

Government of Madras

LAW (EDUCATION) DEPARTMENT

G.O. No. 879, 25th May 1925

Report on vocational classes in England—Written by Mr. R. W. Ross—Recorded. 18

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Report on vocational classes in England—Written by Mr. R. W. Ross—Recorded.

READ—the following paper:—

Letter from R. G. GRIEVE, Esq., M.A., F.R.G.S., Director of Public Instruction, to the Secretary to Government, Law (Education) Department, dated Madras, the 15th April 1925, No. R.C. 2709-C/23.

I have the honour to submit the enclosed report on vocational classes in England received from Mr. R. W. Ross, Principal, Government Training College, Rajahmundry, who was granted study leave in paragraph 2 of G.O. Mis. No. 426, Law (Education), dated 20th March 1924.

ENCLOSURE.

REPORT ON VOCATIONAL CLASSES IN ENGLAND.

Instructed by the Scotch Board of Education I visited schools in Edinburgh and Glasgow and consulted the Education authorities in these places with reference to the subject of vocational instruction. The prevailing feeling is that boys and girls should receive a general education, either elementary or secondary, and that purely vocational subjects should not be taught in day schools. Up to the age of 16 pupils usually do not know what work they are fitted for, and it is believed that purely technical training will prove more effective if started after that age. The need for making education more practical is, however, felt and this has been met by introducing the workshop into the majority of schools. Boys usually spend two periods a week at woodwork or metal work and the training is recognized to be of great value. Such is the type of education given in the majority of the schools, but educational authorities are prepared to experiment with the type of school in which emphasis is placed on some special technical subject in which pupils appear to be interested. In Edinburgh there are the Tynecastle and James Clark schools to which boys and girls are admitted from elementary schools at the age of 13 for a three years' course. At the outset they have to make a choice between a commercial course and an industrial course. The following table shows the number of periods per week devoted to each subject in the Tynecastle school:—

	Periods.
Moral and religious instruction	2
English	8
History	2
Geography	2
Mathematics	9
Science	4
Drawing	3
Music	1
Physical training	1
Benchwork and technical drawing or commercial subjects	8
	40

The subjects the girls take in the industrial course, instead of benchwork and technical drawing (which are for boys), are cookery and housewifery with laundry, or dressmaking or sewing.

In the James Clark Technical school the division of work is as follows:—

	Periods.
English, including History, Geography and Citizenship	13
Mathematics	8
Science, including Physics, Chemistry, Mechanics and Electricity	4
(a) Art	3
(b) Technical	3
(c) Geometrical	1
Handicraft	3
Singing	1
Moral and religious instruction	2
Physical exercises and games	2
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These courses indicate that the purely literary subjects are by no means neglected and that the training given by drawing and handicraft is of a kind that will prepare boys for any type of practical work that they may wish to take up on leaving school. Because of the practical training given, boys find it easy to get into trade workshops where they get further experience and training. They further supplement their knowledge by attending evening classes which specially cater for them. These abound in every town and are largely attended during the winter months—October to March. The classes are held in school buildings; not all subjects are taught in any one centre but only those which appeal chiefly to those living in the immediate neighbourhood.

In Glasgow too there are a few schools where the industrial course is emphasized and at the Allen Glen School which is a large secondary school, boys get advanced instruction in Science and Engineering. Here there are lathes worked by steam and the whirr of machinery in one part of the building reminds one of a factory. Boys from the school enter engineering works with technical knowledge which is of great value to them or if they proceed to the University for Science courses they are well prepared for them.

Considering, however, the size of the population of Glasgow, one feels that the technical courses given in a few schools affect only a very small number of the pupils and must conclude that the school is not regarded as the right place to give such instruction.

In England I visited schools in the large commercial centres of Liverpool, Manchester and London. The problem of industrial education is just being tackled in Liverpool and Manchester and something is being attempted on a small scale. Exhibitions are held from time to time to show the kind of work done in the junior technical schools, but here again the bulk of the pupils are not affected. In London various experiments are being tried by the County Council. Definite subjects are taught in various centres, the subjects varying with the locality. Pupils are admitted between thirteen and fourteen years of age and the training extends for three years. The number of hours per week devoted to technical and general education are shown below:—

Years.							Technical or workshop.	General education.
1	...	...	...	...	...	...	10	20
2	...	...	...	...	...	...	15	15
3	...	...	...	...	...	...	20	10

The technical subjects taught include the following:—

To Boys—

Engineering.

Building (carpentry and joinery, plumbing, painting and decorating, brickwork, masonry).

Woodwork (cabinet and furniture making).

Wood-carving.

Silversmithing.

Printing.

Book-binding.

Photography, etching.

Carriage and motor body building.

Tailoring.

To Girls—

Dressmaking.

Millinery.

Ladies tailoring.

Embroidery.

Upholstery.

Photography.

Laundry work.

Cookery.

Domestic service.

School fees are charged for all these courses and they average £3 a year. The London County Council gives a large number of scholarships worth from £9 to £21 a year. The following syllabus gives some idea of the curriculum in an engineering school:—

ENGLISH.

Language.—Composition—Letter writing and summaries of general reading. General reading and study including particularly industrial processes, biographies, Shakespeare's plays.

Geography.—Study of maps and weather climate charts—Elements of earth history—Industrial centres and trade routes—Thames basin and London area in detail—British Empire and outline of development.

History.—Leading events in British History, especially from economic standpoint—Elementary civics and economics.

MACHINE DRAWING AND CONSTRUCTION.

Drawing.—Instruments—Freehand dimensioned sketching of actual machine details—Preparation of general working drawings—Tracing and blue printing.

Theory.—Notes and sketches of usual machine details—Materials and manufacturing processes—Study of selected papers in current engineering journals.

METAL WORK.

Tin plate.—Course including development of surfaces, soldering, etc.

Bench work.—Giving practice in the use of the usual bench tools and measuring instruments with limit of 0.005 ins.

Machine course.—All varieties of work with lathe, shaping machine, drill, grinder and hack saw.

Forge course.—Usual operations together with case-hardening and tempering.

Theory.—Notes on workshop principles, such as measuring tools, cutting speeds and angles, properties of materials and behaviour of materials under action of heat.

MATHEMATICS.

Arithmetic.—Including logarithms and use of slide rule.

Geometry.—Elements of theoretical geometry corresponding to Euclid I—III—Mensuration of plane and solid figures—Trigonometry to solution of triangles.

Algebra.—To quadratic equations, including maximum and minimum values and arithmetical and geometrical series—Particular attention to graphical representation and use of technical formulae.

SCIENCE.

Physics.—Measurement of length, area, volume and density—Immersion and flotation—Elements of heat with application to ventilation, expansion, etc.—Fluid pressure—Boyle's law—Charles's law—Change of state—Vapour pressure.

Elements of electricity and magnetism.

Chemistry.—Chemistry of air, chalk and water.

The boys do a considerable amount of independent work, including—

(a) papers on technical subjects,

(b) making of a model (original as far as the boy is concerned) with working drawings,

(c) biography of a scientist.

WOODWORK.

The woodwork is designed to promote skill and precision in the use of tools. The work includes—Simple joints and their application—Models suggested to the boys involving essential principles of design—Elementary pattern making.

PRACTICAL GEOMETRY.

The course is designed to give a training in the principles of geometry, and in precision of execution particularly with a view to their use in the machine drawing class.

ART.

Study of nature forms—Reproductions in pencil, paint and clay—Application to design.

Common object drawing and dimensioned sketching of tools, etc.

Free arm and blackboard drawing—Memory drawing.

APPLIED MECHANICS.

Mechanics.—The principles governing the construction and working of machines.

Strength of materials and hydraulics.

Heat engines.—Steam and internal combustion engines with an introduction to steam turbines.

PHYSICAL EXERCISES.

The usual physical exercises by means of apparatus and games, partly in school and partly in open air. Talks on anatomy, physiology and hygiene. Records of physical development are made at regular intervals and carefully watched.

One naturally asks whether these boys and girls get employment easily in trades after leaving these schools and the general opinion is that at least 80 per cent of them do. After they have begun to work in firms, a large number continue their education at night classes.

What bearing has all this upon educational work in India? Conditions in the two countries are very different and the chief distinguishing characteristic is that private enterprise on technical lines is very limited in India. The man who wants to start a factory says he

cannot get skilled labour and a boy when urged to study technical subjects says he cannot get employment after his studies are over. Thus we go on in a vicious circle. I am of opinion that the literary side of education is overdone and that boys should be given an opportunity of working with tools and materials.

To this end manual training should become a compulsory subject in all secondary schools. In addition, in centres where any industry exists, technical knowledge of this may be imparted to boys who wish to study the subject. Time-tables at present are overcrowded and it is difficult to find time for these extra subjects. The solution appears to be the starting of evening classes. Men with practical knowledge will be required as teachers and their services will be available if the classes are held in the evenings. At present school buildings remain unused at night and thus the fullest advantage is not taken of them. The difficulty of lighting does not exist as Washington lights are now available in most centres.

If any advance is to be made in this direction, this type of school has to be opened in a large number of towns and villages, so that boys in any locality are offered educational facilities enabling them to acquire technical skill. It is futile to limit the scheme to one or two large centres.

21st March 1925.

R. W. ROSS,

BOROUGH POLYTECHNIC INSTITUTE.

Junior Technical School (Boys).

SYLLABUS OF METAL WORK.

Course I—

1. Cut and file two square pieces of sheet zinc $1\frac{1}{2}$ " side and solder two edges to make butt joint.
2. Cut and file two parallelograms $1\frac{1}{4}$ " $\times$ $1\frac{3}{4}$ " and lap two edges over $\frac{3}{16}$ and solder to make lap joint.
3. Cut and file two parallelograms $1\frac{1}{4}$ " $\times$ $1\frac{1}{2}$ " to make groove joint.
4. Cut an oblong in tin 6 " $\times$ $1\frac{3}{4}$ " and wire edges to stiffen metal.
5. Cut two equilateral triangles $1\frac{1}{2}$ " sides to make hinge joint.
6. Make a set of geometrical figures in zinc.
7. Make a model of a prism in wire.
8. Make a model of a prism in sheet zinc.
9. Make a frustum of a cone with a butt joint with top and bottom, all joints to be soldered.
10. Make a cylinder in sheet iron with $\frac{3}{8}$ lap joint and riveted.
11. Make a cylinder with butt joint and riveted.

Course II—

Making of models of geometrical solids in sheet zinc from students' own drawings. Making of gauges in stout iron plate, e.g., a piece of iron $\frac{3}{32}$ thick, $3\frac{1}{2}$ " $\times$ $1\frac{1}{2}$ " to be filed parallel lengthwise, finished 1 ", the ends to be squared up and then lined out external and internal at 90° either end; straight edge and calipers only to be used.

A piece of iron $\frac{3}{32}$ thick $1\frac{3}{4}$ " square, to be lined out hexagonal $1\frac{1}{4}$ " across flat sides to be cut off within $\frac{1}{16}$ of lines with cold chisel in vice and then filled up to lines, using straight edge and calipers to test if parallel.

A piece of charcoal iron $5\frac{1}{4}$ " $\times$ $2\frac{3}{4}$ " $\times$ $\frac{1}{4}$ ", one long edge to be filled up true to straight edge and then lined out to drawing one 1 " from finished edge, 2 " from either and an angle of 90 and 120 , the angles to be drilled out within $\frac{1}{8}$ of lines, then chipped and filed true to lines, using straight edge and calipers only; this exercise to be draw filed and afterwards polished.

Models of oblique solids.

Course III—Exercises of Forging—

1. Forge a nail from iron $\frac{3}{8}$ " $\times$ $\frac{3}{16}$ " forging head first to drawing and then cut off $\frac{1}{4}$ " shorter than finished length, that being allowed for tapering point.
2. Forge square taper drift from $\frac{1}{2}$ " bar, using Smith's flatter for finishing.
3. Forge round taper drift from $\frac{1}{2}$ " round bar; forge square first, then hammer down corners. Hammer only to be used.
4. Forge eye bolt $\frac{1}{4}$ " round iron, measure length of iron required for eye and bend at right angles, then finish off on nose of anvil to required shape.
5. Forge S hook from $\frac{1}{4}$ " round iron, measure length of iron required and cut off, taper both sides slightly and forge over nose of anvil.
6. Forge staple from $\frac{1}{4}$ " round iron, measure length of iron required allowing 1 " short for taper ends, forge square taper 2 " long on both ends, then bend according to drawing.
7. Scriber.

Turning, etc.—

1. Dovetail joint to be made in mild steel, a piece of metal $4\frac{1}{2}$ " $\times$ $1\frac{1}{2}$ " to be squared up and lined out, external dovetail and internal the other, drilled and filed up lines to be cut off in half and tested when finished.
2. A piece of $1\frac{1}{4}$ " brass to be turned 1 " parted off $\frac{3}{8}$ " long two sides to be sawn and filed to from equilateral triangle.
3. A piece of brass 6 " $\times$ 2 " $\times$ $\frac{1}{8}$ " finished; and 1 " round hole and 1 " square hole; a 1 " equilateral triangular hole to be drilled and filed out to the lines; the solid piece of brass to fit all three holes.
4. Plain turning. Turn 1 " collar spindle and screw cut same.
5. Hand rail column, and screw cut same, and other exercises of a more advanced character—
External and internal gauges 90° , 120° , 135° .
Dovetail joint in copper to be braised.
Lap and butt joints in iron tube to be braised.
Pair of broad-point calipers, ratchet brace, screw jack.
Face plate, starrett scribing block, etc.

SYLLABUS OF WOODWORK.

Explanatory—

The lesson of each year will include the necessary drawing either to scale or full size, from which the work will be made. Such drawings will be made from rough sketches or from accurately made models.

Lessons on the construction and principles of the various tools; their use and methods of manipulation will be given at the various stages of the workshop course.

Object lessons on the nature and properties of the various kinds of timber used will be given from time to time, and will be supplemented by visits to Kew Gardens, to Museums and places of interest.

In the early stages, the exercises chosen will be such that the number of tools required will be small; but in the second year the exercises will involve the use of an increasing number of tools.

Course I—

Sawing at right angles to the direction of grain, sawing obliquely across, and with the grain. Chiselling horizontally, planing. Cutting out inlaying plane geometrical figures $\frac{1}{4}$ " thick. Various forms of simple joints, as lapped, halving and dovetail joints, housing groove and tongue joints; introducing the use of glue. The necessity of accurate setting out and working to cut lines. Proving dimensions of finished model by placing model on student's drawing.

Course II—

Models and joints of a more complex character, introducing new tools and methods of construction; mortise and tenon joint; cube cut into three pieces, showing volume of a pyramid. Elementary pattern making, surface plate, simple bearings, fire bar with calculations for finding radius of curve, hexagonal nut with core box; introducing simple wood turning, also hack saw and file handles; turned inkwell stand. The uses of patterns and draw being fully demonstrated with moulders sand in casting boxes.

SYLLABUS OF TECHNICAL DRAWING.

B. Engineering Drawing.

First year (Mechanical drawing)—

Notes on pencils, paper and instruments. Fixing, heading and arrangement of work on paper. Use of squares, printing of title, figuring and dimensioning.

Sketching and measuring up five selected wood models; sash lifter; rapping plate; drawer pull, and dowel plates. Sketch detail sheets 1 to 8.

Machine details—with full notes.—

Screw threads, accurate shapes and conventional representation. Standard proportions of bolts and nuts. Type of bolt heads, bolt and nut, castle nut, etc. In this year, much importance should be attached to the production of good lines, printing and figuring, the simple drawings are to have a workmanlike appearance. In the second term, one or two drawings may be inked in, and in the third term, two or more tracings should be made, and flat tints laid on some drawings and on the back of tracings. Streets should be laid on the correct naming and description of views and subjects.

Second year (Machine drawing).—

The first half-hour should occasionally be spent on sketches and notes on details of machinery. Revise sheets 1 to 8. A schedule of parts should be included with all sketches and each view should be named and each section plane indicated. The actual articles should be measured up and sketched, including first year objects omitted. The articles should be selected from riveted joints (3 as group exercise), keys and cotters, collars, couplings, R and L hand coupling box, simple bearings, spanners (with general idea of proportions), crank brace, knuckle joint, pipe flange joints, simple gland and stuffing box, simple valves, crank, connecting rod end.

Assembly or detail drawings of the above, or both, with section.

An accurate knowledge of the names and uses of simple machine details should be given. Tracings and some inked-in and coloured drawings, *always* with dimensions and full printing, should be made.

Blue prints should be made of meritorious tracings and the method demonstrated.

Third year (Machine drawing).—

Sketches from machine detail sheets 8 and 10 to 17.

Sketches dimensioned from actual measurement of articles mentioned below. Sketches of details and (or) assembly with schedule of parts, from which assembly and (or) detail drawings are made always dimensions in ink or pencil, with sections flat tinted and sometimes fully flat tinted. Strong tracings of merit should be blue-printed and every boy taught the method. Timed simultaneous exercises should be introduced at intervals.

Cover with notes and draw selections from—

Levers, pipe couplings, fusible plugs, shaft couplings, bearings, cranks, connecting rod ends, crossheads, pistons, cocks, non-return and other valves, screw-down valves.

Note.—Visits to laboratory should be made to show details in actual position.

SYLLABUS IN APPLIED MECHANICS.**Year II—Course I—**

Force.—Definition and representation, summation of forces in straight line. Parallelogram, triangle and polygon of forces.

Resultant, equilibrant and component forces.

Principle of moments.—The lever; beam reactions.

Units of force, space, time, work, and power, gravity.

Variable forces—time and space averages.

Representation of work by area.

Horse-power and efficiency.

Friction.—Coefficient of friction; work done by mechanical agents against friction or gravity, and for useful purposes. Movements of bodies on inclined planes.

Machines.—Definition and types; velocity ratio; mechanical advantage efficiency, experiments with machines; calculations on, and setting out of, curves showing characteristics of machines. Finding the law of a machine; using pulley on axle with thick and thin cords wheel and axle; single and other pulley blocks; Chinese windlass, screw-jack and Weston's blocks.

Elementary notions of the *strength and characteristics of materials* (2 lessons).

Very elementary notions on *Hydraulics and Pneumatics* (2 lessons).

Year III—Course II—

(Revise Course I as required.)

A. Accurate measurement.—Line and end measurement; refined measurement: gauges. Measurement of areas; use of planimeter; measurements of volumes; micrometer; and cathetometer.

B. Materials.—Strengths and elastic moduli; tension; compression; shear, torsion (simply). Springs in tension and compression. Work stored within elastic limit; beams and rules relating to similar beams, rectangular beams; and flanged ones by approx. method. Some characteristic properties of materials.

C. Motion.—Uniform and otherwise; vector quantities; force; acceleration; mass; momentum; centrifugal force.

Energy.—Potential and kinetic; flywheel; and pendulum (simply) with problems on work; tractive effort and work on inclines, etc.

D. Hydraulics.—Pressure, head, Bramah's; the siphon; pumps (rotary and reciprocating); simple hydraulic machines with problems.

E. Machines.—Revise velocity-ratio, Law of machine and curves for same, etc. Lifting machines—the “facile” block; worm and wheel; lifting crab; hydraulic jack.

Transmission of motion.—by shafts, belts and other gearing. Toothed wheels and worm gearings as applied to machine tools; cases of relative motion.

F. Problems connecting A, B, C, D and E.

SYLLABUS OF MATERIALS.

Description of ores

Description, sketches, etc., of the following furnaces and processes:—

Blast furnace, with particulars of hot blast and cowper stoves, etc.

Puddling, with particulars of manufacture of varieties of commercial iron and its composition.

Cementation steel, with methods of manufacture of crucible shear and double shear steel.

Bessemer process for manufacture of mild steel.

Siemens open hearth steels.

Tool steels, with particulars of composition, strength and cutting speeds.

Lecture on physical properties of steel, with diagram showing per cent carbon in W.I.M.S. High carbon steel and cast iron.

Manufacture of copper from pyrites.

Copper tin alloys and their per cent composition and strengths.

Copper zinc alloys and their per cent composition and strengths.

Composition of solders, white metal, brazing metal, resistance wire alloys.

Malleable iron castings.

Case hardening.

Annealing.

Process of welding by “Thermit.”

Talks on semi steel and Mitis metal.

Properties of aluminium.

Notes on turning tools and tool clearance.

Notes on screw-cutting, including cutting of fraction of threads per inch and multiple start threads.

Lecture on the steam engine and the application of the various metals to its manufacture.

Revision of work.

Order—No. 879, Law (Education), dated 25th May 1925.

Recorded.

(By order of the Government, Ministry of Education)

V. T. KRISHNAMA ACHARIYAR,
Secretary to Government.

To the Director of Public Instruction.
„ Development Department.

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Compare carefully with the original & strike off
3/6/25
please see quibus answered
 5 JUN 1925
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Geography	2
Mathematics	9
Science	4
Drawing	3
Music	1
Physical training	1
Benchwork and technical drawing or commercial subjects	8
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The subjects the girls take in the industrial course (instead of benchwork and technical drawing (which are for boys)) are cookery and housewifery with laundry, or dressmaking or sewing.

In the James Clark Technical school the division of work is as follows:—

	Periods.
English, including History, Geography and Citizenship	13
Mathematics	8
Science, including Physics, Chemistry, Mechanics and Electricity	4
Drawing	3
Handicraft	3
Singing	1
Moral and religious instruction	2
Physical exercises and games	2
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2/m
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These courses indicate that the purely literary subjects are by no means neglected and that the training given by drawing and handicraft is of a kind that will prepare boys for any type of practical work that they may wish to take up on leaving school. Because of the practical training given, boys find it easy to get into trade workshops where they get further experience and training. They further supplement their knowledge by attending evening classes which specially cater for them. These abound in every town and are largely attended during the winter months—October to March. The classes are held in school buildings; not all subjects are taught in any one centre but only those which appeal chiefly to those living in the immediate neighbourhood.

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Years.	Technical or workshop.	General education.
1	10	20
2	15	15
3	20	10

The technical subjects taught include the following:—

To Boys—

Engineering—

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Woodwork (cabinet and furniture making).

Wood-carving.

Silversmithing.

Printing.

Book-binding.

Photography, etching.

Carriage and motor body building.

Tailoring.

To Girls—

Dressmaking.

Millinery.

Ladies tailoring.

Embroidery.

Upholstery.

Photography.

Laundry work.

Cookery.

Domestic service.

School fees are charged for all these courses and they average £3 a year. The London County Council gives a large number of scholarships worth from £9 to £21 a year. The following syllabus gives some idea of the curriculum in an engineering school:—

ENGLISH.

Language.—Composition—Letter writing and summaries of general reading. General reading and study including particularly industrial processes, biographies, Shakespeare's plays.

Geography.—Study of maps and weather climate charts—Elements of earth history—

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Periods	Metal and religious instruction
3	English
3	History
3	Geography
3	Mathematics
4	Science
4	Drawing
3	Music
1	Physical training
8	Handwork and technical drawing or commercial subjects
10	

The subjects the girls take in the industrial course instead of handwork and technical drawing (which are for boys) are cookery and domesticity with laundry or dressmaking or sewing.

In the James Clark Technical school the division of work is as follows:—

Periods	English, including History, Geography and Citizenship
18	Mathematics
8	Science, including Physics, Chemistry, Mechanics and Electricity
4	(a) Art
3	(b) Technical
3	(c) Geometrical
1	Handicraft
3	Singing
1	Moral and religious instruction
2	Physical exercises and games
2	
40	

These courses indicate that the purely literary subjects are not so much neglected as they are in the past. The training given by drawing and handicrafts is of a kind that will prepare a boy for any type of practical work that may be required of him. The courses are designed to give a boy a general education and to train him in the use of his hands. The courses are designed to give a boy a general education and to train him in the use of his hands. The courses are designed to give a boy a general education and to train him in the use of his hands.

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General Education	Technical Education	Years
80	10	1
15	15	2
10	20	3

The technical subjects taught include the following:

Building (carpentry and joinery), Painting and Decorating, Woodwork (cabinet and furniture making), Wood-carving, Shaving, Planing, Book-binding, Photography, Printing, Lithography, Engraving, Metalwork, Jewellery, Watchmaking, Clockmaking, Gunmaking, Gunsmithing, Toolmaking, Blacksmithing, Farrier, Saddlery, Harness-making, Leatherwork, Basketry, Pottery, Glass-making, Paper-making, Bookbinding, Printing, Lithography, Engraving, Metalwork, Jewellery, Watchmaking, Clockmaking, Gunmaking, Gunsmithing, Toolmaking, Blacksmithing, Farrier, Saddlery, Harness-making, Leatherwork, Basketry, Pottery, Glass-making, Paper-making.

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Industrial centres and trade routes—Thames basin and London area in detail—British Empire and outline of development.

History.—Leading events in British History, especially from economic standpoint—Elementary civics and economics.

MACHINE DRAWING AND CONSTRUCTION.

Drawing.—Instruments—Freehand dimensioned sketching of actual machine details—Preparation of general working drawings—Tracing and blue printing.

Theory.—Notes and sketches of usual machine details—Materials and manufacturing processes—Study of selected papers in current engineering journals.

METAL WORK.

Tin plate.—Course including development of surfaces, soldering, etc.
Bench work.—Giving practice in the use of the usual bench tools and measuring instruments with limit of .0005 ins.

Machine course.—All varieties of work with lathe, shaping machine, drill, grinder and hack saw.

Forge course.—Usual operations together with case-hardening and tempering.
Theory.—Notes on workshop principles, such as measuring tools, cutting speeds and angles, properties of materials and behaviour of materials under action of heat.

MATHEMATICS.

Arithmetic.—Including logarithms and use of slide rule.
Geometry.—Elements of theoretical geometry corresponding to Euclid I—III—Mensuration of plane and solid figures—Trigonometry to solution of triangles.

Algebra.—To quadratic equations, including maximum and minimum values and arithmetical and geometrical series—Particular attention to graphical representation and use of technical formulae.

SCIENCE.

Physics.—Measurement of length, area, volume and density—Immersion and flotation—Elements of heat with application to ventilation, expansion, etc.—Fluid pressure—Boyle's law—Charles's law—Change of state—Vapour pressure.

Chemistry.—Chemistry of air, chalk and water.
The boys do a considerable amount of independent work, including—

- (a) papers on technical subjects,
- (b) making of a model (original as far as the boy is concerned) with working drawings,
- (c) biography of a scientist.

WOODWORK.

The woodwork is designed to promote skill and precision in the use of tools. The work includes—Simple joints and their application—Models suggested to the boys involving essential principles of design—Elementary pattern making.

PRACTICAL GEOMETRY.

The course is designed to give a training in the principles of geometry, and in precision of execution particularly with a view to their use in the machine drawing class.

ART.

Study of nature forms—Reproductions in pencil, paint and clay—Application to design. Common object drawing and dimensioned sketching of tools, etc.
Free arm and blackboard drawing—Memory drawing.

APPLIED MECHANICS.

Mechanics.—The principles governing the construction and working of machines. Strength of materials and hydraulics.
Heat engines.—Steam and internal combustion engines with an introduction to steam turbines.

PHYSICAL EXERCISES.

The usual physical exercises by means of apparatus and games, partly in school and partly in open air. Talks on anatomy, physiology and hygiene. Records of physical development are made at regular intervals and carefully watched.

One naturally asks whether these boys and girls get employment easily in trades after leaving these schools and the general opinion is that at least 80 per cent of them do. After they have begun to work in firms, a large number continue their education at night classes.

What bearing has all this upon educational work in India? Conditions in the two countries are very different and the chief distinguishing characteristic is that private enterprise

on technical lines is very limited in India. The man who wants to start a factory says he cannot get skilled labour and a boy when urged to study technical subjects says he cannot get employment after his studies are over. Thus we go on in a vicious circle. I am of opinion that the literary side of education is overdone and that boys should be given an opportunity of working with tools and materials.

To this end manual training should become a compulsory subject in all secondary schools. In addition, in centres where any industry exists technical knowledge of this may be imparted to boys who wish to study the subject. Time-tables at present are overcrowded and it is difficult to find time for these extra subjects. The solution appears to be the starting of evening classes. Men with practical knowledge will be required as teachers and their services will be available if the classes are held in the evenings. At present school buildings remain unused at night and thus the fullest advantage is not taken of them. The difficulty of lighting does not exist as Washington lights are now available in most centres.

If any advance is to be made in this direction, this type of school has to be opened in a large number of towns and villages, so that boys in any locality are offered educational facilities enabling them to acquire technical skill. It is futile to limit the scheme to one or two large centres.

21st March 1925

R. W. DOSS,

BOROUGH POLYTECHNIC INSTITUTE.

Junior Technical School (Boys).

SYLLABUS OF METAL WORK.

Course I—

1. Cut and file two square pieces of sheet zinc $1\frac{1}{2}$ " side and solder two edges to make butt joint.
2. Cut and file two parallelograms $1\frac{1}{2}$ " $\times$ $1\frac{1}{2}$ " and lap two edges over $3/16$ and solder to make lap joint.
3. Cut and file two parallelograms $1\frac{1}{2}$ " $\times$ $1\frac{1}{2}$ " to make groove joint.
4. Cut an oblong in tin 6 " $\times$ $1\frac{1}{2}$ " and wire edges to stiffen metal.
5. Cut two equilateral triangles $1\frac{1}{2}$ " sides to make hinge joint.
6. Make a set of geometrical figures in zinc.
7. Make a model of a prism in wire.
8. Make a model of a prism in sheet zinc.
9. Make a frustum of a cone, with a butt joint with top and bottom, all joints to be soldered.
10. Make a cylinder in sheet iron with $3/8$ lap joint and riveted.
11. Make a cylinder with butt joint and riveted.

Course II—

Making of models of geometrical solids in sheet zinc from students' own drawings. Making of gauges in stout iron plate, e.g., a piece of iron $3/22$ thick, $3\frac{1}{2}$ $\times$ $1\frac{1}{2}$ to be filed parallel lengthwise, finished 1 ", the ends to be squared up and then lined out external and internal at 90° either end; straight edge and calipers only to be used.

A piece of iron $3/32$ thick $1\frac{1}{2}$ square, to be lined out hexagonal $1\frac{1}{2}$ across flat sides to be cut off within $1/16$ of lines with cold chisel in vice and then filled up to lines, using straight edge and calipers to test if parallel.

A piece of charcoal iron $5\frac{1}{2}$ $\times$ $2\frac{1}{2}$ $\times$ 1 , one long edge to be filed up true to straight edge and then lined out to drawing one 1 " from finished edge, 2 " from either and an angle of 90° and 120° , the angles to be drilled out within $\frac{1}{4}$ of lines, then chipped and filed true to lines, using straight edge and calipers only; this exercise to be draw filed and afterwards polished.

Models of oblique solids.

Course III—Exercises of Forging—

1. Forge a nail from iron $\frac{3}{4}$ $\times$ $3/16$ forging head first to drawing and then cut off $\frac{1}{2}$ shorter than finished length, that being allowed for tapering point.
2. Forge square taper drift from $\frac{1}{2}$ " bar, using Smith's flatter for finishing.
3. Forge round taper drift from $\frac{1}{2}$ " round bar; forge square first, then hammer down corners. Hammer only to be used.
4. Forge eye bolt $\frac{1}{2}$ " round iron, measure length of iron required for eye and bend at right angles, then finish off on nose of anvil to required shape.
5. Forge S hook from $\frac{1}{2}$ " round iron, measure length of iron required and cut off, taper both sides slightly and forge over nose of anvil.
6. Forge staple from $\frac{1}{2}$ " round iron, measure length of iron required allowing 1 " short for taper ends, forge square taper 2 " long on both ends, then bend according to drawing.
7. Scriber.

Turning, etc.—

1. Dovetail joint to be made in mild steel, a piece of metal $4\frac{1}{2} \times 1\frac{1}{2}$ to be squared up and lined out, external dovetail and internal the other, drilled and filed up lines to be cut off in half and tested when finished.

2. A piece of $1\frac{1}{2}$ brass to be turned 1" parted off; long two sides to be sawn and filed to from equilateral triangle.

3. A piece of brass $6 \times 2 \times \frac{1}{2}$ finished; and 1" round hole and 1" square hole; a 1" equilateral triangular hole to be drilled and filed out to the lines; the solid piece of brass to fit all three holes.

4. Plain turning. Turn 1" collar spindle and screw out same.

5. Hand rail column, and screw cut same, and other exercises of a more advanced character—

External and internal gauges 90° , 120° , 135° .

Dovetail joint in copper to be braised.

Lap and butt joints in iron tube to be braised.

Pair of broad-point calipers, ratchet brace, screw jack.

Face plate, starrett scribing block, etc.

SYLLABUS/WOODWORK.

Explanatory—

The lesson of each year will include the necessary drawing either to scale or full size, from which the work will be made. Such drawings will be made from rough sketches or from accurately made models.

Lessons on the construction and principles of the various tools; their use and methods of manipulation will be given at the various stages of the workshop course.

Object lessons on the nature and properties of the various kinds of timber used will be given from time to time, and will be supplemented by visits to Kew Gardens, to Museums and places of interest.

In the early stages, the exercises chosen will be such that the number of tools required will be small; but in the second year the exercises will involve the use of an increasing number of tools.

Course I—

Sawing at right angles to the direction of grain, sawing obliquely across, and with the grain. Chiselling horizontally, planing. Cutting out inlaying plane geometrical figures $\frac{1}{4}$ " thick. Various forms of simple joints, as lapped, ha'ving and dovetail joints, housing groove and tongue joints; introducing the use of glue. The necessity of accurate setting out and working to cut lines. Proving dimensions of finished model by placing model on student's drawing.

Course II—

Models and joints of a more complex character, introducing new tools and methods of construction; mortise and tenon joint; cube cut into three pieces, showing volume of a pyramid. Elementary pattern making, surface plate, simple bearings, fire bar with calculations for finding radius of curve, hexagonal nut with core box; introducing simple wood turning, also hack saw and file handles; turner's inkwell stand. The uses of patterns and draw being fully demonstrated with moulders sand in casting boxes.

SYLLABUS OF TECHNICAL DRAWING.

B. Engineering Drawing.

First year (Mechanical drawing)—

Notes on pencils, paper and instruments. Fixing, heading and arrangement of work on paper. Use of squares, printing of title, figuring and dimensioning.

Sketching and measuring up five selected wood models; sash lifter; rapping plate; drawer pull, and dowel plates. Sketch detail sheets 1 to 8.

Machine details—with full notes.—

Screw threads, accurate shapes and conventional representation. Standard proportions of bolts and nuts. Type of bolt heads, bolt and nut, castle nut, etc. In this year, much importance should be attached to the production of good lines, printing and figuring, the simple drawings are to have a workmanlike appearance. In the second term, one or two drawings may be inked in, and in the third term, two or more tracings should be made, and flat tints laid on some drawings and on the back of tracings. Streets should be laid on the correct naming and description of views and subjects.

Second year (Machine drawing).—

The first half-hour should occasionally be spent on sketches and notes on details of machinery. Revise sheets 1 to 8 A schedule of parts should be included with all sketches and each view should be named and each section plane indicated. The actual articles should be measured up and sketched, including first year objects omitted. The articles should be selected from riveted joints (3 as group exercise), keys and cotter, collars, couplings, R and L hand coupling box, simple bearings spanners (with general idea of proportions), crank brace, knuckle joint, pipe flange joints, simple gland and stuffing box, simple valves, crank, connecting rod end.

Assembly or detail drawings of the above, or both, with section.

An accurate knowledge of the names and uses of simple machine details should be given. Tracings and some inked-in and coloured drawings, *always* with dimensions and full printing, should be made.

Blue prints should be made of meritorious tracings and the method demonstrated.

Third year (Machine drawing)—

Sketches from machine detail sheets 8 and 10 to 17.

Sketches dimensioned from actual measurement of articles mentioned below. Sketches of details and (or) assembly with schedule of parts, from which assembly and (or) detail drawings are made always dimensions in ink or pencil, with sections flat tinted and sometimes fully flat tinted. Strong tracings of merit should be blue-printed and every boy taught the method. Timed simultaneous exercises should be introduced at intervals.

Cover with notes and draw selections from—

Lever, pipe couplings, fusible plugs, shaft couplings, bearings, cranks, connecting rod ends, crossheads, pistons, cocks, non-return and other valves, screw-down valves.

Note.—Visits to laboratory should be made to show details in actual position.

SYLLABUS IN APPLIED MECHANICS.

Year II—Course I—

Force.—Definition and representation, summation of forces in straight line. Parallelogram, triangle and polygon of forces.

Resultant, equilibrant and component forces.

Principle of moments.—The lever; beam reactions.

Units of force, space, time, work, and power, gravity.

Variable forces—time and space averages.

Representation of work by area.

Horse-power and efficiency.

Friction.—Co-efficient of friction; work done by mechanical agents against friction or gravity, and for useful purposes. Movements of bodies on inclined planes.

Machines.—Definition and types; velocity ratio; mechanical advantage efficiency, experiments with machines; calculations on, and setting out of, curves showing characteristics of machines. Finding the law of a machine; using pulley on axle with thick and thin cords, wheel and axle; single and other pulley blocks; Chinese windlass, screw-jack and Weston's blocks.

Elementary notions of the strength and characteristics of material (2 lessons).

Very elementary notions on Hydraulics and Pneumatics (2 lessons).

Year III—Course II—

(Revise Course I as required.)

A. Accurate measurement.—Line and end measurement; refined measurement; gauges. Measurement of areas; use of planimeter; measurements of volumes; micrometer; and cathetometer.

B. Materials.—Strengths and elastic moduli; tension; compression; shear, torsion (simply). Springs in tension and compression. Work stored within elastic limit; beams and rules relating to similar beams, rectangular beams; and flanged ones by approx method. Some characteristic properties of materials.

C. Motion.—Uniform and otherwise; vector quantities; force; acceleration; mass; momentum; centrifugal force.

Energy.—Potential and kinetic; flywheel; and pendulum (simply) with problems on work; tractive effort and work on inclines, etc.

D. Hydraulics.—Pressure, head, Bramah's; the siphon; pumps (rotary and reciprocating); simple hydraulic machines with problems.

E. Machines.—Revise velocity-ratio, Law of machine and curves for same, etc. Lifting machines—the "facile" block; worm and wheel; lifting crab; hydraulic jack.

Transmission of motion.—by shafts, belts and other gearing. Toothed wheels and worm gearings as applied to machine tools; cases of relative motion.

F. Problems connecting A, B, C, D and E.

SYLLABUS OF MATERIALS.

Description of ores.

Description, sketches, etc., of the following furnaces and processes:

Blast furnace, with particulars of hot blast and cupper stoves, etc.

Puddling, with particulars of manufacture of various of commercial iron and its composition.

Cementation steel, with methods of manufacture of crucible shear and double shear steel.

Bessemer process for manufacture of mild steel.

Siemens open hearth steels.

Tool steels, with particulars of composition, strength and cutting speeds.

Lecture on physical properties of steel, with diagram showing per cent carbon in W.I.M.S.

High carbon steel and cast iron.

cowper

varied

No. 879, LAW (EDUCATION), 25TH MAY 1925

Manufacture of copper from pyrites.
Copper tin alloys and their per cent composition and strengths.
Copper zinc alloys and their per cent composition and strengths.
Composition of solders, white metal, brazing metal, resistance wire alloys.
Malleable iron castings.
Case hardening.
Annealing.

Process of welding by "Thermit."
Talks on semi steel and Mitis metal.

Properties of aluminium.

Notes on turning tools and tool clearance.

Notes on screw-cutting, including cutting of fraction of threads per inch and multiple start threads.

Lecture on the steam engine and the application of the various metals to its manufacture.
Revision of work.

Order—No. 879, Law (Education), dated 25th May 1925.
Recorded.

(By order of the Government, Ministry of Education)

V. T. KRISHNAMA ACHARIYAR,
Secretary to Government.

To the Director of Public Instruction.
Development Department.

16/ 13
Law(Education)Department

(C.No.1383-A) From the D.P.I.,R.C.No.2709-C
dated 15-4-25.

Subject:-Report by Mr.R.W.Ross on vocational
classes in England.

74. Report is submitted with reference to
Rule ¹⁰ of the Study Leave Rules on p.2 of G.O.
No.896 Fin.,dated the 11th October 1923.

2.Mr.Ross suggests that manual training
should be made a compulsory subject in all secy.
schools. Obviously this suggestion cannot be
carried out, in entirety, at present, but every
encouragement is given to managers of secy.
schools to introduce manual training in their
institutions.

3.Mr.Ross also suggests that, in centres
where any industry exists, technical knowledge
of the industry may be imparted to boys by the
starting of evening classes. Apparently, the
suggestion is one for consideration in the
Development Dept.

4.The report may be sent(u o) to the
Development Dept.for perusal . On return, it
may be circulated to M & M.

25.4.25
Development u.o



Law order no 1383A-1
27-4-25
1346 II
29.4.25

Do See.

Mr. Ross's report describes the attempts that are made in the United Kingdom to provide children which have completed the primary or elementary course of studies an education in technical or industrial subjects without at the same time neglecting the purely literary subjects.

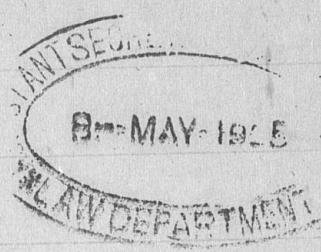
The dyestuffs and dyes schools provide parallels for the system of education which we propose to impart at the preparatory classes to be attached to the Madras Trades School. The ~~etc~~ pupils will be of 13 or 14 years of age and given a three years course at the end of which they get into trade workshops and become fit for any type of practical work. They supplement their knowledge by attending evening classes. Corresponding to these evening classes, we have the regular classes now run at the Madras Trades School admission to which is restricted to bona fide apprentices and workmen who are actually engaged in the trade in which they want further to qualify themselves.

In the penultimate paragraph of his report (p. 7 c.), Mr. Ross suggests that in centers where any industry exists technical

Knowledge of that industry should be imparted to boys who wish to study the subject.

Mr Ross's suggestion here is apparently not that purely separate technical institutions should be started but that existing ^{general} educational institutions should provide facilities for technical and industrial education, if necessary, by opening evening classes. If these facilities are over-crowded, the boys have already ^a ~~too much~~ full day's work and cannot be expected to put in more hours of study without a severe strain and the remedy seems to be to encourage the management of such institutions to so alter their curriculum of studies as to ^{provide} ~~to be able to provide~~ industrial instruction without at the same time neglecting the more literary studies. This ^{type of} education should be available ~~not~~ in a large number of centres and the Govt. Dept cannot undertake it. It must form part of the general educational system of the Presidency - a point which would seem covered by the order in para. 14 (P. 65) of G.O. No. 2043 D.W., dt 28.11.24.

2043 D.W., dt 28.11.24.
R.
25.11.



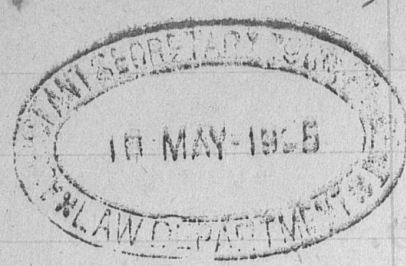
R.
① The Govt. Dept have not yet responded on this point.

DW: W.O 1346-11/25-1
6-5-25
Sp V. 2 4/5

I am not sure that the D. I may not have to cooperate as regards evening classes in large centres eventually.

Law (Education)
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m3

The Report of Mr Ross deals with Manual Training the given as part of the General Education of pupils of the higher elementary & Secondary Schools. We have begun the work already in about 100 schools. The course of study will be revised so far as this course is concerned - I propose to make manual training compulsory in Secondary Schools & this will also be recommended to the Secondary Education Committee - In R' also certain recommendations have been made. The Corporation of the Municipal Dept will be keeping at a later stage of the boys' education to work in the large centres of particular industry by evening classes to supplement their preliminary training in the school - I am sure this is feasible - Education may print the report & Mr Ross for circulation to the Committee proposed to be held in June - 25.

10 2043 D.W.
28.11.24
(P)

Md 16525

This
19.5.25

page in regard to the circulation of copies
to the members of the Committee proposed to
be appointed are noted.

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27
(Law Education) DEPARTMENT. 16
Vocational ^{Instructional} Education 180

Report on Vocational classes
in England - written by Mr.
R. W. Ross - recorded: 1921

READ AGAIN G.O. No., dated 24 Nov 1921 *Recorded*

” ” ” ” ” 192

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C. No. 1383A From the _____, No. _____, dated _____ 192

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(e) The names of the Secretary and Members should be printed in full when they occur on the right hand side, only the first time when they appear on the left side, the initials alone being printed later.

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