



General syllabus of examinations in science and trade subjects : technical schools

AUTHOR(S)

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EDUCATION DEPARTMENT, VICTORIA.



GENERAL SYLLABUS
OF
EXAMINATIONS
IN
SCIENCE AND TRADE SUBJECTS.

TECHNICAL SCHOOLS.

A. O. SACHSE,

Minister of Public Instruction.

FRANK TATE,

Director of Education.

1st January, 1906.

Melbourne :

BY AUTHORITY : ROBT. S. BRAIN, GOVERNMENT PRINTER.

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A. G. RICHES

Inspector of Public Instruction

FRANK TATE

Inspector of Education

1894

Printed by

the Government Printer, Melbourne.

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EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 1.

CHEMISTRY.

INORGANIC CHEMISTRY.

THEORETICAL.

FIRST GRADE.

Physical and chemical properties of water. Specific gravities. Aqueous solutions, saturated and unsaturated. Physical and chemical properties of air. Physical laws of ideal perfect gases. The gaseous, liquid, and solid states. Combustion. Heat in chemical reactions. Hydrogen, oxygen, nitrogen, fluorine, chlorine, bromine, iodine, sulphur, phosphorus, carbon, and silicon, with their simple compounds (under carbon, methane, and acetylene are included). Allotropic states. The general properties of metals, basic oxides, and hydroxides, such as lime, caustic soda, zinc oxide, black oxide of copper, and litharge, and the reactions of these with acids to form salts.

The laws of combination by weight and volume, illustrated by re-actions in which the above-named elements take part. Atomic theory. Molecular and atomic weights. Double decomposition. Dissociation. Density of gases. Vapours, vapour pressures, and boiling points. Valency. Chemical nomenclature, formulæ, and equations. Calculations of quantities by weight and volume.

SECOND GRADE.

The work of the first grade in fuller detail and amplified so as to include the more important compounds of the chief non-metals, with the following metals :—

Na, K, Mg, Ca, Sr, Ba, Zn, Cd, Hg, Al, Sn, Pb, As, Sb, Bi, Cu, Ag, Au, Pt, Fe, Ni, Co, Cr, and Mn.

Ammonium compounds ; cyanides and double cyanides. Periodic law. Law of partial pressures. Methods of determining vapour densities. Determination of atomic weights of elements by specific heat. Continuity of vaporous and liquid states. Electrolysis. Electrolytic and non-electrolytic solutions. Neutralization of acids and bases. Preparation, properties, and relation to one another of the following carbon compounds :—Methyl alcohol, ethyl alcohol, formic acid, acetic acid, oxalic acid. Substitution. Classification of carbon compounds in homologous series. Constitutional formulæ.

ADDITIONAL FOR HONOURS.

Solubility of gases and liquids. Kinetic theory of gases. Theory of solutions, including the application of gaseous laws. More complete consideration of ionization of electrolytes. Chemical equilibrium. Mass action. Thermal chemistry. Determination of molecular weights by solution methods. Methods of determining atomic weights. Elementary spectrum analysis.

PRACTICAL.

FIRST GRADE.

Experiments illustrating physical and chemical changes. Examination of compounds and mixtures ; methods of identifying substances ; separation of mixtures by simple physical methods. Oxidation and reduction processes. Reactions of acids with alkalies, metals, and simple salts. Preparation of simple salts, such as ferrous sulphate, zinc sulphate, alum, calcium carbonate, &c.

Qualitative analysis by wet and dry methods of single salts for ordinary bases and the following acids—sulphuric, sulphurous, hydrosulphuric, thiosulphuric, carbonic, nitrous, nitric, hydrochloric, hydrobromic, hydriodic, phosphoric, chromic, permanganic,

acetic; and also of mixtures containing not more than two bases and one acid, or two acids and one base, comprised in the following list:—

Acids.	Bases.
Sulphuric,	Potassium,
Hydrosulphuric,	Ammonium,
Hydrochloric,	Calcium,
Hydriodic,	Barium,
Nitric,	Iron,
Carbonic.	Zinc,
	Manganese,
	Copper,
	Lead,
	Silver.

SECOND GRADE.

Complex qualitative analysis of salts of the common inorganic bases derived from the metals mentioned in the theory part of this grade with the following acids—sulphuric, hydrosulphuric, sulphurous, thiosulphuric, hydrofluoric, hydrochloric, hydrobromic, hydriodic, nitric, carbonic, phosphoric, hydrocyanic, acetic, and oxalic. Volumetric and gravimetric analysis of a mixture containing not more than three of the following—sulphuric, carbonic, and hydrochloric acids, and silver, lead, copper, calcium, barium, iron, aluminium, zinc, and magnesium.

THIRD GRADE.

The complete analysis of such natural and industrial substances as ores, rocks, coal (proximate, and ultimate for carbon and hydrogen), water for technical purposes, alloys, cements, slags, and manures (including estimation of nitrogen).

NOTE.—At examination, students must be prepared to analyze mixtures in addition to naturally occurring substances.

ORGANIC CHEMISTRY.

A student taking this subject must either have passed in Grade II.—Inorganic Chemistry (Theoretical and Practical), or he may present himself simultaneously in both.

THEORETICAL.

The methods of formation, chief properties, and constitution of the following substances—methane, ethane, and their halogen

derivatives ; alcohols, aldehydes, acids, ethereal salts, and ethers ; cyanogen, hydrocyanic acid, cyanic acid, urea ; ethylene, acetylene, allyl alcohol ; oxalic, succinic, malic, tartaric, citric, and lactic acids ; glycerol, sugars, starches, and gums. Also of benzene, toluene, xylene, monochlorobenzene, mononitrobenzene, benzene-sulphonic acid ; phenol ; nitrophenols, picric acid ; aniline, aniline sulphate and hydrochloride, diazocompounds ; toluidine ; phenylhydrazine, hydroquinone ; benzyl alcohol, benzoic acid ; salicylic acid, gallic acid, tannic acid ; naphthalene, monochloronaphthalene, naphthalene sulphonic acid ; anthracene, anthraquinone, alizarin.

PRACTICAL.

Qualitative detection of carbon, hydrogen, nitrogen, chlorine, and sulphur. Identification of the chief organic compounds. Estimation of carbon and hydrogen. Determination of vapour densities and molecular weights. Preparation of such compounds as ethylene dibromide, ethyl acetate, glycerol, mono-nitrobenzene, aniline, potassium benzene-sulphonate, and phenol.

AGRICULTURAL CHEMISTRY.

FIRST GRADE.

Identical with Inorganic Chemistry—Grade I. (Theoretical and Practical).

SECOND GRADE.

This examination is intended for those following agricultural pursuits, and is designed to test whether they have sufficient knowledge of agricultural chemistry to understand the principles of scientific farming.

THEORETICAL.

General facts concerning the organic compounds entering into the composition of plants and animals. Sugar, starch, and cellulose, as types of important organic compounds not containing nitrogen. Albuminoids, the most important nitrogenous compounds in plants and animals.

Sources of plant food in atmosphere and soil. Assimilation in plants, and the action of light. The functions of roots. The physical structure of clay and sand as extreme types of soils. The humus in soil. Water in soil and conditions favouring its accumulation and removal. Evaporation, drainage, tillage and irrigation. Plant foods in soil, those immediately available and

those not so. The chemical analysis of soils, how conducted, and what it shows. Reasons why chemical analysis does not suffice for determining the agricultural value of a soil. The necessity for experimental plots.

Manures, natural and artificial. Farmyard manure; necessity for its thorough rotting before it is of use to plants. Broad results of the chemical changes during rotting. Other manures such as dried blood and abattoir refuse. Green manure. The chief artificial manures, ammonium sulphate, sodium nitrate, potassium compounds, phosphates, chalk, and gypsum. Fallowing. Rotation of crops. Amounts of the chief elements removed from the soil by the chief crops.

Fundamental chemical facts in the physiology of animal digestion and respiration with reference to maintaining the temperature of the body and the growth and fattening of stock. Loss to the soil in the production of meat, milk, and wool.

PRACTICAL.

A candidate for Agricultural Chemistry—Grade II., must for one year cultivate an experimental plot of not less than a quarter of an acre under the direction of an officer appointed by the council of the school. The field experiments carried on will be similar to those controlled by the Chemical Branch of the Agricultural Department. The experimental work done on this plot will be examined and reported upon by one of the inspectors in the Agricultural Department, and, on receipt of a favorable report from the examiner upon his experiments, a candidate shall be deemed to have passed the practical part of his examination in Agricultural Chemistry—Grade II.

NOTE.—A candidate must pass in the practical as well as in the theoretical part of Grade II. to entitle him to a certificate.

AGRICULTURAL CHEMISTRY.

THIRD GRADE.

This examination is intended for those qualifying to become experts in agricultural chemistry. Candidates will also be required to pass in Agricultural Chemistry—Grade II., and Organic Chemistry, before being entitled to a certificate for Agricultural Chemistry—Grade III.

THEORETICAL.

A more detailed treatment of the course for Agricultural Chemistry—Grade II. will be required, with special reference to the following:—Physical and chemical properties of soils. Nature of humus. Fixation of atmospheric nitrogen in soils, and

liberation of nitrogen from them. Water in soil and its content of soluble substances. The effects of irrigation on soil. Preparation of soils for artificial cultures of an experimental character. Methods of carrying out field experiments. Conditions controlling the efficient application of manures and the utilization of residues from previous manuring. Reduction of loss of ammonia in natural manures. Nitrogenous nutrition of plants. Composition of cereals and cereal products. Grasses. Root crops. Forage plants. Ensilage. The feeding of stock for work, fattening, milk, and wool. Manure furnished by stock on different foods. The chemistry of butter and cheese.

PRACTICAL.

Candidates will be expected to undertake work from amongst the following:—Soil analysis, mechanical and chemical; analysis of manure for phosphoric acid, (total, water-soluble, and citrate-soluble), potash, and nitrogen; analysis of cattle food for ash, crude fibre, crude protein, and total nitrogen; analysis of milk for water, casein, and butter fat; examination of butter for specific gravity, melting point, and content of acids, volatile, soluble, and insoluble.

NOTE.—As in Grade II. the student must pass in both the theoretical and practical work to entitle him to a certificate.

TECHNICAL CHEMISTRY.

Students will be expected to have a general knowledge of the chief methods and appliances used in the application of the following processes to chemical industries:—Pulverizing and grinding, sorting and sizing, mixing and sampling, conveying and elevating, leaching and filtering, concentrating, evaporating, and distilling, refrigerating, and heat-raising. In the study of these special attention should be paid to the broad chemical and physical principles underlying them.

A detailed knowledge will be required of the processes and plant, and of the raw materials and finished products of the industries in one of the following groups—(a), (b), (c), (d) (e), (f), (g), (h), and (i).

The examination in each group will be carried out by means of a written paper or papers as well as by practical work in the analysis of raw materials and products studied in the group.

Candidates for Groups (a), (b), (c), must pass in Inorganic Chemistry—Grade II. (Theoretical and Practical), and for Groups (d), (e), (f), (g), (h), (i), also in Organic Chemistry (Theoretical and Practical), as well as in the selected group.

(a) Manufacturing Chemistry—

Sulphuric, nitric, and hydrochloric acids ; sodium carbonate, hydroxide, and thiosulphate ; potassium cyanide and chlorate ; bleaching powder ; superphosphate ammonia ; carbon bisulphide.

(b) Electro-chemistry—

Candidates in this group must pass the departmental examinations in Electrical Technology—Grades I. and II.

The electric furnace. Carborundum, calcium carbide, aluminium, sodium hydroxide, bleaching powder, potassium chlorate. The electrolytic recovery of metals such as gold, silver, and copper. Electroplating.

(c) Glass and Clays—

Glass, pottery, Portland and other cements, enamels, and colours.

(d) Tanning—

Its processes, materials, and products. Also gelatine, glue, and size.

(e) Fats and Oils—

Oils, soaps, candles, and glycerine.

(f) Sugar and Brewing—

Cane and beet sugar. Malting and fermentation. Wine-making.

(g) Sanitation and Chemical Hygiene—

Examination of food stuffs. Analysis of water and air. The chemical treatment of sewage.

(h) Agriculture—

See Agricultural Chemistry—Grade III.—

(i) Textiles and Dyes—

Structure of textile materials and principles of dyeing. Mordanting, printing, and bleaching. Manufacture and application of typical dyes and dye stuffs.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 2.

ASSAYING AND METALLURGY.

ASSAYING.

FIRST GRADE.

Construction and use of furnaces for assaying. Use of crucibles, roasting dishes, scorifiers, manufacture and use of cupels. Character and use of fluxes and reagents. Collection and preparation of samples of ores. Sizes of samples (simple cases). Coning and quartering. The use of the assay balance and scales. Assay of ores of lead, gold, silver, tin by dry processes. Assay of iron, copper, and lead by volumetric methods, involving separation.

SECOND GRADE.—PASS.

Theory of sampling, with illustrations by cases taken from actual practice. The use of sampling machines. Sampling of metals. Limiting degree of accuracy in operations connected with assaying. The use of the assay ton and special weights in assaying. Dry assay of copper, gold, silver. Use of checks in assaying. Gravimetric and volumetric methods required in technical operations for the determination of lead, copper, zinc, nickel, cobalt, manganese, iron, aluminium, sulphur, silica, phosphorus, lime, magnesia, arsenic, antimony, tin, mercury, silver.

Electrolytic methods, including separations, for the determination of copper, nickel, chlorine. Easy cases of cyanide determinations. Gold and silver bullion assay. Preparation of pure gold and silver. The examination of fuels, but not including ultimate analysis.

HONOURS.

The student will be permitted to choose one of the following branches as additional work for honours:—

1. Iron and steel.
2. Gold and silver.
3. Lead and copper.
4. Fuels.

He will also be required to answer questions on assaying processes generally, and to display a thorough knowledge of the conditions associated with technical analysis. A higher degree of accuracy in manipulation will be expected.

METALLURGY.

FIRST GRADE.

The physical and chemical properties of metals. Classification of fuel. The calorific power of fuel. Application of fuel to metallurgical processes. Refractory materials employed in the construction of crucibles, retorts, furnaces. Furnaces and their construction as applied to the metallurgy of gold, copper, mercury. Ordinary metallurgical processes. Chief methods for the extraction, on the large scale, of gold, copper, mercury.

SECOND GRADE.—PASS.

The operations involved in metallurgical processes in fuller detail, and, generally, a more comprehensive treatment of the subject matter of the first grade.

Metallurgy of iron, nickel, cobalt, lead, silver, tin, antimony, platinum, zinc, aluminium, bismuth, mercury, manganese, chromium. General principles of ore dressing. The chief machines used for the crushing, sizing, classification, and concentration of ores.

Calculation of furnace charges. The principal alloys.

HONOURS.

The student will be permitted to choose one of the following branches as additional work for honours:—

1. Gold and silver.
2. Copper and lead.
3. Iron and steel.
4. Application of electricity to metallurgy.

He will also be required to answer more difficult questions on the subject matter of the ordinary second grade course.

NOTE.—Candidates for examination in both the first and second grades of Metallurgy will be required to make sketches of the various metallurgical appliances described.

Preliminary Courses of Study required before a Candidate is allowed to present himself for examination in—

Subjects in which a "Pass" must also be recorded to entitle the Candidate to a Certificate in—

ASSAYING.—GRADE I.

Chemistry, Theoretical, Grade I.	Chemistry, Theoretical, Grade I.
„ Practical, Grade I.	„ Practical, Grade I.

ASSAYING.—GRADE II.

Chemistry, Theoretical, Grades I. and II.	Assaying, Grade I.
Chemistry, Practical, Grades I. and II.	Chemistry, Theoretical, Grade I.
Mineralogy, Grade I.	„ Practical, Grades I. and II.

METALLURGY.—GRADE I.

Same as for Assaying, Grade I.	Assaying, Grade I.
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METALLURGY.—GRADE II.

Chemistry, Theoretical, Grades I. and II.	Metallurgy, Grade I.
Chemistry, Practical, Grades I. and II.	Chemistry, Theoretical, Grade I.
Mineralogy, Grade I.	„ Practical, Grade I.
Assaying, Grade I.	Mineralogy, Grade I.
	Assaying, Grade I.
	For Honours, also—
	Chemistry, Theoretical, Grade II.
	„ Practical, Grade II.
	Assaying, Grade II.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 3.

GEOLOGY AND MINING GEOLOGY.

GEOLOGY.

FIRST GRADE.

Definition of Geology. Causes tending to modify the Crust of the Earth; Action of Air, Water, Ice, &c., and of Plant and Animal Life. Phenomena of Internal Heat. Earthquakes, Volcanoes, and Origin of Mountain Chains. Eruptive Rocks and the commoner Rock-forming Minerals. Sedimentary Rocks and the materials that compose them. Folding of Strata, Outcrop, Dip and Strike, Joints, Faults, and Dykes. Metamorphism and Crystalline Schistose Rocks. Foliation and Slaty Cleavage. Mineral veins.

Consolidation of Strata and Cementing materials. Unconformity and its significance.

Order of Strata and use of Fossils. Modes of Fossilization.

The succession of Strata as indicated by Australian representatives of the Geological time scale.

Methods of observation in the Field.

The student must be able to recognise examples of the following characteristic Victorian fossils* :—

† *Tetragraptus serra*, Brong.
 ‡ *Tetragraptus fruticosus*, J. Hall
Didymograptus caduceus, Salter
Phyllograptus typus, J. Hall
Goniograptus macer, T. S. Hall
Rhinopterocaris maccoyi, Eth. fils
Dicranograptus ramosus, J. Hall

Rhynchonella decemplicata, Sow.
 § *Dalmanites meridianus*, Eth. and Mitch.
Orthoceras (Cycloceras) ibex, Sow.
Euomphalus northi, Eth. fils
Cyclonema lilydalensis, Eth. fils
Favosites grandipora, Eth. fils
Petraster smythi, McCoy
 || *Atrypa reticularis*, Lin.

Cordaites australis, McCoy
Chonetes australis, McCoy
Gangamopteris obliqua, McCoy
Podozamites ellipticus, McCoy
 ¶ *Cladophlebis denticulata*, Brong.
Tæniopteris daintreei, McCoy
Sphenopteris warragulensis, Stirling

Carcharodon megalodon, Ag.
Conus heterospira, Tate
Volutilithes antiscalaris, McCoy
Trivia avellanoides, McCoy
Dimya dissimilis, Tate
Cardita polynema, Tate
Magellania garibaldiana, Davidson
Placotrochus elongatus, Duncan

Cancellaria wannonensis, Tate
Nassa crassigranosa, Tate
Tylospira coronata, Tate
Pecten antiaustralis, Tate
Trigonia howitti, McCoy
Chione subroborata, Tate

* Typical examples of these fossils are, by the courtesy of Professor Spencer, displayed in a special case at the National Museum.

† *Didymograptus bryonoides*, Hall, in *Prodromus of Palæontology of Victoria*.

‡ *Didymograptus fruticosus*, Hall, in *Prodromus of Palæontology of Victoria*.

§ *Phacops caudatus*, Brong., in *Prodromus of Palæontology of Victoria*.

¶ *Spirigerina reticularis*, Lin., in *Prodromus of Palæontology of Victoria*.

¶ *Pecopteris australis*, Morris, in *Prodromus of Palæontology of Victoria*.

SECOND GRADE.

Classification of the Invertebrata, with some details of the more important representative genera of the following groups :— Foraminifera, Actinozoa, Graptolites, Echinodermata, Crustacea (Phyllopoda, Phyllocarida, Trilobita), Polyzoa, Brachiopoda, and Mollusca, with special reference to Australian forms.

Classification of the Vegetable Kingdom as represented by fossil forms in Australia.

Stratigraphical Geology of Australia and Tasmania.

Lithological and Palæontological details of Victorian strata.

Geological maps and sections.

The student will be expected to recognise examples of Australian fossils.

MINING GEOLOGY.

FIRST GRADE.

Identical with the first grade in Geology.

SECOND GRADE.

Mode of occurrence, especially in the Australian Colonies, of gold, silver, lead, copper, tin, iron, manganese, cobalt, nickel, chromium, and tungsten ores.

Veins, beds, fissure lodes, bed lodes, contact lodes, irregular deposits.

Cross courses, faults, heaves, slides, Schmidt's law for recovering heaved lodes, conditions determining a champion lode.

Genesis of lode matter and theories as to the origin of minerals found in lodes, *e.g.*, by deposition, segregation, or sublimation.

Detailed structure of the principal Victorian gold-fields. Coal mines.

Methods of observation in the field.

Geological maps and sections.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 4.

MINERALOGY AND PETROLOGY.

MINERALOGY.

FIRST GRADE.

Forms of minerals, elementary crystallography, viz., the six systems; regular holohedral and hemihedral forms; notation of forms and planes or faces according to Naumann's system.

Physical, chemical, and optical characters used in the determination of minerals.

The commoner non-metallic and metallic minerals, with their blow-pipe reactions.

The student will be expected to identify crystals and minerals as above, and to use the blow-pipe.

SECOND GRADE.

Elementary crystallography as in Grade I., with the addition of the following:—Combinations in natural crystals, twin crystals, zones, symmetry of crystals; notation of forms and planes or faces according to Miller's system; measurement of angles of crystals.

Descriptive Mineralogy.—Detailed description of mineral species; their physical and chemical characters; geological and geographic mode of occurrence, with special reference to Australian localities.

Determinative Mineralogy.—The more important minerals examined by physical tests and chemical tests in the dry and wet way.

Laboratory practice.

The student will be expected to identify crystals and minerals as above, with practical determination of latter in dry and wet way.

PETROLOGY.

FIRST GRADE.

Identical with the first grade in Mineralogy.

SECOND GRADE.

Physical structure of rocks.

The chief rock-forming minerals which occur as essential or accessory ingredients of rock-masses—their crystalline forms, with chief combinations present (including diagrams), specific gravity, chemical composition, mode of occurrence, &c. Special methods for isolating and determining these ingredients. Methods for approximately estimating the relative proportions of the alkalies in the felspars.

Examination of rock sections by reflected, transmitted, and polarized light (elementary considerations only). Microscopic elements of rocks, viz., crystals, vesicles, microliths, &c. Microscopic structure of rocks, viz., crystalline, fluxion, clastic, &c., structures.

Classification of rocks. Igneous, Sedimentary, and Metamorphic rocks. The structure, mineralogical and approximate chemical constitution, properties, mode of occurrence, &c., of the principal types of rocks, and their chief varieties.

Rocks of economic value as building stones, plastic materials, &c.

Practical determination of rocks by macroscopic characters.

THIRD GRADE.

Mineral microscopy and the microscopic structure of rocks. Determination of rocks.

NOTE.—Students desiring to be examined in Petrology must qualify by previously passing in Mineralogy, Grade I.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 5.

MATHEMATICS.

ARITHMETIC.

FIRST GRADE.

The principles of arithmetical operations and their application to simple questions.

The fundamental rules applied to whole numbers and to vulgar and decimal fractions. Proportion and its application to the ordinary questions of everyday life. The extraction of the square and cube roots of numerical quantities. Decimals. Approximate calculations. The metrical system.

GEOMETRY.

FIRST GRADE.

The properties of lines, triangles, rectangles, and circles, so far as they are treated in the first three books of Euclid; the questions on this subject being set so as to test knowledge of geometrical principles.

SECOND GRADE.

Euclid's Elements, Books I., II., III., IV., VI., XI., 1 to 21, Definitions of Book V., Deductions.

ALGEBRA.

FIRST GRADE.

The definitions and explanations of algebraical signs and terms.

The addition, subtraction, multiplication, and division of algebraical expressions.

Numerical substitutions. Integral indices. Factors, greatest common measure, least common multiple, fractions, ratio, proportion, simple equations of one and two unknown quantities, and easy quadratic equations.

Problems; easy graphical illustrations.

SECOND GRADE.

More advanced treatment of the work prescribed for the first grade, together with involution, evolution, surds, the elements of the theory of equations, progressions, permutations and combinations. The Binomial Theorem. Logarithms. Exponential and logarithmic series. Graphical illustrations and graphical problems.

TRIGONOMETRY.

FIRST GRADE (COURSE A).

Definitions. The measurement of angles by degrees. The circular measure of an angle. The trigonometrical functions, and their relations to one another. The use of the signs $+$ and $-$ to indicate contrariety of direction. The tracing of the trigonometrical functions in magnitude and algebraic sign through the four quadrants. The arithmetical values of the trigonometrical functions of 30° , 45° , and 60° . The solution of all cases of right-angled and oblique triangles, with the proofs of the requisite formulæ. Heights and distances. The areas of triangles. The definition of a logarithm. The use of logarithms in performing the operations of Multiplication, Division, Involution, and Evolution. The methods of using tables of logarithms of numbers and of the trigonometrical functions of angles.

FIRST GRADE (COURSE B).

The use of logarithms for performing the operations of Multiplication, Division, Involution, and Evolution.

The definition of the six trigonometrical ratios—sine, cosine, tangent, cotangent, secant, and cosecant.

Estimating the magnitude of angles by means of lineal measurements and the use of the trigonometrical tables.

The solution of right-angled triangles with the aid of the table of logarithms of natural numbers, the tables of natural sines, cosines,

tangents, cotangents, secants, and cosecants, and the table of logarithmic sines, cosines, &c.

Practical applications of the solution of right-angled triangles and reduction of traverses.

Solution of oblique-angled triangles and practical problems involving the use of the mathematical tables in solving oblique-angled triangles.

After passing in Trigonometry, First Grade, Course A, the Student may present himself for examination in one of the following optional subjects:—

(a) TRIGONOMETRY.—SECOND GRADE—

PLANE TRIGONOMETRY.—Fuller treatment of first grade course, together with Demoivre's Theorem, and its applications in finding the exponential expressions for the sines, cosines, and tangents of angles. Summation of trigonometrical series.

SPHERICAL TRIGONOMETRY.—Definitions and elementary properties of great and small circles, and of spherical triangles and their sides and angles. Relations between the angles and sides of supplemental triangles. The fundamental relations between the trigonometrical ratios of the angles and sides of spherical triangles. The solution of spherical triangles. The analogies of Napier and the formulæ of Gauss.

(b) GRAPHICAL ALGEBRA AND ANALYTICAL GEOMETRY—

1. ALGEBRA—

The Binomial Theorem, any index.

Approximate value of expressions by the Binomial Theorem.

Summation of Series by the method of Undetermined Coefficients.

Partial Fractions.

Expansions of Fractions, by resolution into Partial Fractions, and expansion by the Binomial Theorem.

Expansions by the method of Undetermined Coefficients. Logarithms.

2. GRAPHICAL ALGEBRA—

Representation of Algebraical and Trigonometrical Functions by means of Graphs.

Plotting of curves.

Graphical solution of Equations $f(x) = 0$; $f'(x) = F(x)$.

Solution of equations in Two Unknowns.

3. ELEMENTARY DETERMINANTS—

Meaning of Determinant.

Expansion of Determinants.

Solution of Equations and Elimination by means of determinants.

4. ANALYTICAL CONICS—

The Straight Line.

The Circle.

The Parabola.

The Ellipse and Hyperbola (very elementary).

(c) DIFFERENTIAL AND INTEGRAL CALCULUS.

1. DIFFERENTIAL CALCULUS—

Fundamental Propositions.

Standard Forms.

Successive Differentiation.

Expansions by Taylor's and Maclaurin's Theorems.

Indeterminate Forms.

Maxima and Minima of Functions of one Variable.

Partial Differentiation.

Tangents and Normals to Plane Curves.

2. INTEGRAL CALCULUS—

Standard Forms.

Integration by Substitution.

Integration by Parts.

Formulæ of Reduction.

Definite Integrals.

Double Integration.

Areas and Lengths of Plane Curves.

Areas and Volumes of Surfaces of Revolution.

MENSURATION.

FIRST GRADE.

The meaning and use of algebraical symbols in the expression of formulæ.

The mensuration of *Plane* figures—

RECTILINEAL FIGURES.—The rectangle, parallelogram, triangle, right-angled triangle, trapezoid, trapezium, rhombus; other rectilineal figures.

THE CIRCLE.—Circumference, arc, chords; area, area of sector, area of segment; area of circular ring, area of difference of two sectors having a common angle.

THE ELLIPSE.—Simpson's rule for irregular areas; similar figures.

The mensuration of *Solid* figures—

The area of the surface and the volume of the prism, cylinder, pyramid, cone, sphere, wedge, prismoid.

Similar Solids.

The solution of problems depending on the above, and the practical application to artificers' work.

A knowledge of elementary algebra will be of service to students in this subject.

NOTE.—Students may be examined for Honours in Algebra, Grade II.; Geometry, Grade II.; Trigonometry, Grade II. A fuller acquaintance with the Second Grade work of these subjects will be expected.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 6.

APPLIED MECHANICS AND MECHANICS APPLIED TO MINING.

APPLIED MECHANICS.

THREE YEARS' COURSE.

The course in Applied Mechanics treats of the application of the principles of Mechanics :—

- A. To Building and Engineering Structures.
- B. To Machines.

The course as prescribed for the first and second grades is common to both A and B. For the third grade, alternative courses are provided for the two branches of the subject.

FIRST GRADE.

Matter : solids, liquids, gases. Definitions of mass and weight.

Force.—Representation in amount, direction, and position by lines; parallel forces; supporting forces in a beam; moment of a force; parallelogram and triangle of forces; application to simple cases; centre of gravity in simple cases.

Work.—The conservation of energy; the principle of work and its application in the lever (crow-bar, steelyard, balance, safety-valves); pulleys (ordinary block and tackle); wheel and axle (windlass, crab-winch, capstan, Weston block); inclined

plane (inclines, gravity-railways); screw, right and left hand; single and double threaded screws, forms of threads (screw-press, screw-jack, worm and worm-wheel, screw-cutting gear).

Power.—The horse power (simple cases of work done in pumping water and lifting weights).

Stored Work.—Work stored in a raised weight and in a moving mass (fly-wheels, the fly-press).

Conversion of Motion.—Endless bands; toothed wheels; rack and pinion; crank and connecting rod; cams and ratchet wheels (fast and loose pulleys, guide pulleys, clutches).

Friction.—The laws of friction; surface friction of fluids; work done against friction; sliding and rolling friction; contrivances for lessening friction (lubrication, friction wheels, ball and roller bearings). Cases of useful friction (brakes, screw-jacks, &c.).

Water Pressure.—Pressure at a given depth below a free surface; pressure on vertical surface; the hydraulic press; accumulators.

Pumps.—Lift pump; force pump; air vessels; plunger and bucket pumps; centrifugal pump. Floating bodies. Gas under pressure—relation between pressure and volume (at constant temperature). Compressing pumps.

Heat.—Expansion of bars by heat; co-efficient of expansion; means of counteracting the effect of expansion (expansion in steam pipes and boilers); unequal expansions in composite structures. Definitions of specific heat, latent heat, and the British thermal unit. British thermal unit expressed in mechanical units. Calorific values of coal and wood. Relative conductivity of different substances. Convection currents (ventilation, hot-water apparatus, general applications). General laws relating to radiant heat. General description of refrigerating machines. Text-books of reference:—"Low's Applied Mechanics" (elementary). "Kipper's Steam."

SECOND GRADE.

Materials.—The more important physical properties (weight per cubic foot, strength, elasticity, durability) and the methods used in practice for determining them. Methods of preservation and factors of safety used for stone, brick, cement, lime, cement and lime mortars, concrete, cast iron, wrought iron, steel, timber, together with their manufacture and preparation for use (moulding, casting, forging, welding, tempering).

Loads.—External loads—dead loads; live loads; pressures on foundations and bearing surfaces.

Stress.—Tension, compression, bending, shearing, torsion.

Strain.—Hooke's law.

Stability.—Stability of structures; frictional stability.

Strength.—Bending moment and shearing forces in discontinuous beams. Bending moment and shearing force diagrams.

Moment of Resistance.—Determination of moment of resistance in simple cases, graphically and by calculation. Determination of moment of resistance from moment of inertia. Design of beams.

Joints.—Joints used in timber- and iron-work.

Rigidity.—Deflection of a beam in simple cases. Extension and compression of a bar or rod.

Short columns, simple cases of long columns, effect of fixing ends.

Pipes and Cylinders.—Their strength when exposed to internal pressure; longitudinal and circumferential joints; strengthening of openings.

Framed Structures.—Stresses in "simple" frames; and their determination by the graphic method and by the method of sections.

THIRD GRADE.

Course A (Structures).

The work of this course will consist of the study of the more advanced part of the subject in relation to structures and the application of the principles learnt to the designs of complete structures or parts thereof. All calculations and drawings should be kept until the end of the year to indicate the nature and amount of work done. Students not proficient in engineering drawing should join the class in that subject before entering upon this course.

Continuous beams; cast-iron beams.

Graphic statics for structures.

Design of timber and iron roof trusses.

Plate girders for buildings and bridges.

Columns and struts.

Framed girders.

Trussed beams.

Arches; chimneys; retaining walls.

Text-books of reference:—Unwin's "Machine Design"; Rivington's "Building Construction," vol. 4; "Engineers' Pocket-book" (Trautwine); "A text-book on Mechanical Engineering" (W. J. Lineham).

THIRD GRADE.

Course B (Machines).

Students should know sufficient Algebra and Trigonometry, and if not proficient in mechanical drawing should join the class in that subject before entering on this course.

Stresses and strains in machines

Bending and torsion in axles and shafts.

Pressures on bearing surfaces, resistances and their reduction
Cylinders; pistons; connecting rods; cranks; fly-wheels;
governors.

Slide and other valves; valve gears and valve diagrams.

Theory of engine and boiler design simply treated.

Boiler construction, details and simple calculations.

Transmission of power by coupling rods, toothed gearing, belts,
ropes, and chains.

Text-books of reference:—"An Introduction to Machine
Drawing and Design" (D. A. Low); Unwin's "Machine
Design"; "A text-book of Mechanical Engineering" (W. J.
Lineham).

MECHANICS APPLIED TO MINING.

Strength of wrought iron, cast iron, steel, and timber.

Strength of beams, ropes, and chains.

Work and energy. Sources of energy. Horse-power.

Lever, block and tackle, windlass, capstan, whim.

Fluid pressure. Flow of water in pipes and channels (simple
methods only).

Mine pumps, plunger and draw lifts. Discharge of pumps.
Horse-power required. Allowance for slip and for friction.
Balancing pumps. Boiler feed pumps.

Water wheels and turbines.

Heat, temperature, latent heat. Evaporation and condensation.

Pressure of gases. Atmospheric pressure, steam pressure.

Connexion between heat and work. Evaporative power of
fuels.

Complete and incomplete combustion. Economy in the use of
fuel.

Steam boilers.—Efficiency of riveted joints; Cornish and
Lancashire boilers. Bursting pressure of shell; collapsing
pressure of flue. Strengthening flue-tubes and man-holes; stay-
ing flat surfaces. Rules of the Mines Department. Corrosion and
incrustation. Examination and testing of boilers. Safety-valves
and other boiler mountings. Multitubular and water-tube
boilers.

The Steam-engine.—The more important types of engine and
condenser. The indicator diagram. Correction of faults in work-
ing of engine. Indicated and brake horse-power. Expansive
working. Steam jacketing, superheating, compounding.

Air-compressing machinery. Rock drills.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 7.

LAND AND MINE SURVEYING.

LAND SURVEYING.

FIRST GRADE.

1. *Use and Adjustment of Instruments.*—Construction and adjustment of the chain, optical square, prismatic compass, sextant, theodolite, and level.
2. *Levelling and Measurement of Earthwork.*—Plotting a section from the level-book.
3. *Practice of Land Surveying.*—Details of linear measurement, azimuthal and angular surveying, keeping of field notes, setting out block surveys and roads.
4. *Plotting and Plan Drawing.*—The use of the scale, parallel ruler, protractor; plotting from field notes by protractor, and by co-ordinate drawing of plans; hill shading and feature drawing; printing and lettering.
5. *Computations.*—Reduction of traverses by latitudes and departures.

SECOND GRADE.

1. *Computations.*—(a) Computations for setting out roads; balancing surveys, and computing areas by latitudes and departures; supplying omissions.
2. *Division of Land.*
3. *Land Surveying.*—Setting out curves; topographical surveying.
4. *Computations.*—(b) Computations for setting out curves; computations for areas of curved boundaries.

5. *Sun and Star Observations*.—Determination of latitude, true meridian, and azimuth; barometric measurement of heights.

6. *Charting*.—Construction of maps and charts; compiling from plans and notes; reducing bearings to common datum.

NOTE.—An oral examination in the use and adjustment of instruments will be held at the end of the course.

MINE SURVEYING.

(One year's course).

Use and adjustment of theodolite, dumpy level, miner's dial, optical square, and chain.

Reduction of staff readings from levelling book; plotting profile plan. Preparing longitudinal and cross sections.

Measurement of earthwork; estimating quantity of stone in lodes.

Traversing with the theodolite and needle; ranging of lines by eye.

Booking by sketch and column methods.

Checking use of latitude and departure tables and logarithms.

Reduction and location. Computing distance and bearing between any two points connected by survey.

Areas of squares, rectangles, triangles, circles, and obtaining areas by scaling on plan.

Mine surveying. How to survey a mine; explanation of mining terms; connexion of underground and surface surveys.

Mining problems. Graphical and trigonometrical solution of problems involved in determination of dip, strike, and intersection of lodes.

Determination of the true meridian (simple methods); declination of the needle, dip, and local attraction.

Curves. Laying out curves for tram-lines with theodolite and chain.

Hydraulics; elementary formula for flow of water in pipes and open channels; hydraulic grade line.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 8.

MINING.

FIRST GRADE.

Part I.

Breaking of Ground.—Description of tools and their use. Pick, shovel, hammer, gad, coal cutters. Mining terms and their significance.

Blasting.—Drills, tamping rods, position of holes, line of least resistance, charging, fuse, tamping, force of explosives.

Boring.—Cutting and clearing tools, chisel, auger, and diamond headed borers, rock boring machines, diamond drills.

Timbering.—Description of timber used in mines, round and square timber, slabs, scantlings, dressing of timber, seasoning of timber, axe, adze, and auger; principles of placing timber; poppet heads and skids; timbering in firm, loose, and running ground, of walls, levels, adits, chambers, stopes, junction of roads and working places; vertical and underlay shafts; false sets and pillars.

Exploitation.—Location of shafts and adits, size and partition of shafts; stoping of wide and narrow lodes, of vertical and inclined lodes, with firm and loose hanging wall; overhand and underhand stoping; stowing; location of rises, winzes, shoots, passes, main levels, reef drives, plats; working of horizontal lodes, ore beds, deep leads and seams; day workings, quarrying.

Haulage.—Tram roads, gradients, curves and trucks, air winches and underground hauling engines.

Part II.

Mine Ventilation.—Natural ventilation, noxious gases commonly met with in mining, ventilating machines, exhausters, blowers, and condensers.

Lighting of Workings.—Candles, lamps, and electric light.

Drainage of Mines.—Natural drainage, baling, fixing, and management of pumping machinery.

Masonry and Iron.—Tubbing and walling; use of brick, stone, concrete, and iron in sinking; watertight joints in woodwork, stone, and iron.

Labour.—Contracts for sinking shafts, driving levels, and cross-cuts, &c., tribute contracts, specifications.

Winding.—Signalling, indicators, splicing of ropes, safety-hooks, cages, pithead pulleys, action of acid waters and gases on ropes.

NOTE.—Parts I. and II. are of equivalent value. At the option of the student, they may be taken in separate years, or both in the same year. Students must pass in both parts before a certificate can be granted.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 9.

STEAM AND GAS ENGINES.

FIRST GRADE.

Heat.—The nature of heat conversion of heat into work ; laws of heat ; measurement of heat ; fuels and combustion ; steam, temperature and pressure ; evaporation ; expansion of steam ; condensation.

Various Types of Steam-engines.—The condensing engine, including compound and triple expansion engines. The non-condensing engine.

Boilers and Fittings.—Methods of construction ; staying of boilers ; strengthening internal tubes ; calculations as to strength ; safety-valves and calculations connected therewith. Description of pumps, hydraulic pressure.

Indicator.—Description of the instrument. Method of taking a diagram. Diagrams illustrating defects.

Horse-power.—Nominal and indicated, method of calculating the latter from diagrams. Duties of engineers at starting, during work, and at stopping.

SECOND GRADE.

Fuller details concerning the above. Marine engines and boilers. Propellers, paddle wheels, and screws.

Gas Engines.—General principles. Principal types, system of ignition, &c. Indicator diagrams, and method of calculating horse-power.

Oil Engines.—Principal types. Construction and method of working. Igniting arrangements, &c.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 10.

DYNAMICS AND HEAT.

FIRST GRADE.

Dynamics.

In the first stage candidates will be required to be acquainted with the general principles and formulæ of the science as matters of fact, and with the details of the apparatus used, and the methods of using it, to verify these formulæ experimentally, when such verification is easy.

Units of length and time.

Derivation of the unit of time. Solar day. Variation in the length of solar day. Mean solar day. Mean time. Mean solar second.

Velocity. Measurement of velocity, whether constant or variable.

Acceleration. Measurement of constant acceleration. Acceleration due to gravity.

Mass or quantity of matter. Measurement of mass.

Units of mass (English and French).

Principle of the conservation of matter.

Density. Specific gravity.

Newton's Laws of Motion. Momentum. Force.

Gravitation units of force (pound weight, gramme weight).

Absolute units of force (poundal, dyne).

Distinction between mass and weight.

Definition of energy: Distinction between potential and kinetic energy. Simple illustrations.

Measurement of energy. Units of energy (foot-poundal, erg).

Principles of the conservation and transformation of energy. Simple illustrations of these principles.

Specification of velocity. Composition of two velocities. Simple illustrations of composition of velocities.

Specification of acceleration. Composition of two accelerations. Laws of uniformly accelerated motion and the formulæ embodying them. Atwood's machine; description of and methods of use to verify above formulæ.

Specification of a force. Composition of two forces, whether along intersecting or parallel lines. Experimental methods of verifying the laws of the composition of forces.

Equilibrium of two or three forces.

Moment of a force. Principle of moments. Couples. Equilibrium of a body capable of turning on a fixed axis.

Centre of parallel forces.

Work. Measurement of work. Gravitational units of work (foot pound, gramme, centimetre). Absolute units of work (foot-poundal, erg).

Definition of power. Unit of power. Horse-power.

Centre of gravity and its position in simple cases.

Re-action of smooth surfaces, points, and hinges.

Equilibrium of a body resting on a smooth plane, horizontal or inclined. Stable and unstable equilibrium.

The simple machines.

The simple pendulum. Determination of the numerical value of the acceleration of gravity.

Centrifugal force.

The essential and general properties of matter.

Elasticity. Laws of the resistance of elastic bodies to elongation, compression, bending, and torsion. Experimental verification of above laws.

Different states of matter. Definition of fluid, liquid, and gas.

Fluid pressure. Transmission of pressure through a fluid. Measurement of pressure at any point of a fluid.

The pressure of the atmosphere. Torricelli's experiment. Mercurial and aneroid barometers. Liquid manometer.

Surface of a liquid acted on by gravity. Pressure at any point of a liquid acted on by gravity. Equilibrium of a floating body.

Determination of the specific gravity of insoluble solids and of liquids by the balance, the specific gravity bottle, and Nicholson's hydrometer.

Hydrostatic machinery. Bramah press. Air and water pumps. Siphon.

Compressibility of gases. Boyle's law. Experimental verification of Boyle's law for pressures both greater and less than an atmosphere.

Heat.

The general effects of heat. Heat and temperature.

Thermometry. Construction of the mercurial thermometer. Centigrade and Fahrenheit scales. Reduction from one to the other. Metallic thermometers. Maximum and minimum thermometers.

Expansion of solids. Linear and cubical expansion. Co-efficient of expansion and its measurement. Easy arithmetical problems on expansion. Compensating pendulums. Compensation balance. Force of expansion.

Expansion of liquids. Apparent and real expansion. Co-efficients of apparent and real expansion and their measurement. Easy arithmetical problems. Variation of density of liquids with temperature. Maximum density of water.

Expansion of gases. Air thermometer. Absolute temperature.

Heat as a quantity. Unit of heat. Specific heat. Calorimetry. Ice calorimeter. Method of mixtures.

Fusion. Laws of fusion. Latent heat of fusion. Measurement of latent heat of water. Freezing mixtures.

Evaporation. Laws of Evaporation. Latent heat of evaporation. Cold produced by evaporation. Leslie's experiment. Cryophorus. Carre's freezing machine.

Ebullition. Definition and laws of ebullition. Measurement of the latent heat of steam. Effect of pressure on the boiling point. Determination of heights by the boiling point.

Simple arithmetical problems on specific heat and latent heat.

Hygrometry. Water vapour in the atmosphere. Greatest amount of water vapour that can possibly exist in a given space dependent only on the temperature. Dalton's law. Humidity. Relative humidity. Dew point. Daniell's hygrometer. Wet and dry bulb thermometer.

Distribution of heat by convection, conduction, and radiation.

Convection of heat. Simple experiments illustrative of convection. Heating of houses by hot-water pipes. Ventilation.

Conduction of heat. Simple experiments illustrative of conduction. Comparison of conducting powers of different solids. Action of wire gauze on flame. Safety lamp.

Radiation of heat. Leslie's differential thermometer. Simple experiments illustrating reflection, emissive and absorptive powers of surfaces.

SECOND GRADE.

The course for the second grade shall include all the subjects for the first grade, together with those mentioned below.

Newton's proof of the parallelogram of forces. Couple. Theory of couples. Resultant of any number of couples acting in parallel planes. A force is equivalent to a parallel force together with a couple. Resultant of any system of forces acting in a plane.

Rotation round a fixed axis. Angular velocity. Angular acceleration. Moment of inertia. Torque. Angular momentum. Energy of a rotating body.

Laws of the rotatory motion of a body round a fixed axis (analogues of Newton's laws). Conditions that the centrifugal forces due to the different parts of a rotating body should balance

each other. General information with regard to the central principle axes of a body. Importance of above in machinery.

Resistance to change of direction of the axis of a quickly rotating body.

Simple harmonic motion. Amplitude, period, phase. Formula for period. The simple pendulum. Kater's pendulum.

Friction and laws of friction ; co-efficient and angle of friction.

Work done by a variable force ; diagrams of work in simple cases ; the indicator diagram.

Motion of projectiles.

Impulsive forces. Direct and oblique impact of smooth spheres.

Liquid pressure on plane surfaces due to gravitation. Centre of pressure and calculation of total pressure in simple cases.

Capillarity. Barometer corrections. Measurement of heights by the barometer. The theory of air pumps.

Heat.

Sources of error in the mercurial thermometer.

The air thermometer at (1) constant volume, (2) constant pressure.

Measurement of the relative density of a gas.

Accurate methods of measuring the specific heats of solids and liquids.

Specific heats of gases at constant pressure. Transformation of energy of visible motion into heat. The mechanical equivalent of heat and its determination.

The first law of thermodynamics.

Internal and external work. Joule's experiments proving that the internal energy of a perfect gas depends only on its temperature. Relation between the specific heats of gases. The principle of the method of calculating J . from the specific heats of gases. Indicator diagram. Isothermal and adiabatic curves. Description and theory of Stirling's air engine. Cyclical and reversible processes. Carnot's engine. Second law of thermodynamics.

Thomson's absolute scale of temperature.

Efficiency of a heat engine.

Entropy.

THIRD GRADE.

An intimate knowledge of the courses for the first and second grades will be required, together with the remaining portions of thermodynamics. An elementary knowledge of the calculus will be necessary.

The examination will consist of a preliminary written paper, and those who qualify therein may be required to attend a practical examination at some suitable centre at a subsequent date.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 11.

SOUND AND LIGHT.

FIRST GRADE.

Sound.

Production of sound. Vibratory motion.

Transmission of sound through solids, liquids, and gases. The nature and mode of propagation of sound waves in air.

Velocity of sound. Methods of measuring the velocity of sound in air and in water. Velocity greater in warm than in cold air.

Vibration. Simple harmonic vibration of a pendulum. Amplitude. Period. Vibration-frequency the reciprocal of period. Wave length. Relation between wave length, vibration-frequency, and the velocity of sound in air. Complex vibration. Form of vibration.

Musical note. Characteristics of a musical note, pitch, loudness, timbre, corresponding to the preceding characteristics of the vibration that produces it. Correspondence of pitch with vibration-frequency. Experiments to illustrate this with Savart's toothed wheel and Seebeck's siren. Correspondence of loudness with amplitude. Correspondence of timbre with form of vibration.

Musical intervals. Corresponding relation of vibration-frequency. Illustration of by Seebeck's siren and by monochord, The diatonic scale. The scale of equal temperament.

Vibrations of strings. Transverse vibration. Laws of the vibration of strings. The monochord.

Vibrations of pipes. Open and closed pipes. Relation between pitch, length of pipe, and velocity of sound. Measurement of velocity of sound by organ pipes.

Reflection of sound. Echoes. Whispering galleries. Speaking trumpet.

Light.

Rectilinear propagation of light. Ray. Pencil. Shadows; umbrae; penumbrae. Images formed by small apertures.

Intensity of light. Inverse square law. Photometry. Shadow and grease-spot photometers. Experimental verification of inverse square law.

Measurement of the velocity of light by (1) Jupiter's satellites, (2) Fizeau's method.

Reflection of light. Plane mirrors. Definitions of terms. Laws of reflection of light. Experimental verification. Geometrical construction for image formed by plane mirror. Lateral inversion. Successive reflection from two plane surfaces either parallel or inclined at any angle. Reflection from transparent bodies. Ghost experiments.

Spherical mirrors. Concave and convex mirrors.

Concave mirror of small curvature. Definitions of terms. Pole. Axis. Centre of curvature. Focus. Principal focus. Focal length proved geometrically to be equal to half the radius of curvature. Experimental method of determining the position of the principal focus. Experimental determination of the curvature of a mirror. Conjugate foci treated experimentally. Formation of images. Real and virtual images. Geometrical construction for the image of a point or a small object on or near the axis when the centre or principal focus is given. Corresponding march of conjugate foci.

Convex spherical mirror of small curvature. Definitions of terms as before. Geometrical construction for the image of a point or a small object on or near the axis when the principal focus is given. Image always virtual. Explanation as to how we see images in the above cases in the positions determined.

Refraction of light at plane surfaces. Simple experiments illustrating refraction. Definitions of terms. A ray of light in passing from a rare to a dense medium is bent towards the perpendicular to the separating surface and conversely. Image of a point beneath a smooth water surface. Explanation of the bent appearance a straight rod has when thrust at a slope into water. Explanation why a pond of water looks shallower than it really is. General form of the path of a ray in passing through a transparent plate. Geometrical statement of exact law of refraction. Experimental proof of this law. Refractive index.

Prisms. General form of the path of a ray of light in passing through a prism. Image of a point seen through a prism. Experiments illustrating the action of prisms on a parallel pencil of light. Deviation. The amount of deviation of a ray shown to depend on angle of prism and on refractive index of substance of prism. Minimum deviation.

Lenses. Different kinds of lenses.

Thin convex lens. Definitions of terms. Centre. Axis. Principal focus. Property possessed by centre and by principal focus. Formation of images. Real and virtual images. Conjugate foci treated experimentally. Geometrical construction for the image of a point and of a small object on or near the axis of the lens when the positions of the centre and principal focus are given. Convex lens used as a magnifying glass. Convex lens used to project on a screen an image of a luminous object.

Thin concave lens. Definitions of terms as before. Geometrical construction for the image of a point or a small object on or near the axis when the positions of the centre and principal focus are given. Images always virtual.

Dispersion of light by means of a prism. The composite character of white light. Newton's experiments on dispersion. The spectrum.

Colour. Colour of bodies. Mixture of colours by a revolving disc. Complementary colours.

The eye and vision as far as optical principles are concerned.

The simple microscope.

The compound microscope.

The astronomical telescope.

SECOND GRADE.

The course for the second grade shall include all the subjects for the first grade, together with those mentioned in the following syllabus. Candidates will require to be familiar with the elementary theory of the different subjects, and with the construction and use of the different instruments required.

The nature of wave motion. Wave velocity. Meaning of the terms "stress," "strain," "co-efficient of elasticity." Measures of these quantities in a gas. Newton's relation between the velocity, elasticity, and density. Effect of changes of temperature and of pressure on the velocity of sound in a gas. General explanation of Laplace's correction of Newton's formula.

Accurate methods of measuring the velocity of sound in solids, liquids, and gases.

Methods of measuring musical pitch.

Interference of sound waves. Beats.

Summation and difference tones.

Harmonics. Upper partial tones.

Melde's experiments. Chladni's figures. Lissajou's curves.
 Longitudinal vibration of strings, rods, and columns of air.
 Transverse vibration of rods. Tuning forks.
 Theory of resonance. Sympathetic vibration.
 Analysis of compound notes.
 Theory of consonance and dissonance.
 Composition of vowel sounds.

Light.

Geometrical optics, as much as is required to supply the theory for the first year course in light. Chromatic aberration. Achromatism. Practical methods of testing and determining the constants of mirrors and lenses. Eye-pieces.

Spectrum analysis. The spectroscope. Selective absorption. Absorption spectra. Fluorescence. Phosphorescence. The phosphoroscope.

Colour vision. Colour blindness. Methods of testing. Trichromatic theory.

The wave theory of light. The ether and its hypothetical properties. Nature of the vibratory motion constituting light. Radiant energy. Relation between velocity, wave-length, and period. The rectilinear propagation of light. Waves. Explanation of the laws of reflection and refraction by the wave theory. Interference. Fresnel's mirrors. The bi-prism. The optical bench. Colours of thin plates. Newton's rings. Methods of measuring the wave length of light from interference phenomena.

THIRD GRADE.

An intimate knowledge, both theoretical and practical, of the subjects for the first and second grades, together with physical optics.

The examination will consist of a preliminary written paper, and those who qualify therein may be required to attend a practical examination at some suitable centre at a subsequent date.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 12.

MAGNETISM AND ELECTRICITY.

FIRST GRADE.

Magnetism.

General Properties of Magnets.—Attraction of iron. Position of equilibrium of a suspended magnet. Distinction between poles. Names of poles. Magnetic axis. Mutual action of poles. Lines of force; their general distribution in easy cases by means of iron filings.

Magnetic Induction.—Effect of a magnet on a piece of soft iron in its neighbourhood. Diminution of effect with increase of distance. Comparison of such effects on hard steel and on soft iron. Coercive force. Explanation of the attraction of a magnet for soft iron (induction precedes attraction).

Permanent Magnets.—Methods of magnetization. Determination of the distribution of magnetism in magnets by means of spring balance. Effects of subdividing magnets. Molecular nature of magnetism. Astatic needles.

Terrestrial Magnetism.—Magnetic meridian. Declination. Rough determination of declination. Inclination. Dipping needle. Rough determination of angle of inclination (dip). Mariner's compass. Changes in declination and dip from place to place on the earth's surface. Magnetization of soft iron by the earth.

Frictional Electricity.

Electrification by Friction.—Attraction and repulsion. Two kinds of electrification. Positive and negative. Their mutual relations. Simultaneous and equal development of the two kinds.

Conductors and Non-conductors.—Insulation. Experiment to show the electrification of a conductor by friction.

Electroscopes.—Light rod on watch-glass. Pith-ball electroscope. Gold-leaf electroscope.

Induction.—Simple experiments illustrating induction. Elementary explanation of phenomena. Free and bound charge. Method of charging an insulated conductor by induction. Explanation of attraction (induction precedes attraction). Faraday's ice-pail experiments to illustrate the relation between the primary electrical charge and the corresponding induced charge. The electrophorus.

Potential.—Conducting bodies are at different potentials if when joined by a conductor electricity flows from one to the other, and the direction of flow is from the body at high potential to the one at low potential. Analogies with temperature and water level. The potential of the earth taken as the standard zero of potential.

Quantity of Electricity.—Electricity measurable. Definition of unit quantity. Statement and explanation of the laws of electric action. All included in the formula— $f = qq^1/d^2$.

Capacity of a Conductor.—The charge (quantity) on an insulated conductor and the potential of the conductor due to that charge have always a fixed ratio if the position of the conductor with respect to other conductors which are supposed to be joined to earth is fixed. This fixed ratio (Q) is the capacity of the conductor.

Distribution of Electricity on Conductors.—Experiments to show that on a charged conductor the electricity resides on the outside surface. Electric density. Surface density on differently shaped conductors (simple cases). Action of points. Property of a hollow conductor by which it can discharge any charged conductor brought into communication with it when placed within it.

Frictional Electric Machines.

Condensers.—Plate condenser. Leyden jar. Residual charge. Seat of the charge in a Leyden jar. Dissected jar. Capacity of a condenser.

Condensing Electroscope.—Its construction and elementary theory. Its application to the detection of small potential differences.

Electric Discharge.—Experiments showing the different effects of the electric discharge.

Voltaic Electricity.

Experiments with condensing electroscope to show a difference of potential between two copper wires, one connected with a piece of zinc, the other with a piece of copper, the zinc and copper both dipping into the same vessel of dilute sulphuric acid. Results of connecting the copper wires with each other. Simple galvanoscope to indicate the presence of a current.

Volta's Pile.—Statical potential difference at the two electrodes shown by electroscope. Existence of a current when the electrodes are joined, shown by galvanoscope.

Theory of Simple Voltaic Cell.—Defects of simple cell. How these are obviated. Constant cells.

Details of Daniell's, Grove's, Bichromate, and Leclanché's cells, and explanation of their action.

Electromotive Force.—*Current. Resistance.*

Ohm's Law.

Arrangement of cells in series and in parallel to form a battery. Experiment with the condensing electroscope to prove that the potential difference at the terminals of a battery joined up in series is increased as the number of cells is increased, while that of a battery of any number of cells in parallel is the same as for a single cell.

Effects of the Electric Current.—Influence on a magnetic needle. Direction a north magnetic pole is moved by a current travelling in a given direction. The construction and theory of the astatic galvanometer, and its application to the detection of weak currents.

The heating effect of the currents. Simple experiments to illustrate this effect. Arc and incandescent lamps.

Magnetization of soft iron by the current. Electro-magnets.

Chemical action of the current. Electrolysis. Dilute sulphuric acid voltameter. Copper voltameter. Relation between current strength and amount of chemical action per second.

The Electric Telegraph.—The single needle telegraph. The Morse telegraph.

The Electric Bell.

SECOND GRADE.

The course for the second grade shall include all the subjects for the first grade, together with those mentioned in the following syllabus. Candidates will require to be familiar with the elementary theory of the different subjects, as well as with the construction and use of the different instruments required in the course.

Magnetism.

Molecular nature of magnetism. Unit magnetic pole. Laws of mutual action between two magnetic poles. Coulomb's Torsion Balance. Method of oscillations. Magnetic moment of a magnet. Mutual action between two short magnets; one suspended, the other at a distance—(1) placed magnetic north or south of the first, and pointing east and west; (2) placed magnetic east or west of the first, and pointing east and west. Methods of comparing the moments of two magnets. Terrestrial magnetism.

Frictional Electricity.

Unit quantity. Torsion Balance. The quantitative laws of electrostatic attraction and repulsion, and its results and applications in simple cases. Specific inductive capacity. Method of measuring specific inductive capacity. Induction electric machines. The Replenisher. The Voss machine.

Value for the capacity of an isolated sphere, a spherical condenser, and a plate condenser. Capacity of a Leyden jar in terms of the size of its coatings and the thickness and quality of the glass. The energy of a charged conductor. The guard ring electrometer. The quadrant electrometer.

Voltaic Electricity.

Theory of constant cells. Methods of arranging cells. Theory and practice of the comparative measurement of current strength, electromotive force, and resistances in both metals and electrolytes. Divided circuits. Quantitative law for heating effect of current.

Thermo-electricity. Electrolysis.

Direction and magnitude of magnetic force in the neighbourhood of a current. Mutual action of currents.

Simple laws of magneto-electric induction. Machines for the conversion of mechanical work into electric-current energy. Machines for the conversion of electric-current energy into mechanical work.

Current induction. Ruhmkorff's coil. The Telephone. The Microphone.

THIRD GRADE.

The subjects for the first and second grades treated more fully, together with absolute measurements of magnetic and electric quantities.

The examination will consist of a preliminary written paper, and those who qualify therein may be required to attend at some suitable centre for a practical examination at a subsequent date.

The practical examination will be confined to the experiments and measurements involved in the courses for the first, second, and third grades.

ELECTRICAL TECHNOLOGY.

FIRST GRADE.

The first grade of Magnetism and Electricity shall be taken as first grade of this subject.

SECOND GRADE.

Fundamental and practical units.

Theory, construction, and use of measuring and testing instruments.

Study of the magnetic circuit.

Laws of electro-magnets.

Magneto-electric machines.

Dynamo-electric machines, continuous and alternating.

Physical theory of the dynamo.

Characteristic curves of series, shunt and compound wound dynamos.

Distribution of electric currents.

Conductors.

Switch-boards.

Switches.

Safety fuses.

Arc lamps.

Incandescent lamps.

Accumulators.

Transformers.

Electro-motors.

THIRD GRADE.

Study of different systems of electrical distribution.

Advanced electrical testing.

Use of condensers and of inductive resistances.

Construction and testing of cables.

Mathematical theory and design of the continuous current and alternating current dynamos.

Mathematical theory and design of transformers.

Power, weight, and efficiency of electro-motors.

Electric railways ; advantages and disadvantages of different systems.

Study of the various systems of underground conductors.

Cost of producing light electrically. Standards of light—the B. of T. unit.

Photometers.

Cost of transmitting power electrically; absorption and transmission dynamometers.

Electro-welding.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 13.

BOTANY.

FIRST GRADE.

Morphological.

Elementary Structure of Plants : Roots, stems, leaves, and flowers.

Elementary Tissues of Plants : Cells and vessels, their shapes, formation, general structure, and uses.

Nutritive Organs.—Structure of root in Dicotyledons, Monocotyledons, and Acotyledons. Leaves, their various forms ; veneration, venation, and transformation of leaves. Forms and structure of stems of Exogens and Endogens. Structure of pith, medullary sheath, duramen, alburnum, and liber.

Reproductive Organs.—Inflorescence and its various forms, definite and indefinite inflorescence. General structure of the floral organs : Calyx, corolla, stamens and pistil, style, stigma, ovary, embryo sac, ovules. Æstivation and Placentation. Distinctive forms and characters of fruits. Structure of the seed.

Physiological.

Plant foods. General processes of nutrition, assimilation, respiration. Movements of fluids in plants, transpiration. Influence of light and heat on the various functions of plants. Processes of pollination and fertilization. General embryogeny. Formation and development of the embryo in Monocotyledons and Dicotyledons. Methods of germination.

Systematic.

Outlines of classification, especially of Phanerogamic plants according to natural system.

Botanical descriptions of the following Orders :—Ranunculaceæ, Geraniaceæ, Leguminosæ, Myrtaceæ, Compositæ, Labiatæ, Liliaceæ, Coniferæ.

SECOND GRADE.

Morphological and Physiological.

Fuller treatment of subjects of the first grade, together with the following additional matter :—

Various forms of Parenchyma, Pleurenchyma, Prosenchyma. Structure and growth of cell wall ; general cell contents.

Processes of Endosmose and Exosmose : Formation, structure, and chemical properties of cellulose, starch, sugar, raphides, chlorophyll, nuclei. Structure and functions of epidermis, stomata, hairs, glands, and tendrils.

Nutritive and reproductive organs of Cryptogamic plants.

Structure and life history of Protococcus, Bacillus, Spirogyra, Mucor, Saccharomyces, Marchantia, Pteris.

Systematic.

Fuller details of the classification of Phanerogamic plants. Outlines of the classification of Cryptogamic plants.

Botanical description of the following Orders :—Dilleniaceæ, Cruciferae, Droseraceæ, Rutaceæ, Violaceæ, Malvaceæ, Pittosporæ, Rosaceæ, Umbelliferae, Epacrideæ, Candelaceæ, Goodeniaceæ, Proteaceæ, Thymeleæ, Euphorbiaceæ, Casuarineæ, Santalaceæ, Orchideæ, Gramineæ, Filices.

THIRD GRADE.

A more detailed treatment of Systematic Botany, with full descriptions of the following additional Orders :—

Monimæ, Polygalæ, Stereuliaceæ, Sapindaceæ, Saxifrageæ, Ficoideæ, Rhamnaceæ, Araliaceæ, Gentianaceæ, Campanulaceæ, Ericaceæ, Rubiaceæ, Boragineæ, Convolvulaceæ, Solanaceæ, Myoporineæ, Scrophularineæ, Lentibularinæ, Urticaceæ Cupuliferae, Chenipodiaceæ, Loranthaceæ, Irideæ, Amaryllideæ, Juncaceæ, Fluviales, Palmæ, Cyperaceæ, Lycopodinæ, Rhizospermae.

Method of collecting and drying plants for herbarium purposes.

Preparation and mounting of histological specimens for microscopic slides.

History of Botanical classification—Linnæan and Natural Systems.

Geographical Distribution of Plants.

GENERAL NOTE.—The student will be expected to identify and describe specimens of genera of any of the orders prescribed for study in the First, Second, and Third grades respectively.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 14.

AGRICULTURE, FRUIT - GROWING, AND VETERINARY SCIENCE.

THE PRINCIPLES OF AGRICULTURE.

Agriculture may be defined as a business which undertakes the artificial control of the life of useful terrestrial plants, and of animals which feed on those plants, and the immediate preparations of various food and other products obtained from those animals and plants. Hence, primarily, it is the control and management of terrestrial plant life. For the successful accomplishment of this a thorough understanding of the nature and life processes of plants is necessary, and too much pains can scarcely be taken in acquiring this groundwork of a knowledge of agricultural principles.

In the Elementary Examination, therefore, candidates will be expected to show a clear knowledge of the general nature of land plants and their requirements, and of their connexion with the soil, of the nature of soils, and the steps to be taken to render natural soils more fitted to the requirements of plants. They will

further be required to show a knowledge of the general nature and composition of plant products considered as food for man and beast ; a knowledge which will naturally involve a consideration of the food requirements of animals, and lead to a knowledge of the general processes of animal life, and the relations of animal to vegetable life. Students in this stage will be expected to have considered the primary agricultural operations, but somewhat in a subsidiary way, as illustrating the requirements of plant and animal life and the ways of meeting those requirements.

In the Advanced Examination, in addition to a more detailed knowledge of the above matters, candidates will be expected to show a familiarity with the different agricultural operations, the principles which underlie them, and the implements used in them.

In the Final Examination they will be examined in the principles of general farm management, and in the details of one or more optional branches.

As regards books, there is at present no book which embodies the best and most advanced ideas of English, European, and American agricultural schools, and at the same time presents them in a form suited to Victorian requirements. It will be well therefore for the teacher to have the following works in his library, and to use his own judgment in selecting facts therefrom and also from his own local experience :—

Johnson's "How Crops Grow."

Johnson's "How Crops Feed."

Fream's "Elements of Agriculture."

Warrington's "Chemistry of the Farm."

Wrightson's "Principles of Agricultural Practice."

Stewart's "Feeding Animals."

Church's "Food."

Storer's "Agriculture in Some of its Relations with Chemistry."

Johnston's "Catechism of Agricultural Chemistry and Geology."

Stephen's "Book of the Farm," latest edition.

"Principles of Agriculture." Blackie's "Elementary Text-books."

Lacoppidan's "Agricultural Teacher," translated by Wm. Luplau.

Huxley's "Elementary Lessons in Physiology."

Sach's "Physiology of Plants."

A. N. Pearson's "Farmer's Guide to Manuring ;" "Soils and their Cultivation ;" "Some of the Needs of Plants ;" "Manures and Manuring ;" and other pamphlets.

C. French's "Destructive Insects of Victoria."

J. P. Sheldon's "Dairy Farming."

FIRST GRADE.

Definition of Agriculture.

Nature of Plants.—Composition : Matter dissipated on drying, matter dissipated on burning, matter remaining behind on burning. Chemical elements contained in these matters. Great preponderance of elements of water. The ways in which plants obtain these elements. Structure and function of parts of plants. The seed : its germination ; “shoot” and “root.” Description, microscopic structure, and functions of root ; root-hairs ; absorption of nutrient solution. Elements, or “plant-foods,” contained in the nutrient solution. Essential and non-essential elements. “Water culture” of plants. Effect of deficiency of one or more plant-foods ; effect of over-concentration of nutrient solution. Passage of nutrient solution through the plant, and disposal of the different elements therein. Description, microscopic structure, and general functions of “shoot.” Transpiration ; stomata ; chlorophyl.

The Soil.—The soil as a holder of nutrient solution. Natural sources of plant-foods in this solution. The structure, particles, interstices, moisture, and air of the soil. Ebb and flow of soil moisture. Chemical and fermentative changes taking place in soils. Progress, depth, and actions of roots in an ideal soil. The different natural soils. Steps to be taken to render natural soils better adapted to the needs of cultivated plants.

Tillage.—Draining. Ploughing. Subsoiling ; effect of different subsoils. Scarifying. Rolling. Harrowing. Hoeing ; the Lois-Weedon system. Implements for these operations.

Manuring.—Manures considered as soil alteratives :—Humus, action and sources of ; lime, marl, gypsum, salt. Paring and burning. Alterative effect of grazing. Manures considered as plant-foods :—The plant-foods abundant in all soils ; the plant-foods frequently deficient, and needing to be supplied. Nitrogen, phosphoric acid, and potash ; sources of these. Use of leguminous crops for manurial purposes. Means of ascertaining manure requirements :—Chemical analysis ; test plots.

Growth of Crops.—The growth, from sowing to harvesting, of four typical crops, namely, of cereals—wheat, barley, or oats ; of leguminosæ—peas or beans ; of root crops—potatoes, mangolds, turnips, or carrots ; of green fodder or ensilage crops—maize, sorghum, lucerne, cabbage, or kale. Selection of seed. Choice of time for sowing. Sowing. Cultivating. Blossoming. Fertilization. Formation of fruit or seed. Ripening. Harvesting.

Plant Products as Food for Animals.—Uses of the materials harvested. Food requirements of man and beasts. General nature and composition of animal matter ; animal protoplasm ; muscle, fat, nerve, bone, blood. Animal heat ; respiration ; work ; tissue waste ; excretion. Alimentation. General sketch of alimentary

system. Composition of vegetable food-stuffs. Nutrient and non-nutrient constituents. Nitrogenous and non-nitrogenous constituents. Albumenoid ratio. Albumenoid ratio of some typical food-stuffs. Rationale of mixed diets. Outline scheme of diets for growing, fattening, working, and milk-giving animals. Composition of milk. Use of skimmed milk and of whey as food.

SECOND GRADE.

The subjects of examination, in addition to those of the first grade, will be as follows :—

Soils and their Management.

Soils :—Their origin and mode of formation, more especially as illustrating their qualities.

Proximate Ingredients of Soils.—Sand, clay, humus, lime, and (in volcanic soils to a large extent) iron. Classification of soils according to mechanical qualities dependent upon proportions of these ingredients. Stones and gravel. Subsoils. Effect of different combinations of soil and subsoil. Hard pans. Soil water : percolation and capillary movements ; movement of water downwards during wet weather ; movement upwards to surface during dry weather ; concentration of some dissolved matters at the surface caused by evaporation. Combinations and lie of strata as affecting movements of soil water. General influence of slope and aspect of soils, and of geographical position and climate.

Ultimate Chemical Constituents of Soils.—Plant foods : essential and non-essential ; readily available and difficultly available or held in reserve ; transformations from reserve to available, and *vice versâ*. Disintegrating and solvent processes ; weathering, alternations of heat and cold, wet and dryness, impact of rain, frost ; action of soil moisture and soil gases. Absorption by the soil of carbonic acid, oxygen, and ammonia. Fermentation of humus matter. Soil bacteria, nitrification ; fixation of atmospheric nitrogen. Disintegration of soils by plant roots and by earth worms. Percentage composition of soils ; standards of rich and poor soils. Liebig's law of minimum. Comparison of shallow rich with deep poor soils ; and of mechanically bad but chemically rich soils with mechanically good but chemically poor soils. Injurious constituents : salt, sulphides, ferrous compounds.

Improvement of Soils—By (a) *alterative agencies*, and by (b) *enrichment*.

(a) *Alterative Agencies.*

Preparation of virgin soils ; forest, grass land, and swamp. Preliminary examination of ground, over the surface, and by cutting deep sections. Quantity and kinds of natural vegetation.

Clearing the land : burning the scrub, effect of the heat and of the ashes on the soil. Ring-barking, clearing, and burning the timber.

Drainage of swamps and other soils. Evils of stagnant soil water. Mechanical and chemical effects of draining. Substances dissolved out from soils by drainage water. Principles to be considered in setting out drains. Depth, distance apart, and planning of drains. Open, brushwood, rubble, and tile drains. Draining implements : hand tools and horse-power tools.

Fallowing : so-called "sourness" of some newly-cleared forest and swamp soils ; to be "sweetened" by bare fallowing or by pasturing. General effect of fallowing on soils ; general effect of pasturing ; different effects of sheep pasturing and of cattle pasturing.

Tillage.—Ploughing. Kinds of furrow suitable for different soils. Width of "lands" according to soil and climate. Details of different forms of plough. Deep and shallow ploughing. Subsoil ploughing. Other methods of breaking up hard subsoils and pans. Seasons for ploughing different soils. Scarifying and grubbing ; details of implements. Destruction of weeds ; annual and perennial ; exhaustion of rhizome by frequent hoeing or "cultivating" of such weeds as Canadian thistle, couch grass, and bracken. Paring and burning. Skimming, hoeing, cultivating. Implements. Use of pigs as grubbers. Harrowing, clod crushing, rolling ; implements. Mechanical and chemical effect of the different tillage operations.

Alterative Manuring.—Lime, marl, gypsum, salt. Mixing soils, clay with sand, or sand with clay. Bulky humus-producing manures—farm-yard and stable stuff, compost, seaweed ; green manuring. Use of cattle, sheep, and pigs under this head.

(b) *Soil Enrichment.*

Manures as Plant Foods.—Methods for ascertaining requirements of soils in regard to plant foods : test plots ; chemical analysis, rules for taking samples for analysis. Plant foods generally required are phosphoric acid and nitrogen ; sometimes also potash ; other plant foods generally in sufficient quantity in soils. Uselessness of applying one plant food only if others also are required. So-called "exhausting" and "forcing" effect of partial manuring. Climatic limit to operation of manures. Necessity of moisture. Sources of the different plant foods—nitrogenous : sulphate of ammonia, nitrate of soda, dried blood guanos ; phosphoric : bone dust, bone char, bone ash, guanos, mineral phosphates, Thomas slag, superphosphates, concentrated superphosphate, dried fish, dried offal ; potassic : the potash salts and Kainit ; complete mixtures : farm-yard and stable stuff, night-soil, dried night-soil, seaweed ; compost heaps ; mixtures of various commercial manures. Use of live stock fed partly on purchased

food. Use of leguminous crops. Manner and time of applying different kinds of manures. Valuation of manures according to percentage composition. Profitableness of manuring.

Irrigation.—Preliminary examination of soil and subsoil down to considerable depth. Rejection of soils overcharged with soluble salts, or containing salt layers at a depth. Preparation of land: levelling, subsoiling. Channels, sluices, offtakes. Systems of irrigating: broad surface flooding, and block or panel flooding; open channel and underground pipe delivery. Pearce's calico hose system. Evils of over-irrigation. Drainage in conjunction with irrigation. Manuring in conjunction with irrigation; irrigation a means of bringing manuring to its highest degree of profitableness.

Crops and their Management.

Cultivated Plants.—General considerations as to origin of cultivated plants. Time required for producing a valuable cultivated variety from comparatively valueless wild plant. Fabre's production of wheat from *Ægilops ovata* by eight years' cultivation and selection. Existing varieties of cultivated plants being slowly improved by unsystematic action of crop-growers in seeking good seed. Rapid improvement by systematic methods. Possible production of new crop plants from Australian indigenous flora. Methods of improvement—Selection; differences in character and prolificness of seed from different plants, from large and small plants, from large and small heads or pods, and from large, medium, and small seed. Cross-fertilizing. Effect of change of soil and climate. Choice of seed in the market; adulteration of seed; testing the germinating power of seeds.

Farm Crops.—The different classes and botanical position of ordinary farm crops:—Wheat, barley, oats, rye, maize, sorghum. The grasses, cocksfoot, dogstail, the fescues, foxtail, the poas, oat grasses, rye grasses, sweet grasses, scented vernal, timothy. The clovers, sainfoin, lucern, trefoil, lupine, vetches, pea, beans, furze or gorze, serradella. Mustard, cabbage, rape, kale, kohlrabi, turnip, swede. Beet-root and mangold. Potato. Tomato. Buck-wheat. Onion. Hop. Description of seed, form of plant, habits of growth above and below ground, and general life-history of the above crops. General chemical composition, and food value of crops at different stages of growth, and at maturity. Effect of want of balance of plant foods in the soil on composition and nutritive value of crops. Influence of climate on the same.

Operations of sowing, hoeing, cultivating, and harvesting of the different crops. Details of implements used.

Rotations.—Objects and advantages of rotation of crops. Norfolk, or four-course system. Other possible systems, up to ten-year courses. Catch crops. The crops in a rotation must be chosen according to the constantly changing market requirements.

Crop Pests and Diseases.—The more common insect and fungus pests. General principles of preventive measures. Insecticide and fungicide solutions, emulsions, and powders. Spraying. Details of spraying implements. Selection and production of resistant strains and varieties of cultivated plants.

Live Stock and their Management.

Farm Animals.—Horse, cow, sheep, pig, fowls. General considerations as to zoological position and relation to wild forms. General sketch of anatomy and physiology of horse, cow, sheep, pig, fowl. Differences in alimentary canals, involving differences in food requirements. Action of digestive juices. Differences in structure of young and full-grown animals. Changes taking place during growth, involving changes in food requirements. Management of ordinary farm animals. Requirements during reproduction, parturition, growth, fattening, milk giving. General principles of breeding: variation, atavism, prepotency, heredity. Selection, crossing, interbreeding.

Food and Feeding.—Proximate constituents of wheat, barley, oats, maize, bran, peas, beans, brewers' grain, straw of different kinds, hay of different kinds; potatoes, turnips, mangolds (roots and leaves), linseed, rape, oil cake, milk, meat, &c. Hay making, ensilage making. Comparative value of dry and moist foods. Compressed fodders. Food requirements of animals at different stages of growth, under different conditions, and when exerting different functions. Food ingredients retained and excreted by growing, fattening, working, and milk-giving animals, and consequent different exhausting effect on the farm. Summer feeding; winter feeding. Shelter as a food economizer. Choice of foods, mixed diets. Mixed stall feeding and pasturing. Valuation of foods according to percentage composition. Cost of feeding.

Diseases.—The commoner ailments of live stock, and their treatment. Choice of resistant varieties and strains. Preventive inoculation; its advantages and disadvantages. Communication of disease from beasts to man.

THIRD GRADE.

The candidates will be expected to show a thorough knowledge of the subjects of the first and second grades, and in addition will be examined in general farm management, laying out land in homestead and paddocks, management of labour, market values, marketing; comparative profitableness of various operations. They may also choose any one of the following special subjects:—(a) Dairying, (b) Vine and Fruit growing, (c) Sheep, Cattle, and Horse breeding, (d) Poultry farming, (e) Bee farming, (f) Special Farm Crops, Oil, Fibre, Perfume, and Medicinal.

FRUIT-GROWING.

The course in fruit-growing shall consist of two grades :—

FIRST GRADE.

The First Grade shall be the same as the First Grade in the Principles of Agriculture.

SECOND GRADE.

The Second Grade shall consist of the section "Soils and their Management" (to the end of Irrigation) of the Second Grade in the Principles of Agriculture, and also of the following special course :—

General Considerations.

Origin of cultivated plants ; methods of producing cultivated varieties from wild species ; possible production of new varieties from Australian indigenous flora. General methods for improving plants and varieties. Selection of desirable plants, seeds, buds, or branches for propagation. Effects of crossing. Effects of change of climate.

Operations of the Orchard.

Site and Preparation of Ground.—Choice of site ; soils and subsoils most suitable for fruit-growing. Preparation of the ground ; considerations as to the necessity for and kinds of drainage to be adopted ; ploughing and breaking up for orchard purposes. Shelter, by trees and otherwise. Choice of kinds of fruits for cultivation, dependent upon (a) climate, (b) markets, (c) soil.

Propagation.—The nursery ; site for nursery ; preparation of soil ; selection of seed or cuttings ; sowing the seed ; planting the cuttings. Budding ; selection of buds. Grafting, selection, care and treatment of scions ; grafting materials and tools ; cleft, side, whip, and root grafting. Pruning in the nursery. Budding and grafting old trees. Layering. Inarching. Purchase of nursery stock ; treatment on arrival at orchard ; "Heeling-in." Season for planting out.

Laying out the Orchard.—Laying out in squares, quincunx, and triangles ; measuring off. Digging holes for the trees—in deep soils, in shallow soils. Removing young trees from nursery ; trimming roots. Planting : direction of young tree in regard to prevailing sun and wind. Application of manure. Mulching. Shelter from sunburn. Cutting back. . Labelling and mapping.

Pruning.—General principles : different shapes and sizes of trees, their relative advantages and disadvantages. Dwarfing. Pruning for wood ; pruning for fruit. Pruning tools. Root-pruning. Summer pruning. Pinching.

Cultivation of the orchard ; ploughing ; special orchard ploughs ; cultivators. Summer cultivation. Mulching. Application of manures to trees in bearing.

Diseases.—Insect and fungus pests, general principles of observation and treatment. Spraying ; the principal spraying mixtures, liming, painting, sulphuring, &c.

Kinds and Varieties of Fruit.

The special (*a*) adaptation to climate, (*b*) growth of tree, (*c*) planting, (*d*) pruning, (*e*) cultivating, (*f*) diseases, and (*g*) nature and uses of the following fruit :—

Apples.—Dessert—Cox's Orange Pippin, Jonathan, Rome Beauty, Esopous, Spitzenberg, Gravenstein, Munro's Favorite. Cooking—Dumelow's Seedling, London Pippin or Five Crown, Cleopatra, Rymer, Gooseberry Pippin, Sturmer Pippin, Reinette de Canada. Drying—Boston Russett, Twenty Ounce, Mobb's Royal, Syn, Colonial Fillbasket.

Pears.—Dessert—Doyenne D'Été, Williams' Bon Chrétien, Beurre de Capiaumont, Beurre Easter, Broom Park, Ganzel's Bergamot. Cooking—Uredale's St. Germain's, Cattalic.

Quinces.—Portugal, Apple-shaped.

Cherries.—Early Purple Guigne, Werder's Early Black, Bedford Prolific, Eagle's Seedling, Bigareau, Napoleon, St. Margaret.

Plums.—Early Rivers, Angelina Burdett, Diamond, Prince Englebert, Greengage, Belle de Septembre, Damson, Shropshire. Drying—Coe's Golden Drop, Fellemburg, d'Agen, Diamond.

Apricots.—Holland's Early Peach, Moorpark, Hemskerk, Royal George, Alsace.

Peaches.—Brigg's Early Red May, Amsden's June, Royal George (English), Lady Palmerston.

Nectarines.—Hunt's Tawny, Victoria Rivers.

Oranges.—Navel, Parramatta Seedling, St. Michael, Silletta, Emperor, Mandarin, Seville.

Lemons, Limes, &c.—Lisbon Lemon, Western India Lime, Shaddock.

Grapes (Table).—Snow's Muscat Hambro', Black Hambro', Black Prince, Chasselas, Muscat of Alexandra (Gordo Blanco), Blue Imperial, Zante.

Black, Red, and White Currants.—Kentish Hero, Le Versailles, White Dutch.

Raspberries.—Falstaff, Northumberland, Fillbasket.

Mulberries.—Old English Black.

Gooseberries.—Preserving—Warrington, Rough Red. Bottling—Smith's Round Yellow. Marketing—Highlander, Crown Bob, Roaring Lion, Lord of the Manor, Dan's Mistake, Lord Crewe.

Passion Fruit.—Passiflora.

Loquat.—Loquat.

Figs.—Brown Turkey, Brunswick, White Genoa.

Olives.—Caillon, Pendoulir, Picholine, Manzamillo, Regalis, Nevadilla Blanco.

Almonds and Nuts.—Almonds—Early Jordan, Brande's Jordan. Walnuts—Common Walnut, Dwarf Prolific. Filberts—Cosford, Frizzled, White Filbert, Nottingham. Chestnut—Spanish.

Carob Bean.—The Carob.

Strawberries.—Edith Christy, Trollope's Victoria, Le Marguerite, The Captain.

Marketing.

Fruit Gathering.—Selecting, Sorting, Packing (*a*) for Home Consumption, (*b*) for Export. Storing—Construction of Fruit Store-houses. Preserving and Canning—Drying, by Sun, by Artificial Heat; Evaporators. Preparation of Pulp.

VETERINARY SCIENCE.

FIRST GRADE.

Anatomical and Physiological Outlines.—The skeleton; muscle; nervous system; organs of respiration; circulation; digestion; secretion and excretion; reproduction and locomotion; the skin and its appendages, including the foot.

Outlines of Materia Medica and Pharmacy.—The manner in which medicines establish their action; the manner in which they are believed to cure disease; the arrangement of medicines according to their physiological action; circumstances which modify their action; preparation and modes of administration.

Surgical Outlines.—Inflammation; fractures; diseases of bones and joints; lameness—how to detect and locate it; tumours; wounds; ruptures; diseases of the feet—corns, sand-cracks, false quarter, thrush, canker, laminitis, contracted heels, and navicular disease.

Medical Outlines.—Definition of disease; general symptoms of disease; general causes and general treatment of disease; classification of diseases—contagious and infectious, enzootic and epizootic; constitutional, dietetic and local diseases; parasites and parasitic diseases.

SECOND GRADE.

The Exterior of the Horse.—Divisions of the horse—beauties, defects, blemishes, vices, faults, proportions, attitudes, movements, gaits, defects in gait, dentition, age, colour, soundness; selection, feeding, management; handling and breaking; the principles and practice of shoeing.

The Different Breeds of Horses.—Thoroughbred, Clydesdale, carriage horse, hunter, spring-cart horse, buggy horse, galloway and pony, &c.; the common diseases of the horse—colic, inflammation of the bowels, congestion of the liver, petechial fever, catarrh, bronchitis, inflammation of the lungs, pleurisy, azoturea, heat apoplexy, strangles.

The Different Breeds of Cattle.—Shorthorn, Ayrshire, Alderney, Polled Angus, Hereford, Devon, &c.; the common diseases of cattle—pleuro-pneumonia, tuberculosis, anthrax, milk fever, abortion, difficult calving, hoven, actinomycosis, mammitis, sore teats, &c.

Common Diseases of the Sheep, Dog, and Pig.—Sheep—scabies, fluke, anthrax, hydatids, ophthalmia. Dog—distemper, mange, worms. Pig—swine fever, scarlatina, tuberculosis, rheumatism, &c.

The breeding, rearing, and management of dogs.

Text-books :—McBride's "Anatomical Outlines of the Horse," Smith's "Veterinary Physiology," Finlay Dunn's "Materia Medica," Kendall's "Diseases of Australian Horses."

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 15.

PLUMBING.

FIRST GRADE.

Theory.

The tools used in Plumbers' and Gas-fitters' work, their names and uses.

The materials used (Lead, Zinc, Tin, Iron, Red Lead, and Cement)—their properties and qualities, including the melting point of the metals named.

The fittings used.

Cast and milled sheet lead. Cast and drawn pipes. Compo. pipe.

Solders, their composition and uses.

Fluxes and soldering fluids; soldering bits.

Blowpipe work. The principal joints used in Plumbers' and Gas-fitters' work.

Simple geometrical problems applicable to trade work.

Practice.

Making of various solders for Gas-fitters, Plumbers, and Tinsmiths.

Preparation of fluxes used by the trade.

Tinning of soldering irons.

Preparing and making Plumbers' tarnish or smudge.

Making all kinds of Gas-fitting joints.

Jointing of small lead pipes in various positions.

Seaming of sheet lead. Making bends of sheet lead and seaming same.

Cutting and screwing iron and brass pipes and the general use of taps and dies.

Simple sheet iron work ; stop ends of eaves, gutters, and down pipes.

SECOND GRADE.

Theory.

The elementary principles of sanitary work. Water supplies ; separate and combined drainage systems ; requirements for perfect drainage ; pipes ; traps ; ventilators ; fittings.

Roofing. Rain drainage of houses.

Method of laying gas pipes in buildings and fixing gas meters. Gas burners.

Cold water supply to buildings from the main.

Drains, their sizes, and construction from various materials.

Trapping and ventilation of soil pipes and drains.

Baths, sinks, and urinals, with their services, traps, and wastes. Setting out work and making working drawings.

Calculations as to weight of materials ; cubical contents of cisterns.

Practice.

Lead-pipe bending from 1 inch to $2\frac{1}{2}$ inches.

Making of lead pipes and jointing same in various positions, soldering joints and seaming, sheet lead work.

Making bends and traps from sheet lead, preparing and fitting, soiling and cleaning joints.

Wiping in small sizes.

Fixing lead ridging and bossing up gutter ends, drips, and flashings.

Galvanized iron and zinc work.

THIRD GRADE.

Theory.

The collecting and storage of roof water.

Water supply to houses. House cisterns, their construction, position, management, and care.

Rising mains and other services. Pressure of water under various heads.

Cocks and valves. Brasswork used by plumbers. Filters and water meters.

Principles of hot water circulation and the materials used in the work. Heating by high and low pressure hot water.

Water waste preventors, lavatories.

Sanitary work in dwelling-houses and other buildings in town and country. Chief points to be considered in fitting new houses and in remedying existing defects in old houses.

Various closets with their fittings and supply.

Method of testing drains and soil pipes

Principles of lift and force pumps.

Lead burning.

Effects of gases and acids on different metals.

Setting out work and making working drawings.

Practice.

Drawn pipe bending in large and small sizes

Fitting in position and wiping joints in brass ferrules, wastes, and vent pipes.

Fitting together soil pipes and fixing same in position for wiping. Bossing and dressing sheet-lead coverings for roofs, finials, and internal and external angles.

Working of hot and cold water supply by cisterns, cylinders, and boilers. Water-heating apparatus, lead burning, &c.

Copper tube bending and joint brazing as used in hot water work.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 16.

PHOTOGRAPHY.

FIRST GRADE (TWELVE MONTHS).

Handling of Camera, Lens and Plates—Focussing—Use of Swing Back, Rising Front—Exposure, latitude in it, and its bearing on the final result. Development of Plates and the action of the components of the developing solution. Fixing, and the management of the fixing solution. Printing and Toning on sensitized albumen paper.

Negative making—Improving of Negatives by Intensification or by Reducing, or by the combined effect of both—Gelatino-Chloride (P.O.P.) and Collodio-Chloride Paper and its treatment in Printing, Toning, and Fixing—Bromide Paper Printing—Instantaneous work—Selection of Lenses for certain classes of work.

Carbon Printing—Transparencies for Enlargement and Lantern Slides—Copying—Enlarging, Ferro-Prussiate Paper Printing—Light and its action—Photographic Optics and the Construction of Lenses—Outdoor work.

Platinotype Printing—Ferro-gallic Printing—Preparation of Salt Paper and its treatment—Resin Emulsion Paper, its preparation and treatment—Sensitizing of Albumen Papers—Stripping of Negatives from their glass support—Outdoor practice.

SECOND GRADE (TWELVE MONTHS).

The Wet Plate Process of Negative Making—Stripping and Reversing of Negatives—Photo-Lithographic Transfers—Printing in Line by the Albumen process.

Laying down of Photo-Lithographic Transfers on Stone—Line Etching on zinc—Printing from stone—Copying by the Dry Plate process.

The Theory and Practice of the Screen Negative—The Fish Glue, Albumen, and Gum Enamel Processes for Printing on zinc, brass, and copper.

Theory of the Wet Plate Process—Collodion making—Theory of the Bichromates and their reaction on organic substances—Practical Work in Photo-Engraving on zinc and copper—Photo-Lithography.

NOTE.—A certificate will not be awarded for the Second Grade unless the candidate has passed (previously or concurrently) in the First Grade. An exception will be made in the case of photographers who, in the opinion of the examiners, have a sufficient knowledge of First Grade work.

THIRD GRADE.

Course A.—Collotype Printing.—(Twelve Months.)

Theory of Collotype.—The Wet Plate Negative for Collotype—Reversing by Stripping—Reversing by Mirror or Prism—Reversing by Dusting On Process—The Dry Plate Negative—Preparing of the Collotype Plate.

Practice of Collotype Printing on ordinary Paper, and of Negative Making.

Printing on coated paper, varnishing and mounting of Prints—Tinting of Prints.

Course B.—Photogravure.—(Six Months.)

The Course includes instruction in Copying, Transparency making, in Carbon Printing and Transferring, and Etching the intaglio copperplate.

Course C.—(Twelve Months.)

Orthochromatic Photography in Landscaping; Copying of Coloured Originals by the Dry and Wet Plate—Theory of Colour Filters—The manufacture and use of Colour Filters—Colour Sensitizers and their examination.

Reproductions in Colour by the Three-Colour Process for Half-tone Engraving, Photo-Lithography, and Collotype Printing.

Course D.—(Twelve Months.)

Stereoscopic Photography.

Photo micrography.

Photography by artificial light.

NOTE.—Students taking up any subdivision of Third Grade work must have previously passed in Grade II.

TECHNICAL SCHOOLS.

SYLLABUS No. 17.

METAL WORKING, BLACKSMITHING,
WOOD TURNING AND PATTERN
MAKING, AND METAL FOUNDING.

METAL WORKING, INCLUDING FITTING AND
TURNING.

FIRST GRADE.

Theory.

1. An outline of the principal physical and chemical properties of cast iron, wrought iron, steel, copper, brass and gun metal.
2. The construction and use of straight edges, surface plates, squares, callipers, and gauges, and the mode of testing their accuracy.
3. The construction and use of vyces, chipping chisels, files, scrapers, drills, screwing tackle, grindstones, and emery wheels.
4. An elementary outline of the construction and use of drilling, planing, shaping and slotting machines, and of the tools used in connexion with them.
5. An elementary outline of the construction and use of the lathe, with hand tools or the slide rest. The various modes of centering and chucking work, forging, tempering, and grinding tools for lathe work.

Workshop Practice.

1. Produce a plane surface by chipping, filing, and scraping.
2. Produce a cube in cast iron by planing and filing.
3. Turn a cylindrical shaft, bore and face boss. Fit same on shaft, make sunk and saddle keys.
4. Make and fit feather in shaft. Mark out and file a hexagon nut.

SECOND GRADE.

Theory.

1. Description of the screw-cutting lathe, the adjustments, and methods of arranging change wheels for cutting screws of various pitches.
2. Determination of the proper size and angles of tools for screw cutting.
3. Method of making and using chasers for making and finishing screws.
4. Construction and use of boring bars and boring cutters. Boring machines for large work.
5. Setting out work generally.
6. The theory of cutting tools.

Workshop Practice.

1. Make, temper, and grind the tools required for the sub-joined work.
2. Turning and fitting together parts of simple machines or pieces of mechanism.
3. Cut single and double square threaded screws of regular pitch, with nuts to correspond, both right and left handed.
4. Cut a screw of either Whitworth's or Seller's proportions with regular pitch.
5. Boring with cutter bar and boring head in lathe, and boring machine.

THIRD GRADE.

Theory.

1. Materials used in the construction of ordinary machines and tools; their strength, including crushing, torsion, and tensile strains.
2. Mechanical drawing to scale (workshop practice only). Free-hand drawing.
3. Milling machines. The construction and use of milling cutters, and the division plate.
4. Mill gearing, including tooth wheels; pulleys and speeding.
5. Valves and valve gearing; their adjustment in steam and gas engines.
6. Setting out of complicated work.

Workshop Practice.

1. To do more accurate work than in the second grade.
2. To cut screws of irregular pitch.
3. To make the whole or principal part of some useful machine such as a lathe, steam-engine, gas-engine, electric motor dynamo.

Students taking up this course, who have not previously studied solid geometry and mechanical drawing, should attend concurrently with the first grade, the classes in these two subjects.

BLACKSMITHING (Ordinary Course).

FIRST GRADE.

Theory.

An outline of the manufacture and properties of cast iron, wrought iron, and steel. The construction of various forges, and the tools ordinarily used, with freehand sketches of the same. The steam hammer.

Practice.

Exercises in drawing, pointing, punching, and bending. Twisting square iron. Welding, such as making links, plain hinges, rings, and bolts of various descriptions. Upsetting and welding round, square, and flat iron. Forging keys, T square, blacksmith's tools, engineer's tools, hooks, shackles, and spanners. Exercises with the steam hammer.

SECOND GRADE.

Theory.

Workshop drawing to scale. The strength of cast iron, wrought iron, and steel. Principles of reverberatory furnaces, and method of manufacturing heavy forgings. Principles of die forging.

Practice.

A. Engineering Smithwork.

Exercises in forgings connected with the steam-engine, pumps, mining, and dredging machinery, steam hammer tools and dies.

B. Coachsmithing.

Exercises in forging the ironwork required for vehicles.

C. Agricultural Smithwork.

Exercises in various branches of work connected with agricultural machinery.

THIRD GRADE.

The work of this grade will consist of advanced exercises in theory and practice. They will include complicated forgings, necessitating a good knowledge of template making.

BLACKSMITHING (Art Course).

FIRST GRADE.

Theory.

The work prescribed for the ordinary course, together with free-hand drawing (elementary), O.L. 1.

Practice.

Same as for ordinary course.

SECOND GRADE.

Theory.

The work prescribed for the ordinary course, together with practical plane and solid geometry or geometrical drawing, further practice in freehand drawing (O.L. 1), together with model drawing (O.L. 2A), and general design; workshop drawing to scale.

Practice.

Forging, drilling, and fitting such work as gates, door hinges, lamp stands, fenders, and other work where iron can be used in ornamental ways.

THIRD GRADE.

Theory.

Advanced exercises as in ordinary course, together with modelling ornament (O.M. 2), drawing ornament from the cast (O.L. 2B), and general design.

Practice.

The work of this grade will consist of more advanced and complicated exercises than that prescribed for the second grade.

WOOD TURNING AND PATTERN MAKING.

Materials used. Their qualities and properties.

Tools and the principles of their construction.

General description of the processes of moulding in iron and brass, and of the methods of using patterns of various kinds.

Exercises in turning various forms in timber.

Exercises in making various forms of patterns in the lathe and at the bench, core-boxes, built-up patterns, &c.

Preservation and repair of patterns.

METAL FOUNDING.

Materials used—Pig irons, their qualities and characteristics. Sands, green and dry. Loam.

Tools used in moulding and casting. Furnaces and fuels, cupolas, blowers.

Moulding. The theory and practice of moulding in green sand, dry sand, and loam.

Casting. Mixing of metals, refractory materials. The theory and practice of casting in iron and brass. The method of producing chilled castings, malleable castings, and steel castings.

SYLLABUS No. 18.

MANUAL TRAINING AND CARPENTRY
AND JOINERY.

MANUAL TRAINING

WOODWORKING—FOR ALL VARIOUS COURSES.

PART I.—THEORY.

The student must be able to select the proper wood for any given purpose, and to select the proper tools for any given purpose. He must be able to select the proper method of working any given piece of wood, and to select the proper method of finishing any given piece of wood.

PART II.—PRACTICE.

1. The student must be able to select the proper wood for any given purpose, and to select the proper tools for any given purpose. He must be able to select the proper method of working any given piece of wood, and to select the proper method of finishing any given piece of wood.

2. The student must be able to select the proper wood for any given purpose, and to select the proper tools for any given purpose. He must be able to select the proper method of working any given piece of wood, and to select the proper method of finishing any given piece of wood.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 18.

MANUAL TRAINING AND CARPENTRY AND JOINERY.

MANUAL TRAINING.

WOODWORKING—TWELVE MONTHS' COURSE.

FIRST GRADE.

Two lessons per week should be given in this course, each of not less than one and a half hours' duration. One lesson in four, or an equivalent in time, should be devoted to theory and drawing, the remaining time to practice at the bench.

Theory.

1. *Materials used.*—Wood: Its structure and properties. Varieties of timber, colonial and imported. Defects, warping and shrinkage. Seasoning and preservation. Glue, nails, and screws.

Tools used.—Their names, construction, uses, and value.

The Bench and its fittings.

2. *Drawing.*—Freehand drawing from geometric models, viz., the cube, sphere, cylinder, and cone.

Mechanical drawing. The T and set squares, compasses, and scales. The methods of using them. Drawing to scale simple geometric forms in plan and elevation.

Practice.

1. *The Tools*.—To sharpen, set, and keep them in order.
2. *Exercises at the Bench*.—(a) The Hammer : To hold and strike with it correctly ; to drive, draw, and clinch a nail. The Chisel, Try Square, Rule, and Pencil : To cut a face upon a block, smooth and flat, and another at right angles with the first ; to finish the block to a given size, to chamfer the edges ; to finish the chamfers with ends of different kinds. The Gouge and Chisel : To shape truly different forms of moulding. The Planes and Marking Gauge : To adjust the plane ; to plane two surfaces at right angles smooth, true, and up to line ; to form grooves and rebates of various sizes. The Saw : To saw a marked-off block into boards along, across, and at an angle with the grain ; to saw along a curved line. Brace and Bits, Gimlets, Bradawls : To bore with the tools straight and true. (b) To make the following simple joints :—Halved joint, mortise joint, dove-tailed notched joint, common cup and dovetailed joint, trenched or housed joint, mitred joint. (c) To complete the following piece of work :—A bench hook, a mitre box, a mitred picture-frame, a dovetailed drawer or a dovetailed box with hinged lid.

CARPENTRY AND JOINERY.

FIRST GRADE.*Theory.*

Structure and properties of the timbers commonly used in carpentry and joinery. Market sizes of colonial and imported timber.

The names and forms and management of the principal hand tools ; the theory of their construction.

Right-angled joints, as used in simple framework ; the theory of their construction, with correct proportions.

The application of elementary problems in geometry to marking off work such as bevels for common rafters, mitres, dividing boards.

Drawing to scale simple forms of joints, small doors, and mouldings.

Drawing full-sized sections on boards or rods of simple pieces of framework.

Practice.

Practical use of the ordinary carpenters' tools, with the methods of sharpening and setting them.

Making the following joints :—Mortise and tenon—single, double, and haunched. Tuck tenon ; bridle joint ; halving. Dovetailing, common and lap. Hinging with common butt. Making small and panelled door, small sash, beaded and rebated joint, drawer, cutting common rafters. Beading, rebating, trenching, chamfering.

SECOND GRADE.

Theory.

Conversion, seasoning, and preservation of timber.

The application of solid geometry to the determination of bevels for trip valley and jack rafters, purlins, splayed linings, raking moulds, and hoppers.

Enlarging and diminishing mouldings, setting out swan-necks, ramps, and easings for skirtings and dadoes. Intersection of straight and circular, also of horizontal and inclined moulds.

The general form of skirtings, architraves, door-frames, jambs, sashes, doors, and hinges and screws.

The methods adopted in the construction of the simpler forms of roofs, floors, and partitions—in centering for arches, and in shoring and needling walls.

Setting out work, full size, on drawing boards and rods, taking out quantities, and striking out moulds.

Practice.

Making sashes and frames, solid door-frames, door jambs, screens, shop-fronts, counters, splayed linings, glueing up work and finishing it.

Fixing architraves, skirtings, and dadoes.

Scribing moulds and skirting.

Roofing.—Cutting and fixing timbers.

Scarfig.

Pediments and overdoors.

Louvres, square and circular.

THIRD GRADE.

Theory.

Complex circular work.—The method of finding bevels, face, and falling moulds.

The general form of large centres.

Beading timber.—The various methods adopted.

Staircasing.—Drawing to scale close string, dog-legged, and geometrical stairs. Planning to suit varied circumstances. Setting out pitchboard, winders, and steps. Starting. Arrangement of risers in geometrical stairs to suit hand-rail. Development of wells. Construction of falling moulds.

Setting out full size on boards, newels and balusters.

Construction of self-supporting landings.

Hand-railing.—The modern method of dealing with the subject ; square-cut system development of tangents ; bevels for different pitches ; construction of face and falling moulds ; heights of rails in different positions ; method of dealing with rampant tangents ; effect of shrinkage on joints and bevels.

Method of determining thickness of material to suit any falling mould. Striking out scrolls.

Practice.

Making double curvature door-head.

Bending timber on cylinders by steaming and trenching.

Staircasing.—Making staved and veneered wells, with plain face and rebated ; glueing up strings for winders ; glueing up winders, treads, and risers ; making circular brackets ; fixing newels to landings and strings ; cutting out treads for balusters and return nosing ; fixing stairs, rails, and balusters ; veneering curved risers ; fixing carriages and rough brackets, timbering curved soffits.

Hand-railing.—Joining cylindrical surfaces to rails, working off top and bottom surfaces to falling mould ; squaring up rail ; joining to tangents ; application of bevels ; sliding of face moulds ; moulding rails and jointing up same ; testing rails for pitch and heights ; making patterns for non-balusters ; making working rules for masons and bricklayers.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 19.

COACH BUILDING AND CARRIAGE DRAFTING.

FIRST GRADE.

Theory.

General theory of the trade.

Different timbers used in construction, their properties and application.

Framework, panels, side panels, roof, seat, bottom boards, &c.

Different forms of the simpler joints ; how made and secured as half-lap, mortise, and tenon, at right angles, and to angles (bevels), bevels simple and compound, chamfer, mitre, &c.

Preparation of framing before marking off the joints.

Fixing of ironwork to prevent rust and rattling.

Simple problems of geometry applied.

Detail drawings ; full size of joints and sections, from working drawings.

Detail of springs, wheels, lamps, scroll iron, rails, &c. ; drawings to scale of simple working designs.

Workshop.

Use of the various tools ; how to sharpen, set, and keep in condition.

Making the various joints that have been dealt with in the theory. Working to scale and full size sections of easy design.

SECOND GRADE.

Theory.

Drawing to scale side, front, and back elevation of a lady's phaeton, polo and dog carts, buggies, waggonettes, Stanhope gig, mail phaeton, &c.

Effective application of problems in geometry, and of freehand drawing.

Development of the pillars and angles contained in buggy seats, sham door pillars, &c.

Section of a cone required to form the regular sweeps, &c., found in the seats of mail phaeton, Stanhope gig, &c.

Regulation of necessary head, leg, and seat room, so as to retain a symmetrical effect.

Length and height of hoods.

Marking off, dressing up, and fixing rise and strength of brackets with and without plates.

Boxing out, working mouldings, grooving for panels and boxing generally, with use of routers and gigger.

Treatment of panels; their preparation, bending, fitting, fixing, and retention of form.

Strength of edge-plates, ironwork, &c.

The mixing and intelligent application of paint and other pigments, varnishes, &c., to produce effects required in coach and carriage work.

Workshop.

Practice of subjects treated of in theory.

Full size sections of buggy seats, phaeton quarter, sham door pillar of Stanhope gig, with mortise and lap cut for seat and top rail respectively, and framed into brackets.

Sections of waggonette.

Door hung under different conditions.

Solid side-panel secured to a framed bottom without screwing from the outside.

Making of all incidental joints and sections.

Practical coach-painting.

THIRD GRADE.

Theory.

Higher branches of the trade requiring a knowledge of freehand and solid geometry.

Scale and sectional designs of side, back, and front elevations of a brougham hansom.

Segmental, bijou, and angular broughams, barouche, mourning and dress coach, drag, canoe, and square landaus, victoria, &c.

Projection of side elevation upon a horizontal plane called the "Cant board," and deduction therefrom of all sizes, widths, bevels, joints, &c.

How to proceed in a systematic manner to produce an artistic effect, with symmetry of design, in regulating depth of glass frames and doors, length of boot, fall of hood, head, leg, and seat room in landaus, &c.

Application of geometry in setting out work as shown in developing victoria sham-door pillar.

Lock of fore-carriage, &c.

Concealed hinges, hanging of doors, marking and boxing out mouldings, glass runs, door shuts, and boxing generally ; strength of edge-plates, ironwork, &c.

Design and details of upholstery work for carriages of various kinds.

Workshop.

Practical application of the "Cant board" to the marking and making panels and sections.

Making sections, showing quarter panel, with concealed hinges fitted.

Doors, and the mode of hanging to suit various requirements.

Sham door-pillar, boot sides framed and solid.

The economical planning and cutting out and employment of cloth, leather, and the various materials used in the upholstering of carriages.

TECHNICAL SCHOOLS.

SYLLABUS No. 20.

WOOL SORTING.

FIRST GRADE.

1. To skirt a fleece properly, and to describe while doing so the portion of the fleece being skirted.
2. To roll a fleece correctly.
3. To divide the skirts into "Pieces," "Bellies," "Locks," and "Stained Pieces."
4. To sort the pieces according to their commercial value, making "Broken," "First," and "Second Pieces." The time limit to be under 25 minutes.
5. To explain what is understood by the terms "Combing" and "Clothing," and to divide the fleece into these two classes.
6. To explain the difference between "Washed" and "Greasy" wool, and also the difference in the various descriptions of washed wool.

To explain the means used in preparing these wools for market, as, for instance—"Greasy," "Cold Water Washed," "Hot Water Washed," "Scoured," and "Fell-mongers."

To describe briefly the means usually adopted for placing wool on the market.

SECOND GRADE.

1. To be thoroughly competent in all First Grade work.
2. To distinguish the following descriptions of wool:—

MERINO,	greasy,	scoured,	hot water washed,	cold ditto
CROSS-BRED	"	"	"	"
LINCOLN	"	"	"	"
COMEBACK	"	"	"	"

3. To be able practically to sort Merino and Cross-bred wools into their respective grades ready for the manufacturers, making the distinction between "Combing" and "Clothing" classes.
4. To explain how "Cross-bred" and "Comeback" wool is produced, illustrating by specimens of wool what each crossing will produce.

Certificates of competency will be given only to those passing in both the First and Second Grades.

EXPERTS' GRADE.

The work of this grade will embrace:—

1. To sort Combing Merino wool into all its qualities.
2. To sort Clothing wool into all its qualities.
3. To sort lambs' wool, either Merino or Cross-bred, into all its trade qualities.
4. To sort a Cross-bred fleece into trade qualities.
5. To give an approximate yield of clean wool from greasy.
6. To give approximately the relative values of the various qualities of wool.

Students must have previously passed in Grades I. and II. to be eligible for examination in the Experts' Grade.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 21.

GRAINING AND MARBLING.

FIRST GRADE.

Graining.—The tools and materials used ; mixing and preparing the paints ; preparing the various grounds for oak ; execution of the work.

Marbling.—The tools and materials used ; preparation of grounds ; execution of the work in white vein, dove, black, and gold.

SECOND GRADE.

Graining.—Preparing the grounds and executing the work for mahogany, maple, satinwood, cedar, ash, &c.

Marbling.—Preparing the grounds and execution of the work for Portor, Sienna Breche, Genoa Green, Verd Antique, Rouge Royal, Levant, Walsort, St. Ann's, Derbyshire Fossil, &c.

THIRD GRADE.

Graining.—Further practice in graining the more difficult examples ; inlaying various woods.

Marbling.—Further practice in marbling the more difficult examples.

Inlaying Marble.—Application of marbling to purposes of general decoration.

SIGN WRITING.

FIRST GRADE.

Mixing colours and preparation for the work.

Study of the various alphabetical forms and numbers, their origin and development.

Practice in the formation of the simpler letters and numbers with pencil, crayon, and colour.

SECOND GRADE.

Study of, and practice in, writing more elaborate forms of letters and numbers. Spacing and laying out work.

THIRD GRADE.

The higher branches of the various styles of ornamental lettering. Shading, blocking up, flourishing, the harmony of colours, designing, glass writing, and decoration in burnished gold, &c.

Students before entering upon the courses in Graining and Marbling and Sign Writing should have had some practice in Freehand Drawing; if not, they are recommended to take up Freehand Drawing concurrently with the first year of their course.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 22.

BOOTMAKING.

FIRST GRADE.

Theory.

The foot at rest and in action. Normal and deformed feet. Bunions and corns. Fitting up lasts for bespoke work and for deformed feet. Outline of the principal tools and machinery used in the trade. Theory of clicking as applied to heavy and light work. The theory of fitting and machining men's, women's, and children's boots and shoes. Outline of the theory of pattern cutting, stuff cutting, and sole channelling for machine and hand-sewn work and pumps. Theory of finishing, with a description of the various materials used.

Practice.

Clicking.—Elementary pattern cutting. Putting up men's, women's, and children's boots and shoes—heavy and light—both pegged and machine sewn. Finishing plain work.

SECOND GRADE.

Theory.

Anatomy of the human foot. Details regarding lasts, their construction and measurements. The art of designing patterns for riding boots, walking boots, and shoes. Stuff cutting. Advanced clicking. Putting up best work.

Practice.

Lasts.—Measurement of the foot. Practical fitting up for bespoke work. Pattern cutting. Long work. Bespoke work in men's, women's, and children's boots and shoes. Stuff cutting for machine and hand-sewn work and for pumps. Clicking as applied to glace kid, waxed calf, &c. Putting up best work. Finishing all classes of work.

FITTING AND MACHINING.

*(Women's Class.)**Theory.*

A general description of the cottons, silks, and threads used, needles and other materials. The general principles of the upper-closing and boot-holing machines.

Practice.

Fitting men's, women's, and children's boots and shoes, heavy and light work. Machining—button-hole working and closing for the above. Binding with leather, silk, and galoon.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 23.

COOKERY.

ONE YEAR'S COURSE.

FIRST GRADE.

This grade includes instruction as to the nature and uses of food, the first principles of cookery, and the essentials of good cookery, the management of fires, gas stoves, ranges, and of kitchen utensils, the purchase and keeping of stores, and the principles of domestic economy, so far as they relate to the kitchen.

Demonstration lessons will also be given in the method of preparing and cooking meat, soup, vegetables, fish, puddings, cakes, pastry, &c., in a simple and economical way, the method being explained and shown practically.

NOTE.—Students should be induced to copy all their recipes into a note-book, and to practise each at home after the lesson.

It should be arranged that each student should have during each term not less than two practical lessons under the supervision of the teacher.

SECOND GRADE.

Before entering this course, students will be expected to know the work of the First Grade.

Demonstration lessons will be given in the method of preparation and cooking dishes of a more difficult and elaborate kind, such as soups, entrées, pastry, cakes, fancy puddings, jellies, creams, &c., and those suitable for the sick room.

NOTE.—It should be arranged that each student should have during each term not less than two practical lessons under the supervision of the teacher. They will also be expected to practise at home the recipes shown in the class-room.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 24.

DRESSMAKING AND TAILORS' CUTTING.

To take effect from 1st July, 1901.

DRESSMAKING AND NEEDLEWORK.

ELEMENTARY STAGE.

The Elementary Stage includes instruction in (1) Plain Needlework; (2) Cutting out Underlinen.

I.—PLAIN NEEDLEWORK.

Six Months' Course.

This course comprises all the stitches used in the making up of ordinary clothing, viz.:—Hemming; seaming and felling; stitching; gathering; pleating; running tucks; sewing on buttons; herringboning; buttonholes; sewing on tapes; marking; making gussets; whip stitch; feather stitch; open hem stitch.

The shape and proportion of each stitch shall be learnt first on coarse material (which does not strain the eyes), and afterwards applied to the ordinary fabrics used for clothing.

Patching, darning, and mending.

The work to be completed during the course is—

1. A sampler of stitches worked on Java canvas.
2. A set of small calico specimens worked in coloured cotton.

3. Some one or two garments showing as many of the different stitches as possible.
4. Examples of three different patches.
5. Examples of three different darns.

Text-books :—*Self-teaching Needlework Manuals*, by Emily G. Jones (Longmans and Co.); *Needlework for Student Teachers*, by Amy K. Smith, City of London Book Depôt.

II.—CUTTING OUT UNDERLINEN.

Six Months' Course.

Pupils are advised to take this and the plain Needlework conjointly.

The work of this class includes diagrams of various garments on a reduced scale; how to cut out paper patterns; rules for cutting out material; how to cut out various garments in proportion according to individual measurements.

The patterns taught will be pinafores, aprons, chemises, drawers, combinations, petticoats, shirts, baby linen, and children's garments.

Work required to be done by each pupil by the end of the course.

1. Six diagrams drawn to scale, with notes and directions for making up.
2. Six paper patterns, viz., three flat and three tacked together.
3. Three garments ready for use. One must be hand made.

Diagrams recommended are Mrs. Grenfell's "Cutting out Underlinen."

ADVANCED STAGE.

The Advanced Stage includes (1) Dress Cutting-out and Fitting; (2) Dressmaking, Draping, Trimming, and Finishing. Before entering this course students should know the work of the Elementary Stage.

1.—DRESS-CUTTING AND FITTING.

Six Months' Course.

The system explained. Practice in drafting out patterns.

How to take measures and to draw out patterns for any individual person.

Rules for cutting out lining and material.

Rules for making up bodies.

How to try on dress bodices and fit them.

How to make a "French" bodice.

How to plan and cut out a "dress" skirt.

During the course the pupils will be required to produce—

A complete set of correct diagrams.

Three calico bodices for practice.

One ordinary bodice for practice in common material. This need not be completed.

One ordinary dress bodice completely finished and ready to wear.

One dress skirt, properly finished at top and bottom.

ALTERNATIVE SYLLABUS

FOR

I. DRESS-CUTTING AND FITTING, WITH THE LANGER SYSTEM OF CUTTING OUT.

Course of Instruction.

How to take measures and draw out patterns by those measures.

How to cut and fit on the following :—

1. Own bodice and sleeve.

2. Girls' „ „

3. Tight coat.

4. Eton coat.

5. Double breasted bodice.

6. Gored shirt.

Average bodice and sleeve.

Child's „ „

Sac coat.

Princess robe.

Godet skirt.

During the course the pupil will be required to produce specimens of hemming, overcasting, and buttonholes, as required for a dress, on dress material ; or a plain dress bodice, together with paper patterns of numbers 1 to 6, and pattern in calico, holland, or print of numbers 1 (own bodice with sleeve) and 3 (coat).

II. DRESSMAKING AND FINISHING.

Six Months' Course.

Before entering on this course students should know the work set out in Part I., embracing "Dress-cutting and Fitting." They must be provided with patterns.

Course of Instruction.

All details of dressmaking.

Making complete costumes ready for wear.

Designs for latest fashions and trimmings.

Special lessons on the following subjects:—

Fancy bodices.

Norfolk bodices.

Seamless bodices.

Tailor-made bodices.

Coats.

French cross-cut costume.

Tea gowns.

Blouses.

Skirts in latest designs.

TAILORS' CUTTING.

FIRST GRADE.

The materials used. Rules of measurement, drafting.

Practical drafting and cutting the undermentioned garments for proportionate and disproportionate figures:—Trousers of all kinds, breeches, leggings, gaiters, spats, knickerbockers, sac coats, waistcoats, Chesterfield overcoats.

SECOND GRADE.

Practical drafting and cutting the undermentioned garments for proportionate and disproportionate figures:—Beaufort coats (single and doubled breasted), frock coats, double-breasted vests, dress coats, and vests.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

TECHNICAL SCHOOLS.

SYLLABUS No. 25.

PRINTING (COMPOSING).

FIRST GRADE.

Furniture and tools in the composing room. Lays of cases for book and jobbing founts. The point system. Elementary composition. Dividing and compounding of words. Spacing and justifying. Punctuation. Sizes of furniture and chases. Mechanical quoins and their application. Simple schemes of imposition. Locking up and unlocking of formes. Marks used for reader's corrections. Sizes of papers and cards.

Practical instruction will be given in the composition of plain jobbing work.

SECOND GRADE.

Casting off copy. Estimating cost of composition, &c., on various classes of work. More difficult schemes of imposition than for first grade. Method of making margin. Bookwork. Setting of title pages and other preliminary matter. Signatures. Artistic and general display work. The use of tint blocks. Making up skeleton formes for printing in colours.

Practical work will comprise the ordinary routine of an up-to-date printing office.

PRINTING (MACHINES).

FIRST GRADE.

The hand press and various makes of platen machines ; construction and working of same. Packing to be used for various classes of work. Difficulties likely to be met with. Classes of work most suitable for press or for platen machine. General principles of making ready, underlaying, overlaying. The best paper to use for various classes of work.

SECOND GRADE.

The same as first grade, but on cylinder machine, with the addition of cutting out overlays for cut and colour work, including blocks, electros, &c., and the various process blocks and plates. Rollers, their treatment and management. Inks and pigments, varnishes, oils, &c. Theory and harmony of colour, and the mixing and blending of colours practically demonstrated.

The practical work of both grades will comprise the printing of various classes of work, including jobbing, commercial, artistic, book-cut, colour, tint, bronze, and embossing.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

SYLLABUS No. 26.

ENGINEERING CONSTRUCTION AND HYDRAULICS.

ENGINEERING CONSTRUCTION.

FIRST GRADE.

1. Earthworks, construction and measurement. Appliances and machinery for excavating and transporting rock and earth, the use of explosives; making outside widths; setting out culverts under banks; grading; balancing of earthwork.

Timber.—Properties and defects; pile-driving; timber structures.

Roads and Streets.—Clearing, grading, and forming; gravelling and metalling; Macadam's and Telford's systems of road-making. Kerbing, channelling, cleaning, and maintenance. Roads in sandy ground and in wet clay.

SECOND GRADE.

1. *Masonry and Brickwork.*—Properties and defects; properties, defects, and mode of manufacture of artificial stones and bricks; the manufacture and mode of testing limes and cements. Mortars and concretes.

Iron and Steel.—Properties, mode of manufacture, tests.

2. Street pavements and footpaths.

3. *Tramways.*—General principles of horse, steam, cable, and electric.

4. Brickwork, masonry, concrete, and iron. Reinforced concrete construction; drains and sewers; size and capacity of storm-water sewers in relation to the area drained under varying circumstances.

Specifications; contracts; agreements; bookkeeping for engineers; Local Government Act.

HYDRAULICS.

1. Hydrostatic Laws; computation of flow of water in open channels; pipes and closed conduits; gauging of natural and artificial streams, and the flow of water over weirs.

2. The construction of storage and distributing reservoirs; dams in earthwork, masonry, and concrete; by-washes and outlet works; the details of valves and valve towers; syphon outlets.

The construction of channels, flumes, and tunnels; inverted syphons; sluice gates and scour valves.

The manufacture, testing, and laying of cast and wrought iron pipes; air valves, scour valves; reflux valves, and self-acting throttle valves; water meters. Pumping engines for water supply purposes.

3. General principles of sewerage in connexion with the following:—The construction of drains and sewers; the combined and separate systems; sewer ventilation; disposal of sewage; sewage farming, filtration, and chemical treatment.

EDUCATION DEPARTMENT, VICTORIA.

TECHNICAL SCHOOLS.

APPENDIX.

COURSES FOR DIPLOMAS IN METALLURGY AND MINING ENGINEERING.

No. 27.

ENTRANCE STANDARD FOR DIPLOMA COURSES.

Student to have reached the standard in Mathematics indicated by the pass in Arithmetic, Algebra (Grade I.), and Euclid (Grade I.), of the Department's examinations.

I.—METALLURGY COURSE.

FIRST YEAR.

Algebra, Grade II.

Euclid, Grade II.

Trigonometry, Grade I.

Dynamics and Heat, Grade I., or Applied Mechanics, Grade I.

Sound and Light, Grade I.

Electricity and Magnetism, Grade I.

Theoretical Chemistry, Grade I.

Practical Chemistry, Grade I.

Mineralogy, Grade I. } One or other of these can be postponed till
Geology, Grade I. } the second year.

Engineering Drawing, Grade I., with Freehand Sketching.

Plane Geometry, Grade I., or Fitting and Turning, Grade I.

Solid Geometry, Grade I.

Forge Work (optional).

SECOND YEAR.

Theoretical Chemistry, Grade II.

Practical Chemistry, Grade II.

Assaying, Grade I.

Metallurgy, Grade I.

Mineralogy, Grade II. } One or other of these can be post-
Mining Geology, Grade II. } poned till third year.

Applied Mechanics, Grade II., or Mechanics Applied to Mining.

Engineering Drawing, Grade II.

Petrology, Grade II., or in succeeding year.

Electrical Technology, Grade II. (optional).

THIRD YEAR.

Practical Chemistry, Grade III.

Assaying, Grade II.

Metallurgy, Grade II.

Mine Surveying (one year's course).

In addition to passing in these subjects, practical experience for twelve months will be required before the issue of a Diploma.

II.—MINING ENGINEERING COURSE.

FIRST YEAR.

(Same as for Metallurgy.)

SECOND YEAR.

Graphical Algebra and Analytical Geometry (optional).

Applied Mechanics, Grade II.

Electrical Technology, Grade II.

Assaying, Grade I.

Metallurgy, Grade I.

Mining Geology, Grade II., or Fitting and Turning, Grade II.

Engineering Drawing, Grade II.

THIRD YEAR.

Differential and Integral Calculus (optional).

Applied Mechanics, Grade III.

Applied Electricity, Grade III., or Metallurgy, Grade II.

Petrology, Grade II., or Fitting and Turning, Grade III.

Mining, Parts I. and II.

Mine Surveying (one year's course).

Engineering Drawing, Grade III.

In addition to passing in these subjects, practical experience for twelve months will be required before the issue of a Diploma.

