

**Syllabus of a course of lectures on natural and experimental philosophy /
by A. Walker.**

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S Y L L A B U S
O F A 4
C O U R S E O F L E C T U R E S
O N
N A T U R A L A N D E X P E R I M E N T A L
P H I L O S O P H Y,

By A. W A L K E R.

THE design of this Course is to convey clear ideas of the general order and œconomy of nature; and of the laws by which it is regulated. For Philosophy is a scrutiny into those first institutes by which the Almighty was pleased to create, govern, and regulate the universe; and sets before the inquisitive mind the progress made by human enquiry into this sublime knowledge. The method by which this scrutiny will be prosecuted is in the following order, viz.

LECTURE I. *On the general Properties of Matter.*

1. EXORDIUM on the benefits and improvements arising from philosophical enquiry in arts, trade, agriculture; the knowledge of the Deity, and ourselves.

2. *Matter*, what?—Proved to be made up of particles infinitely small, infinitely divisible, inert, and impenetrably hard, by many new and curious experiments.

3. How the four simple elements of air, water, fire, and earth, in various combinations, form all the bodies or substances in nature.

4. How the principle called the *Attraction of Cohesion* unites the particles of matter into masses of stone, metals, wood, &c.—How this principle, differing in its mode and degree, gives that infinite variety in the hardness, texture, colour, flexibility, &c. of bodies.

5. Capillary attraction (a species of cohesion) accounts for vegetation, secretion, digestion, absorption, &c. illustrated by various experiments.

6. Original particles of matter of the same weight, proved by the descent of a guinea and feather in vacuo, &c.

7. Attractions further explained by *Magnetism*.—Its history, properties, mode of communication and deprivation, explained by new and uncommon experiments—how far an effluvia may be considered as the cause—how far the earth itself may be considered as a magnet, and the cause of the needle's variation, and its dip. Magnetic declination, line of no variation, &c. delineated and explained on a terrestrial globe, covered with the lines of variation on all parts of the earth's surface, taken from Euler, Halley, and last from Captain Cook and others of the latest observation.—Best methods of making artificial magnets, and preserving their attraction.

8. Definition of fire; its properties and effects in an active and latent state.—What are good and bad conductors of it. Phlogiston, and vital air, proved to be the principle of inflammability.—Why fire going into a latent state shall produce *cold*; and into an active state, *heat*. Hence, the reason why cold is produced by mixtures, evaporations, &c. and that heat should expand, and cold contract all kinds of bodies. *Animal heat* (in health) proved to be the same in the hottest and coldest climates, and why.—The pyrometer, æolopile, thermometer, pulse-glass, &c. assist in the above definitions.

LECTURE II. *Mechanics.*

1. **T**HE *Laws of Gravitation* explained by the figure of the earth—the attraction of mountains—the descent of falling bodies—planetary motion, &c.

2. *Centre of Gravity*—defining why leaning bodies do not fall—why bodies may be suspended on a point—and why others may appear to roll upwards.

3. *Laws of Motion*—shewing how two contrary motions produce a third;—how swimming, flying, and shooting, is performed;—how curves and projectiles are generated; and how these laws keep the planets in their orbits.

4. The momentum of a stroke or falling body explained, and calculated.—Percussion and resistance, what.

5. How what we gain in power is lost in the time of working any machine; and how its momentum or moving force is calculated.

6. The lever, wheel and axle, pulley, inclined plane, wedge and screw, explained by various models and experiments, and their united power defined by a machine composed of them all.

7. Friction, of both kinds, what.—Surfaces and pressure, how they add to or diminish friction.—Friction-wheels, friction-balls, or rollers, how applied to mills, engines, wheel-carriages, moving the large stone to Petersburg, &c. and how much rubbing or friction takes from the power of all machines whatsoever.

8. An explanation, by working models, of the common pile-driver.—*Voulon's* pile-driver for *Westminster* and *Blackfriars* bridges.—A saw-mill.—A wind-mill, with an equable motion, and that turns itself to the wind.—The universal joint.—Mr. *Craik's* drill-plough, that saves one-third of the seed, rolls the ground, and harrows it at

the same time.—A turnip drill-plough.—A ventilator of a new construction, that takes out corrupt air from hospitals, ships, sick rooms, or cellars, and pours in a current of fresh air.—Machine for clearing the bottom of rivers.—Carts, waggons, coaches, &c. the advantages and disadvantages of their present construction.—Broad and narrow wheels, friction-wheels, high and low wheels, dished wheels, spring-spoke wheels, teams, and single-horse carts, considered.—How best to apply animal strength.—Shoeing and yoking horses, &c.

N. B. As these models take up too much time, their explanation will be made to any Subscriber who desires it, after the Lecture.

LECTURE III. *Principles of Chemistry.*

1. **S**HEWING how the mechanical and chemical Philosophy ought to go hand and hand.

2. **TERMS OF CHEMISTRY** explained, &c. viz.

1st, **SOLUTION**; by a mechanical exhibition of it—by salt and water—by copper and nitrous acid—by acid and alkaline waters—by analyzing Bath, Seltzer, Pymont, Spa, Harrowgate, Tunbridge, &c. waters.

2d, By concretions, petrifications, the rise of water in air, and its descent in rain, hail, or snow.

3d, **DISTILLATION**; by sea water converted into fresh water—by wine turned into brandy, &c.

4th, **SUBLIMATION**, or dry Distillation; by the rise of sulphur—by the fluors of benzoin—by phosphorus, &c.

5th, **PRECIPITATION**. Of copper by iron—of silver by copper—of iron by fixt alkali, &c.

N. B. These processes may be called *revivification*, as by the above processes it may be seen how the calx of lead, of iron, of copper, &c. may be revived into their respective metals.

6th, **CRYSTALIZATION**. Of gum benzoin—salts of iron—ammoniacal salts—camphor—magnesia, &c.

7th, *Evaporation*. Of salts per deliquium—and in solution.

8th, *Affinities*. Of colours, how produced—how made permanent, and how destroyed.—Polarity, or arrangement of particles, the cause of transmitted colour; proved by new and striking experiments.—Fire defined in an active and latent state; by being let loose from cold bodies, and producing instantaneous heat; and by ice produced near the fire.

LECTURE IV. *Pneumatics.*

THE mechanical properties of the air proved to be, 1st, That heat, or fire, keeps its particles at a distance, and hence its elasticity, by which it is capable of occupying a greater space than

it naturally possesses:—2dly, Capable of being squeezed into less compass than it naturally possesses:—and 3dly, That it is a circumambient ocean—thickest or most dense near the earth's surface, and growing gradually thinner, or more rare, the higher, till it degenerates into nothing.

2d, That it is a body capable of excluding others from the space it possesses.

3d, How necessary to respiration, shewn by its effects on the blood in the lungs—by its purity, and by its phlogification; being breathed, burnt, &c. Hence its effects on animals shut up in close vessels—the Hole of Calcutta—the diver's bell, &c.

4th, That it gravitates, or is kept fast to the earth's surface, by the earth's attraction, and incapable of leaving it, proved by a variety of striking and incontrovertible experiments; in which will appear how *air* and *water* dissolve or imbibe one another; how *vapours* rise into and fall from the atmosphere—the reason of the rise and fall of the quicksilver in a barometer—and why it foretells rainy or fair weather.

5th, That there is no such principle as suction.

6th, How the spring or elastic quality of the air is occasioned—and why that spring is equal to the pressure; illustrated by setting nature to work in various ways, to prove the truth of this proposition.

7th, Definition and reason of winds, viz. irregular, periodical, partial, trade-winds, monsoons, day and night breezes, tornadoes, drafts, buzzings, &c.

LECTURE V. *Pneumatics.*

1. **T**HAT the air is capable of being compressed, proved by the air guns, and various fountains.

2. The theory of sounds, musical chords, musical instruments, echo, &c. illustrated by a dissection of the human ear, by artificial ears, speaking-trumpets, and by firing gunpowder, and striking a bell in vacuo.

3. That the air is an heterogeneous assemblage of the fine particles of all bodies it comes in contact with—that it attracts and precipitates like all other chemical menstrua—proved by artificial, inflammable and suffocating damps—by the nature of infections—and by its dissolving the phlogistic matter of the blood in the lungs.—Hence are pointed out the disorders occasioned by breathing corrupt and noxious air, and the evils arising from living in low, small, or close rooms.

4. That the air lies in a fixed or latent state in, is a constituent part of, and may be drawn from all animal, vegetable and mineral substances; proved by Dr. Priestley's new and curious experiments on airs or gas produced by effervescence, fermentation, putrid substances, breath

of animals, smoke of metals, &c.—How putrid, mephitic, or poisonous airs are produced, affect animals, and are cured.—How vegetables produce good air, and cure bad.—The antiseptic qualities of fixed air (or aerial acid) related (with the mode of its production) as a probable cure for putrid disorders.—*Dephlogisticated, vital, or empyreal air* produced—how an ingredient of inflammation, and of necessity in breathing.—*Inflammable air* produced—proved to be our nearest approach to elementary phlogiston—the same in all inflammable bodies—the other ingredient (with vital air) of inflammability in all combustible bodies—calxes revived by it, and air balloons filled with it.—*Nitrous*, or trial air produced—also acid air, alkaline air, phlogisticated air, fluor acid air, &c.

5. Water produced by the inflammation of two airs, and iron burning as a stick.

LECTURE VI. *Hydrostatics,*

1. **H**OW far water is compressible—proved by the *Florentine* and Mr. *Canton's* experiments—the pulse-glass, &c.

2. That it presses in all directions alike, according to its perpendicular height—proved by pillars of particles—specific gravities—models of smoking chimnies, and their cure—by hydrometers—by lead made to swim, and cork to sink—by a new experiment to shew how much its pressure is against banks, flood-gates, sides of perpendicular pipes, tops of drains, &c.—by the hydrostatic paradox—by swimming—by *Faux's* figures—by the bed made in water by a ship—and by fountains.

3. What solids heavier than water lose by being immersed in it—proved by weighing lead, brass, gold, &c. in air and water—by the alloy found in King *Hiero's* crown, and in English and foreign coins.

4. The nature and use of cranes and syphons explained by decanting fluids out of bung-holes, wells, &c.—*Tantalus's* cup, intermitting springs, &c.—Hence the doctrine of fountains, brooks, rivers, &c.

5. The doctrine of spouting fluids—proved by their effects on water wheels in lifting weights, &c.—by the most approved methods of applying water to wheels—best angle for horizontal spouting—and by the ratio of tapping an head of water.

6. Working models of *Archimedes's* screw pump.—Household or sucking pump—force pump, & extinguishing engine.—Lifting pump—(best way of applying manual strength to them.)—Square pump, with a pyramidal piston (peculiarly adapted to draining.)—Centrifugal pump, that forms the vacuum by a whirling motion.—Pumps that work by the motion of a ship.—A rope pump—and one that is both a lifting & forcing pump in one tube, worked with less labour than any yet contrived, throwing water to any height.—Bucket engine to supply houses or towns with water.—Another for draining mines, of vast power and simplicity.—*Dr. Barker's* cylindrical mill, that gives

motion to the stones without wheels, cogs or rungs.—*Blakely, Boulton and Watts's* patent fire or steam engines.—A common fire engine, with an inverted piston; and one on an entirely new construction.

Many of these engines are only to be seen at the stationary Lecture-Room, George Street, Hanover Square.

LECTURE VII. *Electricity.*

1. **H**ISTORY and present state of discoveries in Electricity.
2. Electric and non-electric substances exhibited by various experiments on conducting and non-conducting substances.

2. Nature of points and round bodies in receiving and parting with electricity—proved by sparks—by mills made to move by the electrical effluvium issuing from a point—by an electric orrery—by the feather experiment—by the wires for preventing damage by lightning—and by experiments made on pointed and round-ended conductors.

3. Electrical attraction and repulsion proved by ringing of bells—and experiments made with the electrometer, electrophor, &c.

4. Theory of negative and positive electricity—proved to be agreeable to the Franklinian hypothesis by the electrical flash—by the electrical circuit, and the electrical shock.

LECTURE VIII. *Miscellaneous Experiments in Electricity.*

NATURE and cause of lightning, thunder, earthquakes, aurora borealis, luminous appearance of the sea, &c.—why steeples and houses are liable to be struck with lightning, and how prevented—the safest situations in a storm of lightning pointed out—and why its mischief seems so whimsical and partial.—Each of these heads explained by phials, batteries, artificial clouds, showers, &c. 1st, The danger of breaks in a conductor shewn, by stones struck out of a wall, and the demolition of a tall pyramid. 2d, The danger of combustibles being in the way of lightning, by the blowing up of a house, the firing of spirits, cotton-wool, inflammable air, gunpowder, &c. 3d, Positive and negative electricity illustrated by various experiments—how superinduced, disturbed, &c. 4th, Piercing books, breaking glasses, &c. 5th, How electricity is applied medically, viz. by shocks, sparks, effluvia, &c. 6th, Its light exhibited as a name, as a diamond necklace, as an aurora in vacuo, &c. &c.—A beautiful fortification blown up by electricity.

LECTURE IX. *Optics.*

1. **V**ARIOUS insects, seeds, farina, pores in roots and branches of plants, animalculæ in various fluids, circulation of the blood, effervescences, discharging fixed air, shooting of salts, &c. exhibited in a curious solar microscope.

2. Light, what it is, and how affected by passing in and out of different mediums, proved by various experiments on a ray of light

with air, water, glafs, lenfes, prifms, &c. fhewing how light is the occafion of vifion; how and why it is condensed in burning-glafles, and dilated by concave lenfes; why convex lenfes magnify objects, and concave diminifh them; why the picture of objects on the retina of the eye are inverted, and why feen upright; why the prifm exhibits various colours; reafon of colours in general, the rainbow, blue fky, colours in bubbles, &c.

3. Theory of the reflection of light, and the angles of incidence and reflection, proved by experiments on plane, convex, concave, and cylindrical mirrors; fhewing why the image in a plane mirror is twice the diftance of the object; why the whole perfon can be feen in a glafs but half its length; why concave mirrors enlarge, and convex diminifh objects; diftortion, anamorphofis, &c. explained, by paintings feen in concave and convex cylindrical mirrors.—Metals melted in the focus of a large metal mirror.

4. Description and diffection of the reflecting, refracting, the patent, and Dr. Herfchel's telescopes; folar, double, fingle, and field microfcopes; opera glafles; diagonal mirrors; magic lanterns, cameræ obfcuræ, fcyoptric balls, &c.

5. Description and diffection of the eye, the ufes of all its parts, and the whole doctrine of vifion explained, by feveral artificial as well as natural eyes; how that noble organ is beft preferved, and affifted in fhort-fighted young and old people.

LECTURE X. *Aftronomy.*

1. **T**RUE figure of the earth proved by obfervation and menfuration; and illuftrated by globes, planetariums, orreries, &c.

2. How the different Seafons are produced; day and night, long and fhort days; heat of Summer, and cold of Winter.

3. Antipodes illuftrated by globes, drawings, and the terella.

4. Why we perceive not the earth's motion; and how the moft ignorant may be convinced, even by ocular demonftration, that it is the earth and not the fun that turns round every twenty-four hours, and alfo how the earth turns round the fun in twelve months.

5. How little the higheft mountains affect the round figure of the earth; and why the fea appears flat, even to a fpectator on the higheft eminence.

6. How and why aftronomers diftinguifh the furface of the earth and heavens by lines and circles, viz. meridians, latitudes, horizon, equator, tropics, ecliptic, figns, conftellations, declinations, &c.

LECTURE XI. *Aftronomy.*

1. **G**ENERAL theory of the moon.

2. Its phafes explained on the orrery, viz. why it appears horned, gibbous, and full.

3. Solar and lunar eclipses, what—how occafioned—why fo feldom—and how calculated.

4. Why the moon appears so much larger at her rising than on the meridian;—why she rises in the harvest full every evening near the same time for a week together;—why she shines for a fortnight together without setting, every lunation, on the frigid zones.

5. How the earth and moon affect each other, and turn round the common center of gravity; how tides are occasioned; the currents of the gulf of *Florida*, *Gibraltar*, &c. the small tides of the *West-Indies*; rapid and high tides of the *Thames* and *Severn*; the equinoctial tides, and the tides of the air.

6. Presumption that the moon is a world; dissertation on her motion, seas, continents, mountains, and how the earth must appear to her inhabitants.

LECTURE XII. *Astronomy.*

1. *P*tolemaic, *Tychonic*, *Copernican* systems, what.

2. Planetary motion by *Descartes*' vortices exploded.

3. *Newtonian* doctrine of centrifugal and centripetal motions explained by curious experiments on the whirling tables, and applied to the explanation of planetary motion;—*Kepler's* problem—and the correspondence of areas and times solved by them.

4. Dissertation on, and probable cause of, the Flood—deduced from the shells and fish-bones found on mountains—from the arrangement of mountains—the breaks in mines—the dipping strata of the earth, &c.

5. On the grand orrery, and transparent ditto, will be a description of each planet in the solar system, its motions, appearance, and moons; in the course of which will be given a familiar doctrine of parallax—how the distances of the heavenly bodies are found—what advantages the world may derive from observations on the transit of *Venus*—what is meant by the equation of time—precession of the equinoxes—the longitude how found by *Jupiter's* satellites, the retrograde motion of the planets, &c.

6. Dissertation on comets, and the universe of systems.

7. Recapitulation of the whole.

* * * *An Epitome of these Lectures, to assist the memory, sold in the room. price 2s.—Also, Mr. Walker's Tour through Europe, price 6s.—another to the Northern Lakes in 1791, price 4s.—and a Treatise on Smoky Chimnies.*

† *Noblemen, or others, may have this Course read at their own houses (if at a proper distance from the apparatus) on easy terms—Use of the Globes taught, &c.*

N. B. *Many of the models mentioned in this Syllabus are too cumbrous to travel, and may be seen at Mr. WALKER's, George-street, Hanover-square; where the Lectures during Winter are read every Monday, Wednesday, and Friday, at Twelve o'clock.*