Programmes of lectures on theoretical, practical, agricultural, and applied chemistry ; and on ... natural philosophy / [Henry Minchin Noad].

15

PROGRAMMES OF LECTURES

ON

THEORETICAL,

PRACTICAL, AGRICULTURAL, AND APPLIED

CHEMISTRY;

AND ON

SELECTED SUBJECTS OF NATURAL PHILOSOPHY.

ARRANGED FOR THE USE OF

Public Institutions and of Public and Private Schools,

AND DELIVERED BY

HENRY M. NOAD,

LECTURER ON CHEMISTRY AT ST. GEORGE'S HOSPITAL;

AUTHOR OF "LECTURES ON CHEMISTRY," "LECTURES ON ELECTRICITY," AND OF THE TREATISE ON CHEMICAL ANALYSIS IN THE "LIBRARY OF USEFUL KNOWLEDGE."

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1849.

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I.

A COURSE OF LECTURES

ON THE ELEMENTS OF

CHEMICAL PHILOSOPHY.

In this Course, which may consist of from Eight or Ten to Twenty-five or Thirty Lectures, the following subjects, or selections from them, are discussed:—

HEAT; expansion of solids, liquids, and gases; the construction of the thermometer; illustrations of specific and latent heat; STEAM; principles and construction of the steam engine; evaporation at low temperatures; vapour in the atmosphere; hygroscopes; distillation; conduction; radiation; dew; equilibrium of temperature, &c.

CHEMICAL AFFINITY, and the *laws of definite proportions;* divisibility of matter; influence of the physical condition of matter on chemical action; circumstances which control chemical action; phenomena attending chemical affinity; decomposition; laws of chemical combination.

Chemical Symbols; atomic theory.

THE NON-METALLIC UNDECOMPOUNDED SUBSTANCES:—

Oxygen Gas; its preparation and properties; its importance and extensive distribution; *experiments.*

Hydrogen Gas; its preparation and properties; the composition of water demonstrated analytically and synthetically; combustion; the hydro-oxygen blowpipe; clouds, fogs, mists, &c.

Nitrogen Gas; its preparation and properties; composition and methods of analyzing atmospheric air; phenomena of rain; diffusion of gases; stability, weight, density and height of the atmosphere.

Nitrogen with Oxygen; nitrous oxide; nitric oxide; nitrous

acid; nitric acid; their preparation and properties experimentally demonstrated.

Nitrogen with Hydrogen; ammonia and its salts.

Carbon; its varieties and properties.

Carbon with Oxygen; carbonic oxide; carbonic acid; oxalic acid; the carbonates and oxalates.

Carbon with Hydrogen; marsh gas, or fire-damp; olefiant gas; *Coal;* coal gas; its manufacture; ignition, or incandescence; nature of flame; the safety lamp.

Carbon with Nitrogen; cyanogen, and hydrocyanic acid.

Sulphur; its sources, purification, and properties.

Sulphur with Oxygen; sulphurous and sulphuric acids; the sulphites and sulphates.

Sulphur with Hydrogen; hydrosulphuric acid; the sulphides.

Sulphur with Carbon.

Selenium; its properties and compounds.

Boron; boracic acid; the borates.

Phosphorus; its preparation and properties; its compounds with oxygen and hydrogen.

Silicon, silicic acid; the silicates; *Glass;* its varieties and manufacture.

Chlorine and its compounds; preparation and properties of hydrochloric acid; the chlorides and chlorates.

Iodine; Bromine; Fluorine; and their compounds.

The Metals; their distinctive characters, properties and uses: *Metallurgy,* embracing a general description of the methods of extracting the principal metals from their ores; illustrated by numerous coloured diagrams.

The constitution of Salts.

Organic Chemistry; preliminary observations; the composition of organic substances, and the methods of analyzing them.

The Amylaceous and Saccharine Substances; starch, sugar, gum, their varieties; woody fibre, cellulose, the vegetable acids, &c.

The Albuminous Substances; vegetable and animal albumen; vegetable and animal fibrin; vegetable and animal casein.

Fermentation; alcohol, ether, wine, beer, vinegar; theory of ferments, antiseptics, putrefaction, &c.

The Chemistry of Agriculture; the food of plants, whence derived; organic substances produced from the food of plants; inorganic constituents of plants; the origin and fertility of soils; interchange and rotation of crops; action of organic and inorganic manures.

II.

A COURSE OF LECTURES

ON THE

APPLICATION OF CHEMISTRY TO PRACTICAL AGRICULTURE.

This Course, the full developement of which requires about Twelve Lectures, embraces the consideration of the following subjects. It has been arranged to meet the growing demand of those interested in the progress of Agriculture as a Science, for the dissemination amongst practical men of those sound principles of Chemical Science which may enable them to appreciate the value of the aid which Chemistry is capable of affording to their art.

INTRODUCTION; value of scientific knowledge in agriculture; present state of agriculture as a science; capabilities of the soil; the art of culture a *chemical* art; progress and prospects of British agriculture.

THE ORGANIC CONSTITUENTS OF PLANTS; oxygen, hydrogen, nitrogen and carbon; their properties and relations to vegetable life.

The Sources of the Organic Food of Plants; viz., carbonic acid; carburetted hydrogen; nitric acid; ammonia.

The Substances formed from the Food of Plants; viz., woody fibre, starch, gum, sugar, &c., their mutual relations and transformations; the vegetable acids; acetic, oxalic, citric, tartaric, and malic acids.

The Substances containing Nitrogen formed in Vegetables; viz., gluten, vegetable albumen, and diastase; their great interest and importance.

THE INORGANIC CONSTITUENTS OF PLANTS; viz., chlorine, iodine, sulphur, silicon, phosphorus, and their combinations.

THE METALS WHICH OCCUR IN VEGETABLES; viz., potassium, sodium, calcium, magnesium, aluminum, silicon, iron, and manganese, the states in which these metals occur, and the offices they serve.

The composition of the *ashes* of some of the most commonly cultivated plants; and the important practical conclusions derived from their examination.

THE NATURE, ORIGIN, AND CHEMICAL EXAMINATION OF SOILS; their improvement by chemical and mechanical means.

Manures, Mineral; great importance of *lime;* states in which it is employed, and theory of its action.

Manures, Organic, their relative values, theoretical and practical.

III.

A COURSE OF LECTURES

ON

TECHNOLOGY;

OR, CHEMISTRY AS APPLIED TO THE ARTS AND TO MANUFACTURES.

As the subjects treated of in this Course are perfectly distinct from each other, any selection may be made from them: the whole would be comprised in about Twelve Lectures.

DIVISION 1.

On the Artificial Sources of Heat and Light.—Of Heat; composition of the different varieties of wood, and their relative values as fuel; peat, brown, and mineral coal, their respective origins; varieties and composition of coal; preparation of charcoal and coke; relative values of different kinds of fuel; different modes of applying heat; stoves, hot air; steam, hot water; *experimental demonstrations of the nature and products of combustion.*

Of Light; physical properties and analysis of light; solid bodies requisite for the production of artificial light; gases of little value as illuminating agents; *experimental demonstrations;* fats and oils as illuminating agents; manufacture of *tallow*, *stearine*, *spermaceti* and *wax candles;* the candle philosophically considered; some of the most useful forms of lamps; the *night lamp without wick; the study lamp; the sinumbra lamp; the carcel lamp; the camphine lamp, &c.*

Coal Gas, its manufacture and constituents; gas from resin; collection and distribution of gas; immense consúmption of gas in London; price of gas; gas metres; portable gas.

The Electric Light considered in relation to economy; *experiments.*

Comparison of the relative values of different illuminating agents.

DIVISION 2.

On Sulphuric Acid; the Alkalies and the Earths; and on the Manufactures dependent on them.

Sulphur, and its applications in the arts; sources, native and artificial; purification of native sulphur; *sulphurous acid*, its use as a disinfectant and bleaching agent; *sulphuric acid*, its manufacture, as at present conducted; immense importance

of this acid in the arts; it is the *key-stone* of most chemical processes; illustration of the manufacture of sulphuric acid; sulphuric acid from green vitriol; enormous consumption of sulphuric acid; *experimental demonstration of its properties.*

The Soda Manufacture; great importance of this alkali; it is one of the chief levers of manufacturing industry; sources of soda—*first*, from certain marine plants, viz. *barilla* and *kelp; second*, from common salt.

Sources of Common or *Culinary Salt.*—Rock salt, its geological distribution; natural brine wells; constituents of the brine and separation of the salt; production of salt from sea water.

Artificial Soda from Common Salt; details of this most important manufacture, illustrated by diagrams, and by specimens of the manufacture in its different stages; crude soda; soda ash; soda salts; carbonate and bicarbonate of soda.

Hydrochloric Acid, a product of the manufacture of soda from common salt; condensation of the acid; its uses in the arts; the manufacture of bleaching powder.

Soap; the general principles of soap making; connection between the manufacture of soap and that of sulphuric acid; the different varieties of soap; their analyses; and the materials used in their preparation.

The Potash Manufacture; constituents of the ashes of vegetables; production of potash from the crude ash; lixiviation, evaporation, calcination; constituents of calcined potashes; estimation of the commercial value of soda and potashes.

Manufacture of Glass; historical; nature and properties of glass; constituents of the different glasses; durability and difficulty of fusion of glass; its states of fluidity and of brittleness. Classification and composition of the different varieties of glass; materials used; decolourizing matters; furnaces, fuels, pots; preparation of materials; fritting, melting, fining, moulding.

Bottle Glass; Window Glass; Sheet Glass; flatting and annealing.

Crown Glass; marvering, blowing and annealing.

Plate Glass; composition, casting, annealing, polishing.

Glass Mirrors; silvering, Drayton's process.

Flint Glass or *Crystal;* casting, grinding, cutting, polishing, optical glass. Faraday's experiments.

Coloured Glasses; pigments used; artificial gems; glass painting; enamel; gilding; glass spinning; glass etching; soluble glass, &c.

Porcelain and *Pottery; Clay*, its origin; composition and varieties; Kaolin, or porcelain earth; pipe clay; plastic clay; fusible clays; potter's clay; blue clay; yellow clay; Fuller's earths; calcareous clays, marls and loams.

Porcelain; history; materials and their preparation; form-

ing or moulding; the lathe or throwing wheel; casting; turning and finishing; drying, glazing, and baking; density and chemical composition of porcelain; painting and gilding.

Stone-ware; fine and ordinary; earthenware, materials used in; clay mills; glazing and printing.

Manufacture of clay pipes.

Manufacture of Stove or *Dutch Tiles*, and of common tiles.

Manufacture of Bricks; properties of good bricks; selection and preparation of the clay; brick kilns; glazed tiles; colour of bricks.

Fire-proof Ware; Hessian crucibles; fire-clay retorts; fire bricks, &c.

Saltpetre or *Nitre;* composition and formation of native saltpetre; saltpetre plantations; theory of the process of nitrification; extraction of saltpetre from the crude earth; refining process; refraction of saltpetre; *experimental illustrations* of the properties of pure nitre.

Gunpowder; its history; peculiar action, and products of decomposition of; its theoretical and actual composition; manufacture; selection and preparation of the charcoal, the influence which it exerts on the quality of the powder; powder mills; granulation, why necessary; glazing and drying; inflammability and force; method of testing the force of gunpowder; *analysis.*

Gun Cotton; its composition and properties; its projectile force as compared with gunpowder.

Aquafortis or *Nitric Acid;* its preparation, distillation and properties; *experiments.*

Borax (biborate of soda); native and artificial; the boracic lagoons in Tuscany; method of extracting the boracic acid; preparation of borax from boracic acid; properties and uses of borax.

DIVISION 3.

On certain other Arts and Manufactures depending on Chemical Principles.

Starch; its composition, properties and preparation; from cereals; from rice; from potatoes; varieties of starch; arrow root; sago; tapioca; salep; tous les mois; analysis of, and methods of detecting adulterations in wheat flour; composition of rice flour.

Potatoe; its composition in the healthy, and in the diseased state; theories respecting the *potatoe disease.*

Potatoe starch, its preparation and uses; *Bright's Nutritive Farina; Prince of Wales's Food; Anderson's Soluble Starch; British Gum* or *Dextrine; English Arrow Root;* detection of potatoe starch in wheat starch.

Conversion of starch into dextrine and sugar; diastase;

malting; great and important assistance furnished by chemistry to *the art of brewing;* the English and German processes compared.

The Art of Baking; detection of adulterations of bread.

The Introduction of Chemical Principles into the Kitchen; Liebig's important experiments relating to the cooking of meat and the preparation of soup; cookery a true *chemical* art.

Fermentation; conversion of sugar into alcohol, and of alcohol into acetic acid; the manufacture of vinegar; methods of testing the purity of vinegar.

DIVISION 4.

On Dyeing and Calico Printing; dyeing a true chemical art; antiquity of dyeing; nature and combination of colours; general principles of the art; red, yellow, blue, black, green, orange, and brown dyes, and the modes of their application experimentally illustrated.

Calico Printing; its antiquity; preparation of the cloth; bleaching; drying; singeing, and calendering; different methods of imprinting colours on calicoes; by hand blocks; by machine blocks; by copper plates; by copper cylinders; great economy of labour introduced by the cylinder printing machine; thickening of the mordaunts and colours; arrangement of the colour laboratory; preparation of the dye extracts and mordaunts; discharges; general account of the various processes of calico printing.

On Tanning; the properties of tannic acid and of the astringent principles used in tanning; oak bark; valonia; dividivi; sumach, &c.; their relative values; preparation of hides and skins; different modes of applying tannin; preparation of light and fancy leathers; the quick and slow processes of tanning compared.

IV.

A COURSE OF LECTURES

ON

ELECTRICITY; GALVANISM; MAGNETISM; ELECTRO-DYNAMICS; AND MAGNETIC ELECTRICITY.

This Course consists of Twelve Lectures, and is arranged in three Divisions; either of which may be taken by itself; or a Selection made from the Three, so as to form a shorter Course. The Lectures are fully illustrated by extensive and powerful Apparatus.

DIVISION 1.

Franklinic or *Statical Electricity;* fundamental effects and phenomena; attraction and repulsion; conductors and non-

conductors; distribution and transference; the Franklinian and Dualist theories; electroscopes and electrometers; electrical properties of bodies; insulation; induction; Faraday's new views and illustrations of induction; *experiments.*

The Electrical Machine; modus operandi; disruptive discharge; spark; discharge in vacuo; brush discharge; discharge at positive and negative conducting surfaces; glow discharge, its nature and causes; latent or dissimulated electricity; the condenser; the electrophorus; *experiments.*

The Leyden Jar; theory of its action; illustrations of the Leyden phenomena; charge and discharge; uses of the conducting coatings; dissected gauze jar; unit jar; battery; quadrant and discharging electrometers; universal discharger.

Experiments illustrative of the Effects of Accumulated Electricity; deflagration of metallic wires, &c.; magnetic, chemical, and physiological effects of frictional electricity.

Atmospheric Electricity; detection of free electricity in the atmosphere; annual and diurnal variations; the *Kite* as a means of exploring the electrical state of the atmosphere; thunder clouds, their origin and structure; varieties of lightning, zigzag, forked, sheet, and ball; velocity of electricity; Wheatstone's experiments.

Thunder; danger from lightning, and means of protection; paratonnerres or lightning conductors; the manner in which they should be arranged, and *experimental illustrations* of their action.

DIVISION 2.

Galvanic or *Voltaic Electricity;* history; Volta's experiments; the contact and chemical theories; the different kinds of Volta-electric batteries; those of *Volta*, *Cruikshank*, *Wollaston*, *Daniell*, *Smee*, *Grove*, *Bunsen*, and *Callan;* their comparative powers and advantages; the water battery; the dry pile; voltaic and frictional electricity compared; *experiments.*

Effects of the Volta-Electric Current:—

1st. *Magnetic;* the galvanometer, or multiplier.

2nd. *Luminous;* THE ELECTRIC LIGHT, considered with reference to economy; *experiments.*

3rd. *Thermal;* ignition and fusion of metals and metallic wires; non-luminosity of thin platinum wires in hydrogen gas; galvanic blasting; *experiments.*

4th. *Physiological;* original experiments of *Galvani;* and later researches of *Matteucci.*

5th. *Chemical;* decomposition of water; Faraday's investigations; Daniell's researches; primary and secondary decompositions; the voltameter; electro-chemical equivalents; decomposition of neutral salts; reduction of the alkaline metals; electro-crystallization.

Electro-Metallurgy; electrography; electroplating; Nobili's electro-chemical figures; electrotypic actions; voltaic assaying; methods of measuring the intensity of the voltaic current; Ohm's formulæ; electricity by combustion; by chemical decomposition; *experiments.*

Electricity of High-Pressure Steam; Armstrong's experiments.

Thermo-Electricity; thermo-electric piles; their application to the measurement of temperatures; terrestrial thermo-electric currents.

DIVISION 3.

Magnetism, Electro-Dynamics, and Magneto-Electricity.

Magnetism; history; general facts and principles; induction; attraction; repulsion; fracture; magnetic curves; theories of magnetism; methods of making artificial magnets; terrestrial magnetism; mariner's compass and dipping needle; inductive effects of the earth's magnetism; variation and periodical changes in the earth's magnetism; theories respecting the earth's magnetism; *experiments.*

Electro-Magnetism; influence of electric currents on magnets; the galvanometer; Oersted's fundamental experiments; influence of electric currents on each other; influence of magnets on electric currents; Ampère's magnetic theory; rotations and motions caused by the mutual actions of magnets and conductors of electricity; *experiments.*

Excitation of Magnetism by Electric Currents; magnetic helices; floating rings and helices; electro-magnets; rotation of an electro-magnet by the magnetism of the earth; electro-magnetism considered as a moving power; electro-magnetism as applied to telegraphic communication; *experiments.*

Magneto-Electricity; electric currents excited by means of others; phenomena of induction by electric currents; various effects of induced currents; electric currents generated by magnets; laws of magneto-electric induction; galvano-magnetic induction machines; magneto-electric rotating machines; inductive influence of terrestrial magnetism; phenomena of rotatory magnetism; Faraday's experiments on the magnetic and diamagnetic condition of matter, &c.; *experiments.*

V.

A COURSE OF LECTURES

ON

THE ELEMENTS OF MECHANICS, PNEUMATICS, HYDROSTATICS, AND HYDRAULICS.

This Course consists of Six Lectures, and is extensively Illustrated by Diagrams and Experiments.

DIVISION 1.

On the Elements of Mechanics; objects of physical science; the physical properties of bodies—1st. *Essential*, viz., extension and impenetrability; 2nd. *Non-Essential*, viz., compressibility, expansibility, porosity, divisibility, elasticity, *gravity*, mass and density.

Physical Forces; cohesion and molecular attraction; inertia; matter incapable of spontaneous change; familiar illustrations; action and reaction; laws of motion; *illustrations.*

Composition and Resolution of Forces; parallelogram of forces; composition of motion; *examples.*

Attraction; molecular or atomic; of cohesion; capillary; general law of gravitation; weight.

Terrestrial Gravity; phenomena of falling bodies; light and heavy bodies fall to the earth with equal speed; *illustration;* increased velocity of falling bodies; relation between height, time and velocity; retarded motion; motion on inclined plane; centrifugal force; whirling table; examples of centrifugal force.

Centre of Gravity; stable and unstable equilibrium; examples; rope-dancing; porter carrying load; motion of quadrupeds, &c.

The Pendulum; centre of oscillation; time of vibration; metronomes.

Simple Machines; lever; cord; inclined plane; wheel and axle; windlass; capstan; treadmill; compound wheel-work; clock-work.

The Pulley; fixed and compound; wedge and screw, uses and applications.

The Regulation and Accumulation of Force; the governor; the fly-wheel.

Friction; the balance; the steel-yard; the compensation pendulum, &c., &c.

DIVISION 2.

On Pneumatics; the nature of the so-called permanently elastic fluids; the mechanical properties of atmospheric air; its colour, density, impenetrability, inertia; *experiments.*

Elasticity of atmospheric air; height of the atmosphere; relation of elasticity to density.

Weight of the atmosphere; the barometer, vertical, diagonal, wheel, *aneroid;* the Vernier; uses of the barometer; the weather glass; rules generally found on the instrument not to be relied on; correct rules; atmospheric pressure, why not felt; adhesion of flies to the ceiling, and of certain fishes to rocks; breathing; bellows; tea kettle; ink bottle; bird cage and fountain; the pneumatic trough for collecting gases.

Rarefaction and *Condensation* of air; the exhausting syringe; a perfect vacuum cannot be produced; the air pump; barometer and syphon gauge; different forms of air pump.

Experiments with the air pump; bladder burst by the pressure and by the elasticity of the air; apparent conversion of a shrivelled apple into a fresh one, and of a bunch of raisins into a bunch of grapes; water raised by elastic force; the Magdeburgh hemispheres; guinea and feather experiment; cupping; air necessary for the transmission of sound; *experiments.*

Condensing Syringe; air gun.

Air Balloon; Lane's balloon with rarefied air; fire balloon; hydrogen gas balloon; parachute; diving bell, &c.

Pumps; lifting pump; pump without friction; suction pump; forcing pump; fire engine; common syphon; Wurtemburgh syphon.

DIVISION 3.

On Hydrostatics and *Hydraulics;* pressure of liquids; its equal transmission; a liquid a machine; the hydrostatic press; the hydrostatic paradox; transmission of signals; Dr. Arnott's hydrostatic bed; circulation of the blood; pressure of liquids proportional to depth; pressure on the bottoms and sides of vessels; *experimental illustrations;* embankments, dams, and floodgates.

Compression of Liquids; cork forced into bottle; water forced into the pores of wood; divers cannot descend, and fishes cannot live, below a certain depth; pressure on water-pipes.

Experimental proofs that liquids maintain their levels under all circumstances; explanation of the hydrostatic paradox; surface of the sea; optical deception in waves; similar property in the revolving screw; ornamental fountain clocks; phenomena of rivers, springs, wells, and cataracts; construction of

canals and locks; supply of water to towns; levelling instruments; spirit levels.

Measurement of Solids; apparent loss of weight by immersion in water; *the increase of weight which a liquid receives by the immersion of a solid is equal to that which it would receive from the addition of a quantity of water equal in volume to the solid;* great importance of this principle; experimental demonstrations of it; remarkable consequences of the effects of immersion; floating bodies; buoyancy; bodies however heavy may be made to float on water; iron boats; life preservers; swimming; amphibious animals; fishes; why a drowned body floats; *philosophical toys illustrating the principle.*

Light Liquids float on heavier; *illustrations;* oil and water; cream and milk; separation of inflamed blood into serum, coagulum, and buff; proof spirit; peculiarity of water in relation to heat; water in the depths of a frozen sea less cold than at the surface; currents in heated liquids; ebullition; application of ice to cool wine.

Stability of Floating Bodies; walking on water; proper positions of ballast and cargo of a ship; danger of standing up in a boat.

Specific Gravity; meaning of the term; standards of specific gravity; determination of specific gravity of solids, liquids, and gases; practical importance of specific gravity; hydrostatic balance; hydrometers.

Hydraulics; force and velocity of efflux of liquids from apertures in vessels; direction of currents and contracted vein; lateral propagation of motion; currents and eddies of water in rivers; resistance of fluids; rowing; form of birds and fishes; railroads and canals.

Water-wheels; overshot; undershot; breast; Barker's mill; Archimedes' screw; sluice governor; chain pump, &c., &c.

WORKS PUBLISHED BY MR. NOAD.

I.

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London: Robert Baldwin, 47, Paternoster Row.

G. Woodfall and Son, Printers, Angel Court, Skinner Street, London.