, as a minimum amount; we really ought to get £10,000 and £2,000 a-year to enable the Council to provide the best machinery, and to produce the best results. We should require, in addition, for Science and Art Schools, a sum of £1,000 to furnish and £1,000 a-year for maintenance, and also £2,700 to buy out the lease, and £2,000 for new buildings.

It is important, we find, that no time be lost by the Libraries Committee in preparing the trust deed required by the Science and Art Department as a condition precedent to obtaining a building grant, and also that complete plans, elevations and sections of the entire premises be prepared and sent to the department, with a formal application for the utmost grant, and a a request for official inspection of the premises. The advice and instructions given by Colonel Donnelly, of the Science and Art Department, and by Sir P. Magnus, of the City and Guilds of London Technical Institute, will be found in our Report.

We have to recommend that memorials be prepared and presented without delay to all Dublin Banks and Public Companies, by a special deputation from the Council, and that the Right Honorable the Lord Mayor be requested to accompany the deputation also, that energetic steps be at once taken by the

Council to obtain subscriptions by one way or another commensurate with the commercial importance of this city.

Dublin, containing 350,000 inhabitants, surely should compare with Keighley, whose 30,000 inhabitants subscribed £30,000 for a Technical School.

We direct special attention to portion of our Report where we recommend application for special State aid to be urgently pressed, and questions asked in Parliament as to whether, on the recommendation of two Royal Commissions on Education, the Science and Art Department will be authorized to increase the amount of their grants to aid Technical Schools in Ireland.

We found three classes of Technical Education in practice in England, with satisfactory results.

1. Manual Training Classes; elementary for lads.
2. Technical Day Classes; advanced.
3. Technical Evening Classes for artisans and apprentices.

each combined generally with Science and Art Classes; and we recommend the Council to make arrangements for commencing in September.

Day Manual Training Class, with Science and Art Classes for lads.

Evening Technical and Workshop Classes, with Science and Art Classes for working artisans and apprentices.

But we recommend that unless the Council receives a much larger amount of money than they have already been entrusted with; that the very useful advanced Technical Day Classes with workshop instruction combined with Science and Art Classes, requiring much more costly and elaborate appliances, and a stronger staff of teachers, be postponed for the present, especially as they are intended for the sons of parents who can afford to keep their boys at school from 14 to 17, and to pay from £12 to £18 a year in fees.

We are of opinion and recommend that in the Manual Training Classes, youths should receive instruction for the head, eye and hand in Mathematics, Drawing and Geometry, Elementary Science, Mechanics, Physics and Chemistry, with workshop practice in use of *wood* working tools and materials during the first year, and in metal working tools for lead and iron during the second year; not with the object of teaching a trade, but to put the lads into the best possible position to choose their future vocation, and to learn the trade in the actual workshop when chosen. The ages of lads may range from 13 to 15. Admission to these classes to be obtained through examination equal to V. Standard National Education Code, or VI. Standard in England.

We consider the Manchester fees of £6 a-year too high for artisans children, though there it is freely paid, and would be disposed

to recommend 1s. per week as sufficient with three terms of about fifteen weeks each per session year; and as it is most important that lads should not be withdrawn in the middle of a session by any failure to pay fee on parents part, we suggest a special large reduction of one-third of the fees, if paid for the whole session in advance, employers would readily advance the amount to any workman, deducting the reduced fee of 9d. weekly from the employee's wages in repayment. Thus, instead of 45s. per year, the reduced fee would be 30s. per year per student. Free studentships and half-fee studentships, should be arranged for boys who pass the examination with special credit. And for those lads who pass their two years course with special credit, free scholarship either to the evening classes for apprentices who go to business at once, or to the advanced day technical courses, if they be established, as we hope they may be, before two years have passed.

We also recommend that the Evening Technical, Science and Art, and Workshop Classes be at once provided for, so as to commence in September, following to a great extent the most suitable Classes at the Polytechnic Institution, London, and the Manchester Technical Schools.

The details of our Report will be found more serviceable to a Sub-Committee than to the Council; so we recommend that a Sub-Committee be appointed by the Council of the Technical Schools to consider these details, and to arrange for teachers, and fees to pupils; for the definite allocation and arrangement of rooms, benches, tools, &c., for Kevin-street; to report to the Council from time to time, and to be instructed to set at work without delay as the time is short for preparation.

We are of opinion, from close observation, that Mr. W. V. Dixon's assistance will prove of great practical value to the Sub-Committee and Council in the arrangement of the Workshops, Classrooms and Laboratories, and in the economical construction of scientific appliances and models. His practical experience in the actual mechanical workshop and chemical laboratory during the past nine years, supplemented by the special experience he is now acquiring at Finsbury Technical College, London, being exactly of the special kind required for such work.

With this in view, we would ask the Council to decide at once whether it would be most advantageous to the school to direct Mr. Dixon to return in June to take permanent charge of the arrangements decided on by the Council, or to adopt Sir Philip Magnus' advice, and arrange for Mr. Dixon to remain in London, and to take advantage of the Special Summer Courses for Technical Teachers in July at the Central Institute, Kensington. We recommend that Mr. Dixon be brought to Dublin for a fortnight before these courses, in any case to aid the Sub-Committee in their planning and decisions regarding workshops and laboratory arrangements,

and that he be sent back to attend the July courses, and obtain teachers' diplomas, which will be serviceable hereafter in many ways. He can then, at the end of July, take up the personal supervision of the arrangements at Kevin-street, so as to have all complete for September opening.

We desire to record that the Council have reason to thank Sir Philip Magnus, the Director of the City and Guilds of London Institute, and also Professor Sylvanus Thompson, the Principal of Finsbury Technical College, for the facilities afforded to Mr. Dixon for attending the working Classes, &c., at Finsbury College, and thus acquiring valuable experience for the service of the Council of the Dublin Technical Schools.

We append, among various appendices to our Report, a list of technical and scientific books, &c., used in Technical Schools in England, for consideration of Book Committee.

We have the honour to remain,

Gentlemen,

Your obedient servants,

THOMAS R. SCOTT.
WM. ROBT. MAGUIRE, *Hon Treasurer.*

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*(For Committee use only.)*

## DEPUTATION REPORT TO COUNCIL OF THE DUBLIN TECHNICAL SCHOOLS,

*Acting as a Sub-Committee of the Public Libraries Committee of the Corporation of Dublin.*

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On Saturday, April 16th—Left per Mail, Dublin to London, in order to meet Sir Philip Magnus, by appointment, on Monday, as he was leaving for the Continent on following Tuesday.

Monday, April 18th—Prepared documents and questions, and met Mr. Dixon, Assistant Secretary, with whom we proceeded to wait formally as deputation on Sir Philip Magnus, at Central Institute, Kensington, by appointment.

Cordially received by Sir Philip Magnus, and conferred with him on our mission, and afterwards inspected the Institution, visiting each room and workshop, and receiving information thereon.

Asked Sir Philip Magnus would the Institute be good enough to assist the Council of Dublin Technical Schools—

1. Generally from time to time with advice, &c.
2. By a money grant towards the establishment of the Schools.
3. By an annual grant towards the maintenance of the Schools.

Replied—That he could answer at once affirmatively for No. 1; but that the answer to Nos 2 and 3 must come from the Council of the Institute. He would recommend the Council to give us any aid in their power, and advised the deputation to draw up and send in a formal memorial to the Council of the City and Guilds of London Institute, specifying our requests and our claims, and showing our objects and constitution, names of Committee, and all subscriptions promised and paid, sources of income, &c. Sir Philip was leaving London next day, but on his return, (15th May), would expect to find the memorial, and would do all he could to secure a grant; but said that had we applied three years earlier, he could have secured us much more help than he could now.

Asked Sir Philip whether our classes would be at once admitted to the system of examinations, and a centre formed at our School in Dublin for examination.

Replied—That every facility would be afforded to us when we complied with the rules laid down; sent in the forms properly filled up in September; and had our teachers and classes ready to commence work early in October.

Asked whether our Council would be accepted as the Local Committee for Dublin.

Replied that our Council would be the proper Local Committee, and would be duly accepted, if the names were sent forward in September next.

Asked Sir Philip for his advice as to teachers, officers, salaries, &c., as he was aware of our connection with the Corporation Libraries Committee, and of the mutual agreement we had entered into.

Replied—He would advise us to commence quietly, and feel our way; that we would need an officer who might be called an Assistant Secretary, to see to all administrative work, to prepare and send out circulars, programmes, prospectus, to summon committees, to receive fees, to work in subscriptions, to superintend examinations, and act as Local Secretary to Guilds and to Science and Art Department, to regulate the Library, and to do all necessary administrative work; very useful that he should be a practical and scientific man, if such can be found for a moderate remuneration, such as we could afford.

No regular Librarian would be required; it would be waste of money at present; the salary for Librarian might be utilized by making it portion of the salary of the Assistant Secretary, who should be well able to do the necessary work for two years at least, unless the School makes very rapid growth.

Thinks we will find a Head Master or Superintendent necessary for the purpose of organizing and regulating the teachers and classes, and of seeing that the teaching in each class is sound by constant supervision; also he should be capable of doing some

good teaching work himself. He should be responsible for the teaching of at least two subjects, and take the classes himself, especially while the classes are only held in the evening. He might gradually establish day classes also, feeling the ground as he proceeds, not beginning too much at once.

Such a man should receive a good salary.

Recommends deputation to apply to Clerks of London Guilds for aid, but fears available funds are allocated; will use his influence now.

Asked Sir Philip his advice as to how we should pay teachers, by fixed salaries or by result fees.

Replied—That in his opinion it is best to pay so much per lesson given in technical classes, amount according to the subject, &c.; 2s. 6d. to 5s. in practical classes, together with a certain proportion of the entrance-fees, and of the result-fees, but not to make the teacher's salary dependent wholly on result fees. (Our recommendation would be to pay teachers by salaries, with a share only of fees.) Workshop teachers should be practical artisans, having also a scientific knowledge of the theories underlying their crafts.

Asked advice as to cheap arrangements for fitting workshops and class-rooms.

Replied—Will best learn this by inspecting schools at work. Syers, of Finsbury Circus, supplies benches and fittings of a good class; but we may be able to manage cheaper ourselves, especially if we have an Assistant Secretary or Superintendent who has a knowledge of the requirements, and will devise the best and cheapest arrangements; they vary in nearly every school.

Drew attention particularly to a new publication, "Exercises on Wood-working," 4s. 6d., Longman, Green & Co., as very useful.

Asked advice as to fees chargeable to artisans and apprentices for evening classes.

Replied—About from 6s. to 7s. 6d. per term, such as in Plumbing and Carpentry Classes, and half fees to Apprentices—6s. Artisans; 3s. Apprentices; 7s. 6d. Artisans, 4s. Apprentices.

Insist on a deposit, which shall only be refunded in event of student sitting for examination to secure result fees.

Asked advice about our Assistant Secretary, now admitted free to observe classes, &c., at Finsbury, he being a practical workman, reared at the bench and lathe in a workshop in Dublin.

Replied—Strongly recommending that he be sent to the Summer Courses intended for teachers at Central Institute in July, after he has finished at Finsbury end of June. Thinks nothing can possibly be of more service to the Dublin Schools than that one at least of their officers should have the opportunity of learning all he can learn of the practical working of the classes, &c., at both Finsbury College and Central Institution. Sir Philip Magnus kindly said that if our Council sent a formal written

application, he would endeavour to obtain leave for our Assistant Secretary to attend Central Courses in July, free of charge, as a continuation of his gratuitous attendance at Finsbury, as the case was a special one, and the arrangement would tend to such great advantage to the Dublin Schools.

Advises us to see Mr. J. Morley, relative to special State aid, and Col. Donelly for Science and Art aid; but considers we have no chance whatever of any grant from Kensington for Technical Classes, even as a special legislative experiment in Ireland, *would be contrary to law.*

Asked Sir Philip whether direct trade or artisan representatives were admitted on any of the Technical Schools in England, for our Council specially provided in the constitution to have four trade representatives on the Council,

Replied—That he was not aware of any school with workingmen represented on the governing bodies, although he is of opinion that if the difficulties could be surmounted such a representation would be useful.

Asked how a just and fair trade representation could be secured in best manner.

Replied—The only method he saw was by means of a subscription franchise, by fixing a small annual subscription, which would entitle each subscribing artisan to a vote. Stated we feared that artisans generally would not subscribe for this object.

Replied—Then if artisans refused to contribute, they should not expect to have any right to a special representation on the Council, but should be sorry to be taken as suggesting that the artisan representation would be any disadvantage, the chief difficulty being how to secure a just representation.

Advised us to consult Mr. Johnson, Town Clerk of Nottingham, and Rev. B. Paton, Nottingham, for information on the trades representation.

We found in Manchester that since last November two artisans have been placed on the Council there.—(See our Manchester Report); and we approve strongly of the principle adopted by the promoters of the Dublin Technical Schools of admitting the artisans to our Council, as we are sure that care will be taken to send trade representatives able and willing to do good work.

The deputation then were shown over the Institute. On top floor is a large room, 50 by 30, intended as museum; noticed some excellent desks 18in. by 26in. on top, made by North of England Furnishing Company, Darlington.

London Offices, Newgate-street; but too costly for Dublin. Refeshment rooms, where dinners are provided at cheap rates for students.

Store rooms for Chemical and Laboratory Classes.

74. A balance room, with large diagram, drawing table in centre, by Steevens and Basto, 195, Stewart's-road, Wandsworth-road, south.
75. A Polariscope room.
71. A gas analysis room.
A photographic room.
Several rooms for caretakers, stores, &c.

ON MEZZANINE.

51. A large junior chemical laboratory, 90 by 40.
Place for 50 to 60 students.
52. A chemical research laboratory, under junior laboratory.

ON SECOND FLOOR.

56. Professor Armstrong's private laboratory.
57. „ „ private room.
58. „ „ class room.
59. Chemistry class room, with raised benches, balanced portable black board.
55. A special stink chemical room, opening only on outer balcony.
62. An art museum (empty).
63. A class room, raised benches, black boards, &c.
65. A wood-carving work room.
Best carving tools, Addis & Son, Sheffield, or light spades and bent tools, Wincote, 23 Edale-road, Rotherhithe, S.E. (See *Polytechnic*, who state Corrington's tools better than Wincote's.

FIRST FLOOR.

49. A junior electrical laboratory, with series of special class experiments, arranged in systematic order.
47 & 48. Do. Magnetism do.
48. Do. Heat do.
A library in centre; £300 a-year granted to add books.
Several rooms belonging to the administration.

ON GROUND FLOOR.

A private room of Professor Unwin.
27. A class room, raised benches, revolving portable black board, enabling drawing to be made horizontal.
22. A chemical preparation room.
A large chemical lecture theatre.
A large physical lecture theatre.
21. A physical preparation room.
A class room for mechanics and mathematics.

34. An optical laboratory.
33. A private room—Professor Ayrton.
32. A class room for physics, capable of being darkened for optical experiments and measurements.
An engineering class room.

ON BASEMENT.

A dynamo room.
An engine room.
A carpenter's shop; tools cost 25s. per student's set, at Bucks.
A mechanical laboratory, fitted with series of instruments and benches and various machines.
An engineering drawing office.
A physics workshop.
An electrical research laboratory.

All fittings and experimental appliances appear to be of too high a class, too well finished and elaborate, and costly for our Dublin schools, the institute being designed to complete the education of Technical teachers, and give high-class scientific training, as in College of Science, Dublin.

The object of the CENTRAL INSTITUTION is to give to London a College for the higher Technical Education, in which advanced instruction shall be provided in those kinds of knowledge which bear upon the different branches of industry, whether Manufactures or Arts.

The instruction to be given will be such as shall qualify persons to become—

(1.) Technical Teachers.
(2.) Mechanical, Civil, Electrical, Chemical and Sanitary Engineers.
(3.) Principals, Superintendents, and Managers of Manufacturing Works.

Laboratory Instruction is given in Chemistry, Physics, Mechanics and Engineering, and special lectures will be delivered on the Technology of different trades.

Students intending to go through the complete course of Technical Instruction, with the view of subsequently obtaining a Diploma, are required to pass an Entrance or Matriculation Examination, which includes Pure and Applied Mathematics, Mechanical Drawing, Physics, Chemistry, and French or German.

Students wishing to attend separate courses are only required to satisfy the Professors that they possess sufficient knowledge to follow such courses.

The fees for separate courses, including laboratory work, are from £10 to £30.

The following Scholarships, tenable for two or three years, are awarded on the results of the entrance examination:—

(1.) The Clothworkers' Scholarship of £60 a-year for two years, renewable for a third year, with free education.

(2.) Two Mitchell Scholarships of £30 a year for two years, one with, and the other without, free education; open to Mitchell Students of Finsbury Technical College.

(3.) Three Institute Scholarships, covering the Student's fees, and tenable for three years.

SUMMER COURSES, 1887:—Besides Courses of Lectures and Demonstrations on Special Technical Subjects, Courses of Lectures and Laboratory Instruction will be given to Technical Teachers and others during the month of July, 1887, by Professors Henrici, Unwin, Ayrton and Armstrong, on subjects connected with Mechanics and Mathematics, with Civil, Mechanical and Electrical Engineering, and with Chemistry. Registered Teachers of the Institute, may, on application to the Director, be admitted to these Courses without payment of fees, so that we may hope that the Dublin Technical Schools will largely benefit by this educational influence on their Teachers.

The Dublin Technical Schools are also closely concerned in the Institute's Annual Technological Examinations.

The City and Guilds of London Institute for the advancement of Technical Education, afford facilities for carrying out an Examination in any of the subjects enumerated in the List given below, wherever a class for instruction is formed, or a sufficient number of candidates present themselves, provided a Local Committee undertakes to carry out the Examination according to the rules laid down in the Programme.

## SUBJECTS OF EXAMINATION.

1. Alkali and allied Branches.
   - A. Salt Manufacture.
   - B. Alkali ,,
   - C. Soap ,,
2. Bread-Making.
3. A. Brewing.
   B. Spirit Manufacture.
4. Coal-Tar Distilling.
5. Sugar Manufacture.
6. Fuel.
7. Oils, Colours, and Varnishes, Manufacture of.
8. Oils and Fats, including Candle Manufacture.
9. Gas Manufacture.
10. Iron and Steel Manufacture.
11. Paper Manufacture.
12. Pottery and Porcelain Manufacture.
13. Glass Manufacture.
14. Dyeing—
    - A. Silk.
    - B. Wool.
    - C. Cotton and other Vegetable Fibres.
15. Bleaching and Printing of Calico or Linen.
16. Leather—
    - A. Tanning.
    - B. Boot and Shoe Manufacture.
17. Photography.
18. Electro-Metallurgy.
19. Textile Fabrics, Manufacture of—
    - A. Cloth.
    - B. Cotton.
    - C. Linen.
    - D. Silk.
    - E. Jute.

20. A. Lace Manufacture.
    B. Framework Knitting.
21. Weaving and Pattern Designing.
22. Electrical Engineering.
    A. Telegraphy.
    B. Electric Lighting and Transmission of Power.
    C. Electrical Instrument Making.
23. Metal Plate Work.
24. Plumbers' Work.
25. Silversmiths' Work.
26. Watch and Clock Making.
27. Tools—
    A. Wood-working.
    B. Metal-working.
28. Mechanical Engineering.
29. Carriage Building.
30. Printing—
    A. Typography.
    B. Lithography, &c.
31. Ores, Raising and Preparation of.
32. Mine Surveying.
33. Milling (Flour Manufacture).
34. Carpentry and Joinery.
35. Brickwork and Masonry.

In the subjects numbered 1, 3, 14, 16, 19, 20, 22, 27, 30, Candidates must select one Branch only, A, B, C, D, or E, in which to be examined.

The Examination will be in two Grades :—I.—Ordinary. II.—Honours. Certificates (First and Second Class) will be awarded in each Grade.

## PRIZES.

The following Prizes will be offered in each subject :—

### HONOURS GRADE :—

1st Prize, £5 and a Silver Medal. 2nd Prize, £5 and a Bronze Medal.

### ORDINARY GRADE.

1st Prize, £3 and a Silver Medal.
2nd Prize, £3 and a Bronze Medal.
3rd Prize, £2 and a Bronze Medal.
4th Prize, £1 and a Bronze Medal.
5th Prize, a Bronze Medal.

There is no limit of age, and no fee for Examination. Any persons desiring to be examined should apply to the Secretary of the nearest Local Committee, who will forward their names to the Central Office in London.

Wednesday, 20th April, deputation proceeded to Nottingham, as advised by Sir Philip Magnus, and to Manchester, intending to call at Leicester, to see Wyggeston School, but this was not found convenient; but we give prospectus. See Appendix E.

## MANCHESTER.

Taking Manchester Technical Schools first, Mr. J. H. Reynolds, the Secretary, devoted some hours to explain details, and show the institution with numerous classes at work.

The building originally belonged to Mechanics' Institute, which being in debt £2,200, transferred building and debt to a new body, consisting of manufacturers, commercial men, and representatives of Queen's College and Schools of Art, who raised £9,000.

The Manchester and Salford Co-operative Society, numbering 10,000 members, and possessing an education fund formed out of 2½ per cent. of their profits, subscribe £25 a-year, and give five £5 scholarships, and send one representative to the Council.

Last November the Council considered the question of admitting direct trade representation, and decided to request the Manchester and Salford Trades' Union Council to nominate two members on the Technical School Council, as the Technical Schools wished to get into closer touch with the trades.

No subscription is given by the Trades Council 60,000 illustrated circulars (see specimen) were prepared and sent to engineers, joiners, plumbers, &c., to bring the schools and work to their personal notice.

It is expected that this new rule will work well. The President and Secretary were nominated by the Trades' Union Council.

The tradesmen and artisans are sending their sons to the schools, thus showing they believe in its efficiency.

There are 2,450 individual students. 40 Engineering Day Students, at £15; 70 Manual Training Students, at £6. 13 to 15 years old, chiefly from middle classes, shopkeepers and small merchants, and some artisans. English Composition and Correspondence is taught.

An elementary knowledge of Euclid and Algebra is expected in students at entrance.

There are 4 Laboratories in this school.

The Secretary attends all day; was constantly in demand for tickets, queries, &c., while with us. Men and lads came to Reading Room in working clothes. £9,000 was raised to pay off debt, £2,200, and alter building and to put in machinery and Fittings, and engage permanent staff of Teachers; this fund is now exhausted.

There is no regular annual income. £2,600 a-year is required for teachers' salaries in both Science and Art, Technical and Workshop Classes; there are 45 teachers, varying £5 to £300 a-year.

There is no Head Master. The Secretary manages to keep all Departments and the masters in touch, and to regulate all details harmoniously, so that Head Master can be dispensed with.

The Deputation inspected the elementary and advanced classes at work in Practical, Plane and Solid Geometry, and Mechanical Engineering, &c., under Mr. Cryer and Assistant Masters. About 90 Students were at work. The Head Master receives £300 salary. His Assistant, a first-class man, has £200 salary. A mechanic in charge of Mechanical Workshop gets £130 a-year.

To meet this expense there are 40 Day Students in Mechanical Engineering, at £15=£600; and the Night Classes under Mr. Cryer also draw largely on results, say=£500.

The total result fees for all the Classes in the School=£1,500.

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|---|---|---|---|
| Received in proportion from Kensington | ... | ... | 1,355. |
| And from Guilds' Institute | ... | ... | .. 145. |
| | | | £1,500 |

Guilds' Examination is *said* to be much more difficult than in Science and Art, purposely, as their funds are very limited. As a rule all grants and results go to the institution. £150 was spent in purchase of models of soap machinery details, &c., from Schroeder, of Darmstadt, whose models, we were informed, are specially good.

The Head of Mechanical Engineering Class, gives his whole time to the work.

Evening Classes taken by Mr. Cryer.

| | | | |
|---|---|---|---|
| Monday, | 7.25 | to 8.25 | Applied Mechanics. |
| | 8.30 | 9.30 | Machine Construction, or Steam. |
| Tuesday, | 7.25 | 8.30 | Practical, Plane and Solid Geometry. |
| | 8.30 | 9.30 | Mechanical Engineering. |
| Wednesday, | 7.35 | 9.30 | Practical, Plane and Solid Geometry. |
| Thursday, | 7.25 | 9.30 | Machine Construction & Mechanical Drawing. |
| Friday, | 7.25 | 8.25 | Metal Working. |
| | 8.30 | 9.30 | Machine Construction and Applied Mechanics. |
| Also Daily Classes, | 9.5 | in | Geometrical and Mechanical Drawing, Mechanics, Steam, Metalurgy. |

With these two Masters are three Workshop Instructors.

The Manual Training School for Boys includes Literary Classes in English and French, Reading, Writing and Arithmetic, Drawing, Chemistry, and Manual Workshop Training, from nine o'clock to four o'clock. Age, at least 13 at entrance, and must pass examination equal to VI. Standard English.

It is not the intention to promote Literary Classes in Dublin.

In the Carvers and Carpenters' Workshop we found—

20 Benches with a lathe on each bench, which we think unnecessary; 3 sets of Tools belong to each bench.

The 20 Lathes cost £8 each = £160, with all overhead pulleys and gear.

The 20 Benches cost £4 each = £80.

The 60 Sets of Tools = £90.

A 8 to 12 H.P. Engine, Otto Gas, £275.

Fifty students every evening.

A steam engine would be more useful for many reasons, but would cost more, requiring the employment of a regular engineer stoker.

A Machine Shop in basement contains—

A Smith's Hearth.

30 Vices arranged both on centre benches and on benches round walls, wherever room.

1 Planing Machine, 3 feet (Craven's), £105.

1 Slotting Machine (Muir), £98.

1 Drilling Machine (Kendal & Griest), £45.

1 Screw-cutting Lathe (Smith, Coventry), £84.

2 Hand-lathes on one bed (Cunliffe & Croom), £45; capable of use, whole length.

1 Handlathe (Craven), £80.

Keep all students busy at work for school itself. Don't sell anything to public.

In Bradford goods are sold, but the principle is considered to be a bad one, for many reasons.

This same room is used for Plumbing Class; no other available.

Two classes, ordinary and honours—Plumbing. Two lecture nights, 7 to 8; two practice nights, 8 to 9.30.

Plumbing Teacher is Mr. Radcliffe, Sanitary Inspector of Gas and Water for Corporation. He receives £16 per annum—October to May, 30 weeks.

Fee for ordinary classes, 10s. session per student; fee for honour classes, 12s. 6d. session per student.

Plumbing students are advised also to join classes in Chemistry, Mechanical Drawing and Applied Mechanics, along with their Plumbing classes.

A Printing Workshop, with presses and students at work; but there are not sufficient means to start proper sets of type. Class in Printing very backward. Teacher is a foreman at a Press Printers. Comes evenings only, and gives 30 lessons for £15.

Typographical Printing—fee 5s. Wednesdays, 7.30 to 9. Teacher, Mr. Johnson.

Lithographic Printing—fee 5s.

A large class room for Theoretical Mechanics, with seats, benches and black boards, is in constant use.

A Weaving School contains 12 different forms of loom:—Velvet loom, towel loom, check loom, jacquard loom, hand-loom—nearly all presented by the makers to the School.

Practised weavers come to the classes to acquire experience in drafting and designing, and are glad of the opportunity to learn afforded here, which is not afforded at any of the works.

A Spinning School, 60 feet by 20 feet, contains a complete range of spinning machinery, except the scutching and opening machines, which are unnecessary for teaching purposes; they occupy much room and are dangerous machines.

The cotton is purchased in the lap, after it has passed elsewhere through the scutcher and opener.

About £4 worth of cotton suffices for the session, and the outcome is sold as waste product.

| | | |
|---|---|---|
| The Weaving Teacher is paid | ... | £50 per session. |
| The Assistant „ „ | ... | 45 |
| | | £95 |

There are only evening classes, and 90 lessons are given.

A Class in Oils and Colours is taught by a chemist, who is also a practical oil manufacturer.

He receives £20 per session, and has 20 students; only night classes. He has two lecture classes, and one practical class, and he receives three-fourths of the students' fees; also paid by practical class equal to about £10.

Lecture Class on Oils, Colours and Varnishes. Wednesday, 8.30 to 9.30; fee, 5s. session.

Lecture Class, Illuminating and Lubricating Oils. Wednesday, 7.25 to 8.25; fee, 5s. session.

Practical Class, Preparing and Testing Oils and Colours for all their uses. Mondays, 7.25 to 9.30; fee, 5s. session.

A Dyeing Room, not open when we inspected, is used at day and night classes by 35 students.

Teacher, Mr. E. Bentz, formerly a Print Works Chemist. Receives £120 a-year.

He gives lectures on Cotton and Linen Bleaching, Dyeing and Printing. Tuesday, 8 to 9; Saturday, 3 to 4; fee, 15s.

He gives Laboratory instruction. Saturday, 4 to 6; Thursday, 6 to 9; fee, 30s.

There are about 30 lectures, followed by laboratory work during session.

Students are thus prepared for, and required to attend examination of the Guilds' Institute, &c.

Steam is laid on for laboratory use.

A small printing machine and working model of a bleaching kier are in the class room.

The teacher gives distinct courses on Wool and Silk Dyeing. Lecture courses, Saturday, 6.15 to 7.15; fee, 15s. Practical courses, Saturday, 4.0 to 6.0; fee, 30s.

About 30 lectures are given, and in Practical Laboratory the nature and properties of Dyes, &c., are made familiar to the students in practical work.

The Teacher also gives a separate course on Coal, Tar and Colouring Matters. Lecture course, Tuesday, 7 to 8; fee, 15s. Practical course, Thursday, 6 to 9; fee, 30s.

Students are required to enter class with some knowledge of Organic Chemistry.

The Art School at top of building has good well distributed top light. Room 60 by 20. We found several tiles in the room,

with which we were well acquainted in the course of business, and were informed they were designed by pupils, and the designs adopted by the makers for the market.

"Notes on Ornament," by Richard Glazier, the Master, published by Heywood, Manchester, is a very cheap and useful Class-book for Technical Art Schools. Plaster Casts and Models were purchased from Bruchiesiani, Russell-street, London.

Head Art Master, £220 a year. Four evenings, five afternoons.

Assistants—For Drawing, £35 a-year, five evenings.
For Wood Carving, £2 per month, for one evening
For Architecture, £5 a session, one evening.

Day Classes in Art—Monday, Tuesday, Wednesdy and Thursday, 2 to 5, 10s. 6d. per term, or 25s. session of three terms, specially arranged to educate students in designing for industrial purposes.

Evening Classes with same object.

Every evening except Thursday, 7 to 9.30, and Saturday afternoon, 2.30 to 5 for three terms.

Fees, 5s. for one term; 9s. for two terms; 15s. for three terms.

A special Class is held by Mr. John Shields, on Woodcarving and Furniture Design.

Fridays, 7.30 to 9.30; Fee 5s. term, or 9s. for two terms.

Instruction in this class is framed to educate apprentices and improvers in Artistic Cabinetmaking and Carving, use of tools, working drawing to scale and construction.

A Chemical Laboratory 40 by 20, with top light on top floor, has thirty positions for thirty students, with fine lecture theatre for 100 students with raised benches and blackboards.

Head Chemist is paid £150; assistant, £80 for whole time.

Another Chemical Laboratory, 40 by 20 for 30 students, was fitted up at a cost of £300. Kensington gave £150, or 50 per cent.

The Science and Art Department, Kensington, has five years lien on the plant, but at end of five years it becomes school property.

No personal guarantee was ever asked for by Kensington, or given. Committee alone are responsible, no one has been made legally so.

The Science and Art Department do not raise any unnecessary obstruction, when they are satisfied with the progress made.

A large lecture hall, with side galleries, was occupied by 90 students engaged under Mr. Cryer and assistant, at Practical Plane and Solid Geometry, &c., the fee being 2s. 6d. in this class.

Geometrical models of high educational value were employed,

made by George Cusins, Broughton, Manchester, who also supplies Chapman and Hall.

Two very good works for class teaching in Carpentry and Joinery, has been published by the Master of Carpentry Class—"Carpentry and Joinery," "Building Construction." Apply to J. Wilson, Chapel Grove, Urmston, Manchester.

Also "Manual Training," by Charles H. Ham, published by Blackie & Son, at 7s. 6d.

New Technical Schools are being established at Bolton, Stockport, Blackburn, Preston, Rochdale, Dewsbury, Burnley, Bingley, Wakefield, &c.

Government add £25 to every £25 provided in the locality as an Exhibition to Royal College of Science, Dublin, and Royal School of Mines; and all fees are remitted in these Institutions.

There are Classes for Women, under Miss J. E. Davis, in Theoretical and Practical Dressmaking, 12s. per term; in Fitting Mantle Cutting, 15s. per term; in Art Needlework, 15s. per term; in Millinery, 15s. per term; in Workroom practice, 15s. per term.

The teacher is paid by receiving three-fourths of the fees. About 150 attend by day and 50 by night, and the teacher thus earns about £130 a-year; she receives no stated salary.

In Appendix B will be found a list of the various classes held, and of the fees charged to students in Manchester and in other schools.

The Manual Training School is a special feature in this school. It forms a continuation School for Boys in Literature, Mathematics, Geography, History, Book-keeping, French, Drawing, Chemistry, and Manual Training in Workshop added on. About 60 or 70 pupils, with 6 teachers, attend; the fees are £2 per term for the first year's course, and £3 per term for the second. Each boy must be able to pass examination at entrance, equal to the VI. Standard in England. Education for head, eye and hand is aimed at, but no regular trade is taught. There can be no better preparation for a tradesman's or workman's son, whose father can spare him the time during the day necessary to accomplish this course of training.

Then such a lad, having finished his course in Manual Training School, is fully fitted to pass on into the classes of the Technical School proper, by day or by night, and to get all the advantages they provide for him. He can work at a trade as an apprentice by day with far greater facility than can any lad who has not passed through the Manual Training School, and he can, by attending evening classes, so improve himself by acquiring a knowledge of the science, as well as the best methods of his craft, that he may become a more skilled workman than he could ever otherwise hope to be, and that at an early age.

This early combined training, followed by workshop actual

practice with Evening Technical Classes, is found the very best method for developing all that is best in the young artisan, and fitting him to earn the best wages, and to advance to higher positions.

The Deputation, while being shown all the Literary and Science and Art Classes, were specially interested in the Technical Workshop Classes, where numbers of men and boys, belonging both to the artisan and lower middle classes, were either attentively hearing lectures, with blackboard, diagram and model illustrations, or busily engaged in the actual practice and application at the bench or machine of the theories they had just learned at the classes. At Carpentry, Joinery and Cabinet Making, there are some 40 students, learning the use of the tools and taking full advantage of the night classes. It is found that joiners who work at their trade all day do not come in large numbers to work at the night classes. There are about 80 to 100 students at day and night at carpentry, and kindred classes altogether who practice chiselling, sawing, planeing, turning, and chiefly acquiring a practical ease in the use of tools. In the Mechanical Engineering Room the lads in their working overalls have a thorough practical workmanlike appearance, filing, drilling, boring, screw-cutting fitting and turning iron and brass. A Blacksmith at the forge and anvil at one end of the room shows the way the iron should be heated and welded and worked, and then causes his pupils to follow him with a corresponding piece of work.

For the payments to Teachers and time required in return, see Appendix A.

| | |
|---|---|
| The Income from Students' Fees amounts to about | £2,000 |
| And from Results Fees to about ... ... | 1,500 |
| | £3,500 |

The total expenditure is about £4,500, so that £1,000 is required from public subscriptions.

We are of opinion, however, that we cannot hope in Dublin for so large an income, and we fear our expenses will be greater, proportionally, so that we should aim to secure £2,000 a-year subscriptions.

## NOTTINGHAM.

University College, Nottingham, Technical School Department, as in Manchester, originated in the Nottingham Mechanics' Institute.

An anonymous donor offered £10,000 if the Corporation would undertake to build and maintain Technical Schools. And after full consideration the Town Council resolved to connect the scheme with one for Free Libraries and Museum, and to build a hand-

some structure, which is one of the chief architectural features of Nottingham.

For this purpose, £60,000 was added by the Corporation to the £10,000 anonymously offered.

The Corporation pay about £7,000 a year to the support of the Institute under special clauses in their Local Act, 1874, empowering the expenditure for Technical Education, They have profit froms gas works, about £3,900, and income from bridge estate of abont £8,000, both at their disposal, towards reduction of rates or other local uses. They pay about £3,900 a-year for the working of the College, and about £3,000 as sinking fund to pay off the original cost. The trades properly object to any system superseding apprenticeship. They once gave £50, and sent Mr. Felkin to represent them on the Committee, but since he left no subscription is given by the trades, and they have no representation.

The Council are somewhat doubtful of the financial prosperity of the Technical and Workshop Classes, until they are put on the rates for direct support, which result they expect will be attained, when the town will benefit by the schools in greatly increased proportion.

There is a small foundry and smith shop; a moulder is employed when needed, 8d. to 10d. per hour, to show moulding process, and instruct in practical metal casting.

Science and Art Classes do not cost very much; £477 is earned in result fees, which pays the teachers, and leaves £100 to help on weak, badly attended, but valuable classes.

A detailed account of the workshops is appended. In Joinery Class all tools are provided:—1 set bench planes, viz., 1 jack plane, 1 trying plane, 1 smoothing plane, 1 handsaw, 1½ rip, 1 tenon saw, 1 dovetail saw, 1 bow saw, 4 chisels, 3 mortise chisels, 1 mortise gauge, 2 squares, &c.

There is a hosiery workshop in basement, with 3 machines, given by manufacturers.

Tables and desks for 20 students.

Also a Lace-making Workshop, in which a lace loom stood till lately, worth £600.

We also inspected a lace mill; the looms are exceedingly costly, worth from £300 to £800 each.

A Superintendent of Workshops receives £100 a-year, and one-fourth of all workshop, fees which, being about £320, adds £80 to his salary.

He takes three Science Classes—Steam, Applied Mechanics, Theoretical Mechanics.

Has an Assistant, who takes Machine Construction and Machine Drawing, and depends upon his result fees; is likely to receive £40 for two or three evenings only.

A special teacher for Special Joinery Class for staircase work, Hand-railing; courses, two evenings a-week, and is paid by his time at market value.

A teacher in Physiology and Hygiene, instructing in each, respectively, 120 and 60 pupils; holds two classes of one and a-half hour each, and is paid £140 by fees and results. Fees, £30; Results, £110 = £140. He was a Science Master, but is now a book-keeper in a Nottingham office.

Joiners taking a Practical Class must also take a Theoretical Class.

The Joinery teacher is a navy carpenter and pattern maker, and is paid £8 a-month for all his time, and no result fees. No evening work in summer.

A Joinery Assistant, to sharpen tools, gets 7s. 6d. to attend on the classes.

The Machine Shop Teacher has been a Mechanical Engineer, in business, as a master, he gets £7 10s. a-month; no result fees.

Has Assistant off and on paid by the hour, 6d. Is engaged by day in a town shop.

Engine Driver and Stoker, £1 a-week; cleans up the machine shop, floor, and benches.

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EXTRACT FROM THE VARIOUS PROSPECTUS OF THE ENGINEERING DEPARTMENT AND TECHNICAL SCHOOLS.

## DAY CLASSES.

MECHANICAL WORKSHOPS.—The workshops are open every day at 9 a.m. for Engineering Students. Students attending the workshops during the day have the opportunity of attending also the special evening classes and the classes and lectures in the Mathematical, Physical, and Mechanical Departments of the College at an inclusive fee. A complete course of instruction in Mechanical Engineering will be provided, extending over two or three years.

Fee, at present, £5 per term.

PRACTICAL CLASSES.—The following are held in the workshops, The fee for each class is 2s. 6d. for the term (two evenings per week, except in the case of the lace classes, which students attend only once weekly.)

*Lace Machine.*—Monday, Wednesday, and Friday, 7-30 to 8-30, or 8-30 to 9-30.

*Pattern Making.*—Every evening except Saturday, 7 to 9-30.

*Builders' Carpentry.*—Every evening except Saturday, 7 to 9-30.

*Filing and Fitting.*—Every evening except Saturday, 7 to 9-30.

*Turning and the Use of Tools.*—Every evening except Saturday, 7 to 9-30.

*Moulding and Casting.*—Monday and Tuesday, 7 to 9-30.

*Staircase Work and Hand-railing.*—Monday, Wednesday, and Friday, 7 to 9-30.

The evening classes in Fitting and Turning, Moulding and Founding, Pattern Making and Carpentry are intended primarily for those engaged in the several trades, and amateurs are admitted to these classes only if the available accommodation is not occupied by members of the several trades. The evening classes are conducted from October to Easter only.

## RULES.

(1.) All students must clear their benches or the tools they have been using before quitting the shops after each class.

(2.) No machine tool may be used for any purpose without the expressed permission of the superintendent of the shop.

(3.) Every piece of work undertaken by a student must be approved by the Professor before it is commenced. No work will be permitted which is not of educational value.

(4.) Injuries to tools caused by culpable carelessness or wilful neglect of instructions, must be made good by the student causing them, and such students will not be allowed to continue their attendance till this rule has been complied with.

(5.) Students executing work for themselves can be supplied with material at the shop at cost price, but all such material must be paid for at the time. No student will be allowed to remove anything from the premises without an order from the superintendent of the shop in which the work has been executed.

## LECTURES.

*Mechanics.*—Special lectures for artisans are given in the large theatre on Tuesdays, at 8 p.m. Fee for the term, 1s.

*Steam and the Steam Engine.*—Wednesday, at 8-30 p.m.

*Electric Lighting and the Transmission of Power.*—Friday, at 7 p.m.

*Tools.*—Friday, 8 p.m.

Fee for the session, 2s. 6d.

## ENGINEERING DEPARTMENT.

The Engineering department of the College at present comprises :—

(1.) Two pattern-makers' and carpenter's shops, furnished with seventeen benches, and affording accommodation for thirty students at the same time.

(2.) A foundry furnished with moulders' bench and tools, two crucible furnaces, and a cupola capable of running down between one and two tons of iron.

(3.) A smithy containing the usual smiths' tools, a full-sized smith's hearth, and a small portable forge. The blast for the cupola, smith's hearth, and the Fletcher crucible furnace is supplied from the Cyclops fan driven by a Robey engine of 20 h.-p. (nominal) of the locomotive type.

(4.) A fitting, turning, and erecting shop, about 30 feet square. The machine tools at present in this shop have been selected so as to constitute a plant by the help of which the other tools, required for a complete equipment, may be constructed on the premises. The shop is fitted with a 2½in. line shaft, carried on adjustable bearings, and driven by the Robey engine above mentioned. It contains ten fitters' vices, the usual hand tools, screwing tackle, Whitworth standard gauges, a hydraulic press, a planing machine, capable of planing 6ft. by 2ft. 8in. by 2ft. 8in.; a 10in. sliding, surfacing and screw-cutting gap lathe; a 7in. Whitworth lathe, fitted with dividing pulley, &c.; a 5in. screw-cutting gap lathe; a 6in. sliding surfacing and screw-cutting lathe; a 9in. shaping machine, with "Whitworth's quick return;" an 8in. shaping machine, self-acting in horizontal, vertical, and angular cut; a 26in. drill, Smith and Coventry's patent twist drill grindstone, with separate bracket for other tools; a ⅝in. shearing and punching machine, hydraulic and screw jacks, &c. A milling machine has been promised. A slotting machine and about half-a-dozen 6in. screw-cutting lathes will shortly be built on the premises, and will complete the equipment of this shop.

(5.) A brass finisher's and instrument maker's shop, which has not yet been furnished with tools.

(6.) A room for the study of the lace machine. This room contains a sixteen quarter 9½ point Leaver's machine (Hancock's patent), and Jacquard, for the use of which the College is indebted to Messrs. H. S. Cropper and Co.; and a blackboard, by the help of which the construction of this and other machines is elucidated.

(7.) A dynamo-shed continuous with the engine-house, and at present containing a Ferranti dynamo and Siemens' exciter, intended to furnish a current for 300 twenty-candle lamps. A trial installation is now being carried out in which Swan 40 volt lamps are arranged (three in series) in parallel circuits, and the lower room of the Free Library is lighted with these lamps. The plant includes a three-light Brush machine.

A museum of mechanism and applied mechanics forms an important feature in the scheme for the technical engineering schools.

In addition to the journeymen regularly employed in the shops, special teachers who are engaged in works in the town attend to take charge of, or assist in teaching, the evening classes. The classes for which special provision is thus made are those on the lace machine, builders' carpentry, staircase, and hand-railing, foundry work, and smiths' work.

The shops are open for Day Students from 9 a.m. The fees paid

by these students at present amount to £15 per annum. They have the privilege of attending the special evening classes, and a complete course of practical and theoretical instruction in mechanical engineering is provided for them. It is believed that a student attending these workshops and classes in the College for two years, and then working in a large engineering works for a further period of two or three years, will receive a much more valuable education than a premium apprentice who enters a works immediately upon leaving school, and confines his scientific studies entirely to attendance upon evening classes.

The construction of electrical instruments and all the mechanical work connected with the electrical transmission of power, and with electric light installations, as well as the electrical measurements necessary to test the efficiency of such installations form a special feature in the Technical Schools.

The object of these schools is to provide instruction in the principles which underlie the staple industries of the town, and in some cases to supplement the training of the workshop and factory by affording systematic instruction in the use of tools. In most educational establishments scientific principles are taught without reference to their application to the mechanical arts: in most factories and workshops empirical rules are given for the purpose of securing practical results without any reference to the principles on which the rules depend, and from which they may in many cases be deduced. In these Technical Schools an intermediate course is adopted, the scientific teaching being blended with the practical instruction. From this point of view all the classes held in the department of Mathematics, Physics, and Mechanics, become a portion of the curriculum of the Technical Schools. The subjects taught in these classes include Mathematics, in which several classes are held to accommodate students who have attained to different degrees of proficiency: Practical Geometry, Building Construction, Machine Construction and Design, the usual branches of Experimental Physics, including practical work in the physical laboratory, Mechanics, Telegraphy, Steam, Electric Lighting, and Transmission of Power, Tools, Iron and Steel, Mechanical Engineering, &c. Classes in all these subjects are held in the evening, but many are held in the morning or afternoon as well, in order to provide a more thorough training for those who can devote more time to study. Day students in the workshops can leave their work for the hour or two during which the class is being held, and return to it as soon as the class is over.

A complete course of instruction is provided in Mechanical and Electrical Engineering, and in the sciences most intimately connected with these professions; also instruction to artisan classes in Mechanics, and in the details and history of the machinery employed in the lace and hosiery manufactures. The students attending the school are divided into day and evening classes. The day students generally consist of young men who intend taking up engineering as a profession, or, being the sons of manufacturers, and looking forward to the management of a manufacturing business, consider it desirable to gain

some knowledge of the construction of machinery. Many of these students are young men leaving school at 16 or 17, while others are students from the universities, who have already obtained their degrees. For these students the College provides chemical and physical laboratories, and lecture theatres, and class rooms for Drawing, Mathematics, Theoretical and Applied Mechanics, &c. Instruction has been given by the professors and others during the last four years in chemical analysis theoretical chemistry, heat, light, electricity, magnetism, mathematics, theoretical and applied mechanics, Steam, Mechanical Drawing, &c., and the achievements of the students in University and other examinations show that the instructions given is not inferior to that provided by old-established Colleges in London, Manchester, and elsewhere.

Certificates may be gained by the students attending a course in any department of Engineering.

On Friday, 22nd, called on several Guilds in London, and arranged appointments for Deputation for Monday, Tuesday and Thursday.

On Saturday, 23rd, called at Kensington, and made appointment with Colonel Donnelly for Wednesday; drove to Finsbury College, but found it closed, and spent day in writing Report.

On Monday, 25th, waited on the Worshipful Company of Mercers, by appointment, J. Watney, Esq., Clerk (who is also Hon. Sec. of City and Guilds Institute), who stated that so much had been given to the Institute, there was small hope of help for us, but he would endeavour to secure us £100 a-year for three years from the Institute, and would lay our memorial before the Court of the Mercers Company.

Waited on Company of Grocers, Robert Somers Smith, Clerk; much same result.

Waited on Company of Fishmongers. Met by the Clerk, W. B. Towse, the Prime Warden, and Mr. Beckwith; was told same story, but undertook to lay memorial before Court.

Waited on Plumbers Company. Saw the Master, Alderman Stuart Knill, who undertook to lay matter before the Court Meeting that day, and approved of our suggestion to make the grant specially for Plumbing Classes.

Waited on Skinners Company, Mr. E. H. Draper, and had long conversation, and received promise to lay matter before the Court.

Waited on Dyers Company, Mr. R. F. Brunskill, Clerk, who kindly had one of the wardens to meet us, and while giving us little hope of assistance, undertook to lay our case before the Court.

Waited on Ironmongers Company, Mr. Beck, Clerk, stated that they had to reduce their grant to Central Institute from £500 to £350, and there was no chance of help.

After waiting on the City Guilds, we proceeded to inspect Finsbury College, found the classes at work in the workshops and classrooms,

The most serviceable account we can give is an extract from the Programme of the Technical College, Finsbury.

The TECHNICAL COLLEGE, FINSBURY, has for its objects the Education of—

(1.) Persons of either sex who wish to receive a scientific and practical preparatory training for intermediate posts in industrial works.

(2.) Apprentices, journeymen and foremen, who are engaged during the daytime, and who desire to receive supplementary instruction in the art practice and in the theory and principles of science connected with the industry in which they are engaged.

(3.) Pupils from middle class and other schools who are preparing for the scientific and technical courses of instruction to be pursued at the Central Institution, Exhibition-road.

The College therefore fulfils the functions of a finishing technical school for those entering industrial life at a comparatively early age; of a supplemental school for those already engaged in the factory or workshop; and of a preparatory school for the Central Institution.

The College embraces the following four chief divisions or faculties:—

1. Mathematics and Mechanics; 2. Physics; 3. Chemistry; 4. Applied Art.

The College is under the general direction of the Principal. At the head of each Department is a Professor, who is assisted by one or more Demonstrators; and besides these there are lecturers and teachers for instruction in special subjects; skilled artisans are employed as instructors in workshops.

The instruction in all the Departments consists of Lectures, Class Lessons, Laboratory, Studio and Workshop Practice. The complete Course of Day Instruction in the Departments of Applied Mathematics and Mechanics, and of Applied Physics, extends over a period of two years, but Students may remain longer at the College. The complete course in the Department of Applied Chemistry extends over three years, but Students who are sufficiently advanced may be allowed to compete at the end of two years, for the Certificate Examinations. The Evening Courses for Apprentices last three years.

The Day Classes comprise regular and systematic Courses for those who, on leaving the College, intend at once to enter the factory, workshop, or some commercial pursuit, as well as for those who will proceed to the Central Institution or elsewhere for higher instruction.

The Session for the Day Classes is divided into three terms:—

The Winter term commences on Tuesday, October 5th, and ends on Wednesday, December 22nd.

The Spring term commences on Tuesday, January 18th. The term ends on Wednesday, April 6th.

The Summer term commences on Tuesday, April 26th, and ends on July 15th.

## DAY CLASSES.

The course of instruction for all day Students comprises practical Mathematics, Lectures and Laboratory Work in Mechanics, Physics, and Chemistry, Mechanical and Freehand Drawing, Workshop Instruction in Wood and Iron, and French or German.

The fee for Day Students for a complete course of instruction is £9 for the session, payable in advance at the commencement of the session in October; or, £10 for the session, payable in three instalments of £5, £3 and £2 at the commencement of each term. These fees* include attendance at all the Lectures, Laboratory and Workshop courses in the department which the Student enters as well as the use of the apparatus and materials.

Applicants for admission, who must not be less than fourteen years of age, will be required to produce a certificate of good conduct from their former school, or other testimony of good moral character. Students will be expected to attend all the courses of instruction included under the department which they enter, but applications for admission from persons wishing to attend some of the courses only will be considered.

Before being admitted as Day Students, they will be required to pass an elementary examination in Mathematics, and to give evidence of possessing a fair knowledge of English.

The examination in Mathematics will include Arithmetic, Algebra, as far as simple equations, and Geometry, as far as the subjects of the second book of Euclid.

The hours of attendance are from 9.30 in the morning till 5 in the afternoon, with an interval from 12.30 to 1.15, except on Saturdays, when the Workshops only are open, and these close at 1.

The punctual and regular attendance of Students at their Classes and Examinations is insisted upon. All Students will be required to sign an undertaking to conform to the rules and regulations for the management of the College laid down from time to time by the Institute.

An intermediate examination will be held at the end of each term, and a report of the attendance and progress of each Student will be sent to the parent or guardian.

At the close of the Session an examination will be held in the work of the College, and on the results of this examination and of the work of the Session in Class, Laboratory and Workshop, prizes will be awarded.

Students who fail to qualify for the second year's course will be directed to repeat the first year's course.

Students who have regularly attended the complete course of instruction in any one department, qualified themselves in Laboratory and Workshop, and have satisfactorily passed the several class examinations, will receive the Certificate of the College.

Students are required to give due notice, if they desire to leave

* In special cases, to be considered by the Committee, these fees may be reduced or remitted.

the College before completing their full course. They are also required, in order to facilitate the arrangement of classes, to notify a fortnight before the commencement of the Session in October their intention of returning to the College.

## SCHOLARSHIPS.

The following Scholarships tenable at the Finsbury Technical College will be awarded on the results of the Entrance Examination, provided the candidate show sufficient merit :—

(1.) Four Saddlers' Company Studentships of £30 a-year each, tenable for two years, open to competition to pupils from public Elementary Schools in accordance with the terms of the Scheme.* (Next Competition, October, 1887.)

(2.) Four Mitchell Scholarships of £30 a-year each, tenable for two years, will be open to competition among the Mitchell scholars attending the Cowper Street Middle Class Schools.

(3.) The Holl Scholarship of £20 a-year, tenable for two years, with free education at the College, to be awarded to a pupil of one of the Middle Class Schools named in the Scheme in accordance with the conditions therein contained.*

## EVENING CLASSES.

The Evening Classes, intended for apprentices, foremen and others, are more especially adapted to the requirements of those who are already engaged in specific industries. The students of these Classes can ascertain from the Head of each Department the courses of instruction best adapted to their several trades.

The industries or trades to which the present courses of instruction at the Finsbury Technical College specially apply are :—

1. Mechanical Engineering.
2. Electrical Engineering.
3. Industries involving applications of Chemistry.
4. The Building Trades.
5. Cabinet-making and other Art industries.

These Evening Classes are intended to afford Technical Instruction to persons engaged during the daytime in various industrial occupations.

Students are free to attend any classes they may select ; but they are recommended to follow the complete course of instruction bearing upon their trade, as indicated in the syllabus for each separate trade.

In connection with each course of lectures in Physics, Chemistry and Mechanics, there is a corresponding course of Laboratory instruction or Machine Drawing.

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* Full particulars of the conditions of the tenure of these scholarships may be obtained on application at the office of the Institute, or at the Finsbury Technical College.

The College Laboratories are open on most evenings from 6 to 9. The Engineering Drawing Office is open two nights a week, and the instruction is specialised according to the trade or occupation of the individual students.

The Engineering Workshops are open on two evenings a week.

All fees include practice in the Laboratories and Workshops.

The Applied Art Department is open every evening, except Saturday, from 7 till 9.30.

The Session is divided into TWO TERMS the first term extending from October to Christmas; the second term from the New Year till about the end of May. The second term for the Classes in Applied Art continues till the beginning of July,

The fees for the separate evening classes vary from 6s. to 12s. 6d. for the session of about eight months, and from 4s. to 7s. for a single term.

*Apprentices are admitted to any of the evening courses at half the ordinary fees.*

PART SESSION 1886–7.

Evening Classes commenced Monday, October 4th, 1886. First term ended Wednesday, December 22nd, 1886. Second term began Monday, January 10th, 1887, College closed (Easter) Thursday, April 7th, to Saturday, April 23rd. Second term ended Friday, May 27th, 1887, except for the Art Department.

As our Assistant Secretary is attending at Finsbury, we directed him to draw up a detailed report of all the facts connected with the working and with the arrangements of workshops, class-rooms, &c., which we annex as Appendix C.

On Tuesday, 26th, called on other Guilds, by appointment. Waited on Worshipful Company of Goldsmiths, W. S. Prideaux, Clerk (is the Solicitor also of Guilds Institute); much interested in our schools, and while holding out little hope, undertook to lay case before Court.

Waited on Haberdashers' Company, Mr. Townend, with similar results.

Waited on Provincial Bank, and saw Mr. Chambers, the Secretary, who had been in Dublin, and personally acquainted with Deputation. Promised all assistance if we would send a formal memorial to Mr. Ross, at Dublin.

Waited on Company of Carpenters, Mr. Preston, Clerk, and received promise of his support, but no great encouragement.

Proceeded to Finsbury College, and inspected classes and shops at work by day, finding the students drawn from the middle classes during day, while at evening classes many artisans attend. (Refer to Mr. Dixon's detailed Report).

Waited on the Secretary of the Irish Society, and arranged to send in formal memorial, asking for a grant for the schools.

## KENSINGTON.

On Wednesday, at 11 o'clock, by special appointment, we proceeded to South Kensington, and waited on Colonel Donnelly, who received us courteously, and showed a very strong desire to render the Council of the Dublin Schools every assistance in his power. Having asked his advice as to what classes we should start with, Colonel Donnelly enquired if we intended to have day classes for boys of 13—and upon hearing that we contemplated night classes to begin with, he referred us to the scheme for special continuous courses in Science, described pp. 41 to 44, Directory, which he urged on our attention, as those classes would largely affect our grants. By working these classes well, the grants help largely to support the evening classes.

A specific extra capitation grant of 10s. per student who attends (sec. 37), 250 attendances necessary, and to pass in one subject, secures the grant.

A fee from 6d. to 9d. a-week will enable better class artisans to have their children's education continued for two or three years, the boys taking the Manual Classes along with the Science and Art Classes, and coming out with a vastly increased earning power.

The first year's course to comprize Mathematics, Free-hand Drawing, Practical Geometry, Chemistry, Physics. Second years' course, Elementary Mechanics, Physics, Mathematics, Practical Geometry, Chemistry. Third year's course to be given a special direction according to the lad's future trade. If he leaves out any of the above course in the first year, he should be made take it up during the second.

Colonel Donnelly desires particularly to see the Day Classes carried out in Dublin.

In the evening classes the capitation grant is only 5s. per student, for which 75 attendances only are required, and to pass in one subject. Supplement the Science and Art training then, with classes of two or three hours each week, where the use of tools, &c., shall be acquired. Boys attending classes at Bristol Schools on these lines are at a premium as apprentices.

Provide some free admissions for worthy boys under an entrance examination.

Secure plenty of free studentships.

If workmen even don't see the advantages at first for their children, provide the fees in some way for them, but as much as possible let the parents pay some fees, as they will then be more likely to see that the children attend and learn.

Paragraph 11, page 32, "Science and Art Directory," gives necessary information as to the qualification required for Teachers. A Degree of University will be sufficient.

On the formal application of the Council, with correct plans and

elevations accompanying same, an Inspector (probably Col. Festing) will be sent to Dublin, to inspect, advise and report; his report of course influencing the amount of grant we shall receive.

No time should be lost, as the season was advancing. We had plans and elevations with us, but we were asked to send complete plans and sections of premises to Col. Donnelly, as soon as possible.

On our request that a special building and furnishing grant, beyond the usual limit laid down in Directory, on the ground of want of accommodation for Science and Art Schools in Dublin, or to enable us to buy up the lease for £2,700, and be rent free, Col. Donnelly replied that he is absolutely quite powerless; he cannot go beyond his powers as shown in the Directory one iota. Unless our Council can bring influence to bear upon the Government, we see no way of getting an increased or extra grant; but we beg to direct the attention of our Council to Second Report of Royal Commission on Technical Education, vol. i., page 538, and also to the Report of Duke of Devonshire Commission, where it is distinctly recommended, "that the Science and Art Department be authorized to increase their building grants beyond present limitations."

And we recommend that Right Hon. A. J. Balfour be approached on this matter, and that, if considered advisable, we request the Right Hon. the Lord Mayor to take the matter up with zeal, and bring the matter before Parliament directly by asking—

"Whether, seeing the urgent need of Technical Schools in connection with Science and Art Classes in Ireland, the Government will authorize the Science and Art Department to increase their ordinary building and furnishing grants, if they see fit to do so, in favour of the new Dublin Schools in Kevin-street, especially as there are no Trade Guilds in Ireland to help on the cause of education in Science, Art and Technology, as they have been doing in England."

When asked for the grant or loan of suitable appliances, model Casts, &c., Col. Donnelly stated the Department has no means and no collection of such objects available for such purpose, they can only give the 50 per cent. on our own expenditure, not exceeding £300. See Directory.

No powers to go beyond the code in giving any special grant for laboratories, &c.

With reference to the important question whether our schools were freehold or leasehold, on being informed they were leasehold, Colonel Donnelly stated that so long as the rent was a charge on the schools, no building grant could be made.

But Colonel Donnelly believes that the building grant can be made, provided that the rent be made a charge on the rates, not

on the building. Absolutely no power otherwise, see page 121, under Building Grant Rules.

Cannot give grant so long as rent remains a charge on the building.

Under any and all circumstances strongly advises that the Corporation do raise the £2,700 necessary, and clear off the rent charge at once.

Requires the trust deed for examination and approval; made enquiry and finds that no trust deed had been received at South Kensington from the Dublin Schools.

## CENTRAL.

After leaving South Kensington, we proceeded to make second inspection of Central Technical Institution. First went to Wood Carving School, and were most kindly received by Miss Rowe, the head of this class; were shown several young ladies and youths at work, chiefly on an elaborate range of carved panelling, which was being executed by the students for some outsider; were told on enquiry that this piece of work was offered to them to execute at a certain price, and accepted as good practice for the students; on further enquiry were told that 2s. 6d. per foot was demanded by a cabinetmaker, but they were doing the work at 1s. per foot; asked would not the purchaser have given the trader his price if the schools had not interfered, and taken it so cheap; was told no—that the work would not have been ordered at all in that case. Several very fine pieces of carving were being executed, and many specimens of finished work were shown. The teacher impressed on us that, unless English workmen were taught to do carving cheaply, all such work must inevitably go abroad, where carvers were working at such low prices.

The Deputation, however, were not at all satisfied with these arguments, and are very strongly of opinion that it is a mistake for any Technical School to sell any of the work produced in Technical Classes to outsiders, or in any way to interfere with the trade by competition, no matter how guarded: let the pupils own the work they turn out, or let it be kept in museums, or broken up, but not sold, even with a view of saving school expenses. It is only fair to mention that, in the course of our enquiry, we only came across two instances of work executed in Technical Classes being sold in open market, and in both cases the practice was disapproved of by all the other school authorities.

The Central Institute Class Rooms, Workshops and Laboratories are almost as perfect as such can be made, but they are so costly and so far above our heads in the Dublin Technical Schools, that we need not occupy further space with a detailed report.

As a curious contrast with the Central Institute system, we next went to meet Mr. H. Cunyngham, of Hurlingham Lodge, Fulham, a gentleman who had both an engineering and a legal training, and who has been engaged under the Charity Commission of England in investigating the condition of the Technical Schools in various parts of the country and abroad, and who, on the kind introduction of Sir Henry Lawrence, was so good as to place his lengthened experience at our service, and to give us many hints.

His experience as regards the cost of properly managed, effective schools was extremely encouraging, as he stated without fear of disappointment, that on £1,000 a year we should be well able to carry on a large technical school in the most efficient manner for 300 students.

Recommends from his experience the appointment of some superintendent or principal, who really believes in the work of Technical Education. Great mistakes had been made in English schools by appointing learned men, who were either too old and too long in the old grooves, or who while undertaking the post, yet had no faith in the new system; such men proved failures, and in fact made failure certain. Much better to get a practical man with a scientific training, and, if possible, a young man who will grow with the school, and take a personal interest in its success, without being too great a gentleman to teach some one or two subjects himself, and who will cost the funds a smaller amount for salary than an older man, who would be also likely to suit the Council promoting the schools, better than a more dogmatic organizer.

Such a man should easily be able to do all the superintendence, to arrange the classes, to be in and out of class rooms constantly, seeing that the teaching was up to the mark, and who could also do all the office and administrative work, for which he might, if needful, be given a clerk, and thus save the cost of an Assistant Secretary.

The appliances for teaching Physics, Electricity, &c., are, as a rule, in schools, far too costly; the principal, with the help of the class instructors, could easily in spare moments construct sufficiently good, simple, plain apparatus as would be required, at a cost of as many shillings as it would otherwise cost in pounds; such construction also should be used to educate the pupil, and when made, the apparatus will generally be more practically useful to handle, less liable to injury, and much more easily repaired if it is put astray.

Mr. Cunyngham informed us, in proof of this, that he had made a whole series of instruments for teaching Electricity for 31s. 6d., in 66 hours' time, which were priced at the instrument makers over £30. The teacher should allow his best pupils to help him.

Professor Guthrie of the Science Schools, Kensington, instructs teachers how to make these instruments, and after a short course, the teacher takes away as his own property a set of appliances to teach his classes in Science. This system is worthy of close attention by teachers, for we want not only to teach well but to teach cheaply.

## CITY.

On Thursday, 28th April, waited, by appointment, on Worshipful Company of Clothworkers, and were received by Owen Roberts, Esq., Clerk (and also one of Hon. Secretaries of Technical Institute), a gentleman who has been labouring many years to promote Technical Education. He, however, gave us the same account of the finances available as we received from other Guilds, but he promised to present our memorial to the Court.

We proceeded to the National Bank Head Office, 13 Old Broad-street, and were kindly received by the Chairman, who took our papers, and accepted us as a Deputation from the Schools, recommending us to bring a formal memorial to the Dublin Office, and that he would see it attended to when it came to London in usual course.

Waited on Drapers' Company, and were received by a Committee of the Company, who questioned us particularly as to the details of our scheme. Were apparently much interested, and promised to commend our memorial to favourable consideration of the Court. Mr. W. P. Sawyer, Clerk of the Company, is also one of the Hon. Secretaries of the City and Guilds Institute.

Proceeded to Polytechnic Institute.

At Polytechnic were received and taken round to see the day classes at work, and again at night to see the night classes. A magnificent gymnasium and swimming bath adjacent thereto no doubt forms one great attraction to the 6,875 individual students who entered the classes last session. The actual membership is limited to 5,000 members, and the advantages offered are too numerous to mention in this Report, while the subscription is only 3s. per quarter. This does not, of course, include fees for class and workshop instruction.

There are several clubs and societies connected with the Polytechnic formed solely of its members.

Students connected with the Science and Art or the Guilds Technical Classes are required to make at least 20 attendances at each class they join, and also to sit for the examination, otherwise an extra fee of 10s. is charged.

There are nearly 200 class subjects taught. We give the list and students' fees in Appendix B.

Special Examinations are conducted by the Trustees in each of the Classes in the Science and Technical Sections, and prizes are

awarded to the three best candidates in each subject, if ten students are eligible under the rules, and have made 20 attendances, and sit for the examination held under the Science and Art or Technical Department. Prizes are also awarded to students in the Practical Handicraft Classes at the Summer Exhibition of the Students' Works.

The masters for each class are carefully chosen and well paid by salaries, not by result fees, for instance—

Andrew Clarke, Esq., F.R.C.S., teaches the Ambulance Class.

B. Thompson Lowne, Esq., F.R.C.S., teaches Hygiene Biology, Physiography, &c.

E. Goodwin Clayton, F.C.S., F.J.C., teaches Geology and Mineralogy.

Robert Avey Ward, teaches Chemistry.

V. Butler Smith, B.A., teaches Mathematics.

C. T. Millis, teaches Metal Plate Work.

J. W. Clarke and J. Taylor, teach Plumbers' Work.

And so on, all being practically acquainted with their subjects.

The evening classes at the Polytechnic appeared to us to be the most useful and the best attended, they are reserved for artisans connected with the trades there taught; amateurs are only allowed to attend at night, if there is room, and then only on payment of double fees.

We were specially interested with the Wood and Stone Carving Class, receiving special attention from the accomplished teacher, Mr. F. L. Schauermann, who is a foreman in Messrs. Gregory's establishment, Regent-street. He was instructed in his art, and passed his examination at Munich; can carve with equal facility in wood, stone, marble and alabaster; has travelled much.

He gives four evenings, from 7 to 10, and Saturdays, 3 to 7; approves of teaching amateurs, as they thus understand good and bad work, and are willing to pay the value of good work.

Uses Addis & Sons' tools, but consider the best tools made are Coningsby's, at present.

Each student requires in wood carving, and is supplied with, about 24 tools; has his own *locker*; sharpens his own tools; expect care to be exercised, but Committee do not require breakages to be paid for in any of the classes. No work made here to be sold in the market; but persons offer a price for articles sometimes as specimens, which we sell.

Thinks any workman wanting to learn any trade should be allowed to do so; should be open to all men willing to take the trouble.

A stone mason named Smart, married, with a family, 38 years of age, earning 7d. to 8d. an hour, came recently to this class, studied and practised with such assiduity for eleven months, that

he became an expert stone carver; he won the first prize, a silver medal, and £5 5s. for a stone carved window, and his employer, Mr. Johnson, of Euston-road, has made him a foreman; he need never now be out of work.

A deaf and dumb stone carver, married, named Norfolk, is at present a student in wood carving (is at a job of carving in the country now), but when at London never missed a night, and got first prize bronze medal and £1 1s. for his wood carving at last examination. The fees per quarter, four evenings a week, 21s.; two evenings a week, 12s. 6d.; and for the special Saturday Class, 12s. 6d. a quarter.

The thoroughly practical character of this class, and the skill of the instructor, renders it one to which genuine artisans are glad to come; and we noticed the same characteristics in all the Poly. Classes, together with a complete absence of all show and polish; no costly appliances or highly-finished benches or lockers, floors, and walls, but a workshop look—even a rather grimy workshop look—over all, and a general appearance of earnest work and attention.

The Carpentry and Cabinetmaking Workshop is in one, but there are two instructors; these classes occupy the room every night, except Friday, when it is used by the Practical Plumbing Class, who cover the wood-working benches with wide, thick wooden benches of their own.

The want of space necessitates this arrangement; it is a very troublesome one, and, of course, the putting away of the lead-work knocks it about more or less.

Separate workshops for each trade would greatly improve the classes and the work.

The Carpenters and Cabintemaking Classes at night consists of workmen, and of intending emigrants.

Fees are from 3s. to 4s. per term; Plumbing fees are higher, being 7s. 6d. per lecture class; 7s. 6d. for Practical Class per quarter.

Metal Plate Classes were being taught by Mr. Millis.

The Modelling and Drawing Classes were at work in the part of the building used in summer as a swimming bath.

Here the students at night are also all belonging to trades—Plasterers, Carvers, Stonecutters, and Cartonpierre workers attend in numbers.

A special Modelling Master attends on Tuesdays and Fridays.

Head Drawing Master is Mr. Ramsay, with three assistant masters, working every night, except Wednesday. There are about 200 students in Drawing Classes; 18 pupils are taught sign writing by an expert; 30 pupils attend Modelling Class.

In the machine shop the character of the work which students were engaged on appeared to us too small—too toylike for a

practical class. The students are allowed to take home their work, paying only for the material.

It seemed to the Deputation that the night classes, limited practically to workingmen and lads, are most successful, and that we can utilize them to a large extent as our pattern in Dublin.

In order to show how fully in touch they are with the trades, the following resolution is given as adopted at a Special Delegate Meening of the London Trades Council, representing 14,500 mechanics in London, held on Saturday, 21st July, 1883 :—

"In the opinion of this Delegate Meeting of Trades any system of Technical, Scientific or Theoretical Instruction for our industrial population, should be accompanied with practical teaching by competent trade teachers, based upon workshop practise, in harmony with the requirements of ordinary business pursuits, similar to the trade instruction given at the Polytechnic Institute."

We have found in the Polytechnic a system of night classes well within the grasp of artisans and apprentices, while we fear in other and more elaborate Technical Institutions we see more or less a straining after effect, too much elaboration, a tendency to get beyond the working classes, and a danger that they may be used more for the benefit of the upper and lower middle classes than for the genuine artisan and apprentice.

On Friday, waited on Mr. Geo. W. Hooper, the celebrated coachbuilder, Victoria-street, Westminster, whose Carriage-building Schools had been for a week or two closed owing to an unprecedented rush of business, which required all workmen and apprentices to leave the classes and work extra time in the actual workshops to compass the orders. Mr. Hooper informed us that at a meeting of the Council of the London Chamber of Commerce, held December 9th, 1886. It was unanimously resolved—

"That a thoroughly representative Committee of the commerce and trade of the metropolis be appointed to consider a well-devised scheme of improved Commercial and Technical Education, suited to the wants of the present time."

Mr. Hooper favoured us with a proof-sheet of a circular and proposed subjects considered to be necessary for the sufficient education of youths and young men preparing to engage in coachbuilding. We annex these two documents, dated April 20, 1887, resulting, so far as coachbuilders' trade is concerned, from the direct action of the Chamber of Commerce; it is understood that the other London trades are also considering this important question (see Appendix D.)

We would suggest that the Dublin Chamber of Commerce should have their attention also directed to this matter of Technical Education in Dublin, and that they be urged to render the Council of the Dublin Technical Schools active and substantial assistance in their efforts to benefit Irish Trades and Manufactures

## WESTMINSTER.

On the introduction of Mr. Geo. W. Hooper, the Deputation was cordially received by the Head Master of the United Westminster Schools, Mr. Goffin, whose courtesy and valuable assistance we desire gratefully to acknowledge. These schools have developed under a scheme of the Charity Commissioners out of four antient foundations, which ten years ago provided very defective teaching for 100 boys, into a United School, where 200 boarders and 800 day boys are provided with a thorough education.

Funds are abundant, and a building as perfect as we have ever seen for the purpose, contains a teaching staff and Teaching appliances, which for practical, useful work and good sound results is unsurpassed. With the admirable literary classes, which we were shown, we have no concern in this Report, but we found here one of the simplest and most practical chemical laboratories we have met with in our inspection of many, with a type of fittings so economically constructed that we have obtained permission from the Head Master for our Assistant-Secretary, Mr. Dixon, now in London, to visit the schools, measure and send home drawings for the use of our schools.

Technical Classes for Coachbuilding, under the special charge of Mr. G. W. Hooper, and Mr. Robertson as Teacher, are held in a basement class-room, fitted with simple, strong drawing benches or tables and forms, and very few appliances are necessary beyond one or two blackboards, 15 feet or 18 feet wide by 10 feet or 12 feet high on which to draw out in chalk full-sized outlines of carriages. There is also required a plumb-line, a square, a straight edge, a large compass, a 4-foot rule and chalk, and with a competent practical teacher the class can be started.

We were also much pleased with the practical simplicity and economy of money and space shown in the arrangements of workshops for carpentry and joinery. Three different forms of carpenters' benches are provided for the sake of variety, and to prevent the boys from supposing that any one particular form of bench was essential to good work. We think, however, that the iron clamp has so many advantages for gripping the timber that it may be adopted for all our benches (Syers, Finsbury Circus, is one maker—we fear it is a patent—but it is not a costly appliance), about 15s. each. There is space for 30 pupils at a time in the shop, and 18 complete sets of tools are provided for them. We think in our schools we may be well content with a smaller proportion. 12 sets of tools for 30 pupils should suffice. Neat corner cupboards are provided, with a special position for each individual tool, so that when the cupboard is open the teacher can see that every tool is in position on the doors. Ledges are attached inside,

with holes suitable for bradawls, gimlets, turnscrews, and strips for chisels, gouges, all so simply arranged that perfect neatness and security is obtained without primary expense, and with great saving of money in the preservation of the tools in actual work.

All pupils are required to sharpen and maintain their tools in good order.

We obtained from Mr. Goffin, in the course of a long conversation, very many useful hints as to school management, details which will prove valuable, but would lengthen our Report beyond reasonable measure.

On Saturday, 30th, were engaged writing report.

## BRADFORD.

On Monday, travelled through Chester and Manchester, to Bradford; visited the Bradford Technical College; were courteously shown the workshops and class rooms by Mr. J. H. Dales, Head Master of Mechanical and Engineering Department, and Mr. Gatenby, the Secretary of the Institution, and afforded much detailed information.

We found in the engineering workshop, which we describe further on, that the students were working overtime, just as in a trade workshop, on a large piece of work for fitting up a bakery and mineral water works for a coffee palace company in Bradford, whose members have some connection with the College, and so placed the order in their hands.

The Head Master, Mr. Dales, states that the machine makers have no objection to this, as it is a very small matter contrasted with the general extent of the trade, while it afforded the best class of practice to the students. We, however, cannot accept the principle as a sound one, and we found that the Secretary and other masters agreed with us in this opinion, and disapproved, as a matter of principle, with the making of goods for public market in Technical Classes. We may state that we only found this practice advocated and carried out here, and in the Wood Carving Classes at the Central Technical Institute already described. In Bradford, and in London, possibly the competition would be comparatively unimportant, but in Dublin, any competition of the same extent would be at once felt and resented. We cannot understand how manufacturers could be expected to support Technical Schools if they created a species of competition like this. This is the second case of selling work to public before referred to. The Day Engineering students pay £15 a-year, in three terms, and the head master considers that a profit is made in the department by charging the full trade value of machines made by the students for the school use, but, as a matter of fact, money has to be paid to support the department year by year, so much as £1,000 being needed this past year.

The Evening Engineering students pay £1 a-year, in two terms for the General Workshop Course, including Wood Working, Pattern Making, all the Machine Tools, Lathe Work, Fitting, &c., Engine and Machine Tool Work.

In the Evening Classes, the students being more numerous, are instructed in groups, three or four going to each machine at one time, one being in charge, the teaching and practice necessarily being much less effective and efficient than in the Day Classes. Many practical artisans and apprentices attend the Evening Classes.

Evening Lecture Classes are held also in Graphic Statics, Building Construction, Steam-Engine Valve-gears, Metal Cutting Tools, Carpentry and Joinery, Applied Mechanics, Steam.

Fees, South Kensington Science and Art subjects, 5s. per session each ; other subjects, one, two, three, or four evenings a-week, respectively, 7s. 6d., 12s. 6d., 15s., 17s. 6d. per session, if students sit for examination ; double fees if students do not sit for examination.

This account of the objects, method of working, and system of management of the Engineering Department was supplied to us by the Head Master, Mr. Dales, as follows, and will prove interesting and useful, though we do not propose to follow it closely.

The objects of this department may be classed under three heads :—

First—The Training of Mechanical Engineer Students.
Second—The Training of Civil Engineer Students.
Third—Affording a comprehensive and sound Mechanical Education to students who are intended for manufacturers.

The extent of these objects, as regards mechanical and civil engineers' students, is to afford a scientific and practical instruction of such a quality and variety as will enable those who go through the prescribed courses to take a position in an office or manufactory without further experience in the way of apprenticeship. It is claimed for the department that, in the face of the tendency to speciality in all branches of manufacture, this will be done in a manner such as would be altogether impracticable, even with the most indulgent training, in an ordinary mechanical workshop, or in the office of a consulting or civil engineer.

The instruction given in this department is divided into four courses, through each of which regular students are required to pass in rotation.

The first or preparatory course consists, firstly, of instruction in mechanical drawing. This is taught by similar methods to those usually adopted in engineers' drawing offices, commencing with tracing from finished work, such work being carefully graduated as regards difficulty. The copies consist of well-designed details of engines, machines, and such matters, a collection of which will

be useful to the students for reference in after life, all tracings made being preserved for that purpose.

This is followed by drawing from details, dimensioning, and finishing the same, then by copying from general drawings, and drawing from measurement of work.

In the second place, the first course includes instruction in the sciences of applied mechanics and steam, the forms, properties and uses of tools and instruments of every description which are required in the engineering trades and professions.

Thirdly, it comprises workshop practice, in the way of making a complete round of the mechanics' shop, including all the machine tools, the model shop, and the smithy.

The workshop is fitted up with every modern machine tool of the best quality, and on a modern scale of size, and contains seventeen kinds of tools or places, as well as a number of fitting benches and model benches. In order that all students may have equal opportunities, and receive instruction at every appliance or place, they are, at the beginning of their first course, supplied with a number of dated checks or tickets, each of which refers to a place in the shop during certain fixed periods, which are so arranged as to allow each individual student to spend such period at the tool referred to, and, moreover, to pass round the establishment from tool to tool, in such order and such time as is thought to be most desirable and beneficial.

A table of all these times and positions is drawn up and posted in the shop at the beginning of every session, and indicates the position of every student at all times during that session. The checks issued to the student, of course, correspond to this table.

Further, with particular reference to the evening students, whose numbers are largely in excess of the number of places in the shop, and also to provide for any excess in the number of day students, if several students are stationed at one place or machine, both the checks and the time table indicate the dates on which each student will be in charge of such machine, and provide dates of chargemanship for every student in the department. Thus, on every day of attendance, a student may watch the working of a tool, study its mechanism, or assist the "chargeman;" but on those dates only which are allotted to him will he have sole charge of the work in hand.

All the work in the shop is made from drawings—hence the necessity of a knowledge of mechanical drawing in the early part of the course; this method being also indispensable for the arrangement of the shop course, on account of the considerable number of students who are employed on the same work.

It may be as well here to mention that the work which is executed in the office and shops of the department is taken by the Director from manufacturers in the trade, at such a rate of remu-

neration as is profitable to the customer, and at the same time sufficient to make up any difference between the amount of fees paid by the students and the working expenses (which are necessarily large) of the department.

The second course consists of instruction in practical draughtsmanship as distinguished from mere linear drawing; also, in the principles and ordinary applications of the prime movers, both steam, gas, and hydraulic; in pattern-making, moulding, and founding; in smithwork; in fitting and erecting; and in the general practice of getting-out and execution of works of various kinds coming under the above heads, from the drawings to the completion. This course is of about the same quality as ordinary workshop practice, with the difference that the student follows every process involved in the production of a piece of work from beginning to end, instead of performing only one operation, or set of operations, as ordinarily.

The third course consists of instruction in advanced draughtsmanship, including the design of steam engines of the various classes and types—stationary, winding, pumping, locomotive, tram, marine, &c.; of boilers of the various classes and types; of gas engines; of engine valve gears and governors of all kinds; of valves of various classes; of pumps and hydraulic apparatus—in short, it may be said to embrace general high-class mechanical engineering. It is intended to meet the requirements of managers, assistant managers and draughtsmen.

This course, and also the second course, is fully illustrated by drawings, diagrams, working models, and all appliances which are necessary to a full acquirement of a thorough knowledge of the subjects laid down.

Throughout the whole series of courses, as close an approximation to ordinary practice is maintained as is compatible with efficient instruction. In all cases, high-class actual work is procured for practice, for the double purpose of creating that interest in the student which is necessary for successful teaching, and at the same time to afford him an opportunity of judging as to his own capabilities in comparison with ordinary practitioners, who must necessarily put forth their best effort.

The Fourth Course is intended for specialists, and in addition to practical draughtsmanship and design, the students are instructed in a subject which they select from a list of all the constructive branches of the trade, as being that which they intend to follow as a business. The special data and refinements of such branches will be dealt with in *minutiæ*, so as to enable the students at once to successfully engage in the production of the matters involved. The time and trouble, which in the ordinary course of things are necessary for the acquisition of the special knowledge required, will thus be saved.

It is considered by the Director to be advisable that all intending Civil Engineers should pass through the first three courses in order to obtain that practical knowledge of work (and of ironwork in particular) which in the present day is so necessary to success in that profession, on account, on the one hand, of the extended use of iron and steel in constructional matters, and on the other, for the production of those semi-mechanical works which the Civil Engineer now finds himself constantly called upon to execute. The Fourth Course, therefore, for Civil Engineers is specially arranged to include purely Civil Engineering matters, such as constructional ironwork, timber work, masonry, brickwork, earthwork, strength of materials and structures; statical and other strains, arches, girders and roofs; land surveying, including instruments, field work, plotting, &c.; measuring and quantity surveying.

The final objects of the department are—Firstly, to place high-class technical knowledge within easy reach of men of first-rate natural ability, in order that they may acquire same without undue strain or waste of energy. Secondly, to educate to the extent of their capability those who require teaching and leading in order to make the best of their capacities; and thirdly, to teach the combined use of scholastic and technical practical knowledge—scholastic knowledge being as one wheel in a machine, useless without the rest.

The department has now on its registers 30 regular day students of the class known as gentlemen apprentices in engineering establishments, some having left such to join the department. The number of this class is likely from general appearances to be largely increased.

Thirty day school boys, who attend two days a week; 108 evening students, including every class to whom such knowledge as can be gained is likely to be useful.

The regular day students attend on the whole of five days per week, from 9.30 a.m., to 4.30 p.m., and are instructed in the first course in mechanical drawing on two half-days a week; in applied mechanics and steam on the other halves of the same days; and they have workshop practice on the remainder of the working days.

The other courses are conducted at the times shown on the College prospectus, with lectures at suitable intervals.

The day school boys have two half days' workshop practice.

The evening students are instructed in mechanical drawing from 7 to 9 p.m., on one evening per week, and have two evenings per week in the workshop, with lectures at intervals.

All First Course students work on the check system, which enables large numbers to be dealt with without confusion or dissatisfaction.

The staff consists of professional engineers and first-class workmen.

The Fees charged are, with three terms a year—

For Regular Day Students, 5 days a-week, £5 a term.
For Occasional do. 2 days a-week, £3 „
For Evening Student, Shop Course, 10s. per term.
For Do. Various Subjects, 5s. to 17s. 6d. per Session, if Examinations are taken, otherwise double fees are charged.

The Day School Department at Bradford is a very important one, under the management of Mr. James Spencer, B.Sc., F.C.S., as Head Master.

It forms a secondary school for boys, to train them for manufactures and commerce, with laboratory and workshop practice. It comprises a liberal and practical education along with the teaching of such science and art subjects as are applicable to the local trades.

There are three terms each year and three separate courses of instruction, and two classes of students, viz. (A) those who are eligible for and undertake to undergo the Science and Art Department Examination ; and (B) those who do not come under that description, and who are charged higher fees. Age of admission, twelve years and upwards, provided always the lad passes the entrance examination, or has passed the fifth standard of Government code.

Hours of attendance, 9 a.m. to 12.30 p.m., and 2 p.m. to 4.30 p.m. every day, except on Saturdays.

The three Courses of Instruction are—

I. General Course, including English, Mathematics, Mechanics, Chemistry, Physics and Drawing.
II. Technical Course, including Design and Manufacture of Cloth, Dyeing, Mechanical Engineering, Building Construction, Advanced Drawing, Modelling, Book-keeping, Wood Carving, Electrical Engineering, Plumbing, Printing, Soap Manufacture.
III. Languages, including French, Grammar and Latin.

Fees for each Course respectively are, for Class A—

I. General Course, 21s. per term.
II. Technical Course, 10s. 6d. per term per subject.
III. Language Course, 10s. 6d. per term per subject.

For Class B advanced fees are charged.

In the School of Art Mr. Walter Smith is Head Master, assisted by specialists in Drawing, Painting, and Modelling.

There are two departments and three terms of fourteen weeks each—

First—The College Course of four years' study, to prepare students as designers, painters, sculptors, or draughtsmen in architects and engineer'soffices.

Second—The Government School of Art Course in Day and Evening Classes.

The aim of the College is to improve and elevate the local industries. The principle and practice of textile designs are specially taught, and the designs are worked out in the Weaving and Dyeing Section of the College.

Fees charged in Day Classes are, for ladies or gentlemen—

Entrance fee, £1 and £1 10s. per term.

For Evening Classes—

Entrance fee, 3s. 4d. and 6s. 8d. per term for artisans.
„ 6s. 8d. and 13s. 4d. „ for others.
Wood Carving Class fees, 10s. 6d. per term.

All materials and appliances to be found by the students.

The Textile Department is one of the most important in the College.

The designing, weaving, and manufacture of cloth, under Mr. T. R. Ashenhurst.

The instruction is theoretical, combined with actual application of the theories in practice by the individual students in the Weaving Shop, which is elaborately fitted with most costly looms and appliances for manufacture of textile fabrics. The fees range from 15s. per term in Evening Classes up to 55s. per term in Day Classes.

The Dyeing and Chemistry Department are also of great importance, and are placed under the care of Dr. Knecht, who lectured on Dyeing at Kevin-street this year.

The course extends over two years ; the qualification for students entering is high, and the fees for the general course are £4 4s. per term.

The instruction appears to be of the highest practical value, and specially suited to the local textile manufacture.

The Evening Science Schools for young men employed during the day is much valued ; a number of Free Scholarships have been founded, open to artisans.

Every effort is made to give the instruction a practical bearing while preparing the students for the examination properly.

The fees amount to 21s. or 25s., according to the group of subjects selected per session, from September to May. There is no workshop instruction included in the Science Courses.

The list of subjects and the fees charged will be found in Appendix B.

## BIRMINGHAM.

Went on Tuesday from Bradford to Birmingham. On Wednesday morning inspected the Birmingham and Midland Institute, the Mason College, and the Bridge-street Standard Primary Schools.

The Birmingham and Midland Institute Council is composed of Official Governors, Borough Governors, Elective Governors, and several Sub-Committees are appointed by the Council. Two out of thirteen of the Elective Governors are always chosen from among the students—the remaining eleven representing the various manufactures and professions. There are considerably over 2,000 subscribing members to the Institute—the subscriptions being one guinea each. The members' privileges consist of—personal admission to news-rooms, writing-rooms, annual conversazione, excursions, lectures, &c. A magnificent lecture-hall has been built, capable of seating 1,200 people.

It is generally found that there is a profit of £1,000 per annum arising under this department in the hands of the Council, and it has been also found necessary to allocate this surplus, in order to meet the deficit arising in the Educational and Industrial Departments. A large portion of the Institute is set apart for the use of the subscribing members, and possesses a very handsome entrance, quite separate from the educational side.

The Deputation was courteously received by Mr. Paxton Porter, Secretary, and was conducted by Mr. Hjorns, Principal of the Metallurgical Section, through the class-rooms and workshops.

The Machine Shop, or Engineering Laboratory, is 50 feet by 25 feet, and contains the usual workshop benches, fitted with 20 vices, placed rather closer together than usual, owing to want of space. At one end is placed a 4-horse power Tangye Gas Engine; but where a gas engine is adopted, the Otto Engine is recommended in preference.

One large grindstone, driven by power.

One Tangye Screw-cutting Lathe, first-class; cost £90.

One Tangye Shaping Machine; cost £40.

One 4 feet 6 inch Slide Rest Power Lathe; cost £30.

One 3 feet Slide Rest Amateur Lathe; cost £15.

One Brassworkers' Foot Lathe; cost £5.

One small Hand-drilling Machine.

One Hydraulic Tensile Testing Machine, up to 30 tons, and would break an iron bar one inch in diameter.

One Dead-weight Transverse Strain Testing Machine.

One Electro-plating Dynamo Machine, by Carlisle, of Birmingham; £60.

One Electric Lighting Dynamo, Elmore and Parker, Wolverhampton; £80.

One Blacksmith's Hearth and Anvil, and all other smaller tools necessary, were the complete outfit of the Machine Shop.

Twenty-six students can be accommodated at a time; nothing whatever is made for sale, the sole object of the master being to instruct his pupils how best to execute their work.

Students are received from 17 and upwards, the average age being 20. The Institute finds students everything necessary for their work, but payment is required for loss or breakage—for loss or breakage caused through negligence. There are only night classes, consisting of actual workmen and small manufacturers. It is found that the sons of rich men generally make bad students; they are "*no use to work*," the masters say; they much prefer students who are looking forward to the necessity of earning their living by actual work.

### The Metallurgical Laboratory.

Here is provided accommodation for 50 students each night, Metallurgy being one of the principal sections in this school.

Each student is provided with bench, double cupboard, and drawer, on the Kensington model. The master cannot speak too highly of the Science and Art Department.

Instead of finding them rigid in the enforcement of their rules, they have repeatedly gone out of their way to make helpful alterations, and to meet the views of the Institute and its teachers.

A Balance Room beside the Laboratory is enclosed with a wood and glass screen. There are 13 Fletcher's Gas Muffles, 4 Coke Muffles, 2 Casting Furnaces, and Retort Benches. The Gas Muffles are found to be costly in use, and if space could be found would be replaced by Coke Muffles.

Great success has been obtained by this department in various public examinations. Out of eleven pupils obtaining high honours, seven received their training in this department.

There is an Electro-plating Workshop for 23 students, fitted with all necessary appliances, and supplied with power from the dynamo already referred to in the Engineering Shop.

On the first floor are numerous class and lecture rooms for scientific studies, and a special library for scientific and tecnological works.

On the second floor additional class rooms, in all of which the desks and seats are arranged for two students, 3 feet 6 inches being the size found to be most convenient, one desk being given to each pupil during examinations, so that the separation may be effectual.

A special lecture room for Physics, a special lecture room for Metallurgy. Chemical Lecture Room for 150 students, with the usual preparation room and stores.

A large Chemical Laboratory, provided with the usual centre tables and side benches; each centre table provides for for twelve students, with through troughs and end troughs; Bunsen's gas burners and water taps with conical spouts. Each table is 4 feet 7 inches wide by 22 feet long, 3 feet 2 inches high, and 2 feet 4½ inches from the ground to the under side of the drawers, which project, leaving room for the knees of the students when sitting at work. The master states that cupboards are necessary underneath the tables, in which to store appliances for the advanced classes. Separate cupboards in another part of the room may be provided for Elementary Classes. The Institute finds all apparatus, but students pay for breakages. There are no trade classes—such as plumbing, joinery, &c.

Application was made to the City and Guilds of London Institute by a deputation of the Council in 1884, but no grant was made on the excuse that Birmingham was sufficiently wealthy to help itself. The Council considered that Birmingham had a very strong claim, situated in the very heart of the manufacturing districts; the Birmingham Institute itself contributing £1,000 per annum of its profits towards the support of industrial teaching.

There is no principal or head master engaged to be responsible for all the departments of the Institute; but Mr. ——— receives £350 per annum as head of Chemistry and Physics Department; and Mr. ——— receives £250 per annum as head of the Metallurgical Department; Miss Lauprecht, Mistress of Hygiene; Mr. Cox, Drawing Master; Mr. Dunn, B.A., B.Sc., Teacher of Physiology; Mr. Cresswell, Teacher of Mechanics; Mr. Adams, Teacher of Geometry; and others receive in payment for their services two-thirds of the students' fees, and two-thirds of the Government grants earned.

It may be seen from the above report that, while the Birmingham and Midland Institute is doing valuable educational work, we can only make use of it in certain departments as a guide for the Dublin Technical Schools. Over £90,000 has been expended upon this building, of which a debt of £18,000 still remains unpaid.

The Deputation visited the Mason College, which is an endowed Institution, providing higher education, almost exclusively confined to the upper and middle classes, contrary to the intentions of the founder, who originally designed it for the benefit of artisans. Laboratories, Class Rooms, &c., are so much above our requirements in Dublin, that it is unnecessary to give any detailed account of them.

The Deputation next visited the Bridge-street Standard School, under the control of the School Board, where a very important and successful experiment was started about three years ago. This school is almost exclusively composed of artisans' children, who,

having passed the seventh standard in other Birmingham Board Schools, may, after the age of ten, come to this school for the continuance of their education for two years.

The special feature of this school is that the lads are practically taught the use of tools, elementary chemistry, practical geometry, and drawing, and the course is so arranged that the lads finish in two years, and are able to obtain situations very readily. Each lad coming to this school pays 3d. per week, but all tools, materials, chemical appliances, &c., necessary for his education, are provided for him.

Dinners also are provided at 2d. per head, and a substantial tea, with bread, butter and jam, at 1d. per head. The numbers attending this school vary from 50 to 100, according to the season of the year.

On the ground floor are class rooms, fitted with plain substantial desks and seats, joined together as usual, with metal frames, each 3 feet 6 inches long, for two scholars, and supplied by the Midland Joinery Company.

Black boards, masters' desks, and cupboard for slates, &c., are supplied by the same makers; accommodation for 60 boys.

There is another class-room on the same floor, having large windows on one side only, and, instead of the ordinary black board, two walls are coated in cement, to a height of five feet from the floor, smoothed and blackened, and used as a black board.

Desks and Benches similar to those already described.

On the first floor is the Lecture Theatre, arranged for 120 boys, with benches rising behind each other, and the usual table, blackboard, cupboards, &c.

A well arranged Chemical Laboratory, for 50 students, having centre tables on the Kensington model, 4 feet 6 by 15 feet, but only 2 feet 9½ high; the usual drawers, cupboards, and centre sinks, but no end sinks; each table designed for 8 pupils.

A Drawing School, with top light only, provided with tables and benches, rising in a series of tiers, 6 inches one above another. There are also the usual number of smaller class-rooms.

The workshop is a well-lighted irregular-shaped room, about 40 feet square, arranged to accommodate 40 boys at work at a time; it contains 6 carpenters' benches, a grindstone, a wood-turning lathe, a large cupboard, a master's desk, and 5 wash-hand basins at one end; separate lockers are not provided for the boys, as the tools used are the property of the school; but a series of wooden tool holders are fixed all round the walls, in which the tools are carefully placed, and kept under the master's eye.

A neat, small kitchen, with gas cooking stove, furnishes the necessary meals, and an airy dining-room, with plain tables and benches, communicates therewith.

These schools are found to answer admirably, and the system is likely to be extended before long.

## LEICESTER.

The Deputation were unable to visit the Leicester Technical School; but as boot and shoemaking, and framework knitting receive special attention, we annex herewith the printed prospectus of the school for the information of the Council.

The teachers do not receive any of the grants earned on results of examination, but are paid a fixed sum per lesson. We have secured a series of the printed prospectus and programmes of the various schools we visited, which will be found of service to the Committee who shall be appointed to arrange details.

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## CONCLUSION.

With reference to the election of trade representatives on the Council, we recommend that, if any difficulty should arise as to the method of election, the Council should adopt the suggestion of giving a vote for trade representatives to all tradesmen or artisans working in Ireland who subscribe one shilling a-year to the schools.

Your deputation, on full consideration of all that they have seen, learned, and been advised during their mission, combined with previous experience and acquaintance with the educational requirements of Dublin, are now quite clear in venturing to recommend to the Council to make all needful arrangements for and to establish in Kevin-street—

1. Day Manual and Science and Art Classes for Lads.
2. Evening Technical Classes for Apprentices and Artisans, with Science and Art Classes and Workshop Training.

We recommend a Sub-Committee to be appointed to settle and carry out all details.

The Day Manual Training Classes are specially recommended by Col. Donelly, of South Kensington, for the children of well-to-do artisans and others. Each pupil should be required to pass an entrance examination, either at this school or at some others equal to the 5th Standard under the National Board.

The education to be devised to train the head, the eye, and the hand, but no regular trade is to be taught. The social standing of the lads or their parents to be ignored, respectability and moral character alone being required in the individual students; the age of the pupils at entrance to be from 13 to 15; each year to be divided into three terms, of about 14 or 15 weeks each; commencing September, January, and April. The length of the educational course is to be two years. The fees chargeable to be as low as circumstances will permit.

Free Scholarships for deserving pupils to be established and encouraged as much as possible.

The hours of school to be from nine o'clock to four every day, except Saturday, with one hour off for lunch or dinner.

The school to supply all shop tools and materials, but the pupils to supply their own books, drawing instruments, paper and working apron.

We should recommend the first year's course should consist of arithmetic and mathematics, free-hand, geometrical, and mechanical drawing; elementary science, and the practice of the use of wood-working tools in the workshop.

The second year's course would comprise advanced studies in the same subjects, with workshop practice in the working of lead and other metals. At the end of the second year the lad's special aptitude will probably be determined so far as to enable him or his parents to make the best choice of his future vocation.

It is also likely that the teachers necessary for the Manual Day Classes can be found amongst the staff engaged for the evening classes.

Double the amount of grants can be obtained from Kensington for day students.

Instead of recommending specific subjects ourselves, we recommend that the Sub-Committee shall select the science and art subjects and the technological subjects from among those we found adopted at various schools given in the Appendix, which they consider most suitable to Kevin-street Schools. Those already picked out and named in the School Prospectus would seem suitable.

For Day and Evening Technical Classes and Science and Art Classes, we recommend that space be appropriated and settled for the following in Main Building, if sufficient funds are available:—

1. A Chemical Laboratory and a Store Room.
2. A Drawing School.
3. A Modelling Room.
4. A Physical Laboratory.
5. A Library and Reading-room for Technical and Scientific Works, especially Elementary Publications.
6. A Large Lecture Room.
7. A Private Room for Secretary and Council Meetings.
8. A Class Room for 40 Students.
9. A Class Room for 40 Students.

And in the Side Buildings—

1. A Carpenter's Workshop.
2. A Wood and Stone Carving Workshop.
3. A Fitter's Workshop, to be used also for Plumbers and Metal Plate workers, and perhaps, if large enough, for Mechanical Engineers.

4. A Mechanical Engineering Shop would cost so much to fit up, we recommend it to be postponed, and probably built specially hereafter.
5. A Weaving Shop, to be postponed also.
6. A Class Room for 40 Students—Leather Work and Bootmaking.
7. A Class Room for 40 Students—Coachbuilding.

Knowing the difficulty of getting sufficient money, we are doubtful of the propriety of recommending any further expenditure at present. Of course this would be but small provision for complete system of Technical Education, but if money cannot be obtained for more, even if for so much, we cannot see what more can be done without involving the Council in debt and difficulty. Indeed, we are of opinion that unless we can get £1,000 quickly contributed privately to start with, and £1,000 a-year for Technical side alone in subscriptions, the Council would not be secure to proceed.

We have the honour to remain, Gentlemen,

Your obedient servants,

T. R. SCOTT,

WILLIAM ROBERT MAGUIRE,
*Hon. Treasurer.*

P.S.—We direct attention to other recommendations in our letter, pp. 2–4.

# APPENDIX A.

## MANCHESTER TECHNICAL SCHOOL.

PAYMENTS TO TEACHERS AND TIME REQUIRED IN RETURN.

| 41 TEACHERS | SUBJECTS | TIME | SALARY | REMARKS |
|---|---|---|---|---|
| ... | Head Master, Boys' Manual Training School | 9 to 1 and 2 to 4, 5 days | £13 6s. 8d. per month | |
| ... | Assistant, Boys' M. T. S. Commercial Evening Classes | 9 to 1 and 2 to 4, 5 days, 2 evenings | £7 1s. 8d. per month | |
| ... | Commercial Evening Classes | 2 nights | 2s. 6d. per night | Temporary |
| ... | Mechanical Engineering | 6 mornings and 5 evenings | £300 per year | |
| ... | Do. | 6 mornings and 5 evenings | £16 13s. 4d. per month | |
| ... | Practical Engineering | 5 days and 2 evenings | £10 16s. 8d. per month | |
| ... | Mathematics and Theory of Mechanics | 5 evenings | £80 per session of 8 months | |
| ... | Building Construction | 5 evenings | £12 1s. 8d. per month | |
| ... | Do. | Saturday afternoon and 3 evenings | £25 per session of 8 months | |
| ... | Wood-workshop | 5 days and 3 evenings | £7 10s. per month | |
| .. | Chemistry | 3 mornings and 4 evenings | £11 9s. 2d. per month | |
| ... | Do. | 5 mornings and 2 evenings | £6 13s. 4d. per month | |
| ... | Metallurgy, Physics | 5 mornings and 6 evenings | £120 per annum | |
| ... | Dyeing, Bleaching | 5 mornings and 3 evenings | £120 per annum | |
| ... | Oils, Colors and Varnishes | 2 evenings | £20 per session | |
| ... | Telegraphy | 1 evening | £15 per session | |
| ... | Art Master | 5 afternoons and 4 evenings | £18 6s. 8d. per month | |
| ... | Wood-carving | 1 evening | £2 2s. 10d. per month | |
| ... | Assistant, Art | 5 evenings | £2 18s. 4d. per month | |
| ... | Architecture | 1 evening | £5 per session | |
| { | Carriage Building | } 1 evening | Technical Grant | The Carriage Masters' Association provides the balance of Salary |

| 41 TEACHERS | SUBJECTS | TIME | SALARY | REMARKS |
|---|---|---|---|---|
| — ... | Masonry | 1 evening | £7 10s. per session | |
| — ... | Bricklaying | 1 evening | £7 10s. per session | |
| — ... | Land Surveying and Levelling | Summer class, Saturday afternoon, Wednesday evening | Three-fourths of fees | |
| — ... | Metal Plate Work | 2 evenings | £10 per session | |
| — ... | Plumbing | 2 evenings | £16 per session | |
| — ... | Quantities Surveying | 1 evening | £5 per course of 20 lessons | |
| — ... | Electrical Engineering | 1 evening | £15 per session | |
| — ... | Cotton Manufacturing | 3 evenings | £50 per session | |
| — .. | Weaving and Designing | 3 evenings | £50 per session | |
| — | Lithographic and | 1 evening | £10 per session | |
| — | Typographic Printing | 1 evening | £10 per session | |
| — ... | Botany and Physiology | 2 evenings | £20 per session | |
| — ... | Geology and Physiography | 1 evening | £15 per session | |
| — ... | French and German | 3 mornings, 2 afternoons, 5 evenings | £100 per annum, and three-fourths fees for ladies' day classes | |
| — ... | Spanish | 1 evening | £20 per session | |
| — ... | Italian | 1 evening | three-fourths of fees | |
| — ... | Phonography | 2 evenings | £20 per session | |
| — ... | Book-keeping | 2 evenings | £20 per session | |
| — .. | Dressmaking | 3 days, 2 evenings | three-fourths of fees | |

# APPENDIX B.

## List of Classes and Fees—Finsbury Technical College, London.

Day Classes—£9 per Session of three terms, 5th October to 15th July, for Lectures, Laboratory, and Workshop Course, with use of apparatus and materials.

The course of instruction for all day students comprises Practical Mathematics, Lectures, and Laboratory Work in Mechanics, Physics, and Chemistry, Mechanical and Freehand Drawing, workshop instruction in wood and iron, and French or German.

Departments.—I. Mechanical Engineering and Applied Mathematics. II. Applied Physics and Electrical Engineering. III. Applied Chemistry. IV. Applied Art. V. French and German languages.

Evening Classes.—6s. to 12s. 6d. per session of two terms, 4th October to 27th May; eight months for separate evening classes intended for artisans; apprentices admitted at half fees.

Department I.—Mechanical Engineering and Mathematics.

Class on Practical Mechanics and Machine Design; Professor Perry; Tuesdays and Fridays, 7 to 8; exercise work, 8 to 9; Laboratory work, 6 to 7; fee 15s. per session. Students expected to work three hours per week in Drawing Office, and two hours a-week in Mechanical Laboratory; fee for complete course, 25s. per session.

Class on Practical Mechanics.—Mr. Crambie; Fridays, 6 to 8; fee 9s. per session.

Class on Practical Geometry.—Mr. Millis; Tuesdays and Fridays, 8 to 9; fee, 6s. per session. Workshops open Mondays and Wednesdays for students in Practical Mechanics.

Mechanical Drawing Office open Mondays and Thursdays, 6 to 9.

Department II.—Applied Physics and Electrical Engineering.

Class on Electrical Technology, Elementary AA.—Professor Thompson; Wednesday, Laboratory, 6 to 8; Lecture, 8; fee, 12s. 6d. per session.

Class on Electrical Technology, Advanced—Professor Thompson; Monday, Laboratory, 6 to 8; Lecture, 8; fee, 12s. 6d. per session.

Class on Practical Physics.—Dr. Walmsley; Friday, Laboratory, 6 to 8; Lecture, 8; fee, 12s. 6d. per session.

Special Class on Electric Bells.—Professor Thompson; Thursdays, 6 Lectures, 8 p.m., with Laboratory instruction; fee, 6s. per course.

Special Class on Electric Deposition of Metals.—Thursdays, 6 Lectures, 8 p.m., with Laboratory instruction; fee, 6s. per course.

Special Class on Gasfitting.—Mr. Millis; Thursdays, 4 Lectures, 8 p.m.; fee, 2s. 6d. per course.

Department III.—Applied Chemistry.

Class on Inorganic Chemistry.—Mr. Evans; Mondays, Tutorial Class, 7 to 8; Lecture, 8 to 9; Wednesdays, Laboratory; fee for course, Lecture and Laboratory, 12s. 6d. per session, or with two evenings in Laboratory, 15s. per session.

Class on Organic Chemistry.—Professor Meldola; Monday, 6.30 to 9; Lecture Demonstration; Wednesdays and Thursdays, Laboratory work; fee, 15s. per session. See prospectus of Laboratory Regulations.

Special Class on Soap and Alkali.—Professor Meldola; Wednesdays, 6 Lectures, 7 p.m.; fee for course, 6s.

Department IV.—Applied Art. Art Lectures Course by Head Master on Art Furniture and Fittings, Wednesdays, 8 to 9. Fee to outside students, 10s. per course.

Studio Courses—B Drawing. Free-hand, with pen, brush, or chalk. C Design: Elementary Design—Application of Design to Industries. D Technical Painting. Every evening, except Saturday, 7 to 9.30.

Life Classes—E Painting—Every evening, except Saturday, 7 to 9.30. F Modelling—Monday, Wednesday, Thursday, 7 to 9.30. G Plaster Casting and Sgrafitto. H Tapestry Painting. I Pottery Painting. K Metal Work in repoussé—Tuesdays, 7 to 9.30. L Cabinet Making Design. Wrought Iron Work Design under consideration.

Fee to students attending three nights per week, 17s. per session. Fee to students attending five nights per week, 25s. per session. For any of the above Courses, including Lectures.

Department V.—Special Trade Classes.

Cabinet Makers' Work—Mr. J. Whitty; Tuesdays and Fridays, 7.30 to 9.; Classes and Workshop Instruction; fee, 7s. per session.

Carpentry and Joinery Work—Mr. H. Staynes; Wednesdays and Fridays, Elementary, 7.30 to 9; Lectures and Workshop; fee, 7s. per session; Mondays and Fridays, Advanced, 7.30 to 9; Lectures and Workshop; fee, 7s. per session; Tuesdays, 6 to 8, Workshop Instruction for Architects and Surveyors.

Metal Plate Work—Mr. Millis; Mondays, 7 to 9, Lectures and Laboratory Work; fee, 7s. per session; Tuesdays, 7 to 8, Lectures and Laboratory Work; fee, 7s. per session.

Plumbing—Mr. W. R. Hoare; Fridays, Elementary, 7 to 9; Lecture and Workshop; fee 7s. per session; Mondays, Advanced, 7 to 9; Lecture and Workshop; fee, 7s. per session.

Bricklaying and Brick Cutting—Mr. H. W. Richards; Thursdays, 8 to 9.30, Lecture and Workshop; fee, 7s. per session.

Brickwork and Masonry—Mr. H. W. Richards; Mondays, 8 to 9.30, Lectures and Technical Drawing; fee, 7s. per session.

Builders' Quantities—Mr. F. G. Minter; Thursdays, 7.30 to 9; fee, 7s. per session.

Arithmetic and Mensuration for Trade Class Students—Mr. Millis; Mondays, 7 to 8; fee, 7s. per session.

Apprentices are admitted to all Classes at half fees.

## POLYTECHNIC, RAQUET-STREET, LONDON.

The Practical Trade Classes at Polytechnic include Carpentry and Joinery—Tuesday and Thursday, 8 to 10; 5s. to Members, 7s. 6d. to others, per quarter; Saturday, 3 to 7, 7s. 6d. to Members, 21s. to others, per quarter.

Hand Railing and Staircase work—Special Class.

Cabinet Making—Monday and Wednesday, 8 to 10; 5s. to Members, 7s. 6d. to others.

Brick Laying and Cutting—Members, 3s., outsiders, 6s., 3 months' Course.

Engineering Pattern Making—Tuesday and Thursday, 8 to 10, 4s. to Members, 7s. 6d. to others.

Filing, Fitting, Erecting, and Millwork—A Special Class.

Metal Turning Lathe and Machine Work—Each evening, Elementary, 2s. 6d. and 5s.; Advanced, 3s. 6d. and 7s. per quarter.

Sign Writing.

Tailors' Cutting—Monday and Wednesday; fee, Members, 4s.; fee, outsiders, 1 evening, 8s.; 2 evenings, 14s. per term of 12 weeks.

Wood and Stone Carving—Each evening, 7 to 10; 2 evenings, 12s. 6d.; 4 evenings, 21s. per quarter.

Plumbing—Friday, 8 to 10, 7s. 6d. per quarter.

House Decoration—Monday, 8 to 9.30, 2s. to Members, and 4s. to others, per quarter.

Watch and Clockmaking—8 Classes; fees, from 7s. 6d. to 12s. 6d. to Members, per quarter.

Upholstery—Thursdays, 8 to 9.30; fees, 3s. to Members, 6s. to others, per quarter.

The Technical Classes include—

Electric Lighting—Tuesdays, 8 to 10; fees, Members, 4s., outsiders, 6s.

Electrical Instruments—Tuesdays, 8 to 10; fees, Members, 4s., outsiders, 6s.

Telegraphy and Telephony—Tuesdays, 8 to 10; fees, Members, 4s., outsiders, 6s.

Complete Course of Instruction for Electrical Engineering—25s. per quarter.

Brickwork and Masonry—5s., 7 months' Course.

Carpentry and Joinery—Monday and Friday, 8 to 9; Members, 4s., others, 10s. per session.

Boot and Shoemaking—Monday, 8 to 9; Elementary, Members, 2s. 6d., others, 5s., per session; 9 to 10, Advanced, Members, 2s. 6d., others, 5s. per session.

Carriage Building—Thursday, 8 to 9.30; Members, 2s., others, 4s. per session.

Mechanical Engineering—Wednesdays, 8 to 9; Members, 2s. 6d., others, 5s. per session.

Mine and Land Surveying—Monday, 7 to 8; Members, 7s. 6d., others, 10s. 6d. per quarter; Friday, 8 to 9; Members, 7s. 6d., others, 10s. 6d. per quarter.

Printing—Mondays, Advanced, Members, 5s., others, 7s. 6d. per 30 Lectures; Wednesdays, Elementary, Members, 4s., others, 7s. 6d. per 30 Lectures.

Quantity Surveying and Measuring—Thursday, 9 to 10; Members, 5s., others, 7s. 6d. per quarter.

Drawing for Watch and Clockmaking—Thursday, 8 to 10; 5s. and 7s. 6d. per quarter; Elementary, Tuesday and Wednesday, 8.30 to 10; 3s. and 5s. per session.

Watch and Clockmaking—Advanced, Friday, 8.30 to 10, 2s. 6d. and 6s. per session.

Metal Plate Work—Thursdays, 8.30 to 10; 2s. 6d. and 5s. per session.

Plumbers' Work—Monday and Thursday, 8.30 to 10; 4s. and 7s. 6d. per session.

Silversmiths' Work—Thursday, 8.30 to 10; 4s. and 7s. 6d. per session.

Technical Drawing for Cabinetmakers—Friday, 8 to 10; 5s. per session.

Wood Working Tools—2s. 6d. and 5s. per session.

Metal Working Tools—2s. 6d. and 5s. per session.

Oils, Colours, and Varnishes—2s. 6d and 5s. per session.

The Science Classes at Polytechnic include—

Building Construction and Drawing—11 Classes, at 2s. 6d. to 15s. per session.

Machine Construction and Drawing—4 Classes, at 2s. 6d. to 7s. 6d. per session.

Practical Plane and Solid Geometry—5 Classes, at 2s. 6d. to 10s. 6d. per session.

Steam and Steam-engine—Elementary, Wednesday, 7 to 8; 2s. to 4s. per session; Advanced, Wednesday, 9 to 10.15; 2s. to 4s. per session.

Pure Mathematics—Elementary, 2s. to 4s.; Advanced, 3s. to 6s.

Sound, Light and Heat—3s. to 5s.

Inorganic Chemistry—4 Classes, 1 hour each; 2s. to 4s. per session.

Practical Inorganic Chemistry—4 Classes each, 7s. 6d. to 17s. 6d. per session.

Organic Chemistry—2 Classes, 1 hour each, 2s. to 4s. per session.

Practical Organic Chemistry—2 Classes, 7s. 6d. to 17s. 6d. per session.

Theoretical Mechanics—Thursday, 9 to 10.15; 3s. to 5s. per session.

Applied Mechanics—Thursday, 8 to 9; 3s. to 5s. per session.

Mineralogy—Tuesdays, 9 to 10; 3s. to 5s. per session.

Geology—Tuesday, 8 to 9; 3s. to 5s. per session.

Botany—Fridays, 7.30 to 9; 3s. to 5s. per session.

Hygiene—Wednesday, 8 to 9; 2s. 6d. to 4s. per session.

Animal Physiology—Wednesday, 9 to 10.15; 2s. 6d. to 4s. per session.

Biology—Thursday, 8 to 9; 2s. 6d. to 7s. 6d. per session.

Physiography—Friday, 8.30 to 9.30; 2s. to 4s. per session.

The Practical Art Classes include—

Drawing, Elementary and Advanced, 3s. to 7s. 6d. per session.

Oil and Water-colour Painting.

Modelling—Tuesday and Friday, 7.30 to 9.30; 5s. to 10s. 6d. per session.

The General Classes include—

Civil Service, Analysis and Composition, Arithmetic, Book-keeping, Geography, Writing, Grammar, Swimming, Gymnastics, French, German, Hebrew, Shorthand, Choral, Theory of Music, Violin, Cornet, &c., Elocution, Fencing, Ambulance, Pharmaceutical.

The smaller fees are for Members, the larger fees for non-members. There is also a Summer Session, from April to July, quite distinct from Winter Session.

## MANCHESTER.

Boys' Manual Training School.—First year's Course, £6; 2nd year's Course, £9.

Day Course.—Mechanical Engineering; fee 5 guineas per term, or 15 guineas per annum.

Chemistry.—Fee for each Lecture Course, 21s. per term; fee for each Laboratory Course, 52s. 6d. per term, or £9 9s. for both courses per session.

Metallurgy and Assaying.—Fee for Lecture Course, Tuesday, 12 to 1, 21s. per term; fee for Laboratory Course, Tuesday, 10 to 12, 31s. 6d. per term, or £7 for both courses per session.

Bleaching, Dyeing, and Printing.—Fee for day students, all time, Laboratory Practice, 7 guineas per term, or £20 for the session. Day students, afternoon, Laboratory Practice, 4 guineas per term, or £11 per session.

Day Drawing Classes.—10s. 6d. per term, or 25s. per session.

Shorthand and Reporting Class.—3s. per term, or 5s. per session.

Science.—Evening Classes; fee for each class, per session, 2s. 6d. generally, except in special exceptions.

Classes for Engineering Course—2 hours.

Machine Construction and Drawing—5s. per session—about 60 lessons.

Descriptive Geometry—2 hours, 2s. 6d. per session of 30 lessons.
Theoretical Mechanics—1 hour, 2s. 6d. ,,
Applied Mechanics—1 hour, 2s. 6d. ,,
Steam—1 hour, 2s. 6d. ,,
Mathematics—2 hours, 5s. ,,
Mechanical Engineering—1 hour, 5s. ,,
Tools, 1 hour—5s. ,,

Practical Engineering Course in Workshop—5 hours, 25s. per session, 8 months; two evenings per week. See Time Table.

Evening Science Subjects taken are—

1. Practical Geometry—Thursday, 7.15 to 9.30; 2s. 6d. per session.
2. Machine Construction—Monday and Thursday, 7.25 to 9.30; 5s. per session.
3. Building Construction—Thursday and Friday, 7.25 to 8.25, 5s. per session; Saturday, 2.30 to 4.45, 5s. per session.
4. Mathematics—5 Classes, 5s. per session.
5. Theoretical Mechanics—Wednesday, 7.25 to 8.25; 2s. 6d. per session.
6. Applied Mechanics—Elementary, Monday, 7.25 to 8.25; 2s. 6d. per session; Advanced, Friday, 8.30 to 9.30; 2.s. 6d. per session.
7. Sound, Light and Heat—Elementary, Thursday, 7.25 to 8.25; 2s. 6d. per session; Advanced, Thursday, 7.25 to 8.25, 2s. 6d. per session.
8. Magnetism and Electricity—Elementary, Monday, 8.30 to 9.30; Advanced, Thursday, 8.30 to 9.30.
9. Chemistry, Inorganic—Elementary, Tuesday, 7 to 8; Saturday, 4.30 to 5 30, 2s. 6d. per session; Advanced, Wednesday, 7 to 8, 2s. 6d. per session. Each Practical Laboratory Course, 10s.
10. Chemistry, Organic, Monday, 7 to 8, 2s. 6d. per session.
11. Geology—Thursday, 8.30 to 9.30, 5s. per session.
12. Botany—Elementary, Wednesday, 7.15 to 8.25, 5s. per session; Advanced, Saturday, 3 to 4, 5s. per session.
13. Physiology—Wednesday, 8.30 to 9.30, 5s. per session.
14. Metallurgy—Elementary, Friday, 7 to 8; Lectures, 2s. 6d. per session; Advanced, Saturday, 6.30 to 7.30, 2s. 6d. per session. Practical Course, each 10s.
15. Steam—Elementary, Monday, 8.30 to 9.30, 2s. 6d. per session; Advanced, Friday, 7.25 to 8.25, 2s. 6d. per session.
16. Physiography, Friday, 7.25 to 8.25, 2s. 6d. per session

Evening Technical Subjects taken—Alkali, Breadmaking, Brewing, Oils, Colours and Varnishes, Oils and Fats, Iron and Steel, Bleaching, Dyeing, and Printing Cotton and Linen, Cotton Manufacture, Weaving and Pattern Designing, Telegraphy, Electric Lighting, &c.; Metal Plate Work, Plumbers' Work, Metal Working Tools, Mechanical Engineering, Carriage Building, Typographical Printing, Lithographic Printing, Carpentry and Joinery, Brickwork and Masonry, Engineering Work, Pattern Making, Practical Joinery, Staircase Making, Quantity Surveying, Dress,making Millinery, Surveying and Levelling.

Evening Art subjects taken—Art Drawing, Freehand, 5s. one term, 9s. two terms, 12s. three terms; Wood Carving and Furniture Design, 5s. one term; 9s. two terms; Modelling, Art Needlework, Textile Design, Architectural Drawing, History of Ornament, Perspective, Life Classes.

## Manchester Technical School.

President—Oliver Heywood, Esq.; Treasurer—T. R. Wilkinson, Esq.; Chairman of Council—Dr. J. Watts; Hon. Secretary—T. Gair Ashton, Esq.

### Boys' Manual Training School.

*Teachers.*

English Language and Literature, Mathematics, Geography and History, Political Economy, Physiography, Book-keeping, French, Elementary Art, and Design—Mr. T. W. Lawrenson and Assistant Master.

Advanced French—Mr. H. Lange.

Advanced Art, Geometrical and Mechanical Drawing—Mr. R. Glazier, Art Master; Mr. H. G. Jordan, Associate Royal College of Science, Dublin.

Chemistry—Mr. H. L. Snape, B. Sc., and Mr. E. L. Rhead.

Manual Instructor.—Mr. A. W. Binns.

Objects.—The main purpose of the School is the harmonious development of a boy's whole faculties, by means of a systematic and progressive course of Intellectual Instruction and Manual Training, which has for its express object the cultivation of the power of observation and the training of the judgment. It is not intended to teach a trade, but simply to provide for each boy a complete education for both head and hand, in the belief that in this way all his powers will be best developed, and he be best fitted to take his part in the world in any position to which he may be called.

The Course of study will also help to determine a boy's special aptitudes, and may thus guide his parents in the choice of his vocation.

The School has no narrow aims: Languages and Literature, Mathematics, Elementary Science, Drawing, and Business Training receive due and proportionate attention, and the pupil is taught by the daily

use of tools a real knowledge and experience of processes and materials which cannot but be of the greatest value to him.

It is hoped that the School will create and foster a higher sense of the dignity of skilled labour and the worth of the skilled workman. It will certainly supply during School years the stimulus of a healthy occupation, and will cultivate in the pupil, through the constant practice of working to drawings and exact measurements, habits of precision, method, and painstaking effort.

The Council trust that parents may be found willing to give their sons the exceptional advantages which the School affords, in the hope that it may lead in many cases to boys, whose tastes and aptitudes make it desirable, joining the higher Technical Classes, thus fitting themselves for becoming highly-skilled workmen or managers, and in any event for entering with great advantage upon any calling or profession at home or abroad.

Conditions of Entrance.—Boys seeking admission to the first year's Course must be at least thirteen years of age, and be able to pass a satisfactory examination in the fundamental rules of Arithmetic, in Vulgar and Decimal Fractions, and in English Grammar and Composition, fully equal to the Sixth Standard of the Education Code. The Entrance Examination will be held on Tuesday, the 31st August, at 9 o'clock. The number of pupils who can be entered is limited; but pupils can be admitted at any time provided there is room, and that they are prepared to take up the class work.

Course of Instruction.—The first year's Course will embrace Language and Literature, Geography, and History, seven hours per week; the higher rules of Arithmetic and Mathematics, five hours per week; Writing, Freehand, Geometrical, and Mechanical Drawing, five hours per week; Elementary Science, five hours per week; Tool Instruction in Carpentry and Wood Turning, eight hours per week. The second year's Course, in addition to advanced studies in the subjects named, embraces Manual Training in the working of Lead, Iron, and other metals.

Terms and Fees.—The School year is divided into three terms of about fifteen weeks each, commencing September, January, and April. There are vacations of two weeks at Christmas, one week at Whitsuntide, and five weeks at Midsummer.

The hours of School are from 9 o'clock until 4 o'clock, with an interval of one hour for lunch, accommodation for which is provided in the School on moderate terms. No boy can be allowed to leave the School earlier than 4 o'clock.

The fees as at present arranged are, for the first year's Course, £2 per term; for the second year's Course, £3 per term. All fees are payable in advance, and no boy will be entered who does not intend to remain for one year at least. The School supplies all shop tools and materials, but pupils must buy their own books, drawing instruments, paper, and certain small pocket tools, all of which are inexpensive, and may be bought in the School at cost price. Each boy will require an apron. Breakages, which are the result of carlessness, will be charged to the pupil.

Scholarships.—Through the liberality of certain of the supporters

of the School, the Council is able to offer a limited number of partially-free Scholarships, with the object of bringing the School within the reach of clever boys whose circumstances are straitened, and which will be awarded upon the results of a special competitive examination.

Equipment.—The workshop occupies a spacious room, and is fitted with twenty benches, and twenty lathes driven by power, saw-bench, grindstones, and complete set of tools for each student. The laboratories and class-rooms are replete with every appliance necessary for satisfactory illustration of all subjects.

General Regulations.—It is expected from every boy that he will attend regularly and punctually to his School duties, that in all things he will render a cheerful obedience, and do his utmost to sustain the character of the School.

The Home Lessons will occupy about one hour and a-half in preparation, and will be based chiefly upon subjects which have already been fully explained. As the progress of the pupils depends greatly upon these lessons being well done, the hearty co-operation of parents in their conscientious preparation is earnestly desired.

Weekly reports of absences and irregularities of any kind will be made to parents.

Term reports of the progress and position of the pupil in each subject of instruction will also be made.

The railway and tram companies offer special facilities to pupils.

## NOTTINGHAM.

Day Class—Term of eleven weeks, 10s. 6d., one class per week; session of three terms, 25s. 6d.

Evening Class—Term of eleven weeks, 5s., two classes per week; for Teachers in Elementary Schools, 2s. 6d., two classes per week; German Elementary Schools, same fees; Italian Elementary Schools, same fees.

Commercial Department—Shorthand, Lower, Advanced and Reporting.

Book-keeping—Single Entry, Double Entry.

French—Commercial Correspondence.

English—Commercial Correspondence.

German.—Commercial Correspondence; fee for each class, 5s. per per term, one or two hours weekly.

Chemistry—Fee for Day Lectures and Classes, 21s. per term; fee for session of three terms, 50s. per term. Fee for Evening Lectures and Classes, 5s. per term; fee for Lectures only, 2s. 6d. per term.

Practical Chemistry—Fee for Day Work, six hours per week, 40s. per term; each additional hour per week, 5s. extra per term. Fee for Evening Work, one evening per week, 10s. per term; two evenings per week, 20s. per term. Artisans admitted in the evening at half fees.

Technical Courses—Chemistry of Brewing, 25 Lectures, 5s. per course (evening.) Chemistry of Dyeing and Bleaching, 50 Day

Lectures, 40s. per course. Chemistry of Benzine and Coal Tar, 30 Evening Lectures, 10s. per course.

Science and Art Chemistry Courses—30 Lectures or 30 Laboratory Lessons in each Course; 1 Organic, Elementary, Inorganic, Advanced, Organic, Practical; fee for each Lecture Course of 30, 2s. 6d.; fee for each Laboratory Course, 5s.

Mathematics, Physics, and Engineering—Arithmetic Class, 2s. per term; Government Pure Mathematics Class, 2s. 6d. per term; Mixed Mathematics, 5s. per term; Physics, 15s. per term; Practical Physics, 18 hours per week in Laboratory, 60s. per term; 8 hours per week, 30s. per term; 5 hours per week, 20s. per term; two evenings per week, 15s. per term.

Natural Science—Geology Lectures, 2s. 6d., Classes, 2s. 6d. per term, Evening; Botany, Lectures and Demonstrations, 7s. 6d. per term, Evening; Biology, Lectures and Classes, 5s. per term, Evening.

Practical Photography—5s. per term, Evening.

Practical Telegraphy—2s. 6d. ,,

Engineering Course—three terms, £5 5s. per term, and £3 3s. per Summer term, or £18 in advance for whole session.

Courses of Lessons in following subjects from October to May; fee, 7s. 6d. per course, all Evening Classes:—

Framework Knitting and Hosiery Machine; Lace Manufacture and Lace Machine (including also attendance at Mechanics or Mechanical Drawing Class); Builders' Carpentry, Staircase and Hand-railing, Brickwork and Masonry (including also attendance at Joinery, Geometry or Building Construction, and Drawing Class); Moulding and Casting, Printing.

Special Course, Evening Lessons for young artisans and apprentices intending to become Mechanical Engineers; October to May, for 2 or 3 years; 1st year's course, 15s.

Science Classes taken are with respective attendances in 1886:—

Geometry, 42; Machine Construction, 77; Building Construction, 57; Mathematics, 57; Theoretical Mechanics, 19; Applied Mechanics, 45; Acoustics, Light and Heat, 25; Magnetism and Electricity, 35; Physiography, 18; Chemistry, Inorganic, 47; Chemistry, Practical, 24; Chemistry, Organic, 11; Chemistry, Agricultural, 21; Geology, 24; Animal Physiology, 123; Botany, 25; Steam and Steam Engine, 31; Hygiene, 68; Total tickets issued, 749.

Technical Classes taken with respective attendances, 1886:—

Fitting, Turning, &c., 56; Lace Machine, 57; Lace Manufacture, 23; Carpenters' Work, 53; Staircasing and Hand-railing, 52; Hosiery Manufacture, 61; Joinery Lectures, 18; Screw-cutting, 14; Moulding and Casting, 3; total tickets, 337; total students, 183.

Attendances at Day Classes:—

| | 1st Term | 2nd Term | 3rd Term |
|---|---|---|---|
| Tickets issued ... | 451 | 417 | 286 |
| Individual Students ... | 292 | 193 | 147 |

Attendances at Evening Classes other than Science and Technological:—

| | | | |
|---|---|---|---|
| Tickets issued ... | 1064 | 833 | 545 |
| Individual Students ... | 860 | 452 | 401 |

UNIVERSITY COLLEGE, NOTTINGHAM.—PROPOSED TRADE SCHOOL.

The Technical Schools' Committee propose in October next to take into their Workshops about fifty boys of the artisan class, who on leaving school intend to follow some mechanical pursuits, such as

(1) Engineering Trades.
(*a*) Fitting
(*b*) Turning
(*c*) Pattern Making

(2) Building Trades.
(*a*) Joiners' Work
(*b*) Carpenters' Work
(*c*) Plumbers' Work

Before admission the boys will be required to have passed at least Standard VI. of the New Code, and also an entrance examination to be held at the Technical Schools.

It is intended to extend the training of the boys over 1 or 2 years, and the course of instruction will embrace the use of tools and such subjects as will enable them the better to understand the principles which underlie the trade they desire to follow. Thus, a boy who intends to become a joiner would be taught Mensuration and Elementary Mathematics, Mechanics, Geometry, and Building Construction and Drawing, and would also receive instruction in the use of wood-working tools. A boy who had gone through such a course would be of considerable value to his employer, and there is no doubt that masters would give the preference to a boy so trained, and in fact some have already intimated their willingness to do so.

The Committee intend to offer some Scholarships for competition amongst the boys, and possibly to remit the fees of some few who have done well in the Entrance Examination but have not gained a Scholarship.

The year will be divided into four quarters, and the fee for the whole course (including workshop practice) 5s. per quarter. The ours of attendance would probably be from 9 to 12.30, and 2.30 to 5. Each boy will be expected to sit for the Government Examination in May, and no boy will be admitted who does not come under the definition of an "Industrial Student." An "Industrial Student" is defined by the Government Regulations to be "the child of parents in receipt of weekly wages, or receiving an income of not more than £200 per annum."

The Entrance Examination will be held in September next. Early application is requested.

Should more than fifty boys apply, they will be admitted on the results of a competitive examination.

LEONARD LINDLEY, Chairman, University College Committee.
WILLIAM LEE, Chairman, Technical Schools' Committee.
WM. H. HEATON, Professor of Mathematics, Physics, &c.
J. WESTMORELAND, Superintendent of Workshops, and Lecturer in Engineering.

## BRADFORD.

Mathematics, Arithmetic, Euclid, Algebra (Mechanical and Engineering Department), 10s. 6d. per term; regular day students, 5 days a-week, £5 per term; occasional day students, 2 days a week, £3 per term.

Evening Classes—Science and Art Subjects, 5s. each per session.

Other Subjects—1 evening per week, 7s. 6d. per session; 2 evenings per week, 12s. 6d. per session; 3 evenings per week, 15s. per session; 4 evenings per week, 17s. 6d. Students not undertaking to qualify and sit for examinations, double fees; session from September 20th to May Examinations; general Workshop Course, evening, 10s. per term.

Day School—General Course, 21s. per term; Technical Course, each subject, 10s. 6d. per term; French and German, 10s. 6d. per term. students not sitting for examinations charged increased fees.

School of Art—Day Classes, entrance fee, 20s.; instruction fee, 30s. per term; Evening Classes, Elementary, Advanced, Modelling; fees for artisans, entrance, 3s. 4d.; Instruction fee, 6s. 8d. per term; for all others, double fees; 3 terms a-year, 14 weeks each.

Woodcarving Class—10s. 6d. per term.

Textile Department—Fees per term, 1st year, Ordinary Course, Afternoon Class, 50s.; Evening, 15s.; 2nd and 3rd year, Ordinary Course, Afternoon Class, 55s.; Evening, 17s. 6d.

Dyeing and Chemistry Department—General Course, 84s. per term; Chemistry Course, 42s. per term; Organic Chemistry, Evening Class, 5s. per session. Students not sitting for examination, 21s. per session; Evening Classes for Practical Dyeing, with material and apparatus supplied, 15s. per term.

Evening Science Classes—1. Elementary Chemistry; 2. Advanced Chemistry; 3. Elementary Electricity and Magnetism; 4. Elementary Sound, Light, and Heat; 5. Advanced Sound, Light, and Heat; 6. Solid Geometry and Machine Construction; 7. Mathematics, Stage 1; 8. Mathematics, Stage 2 and 3; 9. Theoretical Mechanics; 10. Applied Mechanics; 11. Elementary Steam; 12. Advanced Steam; 13. Physiography; fee for each subject, 5s. per session.

Technical Arithmetic—Fee 5s. per term.

Laboratory Practice Classes in the foregoing subjects, 10s. per session.

Students not sitting for the examinations are charged largely increased fees.

## BIRMINGHAM.

### Birmingham and Midland Institute—Industrial Department.

The Session is divided into two terms. The Autumn Term began on Monday, September, 13th, and closed December 23rd. The Winter Term commenced on Monday, January 17th, 1887, and ended on the 22nd of April, with a vacation of one week at Easter. In Science

subjects the Classes continue up to the date of the Government Examinations. No Classes will be held on the evening of the 22nd November, that being the date on which the anniversary of laying the foundation-stone of the Institute buildings is celebrated. There will be about fifteen lessons to each class in each term.

All the Classes are open to female students.

Students under 12 years of age are not admitted to the Classes, except to those in Music.

All fees must be paid in advance. The Council request the particular attention of the students to this regulation.

Annual Students, if above 16 years of age, who pay in advance a year's class fees, amounting to one guinea, or who shall pay in addition to the year's class fees such sum as with their year's class fees shall amount to one guinea, are entitled to the following privileges of the General Department:—Personal admission to the News Room (and in the case of female students, admission to the Ladies' Reading Room), Monday Evening Lectures, Christmas Holiday Lectures, the President's Address, Special Lectures, Conversazione, and Monthly Meetings of the Archæological Section. They may also join the Excursions of the Section.

The opening lesson in the Autumn Term in each of the classes, except the Penny Classes, is free to the public.

### Evening Classes.

Classes are held at the Institute, Ratcliff Place, in Music and Singing, in Metallurgy, Mechanical Engineering and Steam, and in other subjects, as follows:—

Algebra—Elementary, Tuesdays, 7.30 p.m., 1d. per lesson; Advanced, for Matriculation and Science and Art Department, Mathematics, Stages 1, 2, 3, Tuesdays, 8.45 p.m., 3s. 6d. per term.

Architectural Drawing—Mondays and Thursdays, 7.30 to 9.0 p.m.; 5s. per term.

Arithmetic—Elementary, Mondays, 7.30 p.m.; 1d. per lesson; Advanced, for Matriculation and Science and Art Department, Mathematics, Stages 1, 2, 3, Wednesdays, 7.30 p.m.; 3s. 6d. per term.

Book-keeping—Fridays, 8.30 p.m.; 3s. 6d. per term.

Botany—Elementary, Mondays, 7.30 p.m.; 1d. per lesson; Advanced, Tuesdays, 7.30 p.m.; 1d. per lesson.

Chemistry, Inorganic—Elementary, Tuesdays, 7.30 p.m.; 1d. per lesson; Advanced, Wednesdays, 7.30; 1d. per lesson; Honours, Saturdays, 2.30 p.m.; 1d. per lesson.

Chemistry, Practical—Elementary, Wednesdays, 7 to 9.45; artisan students, 10s. per term; other students, 30s. per term; Advanced, Mondays, 7 to 9.45 p.m.; artisan students, 10s. per term; other students, 30s. per term; Honours, Saturdays, 3.30 to 9.30 p.m.; artisan students, 20s. per term; other students, 40s. per term.

French—Elementary, Thursdays, 7.30 p.m.; 3s. 6d. per term; Advanced, Tuesdays, 7.30 p.m.; 3s. 6d. per term; Commercial and Correspondence, Wednesdays, 8.15 p.m.; 3s. 6d. per term; Conversation and Literature Class, Thursdays, 8.0 p.m.; 3s. 6d. per term.

Geology—Elementary, Thursdays, 7.30 p.m.; 1d. per lesson; Advanced, Fridays, 7.30 p.m.; 1d. per lesson.

Geometry—For Matriculation and Science and Art Department, Mathematics, Stages 1, 2, 3, Thursdays, 8.45 p.m.; 3s. 6d. per term; Practical Plane and Solid, Tuesdays, 7.30 p.m.; 1d. per lesson.

German—Elementary, Wednesdays, 7.30 p.m.; 3s. 6d. per term; Commercial and Correspondence, Wednesdays, 7.30 p.m.; 3s. 6d. per term; Advanced, Wednesdays, 8.35 p.m.; 3s. 6d. per term.

Grammar and Composition—Elementary, Fridays, 7.30 p.m.; 3s. 6d. per term; Advanced, Fridays, 8.35 p.m.; 3s. 6d. per term.

Hygiene—Tuesdays, 7.30 p.m.; 1d. per lesson.

Machine Construction and Drawing—Mondays and Thursdays, 7.30 to 9.0 p.m.; 5s. per term.

Magnetism and Electricity—Elementary, Thursdays, 8.45 p.m.; 1d. per lesson; Advanced, Fridays, 8.45 p.m.; 1d. per lesson; Advanced Exercise, Saturdays, 7.30 p.m.; 1d. per lesson.

Mathematics—Science and Art Department, Stage 1, Mondays, 7.30 p.m.; 1d. per lesson; Stage 2, Tuesdays, 8.45 p.m.; 1d. per lesson; Pure, for London University Intermediate Examinations in Arts and in Science, Saturdays, 12.45 p.m.; 10s. per term; Mixed, for Intermediate in Science, Saturdays, 2.0 p.m.; 10s. per term.

Mechanics, Applied—Elementary, Fridays, 7.30 p.m.; 1d. per lesson; Advanced, Fridays, 8.45 p.m.; 1d. per lesson; Theoretical, Elementary, (for S. and A. Dept., and for Matriculation), Mondays, 8.45 p.m.; 1d. per lesson.

Mineralogy, Elementary, including Blowpipe Analysis, Tuesdays, 8.45 p.m.; 1d. per lesson.

Physiography—Elementary, Mondays, 7.30 p.m.; 1d. per lesson; Advanced, Mondays, 8.45 p.m.; 1d. per lesson.

Physiology—Elementary, Mondays, 7.30 p.m.; 1d. per lesson; Advanced, Mondays, 8.45 p.m.; 1d. per lesson.

Shorthand—Elementary and Intermediate, Mondays, 3.0 p.m.; 10s. 6d. per term; Advanced and Reporting, Mondays, 4.0 p.m.; 10s. 6d. per term; Elementary, Mondays, 7.30 p.m.; 5s. per term; Intermediate, Mondays, 8.45 p.m.; 5s. per term; Advanced, Thursdays, 7.30 p.m; 5s. per term; Reporting, Thursdays, 8.45 p.m.; 5s. per term.

Sound, Light and Heat—Elementary, Thursdays, 7.30 p.m.; 1d. per lesson; Advanced, Fridays, 7.30 p.m.; 1d. per lesson; Advanced Exercise, Saturdays, 6.30 p.m.; 1d. per lesson.

Trigonometry—Wednesdays, 8.45 p.m.; 3s. 6d. per term.

Writing—Fridays, 8.0 p.m.; 3s. 6d. per term.

Students attending the Classes will be supplied at the Ticket Office with tickets, on which they must write their names and addresses. These tickets will be collected in the class-rooms, and the students must see that they are properly filled up and given to the Collector. The attendances of the students are recorded solely from these tickets, and care must be taken to fill them up correctly.

When required, the students are requested to furnish information as to age and occupation; these particulars are necessary for the compilation of statistics relating to the Institute.

## Science.

Chemistry and Physics—Principal of the Department, Mr. C. J. Woodward, B. Sc. ; Demonstrator, Mr. Wm. Russell.

Metallurgy, Electro Metallurgy, Iron and Steel, Fuel, Mechanical Treatment of Metals, Mechanical Engineering and Steam—Mr. A. H. Hiorns, Mr. G. C. Marks, Assoc. M.I.C.E., and Mr. T. J. Baker; Demonstrator in Electro Metallurgy, and Iron and Steel (Mechanical), Mr. W. Hawkins; Demonstrator in Iron and Steel, Mr. J. Lester; Demonstrator in Brass Work, &c. (Mechanical), Mr. W. Probert; Assistant, Mr. A. R. Gower.

Botany and Geology—Mr. J. W. Oliver.

Animal Physiology—Mr. G. S. Dunn, B.A., B.Sc.

Hygiene—Miss A. S. Lauprecht.

Applied Mechanics—Mr. A. Cresswell

Theoretical Mechanics and Practical Plane and Solid Geometry—The Rev. E. A. Irons, M.A.

Physiography—Mr. Chas. Clarke

Mineralogy—Mr. C. J. Woodward, B.Sc.

## School of Metallurgy.

Teachers, Mr. A. H. Hiorns, Mr. G. C. Marks, and Mr. T. J. Baker, assisted by Practical Demonstrators.

By the kindness of certain gentlemen interested in the work, the Council have been enabled to make extensive additions to the rooms of this department, which now consist of a Metallurgical Laboratory with 35 furnaces, and all necessary apparatus for the students' use; an Electro-Metallurgical Laboratory fitted with dynamo and every convenience for Electro-deposition and apparatus for each student; and an Engineering Laboratory or Machine Shop, containing gas engine, lathes, vices, testing machines, and other apparatus required in the mechanical treatment of metals.

The following Classes will be held during the Session :—

## Theoretical Classes.

Iron and Steel—Elementary, Tuesdays, 7.30 p.m.

Copper, Zinc, Lead, Tin, &c.—Elementary Metallurgy, Tuesdays, 8.35 p.m.

Electro Metallurgy—Wednesdays, 7.30 p.m.

Gold, Silver, &c.—Elementary Metallurgy, Wednesdays, 8.35 p.m.

Mechanical Engineering—Thursdays, 7.30 p.m.

Steam—Thursdays, 8.35 p.m.

Fuel—Fridays, 7.30 p.m.

Metallurgy—Advanced, Fridays, 8.35 p.m.; Honours, Saturdays, 8 p.m.

Fee to each Class, 1d. per lesson, except for Mechanical Engineering, the fee for which is 3s. 6d. per term. Each student must sign a guarantee pledging himself to attend twenty lessons, and sit for Examination, or pay, in advance, a fee of 10s. for the Session.

PRACTICAL CLASSES.

Fuel, Iron, and Steel, Gold and Silver, Copper, Zinc, Lead, Tin, &c.—Elementary Metallurgy, Mondays, 7 to 10 p.m.

Electro Metallurgy—Advanced, Tuesdays, 7 to 10 p.m.

Iron and Steel—Mechanical, Wednesdays, 7 to 10 p.m.

Fuel, Iron and Steel, &c —Advanced Metallurgy, Wednesdays, 7 to 10 p.m.; Thursdays, 7 to 10 p.m.

*Electro Metallurgy—Elementary, Thursdays, 7 to 10 p.m.

Brass Work, &c.—Mechanical, Thursdays, 7 to 10 p.m.

Fuel, Iron and Steel, &c.—Honours Metallurgy, Saturdays, 3 to 8 p.m.

†Iron and Steel—Mechanical, Saturdays, 3 to 6 p.m.

‡Metallurgy—Elementary, Saturdays, 5 to 8 p.m.

Fee for Elementary or Advanced stages, 20s. per session; Honours stage, 30s. Students not entering for Examination, Elementary and Advanced Stages, 60s.; Honours Stage, 80s., with a deposit of 2s. 6d. for breakages. There are two terms in the Session as in the other Classes of the Institute.

Each student must sign a guarantee pledging himself to attend twenty lessons and sit for Examination, or pay the higher fee.

NOTE.—Students in practical classes must also attend the corresponding theoretical classes, or pay the higher fee for each practical class.

## APPENDIX C.

### FINSBURY COLLEGE REPORT BY W. V. DIXON.

CITY AND GUILDS OF LONDON INSTITUTE.—TECHNICAL COLLEGE, FINSBURY.—DUTIES OF CARETAKER.

1. To open doors of Building in the morning, to see that the boys and attendants are here at the proper time, and that the cleaning and dusting of the staircases, corridors, lecture and class rooms, offices, &c., are properly done.

To see that all lights are put out, all windows and doors are securely fastened before leaving at night.

2. To attend in the Box from 9.30 a.m. to 1 p.m. during the Session; to ring the bell at stated periods for change of classes; to give information to students and inquirers on matters respecting the College, and to make himself otherwise generally useful.

* Students in these Classes must also attend the Theoretical Class in this subject, and be engaged in the trade, otherwise they will have to pay in advance a fee of 40s. per Session.

† This Class will not be held unless there are more applicants that can be accommodated on Wednesdays.

‡ This Class is arranged to meet the convenience of those living out of town.

3. During the vacation to assist in cleaning of the building and offices, and to see that these operations are efficiently performed.

Hours of attendance—

(*a.*) During Session—7.30 a.m. to 1 p.m.; 5 p.m. to 9 p.m.; Saturdays, 9 a.m. to 1 p.m.

(*b.*) During Vacation—9 a.m. to 5 p.m. Wages commence at 25/- weekly, rising to 28/-.

Cost of tools *only* in the various Shops—Mechanical Engineering shop about £500; Carpenters and Pattern-makers, about £100; Physical workshop, about £100; Sheet-metal Worker's shop, about £5; Plumber's shop, about £5.

Numbers of Evening Students at Finsbury—Art Students, 150; Cabinetmakers' Class, 8; Metalplate Workers, 54; Bricklaying Class, 14; Builders' Quantities, 28; Carpentry and Joinery, 25; Plumbing, 58; Chemistry (Inorganic), 90; Chemistry (Organic), 29; Electrical Elementary Class, 95; Electrical Advanced Class, 96; Practical Physics, 14; Complete Course of Electrical Engineering, 43; Complete Course of Mechanical Engineering, 73; Mechanics' Lectures, 22; Practical Mathematics, 18; Practical Geometry, 21.

Of the above 800 students very few attend the Mechanical Drawing Class. As in order to join it a student must take out a complete course in either Mechanical or Electrical Engineering, which few could afford, and would be useless to a great many.

### Physical Workshop, No. 3,

Would accommodate 10 Students. Size, 20 × 20. £100.

Is fitted up for wood or metal work; has two benches, 8 ft. by 2 ft. by 2 in, fitted up for wood work; each with carpenters' wooden vice, and one for metal work, with 3½ tail-vice. 1 5-inch centre screw lathe; bed, 5 feet; rest not geared; to be worked by foot or steam; £32. 1 5-inch centre bar lathe; head divided; £20. 1 4-inch centre bed lathe; foot only; £8. 1 3-inch centre back-geared lathe, £5. 1 Polishing and brushing lathe, £2. 1 Small grindstone, £1 10s. Gas bench for soldering, &c., £5. Presses, drawers and shelves for tools and materials.

In this shop are made several instruments to be used in the Electrical and Physical Laboratories.

Mechanical Engineering Shop costs £150 a-year to keep.

Nothing made in the College is sold; but any article made by a student may become his property if he pays the cost of the material.

The trade classes cost £50 a-year (for all).

### Mechanical Engineering Workshop, No. 14,

Would accommodate 20 students. Size, 28 × 30. £500.

*List of Tools, &c.*

3 6-inch centre 6-feet bed screw and surfacing lathes; rest geared by back shaft, with quick return, £50 each. 1 5½-inch centre 5 feet bed, back-geared lathe, for foot or steam power; £20. 2 5-inch centre 36-inch bed lathes, for foot or steam power, £15 each.

1 Large shaping machine, 8-inch stroke, £70. 1 Large pedestal drilling machine, £25. 1 Small shaping machine, 4-inch stroke, £25. 1 Universal tool grinder, £29- 1 Small portable forge, £2 15s. 4 Benches, 16 ft. by 2 ft. by 2 in.; each bench has 4 vices—1st. 4 5-in. tail vices; 2nd. 4 4-inch tail vices; 3rd. 4 4½-inch cam vices; 4th. 4 4-inch parallel vices; vices 4 feet apart; £45. 1 Small shears, £3 3s. 1 Swivel drilling machine, £3. 1 Hand drilling machine; 2 Whitworth surfaces; sets of Whitworth stocks and dies; files, chisels, hammers, &c.; tool chests, drawers, &c.

N.B.—Cam vices are not as good as the tail vices for chipping, &c., in Iron Workshop.

### Carpenters' and Pattern Makers' Shop, No. 13.

Will accommodate 15 Students. Size, 15 × 30. £100.

*List of Tools, &c.*

2 6-inch centre gap lathes; bed, 6 feet; for foot or steam-power; £12. 1 5-inch centre lathe; bed, 5 feet; for foot or steam power; £8. 1 small circular saw; table, 2 ft. by 3ft. 4 benches, 8 ft. by 24 in. by 2 in.; each with 2 metal carpenters' clamps, one on each side, at opposite ends; 10 clamps, £8. 1 bench at end, against the wall, 15 ft. by 3 ft. by 2 in, with 2 clamps. Tool chests, racks, drawers, and presses. Saws, planes, chisels, gouges, squares, bevels, marking gauges, braces, bits, awls, &c.

N.B.—A band saw is preferable to a circular saw; is less dangerous, and would be more useful to coach builders.

The evening classes in Carpentry and Mechanical Engineering are attended by builders' clerks, architects' clerks, draughtsmen, and clerks from the patent office, in addition to apprentices and improvers in the trades for which they are designed.

### Plumber's Shop. No. 19.

Size, 20 × 28.

Bench along one side and one end, 30 in. wide, 2½ in. thick; one bench in centre 8 ft. × 2 ft. × 2½ in. Three small stoves for heating lead or solder; press for holding tools and materials, £5. Irons, ladles, mallets, &c. The lead used in this shop is sold at about 25 per cent. loss on original cost.

### Sheet Metal Room. No. 11.

Size, 20 × 28.

Bench along one side, 30 in. wide 2½ in. thick; large table in centre of room, suitable for drawing or laying out patterns. Presses and drawers. Anvils, triblets, hammers, snips, &c., £5.

N.B.—The plumbers and sheetmetal workers' classes are the only classes that are reserved exclusively for their respective tradesmen in Finsbury College.

### Chemical Department

Comprises Rooms Nos. 22, Chemical Lecture Theatre; 23, Chemical Lecture Preparation Room; 26, Chemical Demonstrator's Room; 27,

Chemical Laboratory; 28, Chemical Balance Room; 29, Chemical Gas Analysis Room; 30, Chemical Class Room; 31 & 32, Chemical Professors' Room and Laboratory; 30AB, Chemical Stores; 7, Chemical Operations Room. This department, exclusive of salaries, costs £200 a year, giving an average cost per student of £1—could not be done less. For rules as to apparatus, &c., for students, see prospectus.

### Chemical Laboratory. Room 27.

Size, 52 × 60 feet. Fitted up for 100 students.

In addition to the students' ordinary working benches, there are—*a*. Three stone benches, with hoods and flues, suitable for sand baths, combustions, &c.; *b*. Raised platform, with bench fitted up for demonstrations and class work (water and gas laid on); *c*. Dark closet for spectrum work; *d*. Water still; *e*. Blowpipe table; *f*. Stink closets; *g*. General washing troughs; *h*. Four washhand basins. The students' benches are 36 in. high and about 24 in. deep. 4 ft. 3 in. frontage allowed to each student; top of bench covered with lead (S. K. allowance is 3 ft. 6 in.). At the back of each bench is a shelf raised 12 in., over which is a hood connected with the main shaft (for draught). Beneath the benches are drawers and cupboards. Drawers, 25 in. wide and 5 in. deep; cupboards, 25 in. wide (single door) and 27 in. high; and as it is seen that there are two drawers and two cupboards beneath each bench, one drawer and one cupboard is given to a day student, and the other drawer and cupboard to an evening student, both of which work at the same bench. Each student has two gas taps on his benches and is supplied with two burners and necessary L. R. tube, with retort stands and fitter stands. The retort stands are made by fixing brackets with rings to the pillars which support the hoods over the raised shelf. The fitter stands are formed by a slip of wood sliding out from beneath the shelf. The general reagents are left on the benches for each student, and the special on shelves round the walls. Each student must supply himself with a complete outfit as specified in the calendar, which may be obtained at the stores No. 30H & B.

### Balance Room, No. 28.

Size, 23 × 21 feet.

Contains 5 small balances, in glass cases, with drawer and rider moved from outside case, and weights, to carry 50 grains (by Becker). 2 larger and finer, to carry 50 grains (by Oertting). Each balance rests on a separate table, supported on iron brackets, fastened to the wall. Tables, 24 in. by 18 in., and 30 in. by 24 in., and height, 36 inches. Desks suitable for drawing, with one drawer beneath. Glass cases, &c. Also a large table for drawing diagrams upon, 10 feet, by 6 feet (divided brass slip along one side and ends).

### Gas Analysis Room. No. 29.

Floor covered with linoleum in one piece, and raised about one inch all round the walls, contains benches, glass cases, &c., and the various gas analysis apparatus, cathetometer, barometer, thermometers, &c.

### Class Room. No. 30.

Fitted-up with desks, black boards, &c.; glass cases round the walls, used at present as a small chemical museum.

### Chemical Lecture Preparation Room. No. 23.

Adjoins Chemical Lecture Room; is also used for storing some of the chemical apparatus.

### Chemical Lecture Room. No. 22.

Size, 50 by 30 feet; windows with screens for darkening; gas can be controlled from the lecture table.

### Chemical Operations Room. No. 7.

Size, 35 × 20.

This room is chiefly used for organic work, combustions, distillations, &c. Contains a large stone bench, with two 24-inch basins, with steam jacket, for boiling, and one steam-heated still, washing troughs, cupboards, &c. Lead-covered benches, with gas, water, and steam laid on.

N.B.—This room is right over the engine boilers.

### Student's List of Tools and Cost at Finsbury,

Required by each student in manual work in the Wood and Iron Workshops. These tools to be the property of the student, or found by the College on the deposit system.

1 Jack plane, 5s.; 1 trying plane, 6s.; 1 6-inch square, 2s.; 1 single tooth gauge, 9d.; 3 firmer chisels, 2s. 6d.; 1 mortice chisel, 1s.; 1 2-foot rule, 1s. 6d.; 1 pair of callipers, 1s. 6d.; 1 steel L square, 1s. 6d.; 1 steel straight-edge rule, 1s. 6d.; 1 centre punch, 6d. Total, £1 3s. 9d.

The above to be kept in student's own locker. All other tools to be kept in racks in the shops, and to be in proportion to the number of students.

### Instructor's Estimate of Machines, Tools, &c.,

Required for Wood Workshop; suitable for divisions of 36 students. These to be used by advanced students only.

A circular saw bench for 12-inch saw, £30; machine band saw, £35; 4 wood-turning lathes, £60; 18 benches, about 9 feet long by 2 feet 6 inches, with 2 screws to each, £108; tools common to the shop, exclusive of those provided for each student, £90. Total, £323. Fixing and shafting not included. This estimate is much beyond our means at present in Dublin.

### Instructor's Estimate of Machine Tools, &c.,

Required for a complete Iron Workshop, suitable for divisions of 36 students.

A 10-inch self-acting screw cutting gap lathe, £100; 4 6-inch centre self-acting lathes, £40 each, £160; 2 4-inch centre hand-rest lathes, £30; an 8-inch stroke shaping machine, with circular shaping

attachment, £80; a 3-inch stroke shaping machine, with circular shaping attachment, £30; radial arm double-geared drilling machine, £70; 2 smaller radial arm double-geared drilling machines, £50; 2 smaller radial arm double-geared drilling machine, £50; milling machine, £70; slotting machine, £60; planing machine, to plane 4 feet long by 2 feet, £80; emery wheel tool grinder, £50; 20 vices, of various sizes and makes, £45; benches for vices, £40; screwing tackle, reamers, drills, tool holders, marking out table, surface plates, &c., £100.

Wood workshop and Smiths' shop—A 10-horse engine, which would be sufficient for other workshops, £120; also boiler for same, £120. Total, £1,205.

This estimate does not include fixing or shafting, pullies or belts.

Also much beyond our present means in Dublin.

W. V. DIXON.

## APPENDIX D.

INSTITUTE OF BRITISH CARRIAGE MANUFACTURERS.

DEAR SIR,

You will have noticed in the last Annual Report that at a Meeting of the Council of the London Chamber of Commerce, held on December 9th, 1886, your President proposed the following resolution, which was carried by an unanimous vote:—"That a thoroughly representative Committee of the Commerce and Trade of the Metropolis be appointed, to consider a well-devised scheme of improved Commercial and Tech-nical Education suited to the wants of the present time."

Steps are being taken to carry out the resolution to a practical result, and it is necessary that each trade should carefully consider the educational wants of all those engaged in it, with a view to the utmost possible efficiency; for after industry, honesty, and perseverance, the most valuable auxiliary in the future will be the skill, trained technical knowledge, that will aid the best possible use of materials with the least possible waste, either of materials or time. In fact, looking to the rival manufactures of foreign countries entering our own free of duty, it behoves the individuals engaged in British industries to grapple with the difficulties of the present state of affairs, and to make known to teachers of the young people now being prepared to enter trade their actual needs in the course of their daily life, whether as chiefs, officers, or privates in the army of industry.

It is possible that all the subjects set down cannot conveniently be acquired in the ordinary Schools of the country; it is, however, probable that in many towns where technical classes are held in the evenings, and where Mechanical and Literary Institutes exist, the whole may be acquired (where desired) before the time arrives when

the young men set up homes of their own, in whatever grade of life their lot may be cast.

The Council invites your friendly aid in the novel and difficult task it has undertaken, trusting you will be so good as to return the accompanying paper within fourteen days of its receipt.

By Order of the Council,

I remain, dear Sir,

Yours faithfully,

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*Secretary.*

PROPOSED SCHEMES OF GENERAL PRELIMINARY EDUCATION FOR YOUTHS AND YOUNG MEN PREPARING TO ENGAGE IN THE BRITISH CARRIAGE MANUFACTURE, ISSUED BY THE COUNCIL OF THE INSTITUTE OF BRITISH CARRIAGE MANUFACTURERS. Office, Committee Room No. 6, Westminster Town Hall, London, S.W.—April 20th, 1887.

*Subjects:*

For Employers—Good Reading, Good Writing, Dictation (Writing Letters on various subjects), Writing Essays on various subjects, Arithmetic, Book-keeping, Euclid, Algebra, Drawing (Freehand and Mechanical), Latin, Geography (chiefly Commercial), History, one or two Foreign Languages: French, German, Italian, Spanish; Mechanics, Metallurgy, Elements of Botany and Forestry, Animal and Vegetable Substances used in Manufactures; Elementary Engineering, Contrast and Harmony of Colours, Elements of Commercial Law, Hygiene (Attaining and Maintaining Sound Health and Strength).

For Managers and Foremen—Good Reading, Good Writing, Dictation (Writing Letters on various subjects), Arithmetic, Euclid, Algebra, Book-keeping, Drawing (Freehand and Mechanical), History, Geography (chiefly Commercial), one Foreign Language (French or German), French, German, Mechanics, Metallurgy, Elements of Botany and Forestry, Animal and Vegetable Substances used in Manufactures, Elements of Engineering, Contrast and Harmony of Colours.

For Accountants, Clerks and Storekeepers—Good Reading, Good Writing, Dictation (Writing Letters on various subjects), Arithmetic (including Foreign Money and Exchanges and Foreign Measurements), Book-keeping, to include Prime Costs, Labour Accounts, Valuation of Work, Compilation of Statistics, Making-up Accounts, Drawing-up Balance Sheets, Bills of Exchange, Shorthand, Type-writing, Geography (chiefly Commercial), one Foreign Language (French or German), French, German, Condensing Reports, Correcting Printers' Proofs.

For Skilled Artisans (General)—Good Reading, Good Writing, Arithmetic, Drawing (Free-hand and Mechanical), Mechanics, Book-keeping, Geography (chiefly Commercial), one Foreign Language (French or German).

In addition, for Wood Workers—Elements of Botany and Forestry, Elements of Engineering.

For Smiths—Metallurgy (Iron and Steel), Heat, Elements of Engineering.

For Painters—Contrast and harmony of Colours, Chemistry, composition and character of Oils, Turpentines, Varnishes, Colours; Reasons of success and failure, Elements of Analytical Chemistry.

For Trimmers—Animal and Vegetable Substances used in manufacture, Dyes (Weaving), Testing of woven and other materials used in this department.

SCHEME OF INSTRUCTION IN SPECIAL TECHNICAL CLASSES.

*Subjects:*

For Employers—Principles of Designing Carriages, Principles of Constructing Carriages, Scientific methods of Designing and Proportioning Wheels, Axles, Springs; Mechanics, as specially applied to—Construction, Proportion and Relative Strength of parts; Suspension, Durability, Lightness, Comfort; Adapting Vehicles to the size and description of Draft Animals as regards—Speed, Efficiency, Safety; Drawing and Designing Carriages to Small Scale, Half Scale (full working size), Drawing and Designing parts of Carriages—Bodies, Carriages, Wheels, Axles, Springs, Lamps, Linings, Heraldry; Framing (theoretical), Framing (practical); Qualities and characters of Woods, manipulation and testing qualities of wood, iron, steel, cloth, leather, &c.; Kinds of Carriages used in Great Britain and Ireland, British Colonies, Foreign Countries.

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# APPENDIX E.

## LEICESTER SCHOOL OF TECHNOLOGY, SCIENCE AND ART.

Committee of Management:—Mr. H. Simpson Gee, Chairman; the Mayor of Leicester, Mr. Alderman Barfoot, Mr. William Bohm, Mr. William Collier, Mr. Alderman Chambers, Mr. J. H. Cooper, Mr. James Ellis, M.P.; Mr. Francis Hewitt, Mr. T. Fielding Johnson, Mr. W. T. Rowlett, Dr. Shaw, Mr. John Sarson, Mr. Alderman Stafford, Mr. Alderman Stevenson, Rev. Canon Vaughan, M.A.; Mr. W. H. Walker, Mr. J. G. Ward, Mr. B. C. Wates, Mr. Alderman Windley. Treasurer, Mr. B. C. Wates; Secretary, Mr. A. H. Burgess, Berridge-street.

GENERAL INFORMATION.

The course of instruction in the Technical Classes will be in accordance with the programme of the City and Guilds of London Institute for the Advancement of Technical Education. The Institute grants certificates and awards valuable money prizes and silver and bronze

medals in each subject on the result of the examination, which will be held from 7 to 10 on Wednesday, May 25th, 1887.

The Court of the Worshipful Company of Frame Work Knitters has generously offered to the Leicester Technical School the sum of £20 a-year for three years, to be called "The Frame Work Knitters Company's Gift," to be awarded in scholarships or prizes to students who distinguish themselves in the annual examination in Frame Work Knitting. The members of the Court have also expressed their intention of conferring the gift of the Company's Freedom upon the best scholar or prize-winner of the Company's gift when he reaches the age of twenty-one.

Further information can be obtained at the school on application to the Rev. H. S. Biggs, and any students having suggestions to make are requested to confer with Mr. Biggs.

It is expected that all students in the various Technical Classes, and in the South Kensington Science and Art Classes, will make at least twenty attendances, and that they will present themselves for the examination of the City and Guilds of London Institute on May 25th, 1887, or for the examinations of the Science and Art Departments, held in May.

In addition to the examination of the Institute, the local committee propose to hold separate examinations in the Clicking, Making, and Sewing Machine Departments of the Boot and Shoe Section. Arrangements will be made for granting local certificates and prizes to the successful candidates.

The Committee wish to point out to students in the Science and Art Classes that by a recent regulation of the department, prizes are awarded only to registered students who have made, during the session, at least twenty attendances.

The school will close for about three weeks after the week ending December 18th. Due notice will be given of the resumption of the classes. There will also be a short recess at Easter, of which notice will be given.

FEES.

For Practical Chemistry, 15s. for the session. (This fee includes the use of all apparatus and chemicals; but students must find their own platinum wire and foil, and must pay for the apparatus broken by them. Only students who have gone through a course of theoretical lessons in Chemistry can be admitted to this class).

For the classes in Technology and Science (except Practical Chemistry), 3s. 6d. for the session.

For practical instruction in the Stocking Frame to pupils of the Hosiery Class, 5s. for the course of ten lessons.

For the course of Lectures in Biology, 10s. 6d.

For the Latin and Greek Classes, 21s. for the session.

For the Classes in Modern Languages, 10s. 6d. for the session.

For the Art Classes, 3s. 6d. for each term.

Forms of entry may be obtained upon application at the Wyggeston Boys' School, or at the office of the Secretary, Mr. A. H. Burgess, Berridge-street.

JAMES WENT, M.A., *Head Master.*

Classes in Technology, Languages, Science, and Art, will be held as follows :—

1. Technology of Frame Work Knitting.—Elementary Class, Tuesday, 7.30. Instructor—Mr. J. H. Quilter (Silver Medallist in Frame Work Knitting of the City and Guilds of London Institute for the Advancement of Technical Education). Commencing Wednesday, October 20th. Advanced Class, Friday, 7.30. Instructor—Mr. W. T. Rowlett. Commencing Friday, October 22nd.

2. Technology of the Boot and Shoe Trade.—Pattern Cutting and Clicking Department. Instructors—Mr. J. C. Swain and Mr. F. Knight (Silver Medallist and holder of Honours Certificate for Boot and Shoe Manufacture of the City and Guilds of London Institute for the Advancement of Technical Education). Making and Finishing Department. Instructor—Mr. William Stanger. Sewing Machine Department. Instructor—Mr. H. C. Pretty. Clicking and Making Departments—Advanced Section, Monday—Clicking, &c., 7.30 to 8.45 ; Making, &c., 8.45 to 9.45. Section A, Tuesday—Clicking, &c., 7.30 to 8.45 ; Making, &c., 8.45 to 9.45. Section B, Thursday—Clicking, &c., 7.30 to 8.45 ; Making, &c., 8.45 to 9.45. Sewing Machine Department—Advanced Section, Wednesday, 7.30 to 8.30 ; Sections A and B, Wednesday, 8.45 to 9.45. The Classes will commence on Monday, Tuesday, Wednesday, and Thursday, October 25th, 26th, 27th, and 28th. During the Spring Months, Supplementary Lectures wil be given on the various materials used in the manufacture of Boots and Shoes, on the principals of prime-costing, and on the Anatomical Construction and Natural Functions of the Human Foot.

3. A Course of Lectures on the Chemistry of Wool Dyeing. Instructor—Mr. A. W. Poyser, B.A. Elementary Class, Thursday, 7.30 ; Advanced Class, Thursday, 8.45. Commencing Thursday, Oct. 21st.

4. The Technology of Plumbers' Work Instructor—Mr. T. S. Elgood (Whitworth Scholar). Thursday, 7.30. Commencing Thursday October, 21st.

5. Mechanical Engineering. Instructor—Mr. T. S. Elgood (Whitworth Scholar). Wednesday, 7.30. Commencing Wednesday, October, 20th.

6. Carpentry and Joinery. Instructor—Mr. W. M. Cowdell (Honours Certificate, Science and Art Department, South Kensington). Thursday, 7.30. Commencing Thursday, October 21st.

7. Brickwork and Masonry. Instructor—Mr. W. M. Cowdell (Honours Certificate, Science and Art Department, South Kensington). Thursday, 8.45. Commencing Thursday, October 21st.

8. Latin. Mr. E. E. Law, B.A. Monday, 7 p.m.
9. Greek. Mr. E. E. Law, B.A. Monday, 8.15.

} Commencing Monday, October 18th.

Classes will be formed for both Elementary and Advanced Instruction. The Latin and Greek Authors read will be those selected for the Matriculation Examination of the University of London in June, 1887.

10. French. M. Pelluet. Tuesday, 7.30. Commencing Tuesday, October 19th.

11. German. Herr Schmidt. Thursday, 7.30. Commencing Thursday, October 21st.

The Course in each Language will consist of twenty lessons.

12. Sound, Light, and Heat. Friday, 7 p.m. Rev. Edward Atkins, B.Sc.
13. Inorganic Chemistry. Friday, 8 p.m. Rev. Edward Atkins, B.Sc.

} Commencing Friday, October 8th.

14. Practical Chemistry. Tuesday, 7 p.m. Mr. A. W. Poyser, B.A. Commencing Tuesday, October 12th.

15. Magnetism and Electricity. Thursday, 7.30. Mr. E. M. Elligott, B.A. Commencing Thursday, October 7th.

16. Building Construction. Tuesday, 7.30. Mr. T. H. Thirlby (Certificated Art Master, South Kensington). Commencing Tuesday, October 5th.

17. Machine Construction and Drawing. Tuesday, 7.30. Mr. E. M. Elligott, B.A. Commencing Tuesday, October 5th.

18. A Course of Twelve Lectures in Biology, with practical laboratory demonstrations, by Dr. Frank M. Pope. Wednesday, 7.30. Commencing Wednesday, October 13th. This class will be limited to 20, and students will require microscopes. Text Book—Huxley and Martin's "Course of Elementary Instruction in Practical Biology."

19. Art Classes are held on Monday, Tuesday, and Thursday evenings, from 7 to 9. The School is registered as a School of Art by the South Kensington Department, and the Classes, both elementary and advanced, are conducted with efficient assistance by Mr. G. S. Catlow. The Class for Perspective meets on Monday, at 7.15, and that for Practical Geometry at 8.15. On Saturday afternoon, at 3, a Special Class is held for advanced Painting from Still Life, the Draped Figure, Flowers, and Landscape. Persons desirous of joining this Class are requested to send their names to Mr. Catlow, at the School. The Classes will commence on Monday, September 27th.

### Leicester Technical School.

The Worshipful Company of Framework Knitters has placed at the disposal of the Committee the sum of £20 a-year for three years, to be called the "The Framework Knitters Company's Gift," to be given in prizes to students who distinguish themselves in the Annual Examination of the City and Guilds of London Institute in Framework Knitting.

The gift will be distributed this year when the results of the Examination are disclosed, as follows :—

Framework Knitting—Advanced Stage, First Prize, £5; Second Prize, £3; Third Prize, £2. Elementary Stage, First Prize, £3; Second Prize, £3; Third Prize, £2; Fourth Prize, £2.

In addition to the above, T. Loveridge, Esq., Master of the Worshipful Company of Framework Knitters, has kindly offered Five Guineas for Prizes to the Students of the Leicester Technical School.

These prizes will be given on the result of the May Examination of the City and Guilds of London Institute for the Advancement of Technical Education, and they will be given to the first and second students who do not obtain one of the prizes offered by the Institute, and who have made *at least twenty* attendances. Only students who are in receipt of wages will be eligible for these prizes.

Wool Dyeing—Advanced Section, First Prize, 10s. 6d.; Second Prize, £10s. 6d. Elementary Section, First Prize, 10s. 6d.; Second Prize, 10s. 6d.

Boot and Shoe Maunfacture—Advanced Section, First Prize, 10s. 6d ; Second Prize, 10s. 6d. Sections A and B, First Prize, 10s. 6d ; Second Prize, 10s 6d.

Plumbers' Work—First Prize, 10s. 6d.; Second Prize, 10s. 6d.

### Boot and Shoe Section.

The Committee of the Technical School propose to hold the Local Examination for Certificates and Prizes in (1) Clicking and Pattern Cutting, (2) Making and Finishing, and (3) Machinery, including the getting up of Uppers, on Wednesday, June 22nd, from 7 to 10 p.m., in the Large Hall of the Wyggeston Boys' School. No student can be examined in more than one of the above-mentioned sections.

Certificates will be awarded to the successful candidates, and the Committee offer Two Prizes of the value of £1 and 10s. to the First and Second Candidates in each section. The Prizes (which will be given in money or otherwise, at the option of the students) will only be assigned to students who have made twenty attendances altogether, but any student may compete for a Certificate.

Students who wish to compete are requested to fill up the form, which will be supplied by the Instructors, or on application at the School, and to forward it to Mr. Biggs at the Wyggeston Boys' School, not later than the morning of Thursday, June 16th.

### Plumbing Section.

A practical Examination in Plumbing will be held in Leicester by the City and Guilds of London Institute, on May 28th.

Plumbers passing the theoretical and practical Examination of the City and Guilds of London Institute will be entitled, on production of the Institute's Certificate, accompanied by a satisfactory testimonial from their employers, to be enrolled by the Plumbers' Company as "Registered Plumbers."

Apprentice-Plumbers who obtain the Institute's Certificates for theoretical and practical work, will, on the expiration of their term of apprenticeship, be entitled to enrolment in the Register of the Plumbers' Company.

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## APPENDIX F.

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### List of Text Books and Books of Reference for Library, for Selection by Book Committee.

For Text Books and Works of Reference recommended for Libraries by the City and Guilds of London Institute—see the Official Programme, 1886-87.

## Manchester Technical School Text Books.

### Mathematics and Mechanics.

| | s. | d. |
|---|---|---|
| Practical, Plane, and Solid Geometry, Angel ... | 1 | 2 |
| Plane Geometry and Projection, Angel ... ... | 3 | 0 |
| ,, ,, Plates, Angel ... | 4 | 6 |
| Dynamics, Blackie ... ... ... | | |
| Examples in Applied Mechanics, Cryer and Jordan ... | 0 | 9 |
| Descriptive Geometry, Edgar and Prichard ... ... | 3 | 5 |
| Elements of Geometry, Euclid ... ... | 0 | 5 |
| Geometry, Hamblin Smith ... ... ... | 2 | 8 |
| Perspective, Knight ... ... ... | 0 | 9 |
| Practical Mechanics, Perry ... ... ... | 2 | 8 |
| Exercises on Mechanics, Tate ... ... ... | 1 | 6 |
| Algebra, Todhunter ... ... ... | 1 | 11 |
| Mechanics, Todhunter ... ... ... | 3 | 5 |
| Trigonometry, Walmsley ... ... ... | 1 | 11 |
| Solid Geometry, Wilson ... ... ... | 2 | 8 |

### Mechanical Engineering.

| | | |
|---|---|---|
| Steam, Ever ... ... ... ... | 0 | 9 |
| Elements of Mechanism, Goodeve ... ... | 4 | 6 |
| Steam Engine, Goodeve ... ... ... | 4 | 6 |
| Principles of Mechanics, Goodeve ... ... | 4 | 6 |
| Manual of Mechanics, Goodeve ... ... | 1 | 11 |
| Grammar of Lithography, Richmond ... ... | 3 | 9 |
| Workshop Appliances, Shelley ... ... | 3 | 5 |
| Machine Design, Unwin ... ... ... | 4 | 6 |
| Machine, and Machine Printing, Wilson ... ... | 3 | 9 |
| Electrotyping and Stereotyping, Wilson ... ... | 3 | 9 |

### Builders' Work.

| | | |
|---|---|---|
| Quantities, Fletcher ... ... ... | 5 | 0 |
| Building Construction, Wilson ... ... | 1 | 0 |
| Carpentery and Joinery, Wilson ... ... | 1 | 6 |
| Wood Carving, Wyman ... ... ... | 3 | 9 |

### Physics.

| | | |
|---|---|---|
| Magnetism and Electricity, Angel ... ... | 1 | 2 |
| Sound, Light and Heat—Advanced, Lee ... ... | 2 | 3 |
| ,, Elementary, Lee ... ... | 1 | 2 |
| Telegraphy, Preece and Siveright ... ... | 3 | 9 |
| Magnetism and Electricity, Thompson ... ... | 3 | 5 |
| Sound, Light and Heat, Todhunter ... ... | 2 | 8 |

### Chemistry and Metallurgy.

| | | |
|---|---|---|
| Organic Chemistry, Armstrong ... ... | 2 | 8 |
| Metals, Bloxam and Huntingdom ... ... | 3 | 9 |
| Metallurgy, vol. i., Greenwood ... ... | 2 | 8 |
| ,, vol. ii., Greenwood ... ... ... | 2 | 3 |

| | s. | d. |
|---|---|---|
| Steel and Iron, Greenwood ... ... ... | 3 | 9 |
| Analysis Tables, Griffith and Rhead ... ... | 1 | 0 |
| Brewings, Hooper ... ... ... | 5 | 8 |
| Analysis Tables, J. Campbell Brown ... ... | 2 | 1 |
| Assayer's Manual, Kerl ... ... ... | 9 | 5 |
| Chemistry, Roscoe ... ... ... | 3 | 5 |
| Chemical Analysis, Thorpe and Muir ... ... | 2 | 8 |
| Inorganic Chemistry, vol. i., Non-Metals, Thorpe ... | 2 | 3 |
| Inorganic Chemistry, vol. ii., Metals, Thorpe ... | 2 | 3 |
| Quantative Chemical Analysis, Thorpe ... ... | 3 | 5 |
| Chemical Philosophy, Tilden ... ... | 2 | 8 |
| Arithmetical Chemistry, Part I., Woodward ... | 0 | 9 |
| ,, Part II., Woodward ... | 1 | 6 |

NATURAL SCIENCE.

| | | |
|---|---|---|
| Geology, Davis ... ... ... | 0 | 9 |
| Botany, Edmond ... ... ... | 1 | 6 |
| Physiology, Husley ... ... ... | 3 | 5 |
| Physiography, Husley ... ... ... | 4 | 6 |
| Historic Ornaments, Redgrave ... ... | 3 | 0 |
| Notes on Light, Tyndal ... ... ... | 1 | 2 |
| Physiography, Lawson ... ... ... | 1 | 11 |
| Historic Ornament, Redgrave ... ... | 3 | 0 |
| Notes on Light, Tyndal ... .. ... | 1 | 2 |

TEXTILE FABRICS.

| | | |
|---|---|---|
| Design Pocket Book, Ashenhurst ... ... | 1 | 0 |
| Design Textile Fabrics, Ashenhurst ... ... | 3 | 5 |
| Textile Calculations, Ashenhurst ... ... | 4 | 0 |
| Dyeing and Tissue Printing, Crooke ... ... | 3 | 9 |
| Dyeing, Hummel ... ... ... | 3 | 9 |
| Cotton Spinning, Marsden ... ... ... | 4 | 11 |

COMMERCIAL SUBJECTS.

| | | |
|---|---|---|
| Fables, Æsop ... ... ... ... | 0 | 5 |
| Arithmetic, Barnard Smith ... ... ... | 1 | 2 |
| Book-keeping Manual ... ... ... | 0 | 6 |
| Geography, Carsatelli ... ... ... | 1 | 2 |
| Book-keeping, Hamilton and Ball ... ... | 1 | 6 |
| English Grammar, Morris ... ... ... | 0 | 9 |
| Phonographic Teacher, Pitman ... ... | 0 | 5 |
| Phonographic Manual, Pitman ... ... | 1 | 2 |
| Reporter's Companion ... ... ... | 2 | 0 |

LANGUAGES.

| | | |
|---|---|---|
| French Correspondent, Asher ... ... ... | 2 | 3 |
| German Correspondent, Asher ... ... ... | 2 | 3 |
| First French Reader, Bue ... ... ... | 0 | 8 |
| First French Book, Bue ... ... ... | 0 | 8 |
| French, Charlin ... ... ... | 1 | 6 |

| | s. | d. |
|---|---|---|
| French Translation, Cassal and Karcher ... ... | 2 | 8 |
| Second French, Chardenal ... ... ... | 1 | 6 |
| French Newspaper Reading-book, Hachette ... | 1 | 11 |
| Key to Spanish Grammar, Hossseld ... ... | 0 | 5 |
| Spanish Grammar, Hossfeld ... ... ... | 2 | 3 |
| Germans at Home, Lange ... ... ... | 1 | 4 |
| German Manual, Lange ... ... ... | 5 | 8 |
| German Composition, Lange ... ... ... | 3 | 5 |
| French Book (1st year), Macmillan ... ... | 0 | 9 |
| „ (2nd year), Macmillan ... ... | 1 | 6 |
| „ (3rd year), Macmillan ... ... | 1 | 11 |
| Progressive French Reader (1st year), Macmillan ... | 1 | 11 |
| German Book (1st year) ... ... ... | 1 | 2 |
| English Grammar, Brewer ... ... ... | 0 | 9 |
| Geography, Carsatelli ... .. ... | 1 | 2 |
| Composition, Collins ... ... ... | 0 | 9 |
| Arithmetic, Davis ... ... ... | 1 | 0 |
| Geometry, Gill ... ... ... ... | 0 | 9 |
| Introductory Science, Huxley ... ... ... | 0 | 9 |
| Chemistry, Jago ... ... ... | 1 | 6 |
| Political Economy, Jevon ... ... ... | 0 | 9 |
| Book-keeping, Tarll ... ... ... | 0 | 9 |
| Home Work, Sexton ... ... ... | 0 | 6 |
| Physiography, Thom ... ... ... | 1 | 6 |

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## NOTTINGHAM UNIVERSITY COLLEGE TEXT BOOKS.

| | | |
|---|---|---|
| Elements of Mechanism, Goodeve (Longmans) ... | 6 | 0 |
| Principles of Mechanics, Goodeve (Longmans) ... | 3 | 6 |
| Steam Engine, Goodeve (Lockwood) ... ... | 5 | 0 |
| Strength of Materials, Anderson (Collins) ... ... | 2 | 6 |
| Workshop Appliances, Shelley (Longmans) ... ... | 3 | 6 |
| Metals, Bloxam (Longmans) .. ... ... | 6 | 0 |
| Practical Mechanics, Perry (Cassell) ... ... | 3 | 6 |
| Cutting Tools, R. H. Smith (Cassell) ... ... | 3 | 6 |
| Practical Mechanics, Twisden (Longmans) ... ... | 6 | 0 |
| Elements of Machine Design, Unwin (Longmans) ... | 6 | 0 |
| Kinematics of Machinery, Rouleaux (Macmillan) ... | 21 | 0 |
| Steel and Iron, Greenwood (Cassell) ... ... | 5 | 0 |
| Steam Boilers, Wilson (Lockwood) ... ... | 5 | 0 |
| Elementary Text Book for Surveyors, Castle (Simpkin) ... | 5 | 0 |
| Graphic and Analytical Statics, Graham (Lockwood) ... | | |
| Levelling, Simerd (Lockwood) ... ... | 8 | 6 |
| Land Surveying, T. Baker (Weale) ... ... | | |
| Railway Appliances, Barry (Longmans) ... ... | 3 | 6 |
| Coal and Coal Minings, Warrington Smith (Weale) ... | 3 | 6 |
| Electro-Dynamic Machinery, S. P. Thompson | | |
| Electric Lighting, Gordon | | |

## Reference Books.

| | s. | d. |
|---|---|---|
| Machinery and Mill Work, Rankine (Griffin) ... | 12 | 6 |
| Manual of the Steam Engine, Rankine (Griffin) ... | 12 | 6 |
| Applied Mechanics, Rankine (Griffin) ... ... | 12 | 6 |
| Civil Engineering, Rankine (Griffin) ... ... | 16 | 0 |
| Strength of Materials, Barlow (Lockwood) ... ... | 18 | 0 |
| ,, ,, Box | | |
| Mills and Mill Work, Fairbairne (Longmans) ... | 32 | 0 |
| Turning and Mechanical Manipulation, Holtzappfel ... | 50 | 0 |
| Mechanical Principles of Engineering and Architecture, Moseley (Longmans) ... ... ... | 24 | 0 |
| Theory of Strains and Girders, Stoney (Longmans) ... | 36 | 0 |
| Treatise on Valve Gear, Zeuner (Thom) ... ... | 12 | 6 |
| Steam and Gas Engines, Bourne | | |
| Dyeing Textile Fabrics, Hummel (Cassell) ... ... | 5 | 0 |
| Cantor Lectures on Wool Dyeing, Jarmain (G. Bell & Son) | 5 | 0 |
| Hand-book of the Wild Silks of India, Wardle (Chapman) | 1 | 0 |
| Modern Chromatics, Rood (Keegan Paul) ... ... | 5 | 0 |
| Chemistry of Coal Tar Colors, Benedict-Knecht (Bell Series) | 5 | 0 |

## For Reference.

Hand-book of Dyeing and Calico Printing, Crookes.
Traite de la Teinture des Soies, Moyret.
Dyeing and Calico Printing, Calvert.
Matieres Colorantes, Renard.

## Text Books—Government Courses.

| | | |
|---|---|---|
| Inorganic Chemistry, Jago (Longmans) ... ... | 2 | 0 |
| Chemistry, vol. i., Thorpe (Collins) ... ... | 3 | 0 |
| ,, vol. ii., ,, ,, ... ... | 3 | 0 |
| Chemistry (Organic), Armstrong (Longmans) ... | 3 | 6 |
| ,, ,, Morley (Churchill) ... ... | 7 | 6 |
| Practical Chemistry, Jago (Longmans) ... ... | 2 | 0 |
| ,, ,, Clowes (Churchill) ... ... | 7 | 6 |
| Text Book of Geology, Geikies. | | |
| Physical Geology, Jukes-Brown's. | | |
| Manual of Geology, Geikies. | | |
| ,, ,, Prestwich. | | |
| ,, ,, Philipps, edited by Prof. Seeley. | | |
| Geology of England and Wales, Woodward. | | |
| Elementary Electricity, S. P. Thompson. | | |
| Natural Philosophy (Part III.), Deschanel. | | |
| ,, ,, (Part IV.), ,, | | |
| Chemistry, Roscoe (Macmillan) ... ... ... | 4 | 6 |
| Inorganic Chemistry, vol. i., Thorpe (Collins) ... | 3 | 0 |
| Inorganic Chemistry, vol. ii., Thorpe (Collins) ... | 3 | 0 |
| Chemistry, Kolbe (Longmans) ... ... | 7 | 6 |
| Inorganic Chemistry, Fownes (Churchill) ... ... | 9 | 0 |
| Anorganische Chemie, Richter ... ... | 8 | 0 |

| | s. | d. |
|---|---|---|
| Chemical Philosophy, Tilden (Longmans) ... ... | 3 | 6 |
| Principles of Chemistry, Muir (Cam. Univ. Press) ... | 15 | 0 |
| Organic Chemistry, Morley (Churchill) ... ... | 7 | 6 |
| „ Remsen (Macmillan) .. ... | 6 | 6 |
| „ Armstrong (Longmans) ... | 3 | 6 |
| Organic Chemistry, Fownes (Churchill) .. ... | 10 | 0 |
| Organische Chemie, Richter ... ... ... | 13 | 6 |
| Arithmetical Chemistry, I., Woodward (Simpkin) ... | 1 | 0 |
| „ II., „ ... | 1 | 6 |
| Chemical Calculations, Thorpe (Macmillan) ... | 2 | 0 |

FOR REFERENCE.

Treatise on Chemistry, Roscoe and Schoelemmer (Macmillan)
Elements of Chemistry, Miller (Longmans)
Dictionary of Chemistry, Watts (Longmans)

| | | |
|---|---|---|
| Applied Chemistry—Text Books of Science (Longmans), each | 4 | 6 |

Chemical Technology, Wagner (Churchill)
Dictionary of Arts, Manufactures and Mines, Ure
Chemistry applied to Arts and Manufactures, Mackenzie

| | | |
|---|---|---|
| Practical Chemistry, Clowes (Churchill ... ... | 7 | 6 |
| „ Jones (Macmillan) ... ... | 2 | 6 |
| Quantitative Analysis, Thorpe (Longmans) ... | 4 | 6 |
| „ vol. i., Fresenius (Longmans) ... | 15 | 0 |
| Volumetric Analysis, Sutton (Churchill) ... ... | 14 | 0 |

FOR REFERENCE.

Select Methods of Chemical Analysis, Crookes (Longmans)
Commercial Organic Analysis, Allen (Churchill)

| | | |
|---|---|---|
| Pharmaceutical Chemistry, Attfield (Van Vorst) ... | 15 | 0 |
| Laboratory Text Book (Brewing), Briant (Briant) ... | 10 | 6 |
| Agricultural Chemistry, Frankland (Macmillan) ... | 7 | 6 |

Practical Treatise on Casting, Spretson.
„ „ on Mill Gearing, Box.
Railways and Tram Cars, D. K. Clark.
Locomotive Engineering, Z. Colburn.
Dictionary of Engineering, Spon.
Electric Illumination (2 vols.), Dredge.
The English Mechanic.
Engineering.
The Engineer.

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## BRADFORD TECHNICAL COLLEGE TEXT BOOKS.

| | s. | d. |
|---|---|---|
| Workshop Appliances, Shelly. | | |
| Strength of Materials, Anderson. | | |
| Practical Chemistry, J. Spencer (Boulton) ... ... | 1 | 6 |
| Algebra, Todhunter (Macmillan) ... ... | 3 | 6 |
| Arithmetic, B. Smith (Macmillan) ... ... | 4 | 6 |
| Steel and Iron, W. H. Greenwood (Cassell) | | |

| | s. | d. |
|---|---|---|
| Euclid, Potts. | | |
| Algebra for Beginners, Todhunter. | | |
| Trigonometry for Beginners, Todhunter. | | |
| Qualitative Analysis, Thorpe | | |
| Inorganic Chemistry, Thorpe. | | |
| Qualitative Analysis, Valentine. | | |
| „ „ Fresenius. | | |
| Wool Dyeing, Hummel. | | |
| Organic Chemistry, Remsen ... ... ... | 6 | 6 |
| Coal Tar Colors, Benedikt-Kuecht (Bell) ... ... | 5 | 0 |
| Vegetable Anatomy, Balfour ... ... ... | 1 | 0 |
| Systematic Botany, Balfour ... ... ... | 1 | 0 |
| Qualitative Analysis, J. Spencer (Murby) ... ... | 1 | 0 |
| Practical Chemistry, F. Jones (Macmillan) ... ... | 2 | 6 |
| Text Book of Chemistry, N. Valentine (Churchill) ... | 6 | 6 |
| Practical Solid Geometry, Payne (Murby) ... ... | 1 | 6 |
| Machine Construction and Drawing, Tomkins (Collins) | | |
| Elementary Lessons in Mechanics, Magnus (Longmans) ... | 3 | 6 |
| Hydrostatics and Pneumatics, Magnus (Longmans) ... | 1 | 6 |
| Arithmetic for Schools, Normell (Murby) | | |
| Acoustics: Light and Heat, N. Lees | | |
| Elementary Physics, Balfour Stewart | | |
| Electricity and Magnetism, Angell | | |
| Elementary Magnetism, Sylvanus Thompson | | |
| Land and Marine Engine, Evers (Collins) | | |
| Locomotive Engine, Evers (Collins) | | |
| Steam and the Steam Engine, Evers (Collins), Advanced Series | | |
| Steam Engine, Goodeve (Lockwood) ... ... | 6 | 0 |
| Applied Mechanics, Evers (Collins) | | |
| Elements of Mechanism, Goodeve (Longmans) ... | 6 | 0 |
| Principles of Mechanics, „ „ ... | 3 | 6 |

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## BIRMINGHAM AND MIDLAND INSTITUTE TEXT BOOKS.

The following are the books recommended by the Teachers; they may be obtained of Messrs. Cornish Brothers, 37 New Street, or the Midland Education Company, Corporation Street, at the prices marked against them :—

| | s. | d. |
|---|---|---|
| Mechanics (Applied)—Elementary Division—A Manual of Mechanics, by T. M. Goodeve, M.A. ... ... | 1 | 11 |
| Mechanics (Applied)—Advanced Division—Elements of Mechanism, by T. M. Goodeve, M.A. ... ... | 4 | 6 |
| Mechanics (Applied)—Advanced Division—Principles of Mechanism, by T. M. Goodeve, M.A. ... ... | 2 | 8 |
| Mechanics (Theoretical) Magnus' Lessons in Elementary Mechanics... ... ... ... | 2 | 8 |
| Chemistry (Elementary Stage)—Arithmetical Chemistry. Part I. C. J. Woodward... .. .. | 0 | 9 |
| Thorpe's Chemistry. vol. i. (Collins) ... ... | 2 | 3 |

| | s. | d. |
|---|---|---|
| Chemistry (Advanced Stage)—Thorpe's Chemistry, vol. ii. (Collins) ... ... ... ... | 2 | 3 |
| Chemistry (Honours Stage)—Arithmetical Chemistry. Part II. C. J. Woodward ... ... ... | 1 | 6 |
| Tilden's Chemical Philosophy ... ... | 2 | 8 |
| Chemistry, Practical (Elementary Stage)—Jago's Practical Chemistry ... ... ... .. | 1 | 6 |
| Chemistry, Practical (Advanced Stage)—Practical and Analytical Chemistry, by Clowes ... ... | 5 | 9 |
| Chemistry, Practical (Honours Stage)—Thorpe's Quantitative Analysis ... ... ... | 3 | 5 |
| Fresenius' Quantitative Analysis ... ... | 11 | 3 |
| Chemistry (Elementary Stage)—Farm, St. Jago's Inorganic Chemistry... ... ... | 1 | 6 |
| Magnetism and Electricity (Elementary Stage)—Angell's Magnetism and Electricity ... ... | 1 | 2 |
| Silvanus P. Thompson's Electricity ... ... | 3 | 5 |
| Magnetism and Electricity (Advanced Stage)—Arithmetical Physics. C. J. Woodward. Part IIa. ... ... | 0 | 9 |
| Silvanus P. Thompson's Electricity ... ... | 3 | 5 |
| Sound, Light and Heat (Elementary Stage)—Lee's Acoustics, Light and Heat ... ... ... | 1 | 2 |
| Sound, Light, and Heat (Elementary Stage)—Arithmetical Physics. C. J. Woodward. Part Ia. ... ... | 1 | 6 |
| Sound, Light, and Heat (Advanced Stage)—Deschanel's Natural Philosophy. Part IV. ... ... | 3 | 5 |
| Mineralogy—Rutley's Mineralogy ... ... | 1 | 2 |
| Gurney's Crystallography ... ... | 0 | 9 |
| Metallurgy—Greenwood's Metallurgy 2 vols., vol. i., 2/8; vol. ii. ... ... ... ... | 2 | 3 |
| Metallurgy (Practical—Honours) -Mitchell's Assaying ... | 24 | 0 |
| Do. do. Bailey's Iron and Steel ... | 2 | 8 |
| Iron and Steel—Greenwood's Steel and Iron... ... | 3 | 9 |
| Electro-Metallurgy—The Art of Electro-Metallurgy. Gore | 4 | 6 |
| Fuel—Fuel and Combustion. Williams ... ... | 2 | 8 |
| Animal Physiology (Elementary Stage)—Huxley's Lessons in Elementary Physiology ... ... ... | 3 | 5 |
| Animal Physiology (Advanced Stage)Kirke's Handbook of Physiology ... ... ... ... | 10 | 6 |
| Physiography—Findlater's Physiography ... ... | 1 | 2 |
| Skertchley's Physical Geography ... | 0 | 9 |
| Practical Plane and Solid Geometry—Practical Solid or Descriptive Geometry, by J. H. Edgar and C. S. Pritchard | 3 | 5 |
| Angell's Practical Plane and Solid Geometry ... | 1 | 2 |
| Mechanical and Architectural Drawing—Unwin's Machine Design ... ... ... ... | 4 | 6 |
| Rivington's Building Construction, vols. i. and ii., each ... | 8 | 0 |
| Botany (Elementary Stage)—Oliver's Lessons in Elementary Botany ... ... ... ... | 3 | 5 |

| | s. | d. |
|---|---|---|
| Botany (Elementary Stage)—M'Nab's Botany, Morphology, and Physiology ... ... ... | 1 | 2 |
| Botany (Advanced Stage)—Prantl and Vine's Text Book of Botany ... ... ... ... | 6 | 9 |
| Vegetable Morphology and Physiology—Prantl and Vine's Text Book of Botany ... ... ... | 6 | 9 |
| Geology (Elementary Stage)—James Geikie's "Geology" (Chambers) ... ... ... | 0 | 9 |
| Geology (Elementary Stage)—Juke's School Manual of Geology | 3 | 5 |
| „ (Advanced Stage)—Jukes-Brown's Handbook of Physical Geology ... ... ... | 4 | 6 |
| „ (Advanced Stage)—Jukes' School Manual of Geology | 3 | 5 |
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