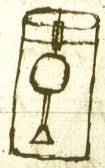
Matter The term matter is applied to all ponderable substances & which is only known to us by its properties. These may be divided into essential & secondary & without them matter could not exist. The essential qualities are extension, impenetrability, & inertia, by which we mean; 1stly space 2dly the property of excluding all other atoms from its own space, & 3dly we mean by inertia the power of remaining in that state in which they may be. at rest from The secondary properties are such as give to matter their common appearance, such as 1st gravity, which exist equally in all substances, as may be seen by a feather & a guinea descending with equal velocity in vacuum

Sp. Gravity but their Specific Gravity is according to their density, when compared to some other menstruum. To find out the exact proportion, there are several instruments.

Hydrometers for Fluids 1st A hollow ball with a weight attached at one end & a scale at the other, which rises or falls according to the density of the fluid in which it is immersed. to wit. —



Mr Loyd's Hydrometer

2nd A is an empty empty full E is a tube leading from it & F a notch in it. B a vessel full of the fluid whose Sp Grav is required, & D a cup with weights. — So that suppose B is filled with water & ~~keeps~~ it requires a 1000 grains to immerse A

to the notch F, but that it requires 1800 grains, when B is filled with S Acid, then 1800 being divided by 1000 the quotient is 1.8 which is the Sp Gravity of the S Acid.— There is also one more way, viz. — a number of small balls regularly graduated, so that when thrown into any fluid the one that remains stationary, has the Sp Gravity marked on the outside. For solids, the process is very simple viz weigh it in water & then out of it, & the weight of it in air not immersed ~~water~~ divided by the difference is the Sp Gravity.—

(I have missed two lectures on account of illness)

Heat.— Caloric possesses these three great ~~qualities~~ properties viz Expansion, Evaporation, & Incandescence. Most bodies when Caloric is applied to them, expand & when subtracted contract but there are exceptions. Thus water (& some other substances as Iron, Bismuth & Antimony expand at the moment of consolidation, which fits them so well for receiving impressions) gradually expands from 39 1/2 Far, which is its maximum density, to 32 when it is increased in bulk $\frac{1}{10}$th

Mr Loyd's Hydmr [1] [2]

Mr Lowe's Hydrom

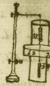
Heat

Water expands at congelation

Dr Hope's [3] method of showing that water above $39\frac{1}{2}$ becomes Sp. lighter.—

Dr Hope has shown this very neatly.

32° + 68° — et vice versa — 39½° + 32° } (39½° is Max D)



Thermometers

Of this property of expansion in heat, we make various uses, of which one of the greatest is, the Thermometer. The principal fluids used in this instrument are Air Alcohol & Mercury. Air is used for very delicate experiments, Alcohol for intense cold, & Mercury for all common purposes. The great advantage of Mercury is that up to 212° of Far it expands equally, which is not the case with most other fluids. In different countries different scales are used: thus in England Farheit, & on the Continent chiefly Celsius or commonly called the Centigrade. from its being divided, between the freezing & boiling point into a 100°— whilst Far is in 180°.

To reduce different scales.

so that to reduce the ~~one~~ former into the ~~other~~ latter.

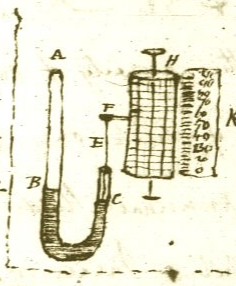
$$C^\circ \times \frac{9}{5} + 32 = \text{Far}$$

In Reaumur it is

$$R^\circ \times \frac{9}{4} + 32 = \text{Far}$$

Register Thermo.

There is also another kind of Thermometer, called a Register, for which purpose they have been various means invented. Such as this, which is by far the most ingenious & useful. —



A is a tube filled with Spt of Wine from B to C is Mercury. C a float & E a wire, fixed in the float at one end, & at the othe F a pencil. - H, a revolving cylinder covered with paper, ruled vertically & horizontally, the former for the times & the latter for the degrees. - So that the Alcohol expanding in A pushes up the float C. & with it the pencil F. thus marking the cylinder, which is made to revolve in a certain given times. —

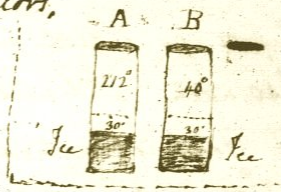
All bodies tend to a diffusion of Caloric, yet their capacity for it, is by no means the same, thus if equal quantities of Mercury & water be mixed together, of different Temperatures, the

Capacity

Medium will be nearest that of the greater, shewing that water has the greater capacity.

The power of Conduction.—

Different bodies conduct with different power, thus from most of the metals conduct Caloric quickly; while fluids are extremely bad conductors.



For example.—
The Ice in B will melt sooner than that in A.
The reason of this is that the water at 40° is at its Mr Density, & therefore penetrates the stratum of cold water & so reaches the Ice sooner, than the water 212°. which is Sp. Gr lighter that that at 30°.— This also proves that water only transmits Caloric by the motion of the particles themselves, & not by specific conduction.—

The Mr Density in Salt & fresh water.—

The Mr. Density in Salt & fresh water is 7° ½° above each of their freezing points. which is the reason that

? Air passing over the former becomes much colder than when it passes over the latter." ? quite incorrect—

N L. 50° – 6260 } above the surface
— 55° – 4912 } of the earth, is
— 70° – 1557 } perpetual congelation.

Other Philosophers have calculated that for 335 feet ascent there Temp. diminishes 1° Fr.— The cause why the Atmosphere near the surface is hotter than a higher air is, that the lower stratum is more condensed by the great weight of the superior air & therefore does not obey the common law of hotter fluids

ascending; whilst the upper stratum is cooler, & of that reason because has a greater capacity for Heat.—

When any body is liquefied, a certain quantity of Caloric is imbibed which is not sensible to the Thermometer, so, as called by Dr Black the discoverer, latent. Also when a liquid becomes solid a great quantity of Heat is evolved,—all which Phenomena admirably tend to an equilibrium of Caloric in Nature

latent Caloric

Water when converted into steam increases in bulk 1700,. When the weight of the atmosphere is taken off water it boils at below the temperature of the human body.

When air is included in a bottle, although shut out from the surrounding atmosphere, yet presses on the inside with a force equal to that which is exerted on the outside, this is caused by the elasticity of the air, which of course when introduced into the vessel, is of equal density with the surrounding atmosphere.

Water boils at a lower temperature in Iron than in Glass so that, when water is only boiling gently in a Glass Vessel it will boil much more rapidly, if a piece of Iron is thrown in. — There have been various hypotheses how the atmosphere retains its vapours. D'Hopes opinion is, that the water it is held in solution, as the air like salt in water. The atmospheres capacity for water does not decrease in a regular ratio as the temperature becomes less, this is the reason why Rain is formed when two currents of air of different temperature meet, shewing that the capacity of the mixture for water is less than its component parts. When very dry air is exposed to moisture it increases in bulk $\frac{1}{5+4}$. but if confined it also increases in elasticity in the same proportion.

Unconnected facts.

Hygrometer

Of all the various Hygrometer which have been invented for ascertaining the quantity of moisture in the air Mr Leslie's one is one of the most ingenious, namely, his differential thermometer, having one of its bulbs covered, with muslin dipped in water, which instrument by its fall or rise, shew the rapidity or slowness of the evaporation of the water.

Radiation

Heat is diffused by two ways conduction & radeation.

All bodies throw of heat in right lines, which do not affect the air in their passage, and are easily collected into a focus by a lens or Mothers, this is called radiation & on which many Natural Phenomina depend.— Different bodies throw of heat in this manner with different powers, thus a black substance throws it off more quicker than a metallic or as splendent. And Lechonery the Black substance at a 100

8) The same substance covered Paper radiates

at 98 Glass at 90 Red Lead 80 + Metallic subn 12.	All these substances if cooled below the surrounding air receive Caloric with the same powers as they transmit it.

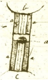
There have been many doubts whether bodies at the same Temperature radiate, this is proved by various substances as glass, wool, straw &c becoming cooling on a clear night cooler than the ambient atmosphere caused by their being no clouds to radiate in return

The Glass Valve in Booths Apparatus. Glass Valve in Booths Appr.

(a a) tubes from the upper & lower vessels.

(c b) smaller tubes open at both extremities fitted into a a - a a

(d) a plano-convex piece of Glass which plays in the space between c & b its plane surface is ground to the edge of c & its convex is made rough



A Vegetable blue destroyed by Chlorine becomes red by a further addition of the blue. Explanation. - when Sulphurous Ac. is added to a blue they unite & form a colourless compound but when chlorine is added decomposition ensues, the Chlorine takes Hy Drogen & forms Mur. Ac. the Oxygen unites with colouring principle, form a colourless compound so that upon a farther addition of Vegetable Blue the Muriatic acid exerts its proper action. - Bleaching power of Chlorine

1826 — Dr Hope's Chemistry — 10 (9

Notes Chemistry