Syllabus of a course of lectures on natural philosophy / University of Edinburgh.

(23)

SYLLABUS

OF

Lectures

ON

NATURAL HISTORY.

During the Course, the mode of conducting investigations in Natural History will be exemplified by an explanation on the spot of the numerous interesting natural appearances that occur around Edinburgh.

The Students of Natural History are admitted to the College Museum, every lawful day, from 11 A. M. *to* 5 P. M. *during the Courses of Natural History.*

N. B.—*Attendance on Class of Natural History required by the Medical Faculty of the University, the Army Medical Board, &c.*

UNIVERSITY OF EDINBURGH.

SYLLABUS OF A COURSE OF LECTURES

ON

NATURAL PHILOSOPHY.

The following Syllabus is intended to contain a general outline of the subjects embraced in a Course of Natural Philosophy, each of which is intended to be accurately discussed and illustrated in the Class. Want of time prevents the possibility of accomplishing this in a single Session, and the Professor intends using his judgment, in varying from year to year both the distribution and selection of subjects, several of which will be treated of more fully one year, and more cursorily the next.

During the progress of the Course, those instruments actually employed in experimental investigation will be described; and instructions given for their use, and for the conduct of experiments. It is intended also occasionally to give distinct lectures upon the Instruments and methods of observation fitted for the use of Travellers.

Introductory Lectures on the Study of Natural Philosophy.

I.—PROPERTIES OF BODIES.

Matter known to us only by its Properties: these are,—

I. Essential.

1. Extension. 2. Figure. 3. Impenetrability.

II. General or Contingent.

1. Porosity.
2. Divisibility.
3. Elasticity. Compressibility.
4. Mobility.
5. Ponderability. Universal Gravitation.
6. Cohesive Attraction. Capillarity. *Boscovich's Theory.*

II.—STATICS.

Definition and Measure of Force.

Fundamental Properties of the Mathematical Lever.

COMPOSITION OF FORCES.

I. Applied at a point. Parallelogram and Triangle of Forces. Forces in different planes.

Conditions of Equilibrium. 1. Of a free point. 2. Of a point resting on a plane or curved surface.

II. Parallel Forces. Doctrine of Moments. Couples.

CENTRE OF GRAVITY.

General Theory. Particular Applications.

Guldin's Theorem.

SIMPLE MACHINES.

1. Lever. Balance. System of Weights and Measures. Mechanical Adaptation in the Structure of Man and the lower Animals. Law of Physical Developement in Man.
2. Wheel and Axle.
3. Toothed Wheel.
4. Pulley. Block-Machinery.
5. Machine of Oblique Action.
6. Inclined Plane.
7. Wedge.
8. Screw.

Virtual Velocities. Attempts at Perpetual Motion.

EQUILIBRIUM OF FLEXIBLE BODIES.

Catenarian Curve.

Suspension Bridges.

THEORY OF ARCHES. Bridges. Domes. Illustrations of the Theory. Conditions of Stability in Practice. Architectural principles, and illustrations.

EQUILIBRIUM of ELASTIC BODIES and STRENGTH of MATERIALS.

1. Longitudinal Tension. Modulus of Elasticity.
2. Longitudinal Compression.
3. Elasticity opposed to Flexure. Principles of Carpentry. Strength of Models.
4. Torsion. Balances of Cavendish and Coulomb.

III.—DYNAMICS.

DEFINITIONS. Velocity. Momentum. Accelerating Force. Moving Force.

EXPERIMENTAL DATA.

1. *Motion undisturbed by external Force is uniform.*
2. *The effect of a Force upon a body in motion is the same as its effect upon a body at rest.*
3. *The velocity acquired by a given body in a given time is proportional to the Intensity of the Force acting upon it* (*force being measured as in Statics.*)

Insufficiency of Dynamical principles derived *a priori*. Examination of Newton's three Laws.

Uniformly Accelerated and Retarded Motion.
Atwood's Machine.
Descent along Inclined Planes.
Motion along a Curve.
Descent in the Cycloid:—in the Circle.
Pendulum.
Used for the measure of Gravity. Necessary Corrections.
Applied to Clocks. Clock and Watch Escapements.
Centrifugal Force.
Conical Pendulum.
Influence on the Earth's Figure.
Deflecting Forces.
I. Parallel deflecting Forces.
Projectiles. Force of Gunpowder.
II. Central Forces. (*See Astronomy.*)
Collision of Bodies.
Force of Impact. Measure of Elasticity.
Direct Collision.
1. Inelastic bodies.
2. Elastic bodies.
Indirect Collision.
Rotation of Bodies.
I. Round a fixed Axis.
Moment of Inertia. D'Alembert's principle.
Centre of Gyration. Rolling bodies.
Centre of Oscillation. Compound Pendulum.
Centre of Percussion.
II. Where there is no fixed Axis.
Centre of Conversion.
Sources and Application of Mechanical Power.
Animal Force.
Inanimate Force. Maximum effect of Machines.
Friction.
Wheel Carriages. Roads.
Stiffness of Ropes.
History of Mechanics. Authors.

IV.—HYDRO-DYNAMICS.

Fundamental Laws of the pressure of Fluids esteemed incompressible.
Practical Application of these principles,—
1. To the exertion of Force in Bramah's Press.
2. To the Spirit Level.
3. To the determination of Specific Gravities by the Hydrostatic Balance. Hydrometer.

THEORY of FLOTATION.
Conditions of Stability of a Floating Body. Metacentre.
Oscillations of a Floating Body.
MOTION of FLUIDS.
Through apertures. Clepsydra.
Through Pipes. Retardation of Rivers. Aqueducts, Water-Courses.
Motion of Sluggish or Viscous Fluids:—*Theory and Mechanism of Glaciers.*
Impulsion of Fluids. Water Wheels.
Resistance of Fluids. Terminal velocity. Resistance to Motion in Canals. Waves.
Reaction of Fluids. Barker's Mill.
Centrifugal Force of Fluids. Centrifugal Pump.
Hydraulic Engines. Archimedes' Screw. Chain Pump. Hero's Fountain. Hydraulic Ram. Thom's Sluices.
Sources of Hydraulic Power.
HISTORY. Authors.

V.—PNEUMATICS.

PRESSURE OF ELASTIC FLUIDS.
Marriotte's Law. Its practical limits.
Pressure of the Atmosphere.
The Barometer. Its application to the measurement of heights.
Ascent of Balloons. Diving-Bell.
Pressure of Air applied to do work.
Action of Pumps. Air-Gun. Syphon.
Atmospheric Engine. Gas Engine.
Application of other Elastic Fluids to the same object.
Steam Engine;—Condensing,—Non-condensing,—Locomotive.
Force of Fired Gunpowder;—of the Liquefied Gases.
MOTION OF ELASTIC FLUIDS.
Force of Wind.
Resistance of Air to projectiles.
Vibrations of Elastic Fluids.
ACOUSTICS, OR THE THEORY OF SOUND.
I. Nature of Sound.
II. Its propagation, (1.) in Gases and Vapours, (2.) in Liquids, (3.) in Solids.
Reflection, Refraction, and Interference of Sound.
III. Musical Sounds in general.
α. Pitch. β. Intensity. γ. Quality.
Vibration (1.) of Strings, (2.) of Air in Tubes, (3.) of Solid Bodies.
IV. Principles of Harmony. Musical intervals. Temperament.

V. Communication of Vibrations.
Vibration of Reeds and of Membranes.
Organs of Voice and Hearing.

VI.—HEAT.

Effects of Heat.

1*st.* Dilatation. Origin, Nature, and Construction of the Thermometer. Dilatation of Gases, Liquids, and Solids.

2*d.* Liquefaction. Latent Heat.

3*d.* Vaporization. Force of Steam. Vapour existing in the air at Common Temperatures. Theory of Solution in Air. Theory of Dalton. Principles of the Hygrometer.

4*th.* Incandescence. Flame. Safety-Lamp.

Sources of Heat.

α. Natural. β. Artificial.

Communication of Heat.

Distinction between *Heat* and *Temperature.* Specific Heat of Solids, Liquids, and Gases.

1*st.* *Radiation* of Heat.

Reflection, Refraction, Transmission, and Polarization of Radiant Heat. *Law of Cooling.* Newton's, Dulong and Petit's. Analysis of Leslie's Discoveries. Discoveries of Nobili and Melloni.

2*d.* *Communication of Heat in Solid Bodies.*

Conducting Power, a specific character of different Substances. Its Definition and Measure. Positions assumed in Theoretical Investigation. Analysis of Fourier and Libri. Speculations as to the original Form and Temperature of the Globe. Their bearing on Geological Theories.

Theories of Heat.

Analogies of Heat, Light, and Electricity.

Application of the Doctrines of Pneumatics, and of Heat, to Meteorology.

Constitution of the Atmosphere. Dalton's Views.

Temperature. Climatology. Diurnal and Annual Curves of Temperature. Decrease with Height. Proper temperature of the Earth and Ocean.

Pressure. Periodical Variations. Accidental Variations.

Humidity. Hygrometers. Distribution of moisture in the Atmosphere. Wells' Theory of Dew. Theory of Rain.

Atmospherical Phenomena and Precipitations.

VII.—ASTRONOMY.

Apparent Motions of the Heavenly Bodies.

Methods of Observation. Parallax.

Atmospherical Refraction.

FIGURE OF THE EARTH.

Elements of Mathematical and Physical Geography. Problem of the Longitude. Evidence of Changes in the Earth's Figure and Condition.

MOTIONS OF THE SUN AND MOON.

Form of the Earth's Orbit. Seasons.

Sun's distance, figure, rotation, and spots.

Moon's orbit, periodic revolutions, rotation, figure, and physical appearance.

Solar and Lunar Eclipses. Occultations.

OF THE SOLAR SYSTEM.

Kepler's Empirical Laws derived from Observation; viz.

1*st. That the radius vector of a planet describes equal areas in equal times.*

2*d. That the Planets move in Ellipses, the sun being in one of the foci.*

3*d. That the squares of the times of revolution of the planets are as the cubes of their mean distances.*

Primary Planets. Their distances, orbits, periods, heliocentric derived from their geocentric places, figure, rotation, and physical appearance.

Secondary Planets. Their orbits and phenomena.

Comets. Their history and physical appearance. Their orbits, periods, and the variation of their elements. Predicted returns of Comets. Halley's, Encke's, Biela's or Gambart's. The existence of Ether probably deducible from their motions.

THEORY OF UNIVERSAL GRAVITATION.

Historical sketch of the history of Astronomy before the time of Newton. Epoch of the Principia.

Kepler's Laws necessary results of Central Forces of the kind contemplated by Newton.

Spheroidal Figure of the Earth a necessary consequence of Gravitation combined with Centrifugal Force. Attraction of Spheres and Spheroids.

PERTURBATIONS. The mutual action of the heavenly bodies modifies Kepler's Laws.

Lunar Theory. Newtonian Solution of the Problem of Three Bodies. Variation. Annual Equation. Progression of Apsides. Evection. Change of Inclination. Regression of Nodes.

Planetary Theory. Conditions of stability of the System. Lagrange's Theorem. Mutual Action of Jupiter's Satellites.

Precession of the Equinoxes.

Nutation of the Earth's Axis.

*** Aberration of Light.

The Tides.

More recent history of physical Astronomy. Evidence for the Newtonian Theory of Gravitation.

SIDEREAL ASTRONOMY.

The distance of the Fixed Stars. Their real and apparent Motions. Annual Parallax. Double Stars. Sidereal Systems. Universality of the Law of Gravitation. Physical Appearance of Stars and its changes. Nebulæ.

VIII.—OPTICS.

GENERAL PHENOMENA OF LIGHT. Photometry. Propagation not instantaneous. Aberration.

I. REFLECTION AND REFRACTION OF LIGHT.

Reflection at Plane Surfaces. *Kaleidoscope. Goniometer.*

Reflection at Curved Surfaces. Spherical Aberration. Caustics. Formation of Images. *Concave and Convex Mirrors.*

Refraction. Total Reflection. *Camera Lucida.* Refraction through Prisms; through Lenses.

Optical Instruments. *Burning and Illuminating Lenses and Mirrors.* Their application to Light-houses. *Camera Obscura. Magic Lantern. Solar Microscope.*

ON THE EYE AND VISION. *Spectacles. Microscopes. Telescopes. Divided Object-glass Micrometer.*

II. DECOMPOSITION OF LIGHT.

Dispersion.—The Solar Spectrum. Its fixed lines.

Achromatic Telescope. Inventions of Hall, Dollond, and Blair.

Accidental Colours.

Absorption.—Sir David Brewster's Analysis of the Spectrum.

III. UNDULATORY THEORY OF LIGHT.

The preceding facts may in general be satisfactorily explained upon the hypothesis of Light consisting of material particles.

Explanation of Reflection and Refraction, upon the hypothesis of Light consisting of Waves.

The remaining phenomena are more simply expressed in the language of Undulations.

Interference of Light: Dr Young's Discovery.

Colours of Thin Plates. Newton's Rings. Newton's Hypothesis of Fits.

Diffraction.—Experiments of Newton, Fraunhofer, Fresnel, and Herschel. Comparison with theory.

IV. POLARIZATION OF LIGHT.

Phenomena of Double Refraction. Huyghens' Law.

Polarization by Reflection. By Refraction. Its signification on the hypothesis of Waves.

Interference of Polarized Light. Depolarization.

Colours of Crystallized Bodies examined by Polarized Light. Remarkable appearances presented by Uniaxal and Biaxal Crystals and by Quartz.

Polarizing Structure induced in Artificial Substances, discovered by Sir David Brewster.

Circularly and Elliptically Polarized Light. Analogous phenomena discovered in the case of Heat.

IX.—ELECTRO-MAGNETISM.

General Principles of Electricity. Historical Sketch.

Common Electricity. Its attraction, repulsion, distribution, dissipation, and conduction. Electrical Machine. Electrical Balances. *Induced Electricity.* Electrophorus. Leyden Jar. Condenser. Luminous, heating, and physiological effects. *Atmospherical Electricity. Animal Electricity.* Electricity induced in minerals by heat. Application of Mathematical Reasoning to the action of Statical Electricity.

Galvanic Electricity. Discovery. Production. Voltaic Pile. Its mechanical, luminous, heating, physiological, and chemical Effects. Conduction.

Electricity developed by Contact, by Pressure, and by Chemical Action.

Magnetism.

Its Discovery and Laws. Artificial and Natural Magnets. Its Communication and Distribution.

Terrestrial Magnetism. Variation. Dip. Intensity. Position of the Magnetic Poles. Influence of the Aurora Borealis on the Needle. Gauss's Instruments and Methods of Observation. Desiderata.

Analogies between Magnetism and Electricity.

Electro-Dynamics. Oersted's Discovery of the mutual action of a Magnet and a current of Galvanic Electricity. Extension to Common Electricity. Theory of Ampere. Probable Origin of Terrestrial Magnetism.

Magneto-Electricity. Discovery of Faraday. Its Production. Its Physiological, Magnetic, Luminous, Heating, and Chemical Effects. Applied to the Explanation of Arago's discovery of Magnetism induced by Rotation.

Thermo-Electricity. Discovery of Seebeck. Its production, magnetic effects, and other properties. Thermo-Multiplier.

Identity of Electricity derived from different Sources.

PRINTED BY STARK & COMPANY, OLD ASSEMBLY CLOSE, EDINBURGH. 1844.