Notes of a Course of Lectures
on Natural Philosophy

By J. Dunwoody L.L.D.

Space and Time

Space is extension without matter —
— Three dimensions — The subject of Geometrical investigation — remarks — Demonstration —
— Space absolute — relative or place and situation — first impossible — second possible —
— Divisible — in infinitum — Demonstration
1 Points — 2. Parallel lines 3. Rectangle and square — observations — Space unbounded —
— Time — cannot be defined — succession of events — beats of a watch — a proper quantity tho' we may not be able to measure it accurately — Instants — moments — Analogy between space and time — Time like space may be represented by lines or numbers — remarkable difference is that the latter is of three, the former only of one dimension
— two points of space are at distance, two ~~points~~ Instants of time are successive — Divisible without end — Eternal homogeneous — All things are placed in space in the order of ~~succession~~ situation, all things placed in time in the order of succession — remarks or creation — absolute time unknown — sensible or relative
— Season measured — Analogy between space and time same epithets — Duration different —
Space is the object of Geometry, not of Nat: Philosophy

Of Matter

Definition — what things can and what not be defined —

Essential property unknown —

— Distinguishing properties

1 Extension — this the Essential property of space — Three Dimensions

2. Divisibility — In infinitum — observations on the pretended mathematical demonstrations of the infinite divisibility of matter

— Actual divisibility carried to great lengths — 1 grain of Gold wrought into leaf will cover fifty square inches — a Cube of Gold $1\frac{1}{4}$ Inch in the side will gild a Silver wire sufficient to surround the globe — Chemical Solutions — Copper in aquafortis one grain to ~~the~~ a gill will cover with an incrustation of copper as much clean iron wire as the aqua fortis will wet — Silver in Nitrous acid &c

— Two ounces of assafoetida in fourteen days lost 3/4 grain of its weight — sphere which its particles filled — Candle — light through a glass — how the first ~~thus~~ ~~are~~ is not affected &

either the idea of Solidity is supposed to [illegible]

& the light of all the other Stars be hid
& much in its course !! —

Microscopic animalcules — some as much less
than a grain of sand as that grain is less
than two hundred and sixty of the largest
mountains in the world —

+ Consequences of the supposed infinite divi-
sibility of matter — In one thin cuticle of
animalcules, in the Blood of minute
animals, it supposes that a grain of sand
would contain more of these animals than
10.266 of the largest mountains would
contain grains of sand — It is necessary
to suppose bodies made up of small particles
+ any quantity of matter however small may and
any finite space however great, being given the
small quantity of matter may be so diffused
thro' the space as to fill it so that there shall
be no pore in it above a diameter shall exceed a given
straight line — None

+ There may be a given body whose matter shall
be extended into a space absolutely full, that space
may be any given part of its former magnitude

+ There may be two bodies of equal bulk whose quan-
tities of matter may be unequal in any proportion;
yet the sum of their pores may shall be nearly in a
ratio of equality

— Solidity of Matter —

Solidity is an universal property of matter the only property which completely distinguishes it from space spirit &c. — every thing else. — Solidity is that prop. by which matter occupies space to the exclusion of other matter — two particles of matter cannot exist in the same place at the same time. — acquired by ~~the~~ the sense of touch — sight could never have given ~~this~~ this idea — Painting camera obscura communicates shape colour and all the other properties of a body except solidity, which can only be acquired by ~~the~~ touch

— This property called sometimes impenetrability

— Bodies appear to be easily penetrable Instances of the apparent penetrability of matter — Light through transparent substances glass — water — the finger held between the small hole in a window shutter — Musk through ~~wall~~ wood — Sulphurous vapour tinges ~~gol~~ silver through many folds of paper. Sympathetic ink through a thick vol.^m Chemical experiments &c — These prove Matter to be porous — box with musket bullets

— The resistance opposed to the touch which excites the idea of solidity is supposed to arise

on contact. Yes It is extremely probable
that the particles of matter are not in contact
Expanded by heat and Contracted by cold
Copper and Iron occupy a less space when cold
than respectively — water and Spirit — Two
objects glasses of a long focal distance do not
touch — & Those proves the particles not be
in contact — Electrical shocks

— Boscovichs System — General view of it —
— Bodies are in many remarkable instances resisted
repelled with without coming in to contact —
— Physical points endued with powers of at-
traction and repulsion —
Magnitude of a Body is the Geometrical
Solidity —
— Since the particles of matter are not in con-
tact and its diff! bodies may be placed at
diff! distances from each other, hence equal
magnitudes may contain unequal quantit
ties of matter —

— Quantity of matter depends on the bulk
and Density — which last term expres-
ses the nearness of the particles to each oth
or fewer portions of the number of particles

in one body to the no. in another of the same bulk — I say in proportion for absolute number of particles in any body is wholly unknown — The Quantity of matter in a body is equal to the bulk × the density &c M = B. D ——

Formula —

$$M \doteq B.D. \quad B \doteq \frac{M}{D}. \quad D \doteq \frac{M}{B}$$

The weight is an accurate measure of the quantity of matter — this supposes the ultimate particles of the same bulk and weight and that the difference among bodies of different weight arises from the number of particles which the bodies contain — Admitted particles of matter totally unknown —

+ Experiments — water hammer — air striking the pumpstaff after breaking the bladder — Elastic shaft

— Inertia of Matter —

Matter hopefully indifferent to either motion or rest — The resistance which a body shows to an attempt to change its state from rest to motion ~~&c~~ or the contrary is called the vis inertiæ — Proportional to the quantity of Matter — Every body continues in its state of rest or of motion uniformly in a straight line —

Motion

Every particle of matter is connected with only one point of space and one instant of time — If it is not annihilated the moment of its creation it becomes connected with successive instants of time. If it remains in one point of space it is said to be at rest, but if during the successive moments of time it becomes connected with the several contiguous points of space it is said to be in motion — Motion is therefore the successive existance of a body or particle of matter in various contiguous ~~space~~ points of space ——— But this definition does not make it intelligible — Simple idea incapable of definition — Since no attempt of ever made to define rest or any motion, we think first more natural to matter. But we shall afterwards learn that from the moment any one particle of matter was put in motion, it was impossible for any other particle to remain at rest —

— Motion must be performed in an instant, otherwise a particle of matter would exist in two points of space at the same instant of time ——— Also in a body in moving from one point of space to another must pass thro' all the intermediate points, otherwise during the interval of the motion it must be no where. ———

— Absolute and relative motion — The former is the change of absolute place, the latter that of situation — Illustrated by Examples — The relative motion of bodies are the differences of their absolute motion. ——

— Absolute and relative motion may be different and even contrary to each other ——

In any case the discovery of absolute motion is impossible — Examples —

Newtons illustration of Absolute and relative motion by a bucket of water, hung by a string twisted & motion of Ships — Heavenly bodies — centrifugal force &c. All that can be observed in motion is the space passed over and time employed — In the space and duration both susceptible of three varieties — In space form or magnitude — Duration is called the Duration. If the duration never changes the path is a right line and the motion is uniform — Curvilineal — Direction or that part in any point is the tangent to the curve in that point — Magnitude or length of the path determines the quantity of motion — A motion is similar to another when its path duration and direction are similar and it is dissimilar when any of them are dissimilar — If the time is long it is called slow, if short fast. If the path is long it is called swift, if short, it is called slow — The terms swift and slow do not depend on the space alone but on both jointly — The quality by which motions differ in this combination of ideas of space and time is called Velocity — the rate of incident — The term velocity expresses how much of one thing corresponds to a determined unity of another — In this sense the term velocity must be understood not as expressing any proportion as subsisting between space and time but only the proportion which such subsist among the different spaces corresponding to the same determined unity of time

Motion Uniform — Accelerated — Retarded —

In consultation respecting the two last Numbers we are obliged to suppose the Motion uniform for a very small portion of time — But not strictly true. But when the time is taken less than any assignable quantity the velocity — the proportion of our Numbers will be true — Since the Motion that during an infinitely small portion of time, or through an infinitely small space the velocity is constant —

— Uniformly accelerated or retarded motion is when the velocity receives equal increments or decrements in the equal times —

— It is only in respect to time that the notion of Natural Philosophers differ from that of Geometers. In Elementary geometry figures are considered as produced by motion but without any regard to time — It was reserved for Sir I. Newton to ~~excite~~ create a new and sublime species of Geometry by introducing this idea into the notions considered —

— As in all varied motions we are obliged to suppose the velocity uniform for a certain moment of time and from the properties of uniform motion we determine the momentary properties of any motion, however varied, it becomes necessary first to consider the chief properties of uniform Motion —

Assumption

1st $s \div T.\ 2\ s \div v.\ 3,\ T \frac{1}{v}.\ 4^{th}\ v \div T\ 5^{th}\ s \div vT$

6th $v \div \frac{s}{T}.\ 9^{th}\ T.\ \frac{s}{v}$

As the change of Motion is measured by the
Path of the motion, and as this depends on the
velocity, the quantity of motion of any particle
will increase with its velocity, and consequently of
any body as the product of the two, particles or quan.
of matter into the velocity; or it will be equal to a
rectangle under the Quantity of matter and the

Therefore Let Q = quantity of motion or Momentum
M = Quantity of matter
V = Velocity

Then $Q \doteq M.V.$ $M \doteq \frac{Q}{V}$ $V \frac{Q}{M}$

2d and 3d Laws of motion

Rem — Compos" and Resolution of forces

x The instantaneous action of the moving
cause is supposed to produce continued
motion

Attraction

– How can matter be said to be inert when it is constantly exerting power? – Greater ~~inerate~~, spiritual, powers in the latter were imposed —

Exp. light bodies such as Glass Globules corks &c. floating on the surface of water tend toward the sides of the vessel and one another

– This ~~can~~ power whatever be its cause was called by Newton attraction –

– A body near the earth when unsupported falls to the Earth — attraction of the Eart

– Two kinds Corpuscular attraction and Gravitation — universal principle inherent in all bodies as far as observation goes –

Corpuscular-attraction

— This species of attraction acts most powerfully in apparent contact and decreases rapidly by a law not yet discovered —

Phenomena — Analysis

Two Glass Globules floating on water attract each other — one may be drawn forward by the other — Swan — water rises on the sides of vessels and floating bodies — Water rises in capillary tubes — Drops of water, wine, and other fluids round — water hangs to the finger — Two plane surfaces cohere — Marble or glass more powerfully when wetted or oiled
× the fluid excludes the atm air whose spring would tend to separate them — Two pieces of lead cohere with a prodigious force — water rises between two plates — parallel — Inclined — In the latter case the surface is a Hyperbola — Water raised in the rope pump by this attraction — ~~The attract~~ These attract take place in the same degree in Vacuo, there fore the atmosphere has no share in the production of the Phenomena —
× India Rubber, clay, bird lime &c Glue —

— Drop of merc.y on paper and iron
round on all other metals flat —
— Heights in Capill.y tubes $\frac{1}{9}$
— Cause of the ~~attraction~~ ~~the~~ motion the
attraction between the water and the Glo-
bule or cork, not as commonly supposed
between the side of the vessel and Globule
-proved by presenting a dry and wet tube
to the globule, attracted by the latter but
not by the former — and by greasing or oiling
the bubble — Water raised in Capillary
tubes by the attraction of the ~~power~~ highest
glass annulus of the tube — If the
brim of the vessel be made dry and ~~the~~
the water raised above the brim so
as to be highest in the middle the
globule will move towards the middle
Synthesis
— Solidity or compactness of bodies texture
owing to Coh.n attraction — Ascent of
fluids thro' vegetables — sponge sugar
sand &c — watering a plant —
+ If a glass tube be rammed full of dry ashes
the water will in the course of 2 or 3 days
rise to the height of 30 or 40 Inches

a drop oil will move up an inclined plane towards the concourse of the two planes If a piece of fir wood of one inch in surface is soaked with water, and float on the surface it will require a weight of 5 grains besides its own weight to seperate it from the surface — The Owing bell when near the surface requires a great additional power to seperate it from the water — Bubbles of air in beer — attracted by the glass — On the surface of an egg in water in Vacuo — Light attracted by transparent media — hence Refraction and Reflection — Light attracted by opake solids hence inflection of light — undulating line

— water oils &c are retained in the hardest bodies by this attraction which is so powerfull that in many cases nothing but fire is capable of seperating them — The above species of attraction [corpuscular] is commonly called Co-hesion

+ There is another kind called Chemical or Electrive attraction — Examples of Chemical attraction — Solution — Precipitation — &c —

× Sir I. Newton — principle — When a fluid attracts a solid with a force greater than the cohesion of the solid — part be of the solid, unite & ffluid