No 3

Notes

on

Davys Lectures

Royal Instn

by M. F.

1811

Royal Institution 1811 —

Saturday 9th Feb. at 2 o'clk

Chemical Philosophy Lect. 4th —

- Radiation of heat, its connexion with light, difference of their effects, Property in light analogous to Polarity. Note & experiments on this subject. Connexion of heat and light with Electricity. Hypothesis respecting heat and light illustrated by Expts. The received doctrines of Chemistry, how connected with this subject.

In this Lecture Mr Davy established the Experiments of Prevost and Leslie on the Radiation of heat and adjusted Radiation of Cold. — Doctor Herschels experiments on the Solar Spectrum were described — Leslie thinks that heat is

radiated by vibrations or pulses
in air like sound. Mr D— disproves
this hypothesis by showing that
heat is radiated in vacuo.
Exp.t Charcoal burned in the
exhausted receiver of the air pump
by the Voltaic battery radiates from
a small mirror and raises an
air thermometer —
— Exp.t with ice was not performed
— also Leslie's experiments with
canisters were only described

+ See Lectures 6th and 7th of
Chemical Philo.y, Vol 2
of notes on Davy's lectures

— Mr D— in remarking that
the Ladies allowed that a silver
tea pot was preferable to a black
earthen one said he always
have great regard to the obser.s
of the Ladies!!

Saturday 16 Feb. 1811

Chemical Philosophy Lect. 5th

Elect. in its application to Chem.
General properties of Electrified
bodies, Attraction, Repulsion; con-
struction of the apparatus of Volta
and its operation exhibited by the
great combination of 2000 double
plates. Experiments on the form-
and decomposition of bodies.

Description of the Voltaic
apparatus. Shewed the effect
of the great combination of
2000 pair by Experiments on
Charcoal various metals Copper, Silver
Gold, Platina — fusion - on water
- a thick wire of platina fused
- Effects on fluids — Spark in
water - in Gases.

– The room was darkened for the preceding experiments which had the best effect.

– We then proceeded to give an account of common Elect.ty – construction of the Electrical machine and apparatus – Attraction repulsion – Positive negative – Induced Electricity or polarity – Resemblance of Electricity to Magnetism – like poles repel and unlike poles attract each other –

– Large Tin conductor, negative at the end next the Cylinder positive on the opposite end, and Metal in the middle. Shewn by firth both very impressively.

– A 15 Jar Battery charged by the great Voltaic apparatus. Discharge so small that it could scarcely be perceived – In one or two trials the spark was not seen. The battery not in order. —

+ These Experiments were not equal in the impression they made, to Mr Dr first experiments on the 9th of June last. —

Saturday 23 Feb 1811
Chemical Philos? Lect: 6th

New apparatus composed of large plates; its effects of ignition. Chemical operation of Voltaic Electricity. Analogous combination in Nature. General inferences respecting the Identity of Chemical and Electrical action.

Great and small plates compared — 4 of the common length of a 4 inch plate, — and 6 lengths of 11 by 4½ Inches, mounted alike in Wooden troughs.

The shock was the same in both, the same even from plates of one inch square. But in the ignition of wire the great plates has much the advantage. Each compared by single troughs

by two, three to all the six.
— Experiments with the great plates to ascertain the power of ignition with respect to the number of plates. A platina wire was stretched on a brass rod or tube divided into equal parts, by which the length of wire ignited could be measured. The lengths were, for one two three and fourth, nearly as the squares of the N.º of lengths, but for five and still more for six the proportion was less. If the number was greatly increased, the ~~quantity~~ length of wire ignited would be less in the ratio probably of the square root of the number!!!
— The ignition is probably as the cubes of the surfaces —
— What is the cause of this difference between great and small plates in the shock and power of ignition? Terms quantity-intensity explained—applied to the Common Electrical apparatus — Small qu.y thrown over a larger surface, the intensity is diminished — E.G. Charge of a small jar thrown into a large jar or battery, the shock is much diminished
— The human body is a bad conductor — does not conduct the whole from the voltaic battery — no more from a large than a small battery; but metals, very good conductors, carry off the largest plate
— Hence the decomposition of water is as rapid from small as from large plates, because water is a bad conductor. Exp.t water decomposed in two equal tubes

with the same No. of unequal plates — quantity decomposed in both is the same.

— All experiments on imperfect conductors succeed as well with small as with large plates; but on good conductors such as metals, great plates are far preferable. —

— Platina wire ignited in Vacuo gave a strong light — brighter as the vacuum was more perfect because said M. D. there was nothing to carry off the heat — Platina heat radiates in Vacuo. This completely disproves Leslie's theory of radiation by pulses or Vibrations of air.

— Gold Silver and other less fusible did not appear to advance

— Platina more easily ignited than any other metal by Electricity Exp.t Two wires one platina the other Zinc of the same length and thickness were connected Longthwise with each other, and the charge of the six trough of large plates sent through both — The platina wire was red hot before the Zinc had acquired almost any sensible heat.

+ M. D. after these Exp.ts proceeded to give a history of the rise and progress of discoveries on Electricity —

+ This was the least interesting history of the science which I have ever heard — He was more intent in sustaining on the Characters of Gilbert,

Boyle, Newton Franklin and a few others, than of pointing out their discoveries

Saturday 2 March 1811

Chemical Phil.y Lect 7th —

Chemical arrangement of bodies. Oxygene; its properties. Nomenclature representing the proportion in which it combines. New views respecting combustion. Constitution of the Atmosphere. ——

— Great variety of the bodies in Nature — Analysis would appear at first impossible. — Minutest quantities of several bodies. Hence Synthesis & Analysis &c. —

— Elementary bodies, names of those contained by the ancients on this subject — Water the origin of all things, others maintained that fire was

The Journey down &c
at length soon - Earth, water,
Air and fire - Modern Che-
mistry has extended the No.
to about 40. —

— The Voltaic Apparatus
has effected a new divis-
of bodies, Those which range
round the positive, and those
round the negative pole of the
battery - Of the former - Oxygen
and all bodies which con-
tain much oxygen - Hydrogen
Alkalies, earths and Metals
arrange round the negative
pole

— Now it is probable that
all bodies may be formed
or consist of only two ele-
mentary substances Oxy.n
and Hydrogen. ———

oxigen — Method of procuring oxygen gas — Black oxyd of manganese — oxy-m of pot ash — only described. — Principal property that of increasing light and flame of inflam. bodies —
Experiments — Taper in a jar of oxygen gas — Iron wire burnt in Bell, in the common way — It was then tried in another Experiment of the same kind, to light the wire by the voltaic battery, but it did not succeed. —
— Combustion — Various theories — Phlogiston — Stahls theory explained and illustrated by Expt. of burning Sulphur and forming Sulphuric acid — Lavoisiers Principle — Expl. on Theory &c &c —

+ Atmosphere — It has long been known that but a small part of the atmospheric air is employed in supporting both flame and flame — Mayo — Boyle Hook &c. — here the history of this discovery given. —

+ Several experiments exhibiting the proportion in which oxygen combines with other bodies — Water — air — Nitric acid &c

Expt. Carbonic acid decomposed — Phosphorus and Potassium exploded violently

— Potassium and Arsenic heated in a Glass retort, burnt brilliantly and in Nitrogene Gas. Flame. Oxygen not necessary in Combustion

From the Observer of
Sunday 3 March 1811

Doctor Davy's seventh lecture yesterday began with an account of the progress which had been made in reducing the number of bodies considered by Chemists as simple. In the infancy of the science, salts, and alkalies and earths &c were considered as simple substances, but as our knowledge improved by experiments, it was discovered that these substances were compounds, and we are still progressively advancing in ~~knowledge~~ the reduction of the number of simple substances. The present state of knowledge may be considered as an approximation to truth rather than the discovery of truth itself - our own countryman, Mr Mayo

appears to have been the first who discovered that a part of the Atmosphere was necessary to support life and combustion, and that metals gain in weight during their calcination.
To D. Priestley belongs the merit of being the first discoverer of oxygen Gas, or Vital air which he produced from red lead. This discovery was afterwards claimed by the French, and Scheele at the same time nearly obtained oxygen gas from Manganese and called it Empyreal air.
The discovery of Scheele the subsequent to that of D. Priestley, was made without any knowledge of the D^r Experiment — The name of oxygen Gas was given to it by the French from its communicating and qualities to Sulphur, phosphorus and other bodies which are burnt in it. The property of the water D. D. opposed. He said it might extract more justly be called Hydrogen, as it formed the greatest part of water. D. D. stated at some length the leading points of the Phlogistic and Antiphlogistic theories, and observed that the latter, when it was formed, agreed better with Phenomena; but that the discoverers had used a natural alteration in the new nomenclature necessary, and produced a change in the whole theory of Chemical Science. Priestley to Lavoisier had shown that common air absorbed oxygen, and the oxygen becoming fixed gave out its light and heat in passing from the gaseous to a solid state. This hypothesis was not supported by recent experiments, for some substances could be burned when no oxygen was present and gave out intense light and heat. He exhibited the combustion of potassium in carbonic acid gas, which gave out a brilliant red flame. The gas was

ter decomposed and charcoal found in the retort. The metals were also capable of combining without the presence of Oxygen and during this combination light was given out. Potassium and Arsenick were placed in a closed retort containing Nitrogen gas. They were ignited by the flame of a spirit lamp, and during their combination gave out a brilliant light. - Davy considered heat and light as the results of Chemical action, the particles of bodies being violently excited by this action are separated by their polar expansion and moving through free space, produce radiant heat and light - Davy also made the experiment of our illustrious countrymen Black and Boyle, and it was a satisfaction to find that their Doctrines

Doctrines after being disregarded for more than a century, were now found to be more conformable to nature than the Systems by which they had been supplanted It was a duty we owed to the memory of our own Philosophers not to suffer the merit of their discoveries to be lost by the pretensions of foreigners. This he considered to have been the case with respect to the Pneumatic Chemistry which was peculiarly the nation of this country, tho' it had been stolen by the French and returned to us under a new dress. The French were always talking of their discoveries, and the Germans always quoting their own Philosophers and it was the more necessary on this account that we should not suffer the honours of our countrymen to be taken away.

The proportion of Oxygen gas in the Atmosphere was little more than one fifth of the whole, and it was found that this proportion was not affected by the place from whence the air was taken. He had made experiments on air taken from the Atlantic Ocean, from the Bristol channel, and the narrowest part in Bristol Key, had also been taken from the Slave coast, from Egypt and from Paris, but the proportion of Oxygen gas was, in all these cases the same. From whence it may be inferred that the salubrity of the Atmosphere does not depend on the proportion of Oxygen, but on certain effluvia or miasmata too subtle to be detected. From a variety of experiments it has been proved that the azote or Nitrogene of the Atmosphere was as necessary to animal life as the Oxygen. Animals confined for a length of time in Oxygen gas were found to perish and it was Dr D's opinion that Nitrogene and Oxygen were both absorbed during the action of respiration.

It is generally said that Hydrogen may be burned in Oxygen gas; it might with as much truth be said that Oxygen may be burned in Hydrogen gas. Dr D. exhibited an experiment in which a stream of Oxygen gas was kindled into a vessel containing Hydrogen gas and set fire to by the Electric spark; the Phenomenon of combustion was precisely the same as in the usual mode when the experiment is performed. Dr D concluded by observing that the science of chemistry was rapidly advancing to a state of simplicity

in which the number of the ele-
ments would be reduced to a very
few, and in which it was probable
~~that~~ we should be able to anticipate
the results in all cases with cer-
tainty and precision.

Saturday 9th March 11

Chemical Philos: Lect 8th

Oxymuriatic Gas or Chlorine
Its properties. Number
representing the proportion
in which it combines; a
body as yet undecompounded
Compounds of it with extra-
ordinary detonating powers.
Theory of Bleaching. New
views on this subject.
New compound of this Gas
and Oxygen. Singular pro-
perties.

In this lecture Sr H D began
with observing that he
should have to bring forward
a new series of facts attended

with a new series of opinions
He did not expect they would
be universally received without
opposition; but he believed they
would be found agreeable to the truth
by future experiments. The French
in forming a new nomenclature
of Chemistry, had founded it on
opinions instead of facts; and when
those opinions were erroneous the
terms of the new language had only
served to perpetuate error. The
peculiar gas discovered by Scheele
which he called dephlogisticated
marine acid the French had after-
wards called Oxymuriatic acid gas
from a supposition that it ~~was~~
was a combination of oxygen
with muriatic acid. This gas Dr D
said he should prove, did not con-
tain a particle of Oxygen, but be
a peculiar simple substance,
sui generis, possessing like oxy-
gen, an acidifying principle
when combined with inflam: subs: to

what is called muriatic acid
is a combination of this gas
with Hydrogen. ——
He next treated the properties
of this gas. In some instances it
supports combustion; but is always
fatal to animal life. Most of the
metals inflame in it spontaneously
which he exhibited by several
experiments. In all the treatises
on Chemistry it is stated that
the combustion of charcoal takes
place in this gas; this Dr D said
was not true. When Charcoal is
ignited in this gas the Hydrogen
contained in the moisture of the char:
is inflamed, but the Char: remains
unaltered. A piece of very dry
Charcoal was included in this gas
and ignited by the Voltaic Battery.
The light given out was intensely
~~brilliant~~
bright but no decomposition
of the Char: or the gas took place

In the oxygenated the Light will continue for any length of time without discharging the Channel. D. D. then proceeded to shew by a variety of experiments, both direct and synthetic, that this gas is a simple substance. Perfectly dry oxy: gas and Hydrogen gas were burned together, without the least water being produced, which must have been the case had it contained oxygen. The result was muriatic gas only. When Phosphorus was burned in it the result was not Phosphoric acid, but a peculiar volatile substance different from it in many of its properties.

All other known substances burned in this gas, produce combinations quite distinct from oxides of the same substances. When potassium is inflamed in or flamed on it the oxy: m: of potash is produced. When the alkalies and alkaline earths, which are metallic oxyds, are heated in this gas, the substance called Muriate of soda of potash and of lime are produced and the oxygen of the alkalies and earths is given out. Muriat of soda is held by chemists to be a more compound substance than soda, thus D. D. denied. Soda is a metal united with water and oxygen. What is called the muriat of soda is the same metal united with what is improperly called the oxy: muriatic acid. The same is true with respect to the muriat of potash and lime. Oxy: m: acid will combine with oxygen and form a new compound, which has been discovered only a few days. The oxygen gas may be separated from the other, by a small excess of the decomposition. Light and heat

are given out, tho' the gases after the separation occupy more space than before which D. considered as a proof that light and heat are produced by the above mentioned action, and it is not requisite that the substance should be condensed into a smaller space.

Another proof that Oxygen is not necessary to combustion is furnished by this compound gas; metals will not inflame in it spontaneously, but when the oxygen is separated from it the metals immediately take fire.

Oxy. M. acid is of great importance in the process of bleaching, Berthollet suspected that it destroyed substances of colour by depriving them of their phlogiston. But Thenard attributed this effect to its supplying them with Oxygen.

D. D. stated that it produced the effect by forming with the hydrogen of water, muriatic acid, which acts on the vegetable fibre, and the oxygen of the water acts on the colouring matter. D. D. observed that the muriates and their forms considered the vegetable fibre, that the effects in this respect were less prejudicial to linen than to cotton, and were considerably lessened in both, when the Oxy muriat of lime was employed. He was glad however convinced from his own experiments, that it was prejudicial to the vegetable fibre. He had tried a variety of substances to obviate this effect, and he had found that Oxy. M. of potash was the least prejudicial, but he was afraid the soda would prevent its application to the purpose of bleaching. Next to pot ash he found the Oxy. M. of Magnesia least injurious to

to cotton and linen. Its bleaching operation was rather slower in its power, but its superiority in preserving the soundness of the fibre was such that he believed it would become an article of common use; and it had these advantages, that it could with the Hydrogen by applying a slight degree of heat and might thus be restored, after being used, to its former state and serve repeatedly for the same purpose.

Sir H. Davy concluded, that for the name of Oxymuriatic acid he would propose that of Chlorine — gas, from the Greek word Chloros green, one of the properties of this gas. He should however be ready to adopt any other that might seem to designate it better. He suggested that theory by which the name of oxymuriatic gas was formed, should have retarded the progress of Chemical Science. Hypothesis were matters of the Imagination; but Things, as one of the Ancients had observed, were Children of heaven, and ought alone to be regarded as the supporters of Science. Hypothesis were like the large and fair blown flowers of the hot-house, yielding neither fruit nor seed; facts were like the grasses, the flowers of which were scarcely perceptible, but where on respiration abundant nourishment for the sustenance of Mankind.

Saturday 16th March 1811

Chemical Philosophy Lect 9th

Inflammable gas or Hydrogene: its properties; proportions in which it combines; relations to other inflam.le bodies. Experiments on its combinations. Hypothesis that it is the principle of Inflty discussed.

Dr. D. began with observing that the opinions which he had before opposed, that oxygen was the only supporter of combustion, was also contrary to a variety of Phenomena attending the combustion of hydrogen. It was found that all bodies which were in a considerable degree, in the Gaseous state of Electricity had a strong Chemical action on each other,

and the effects of them combination were exactly analogous to common combustion. Hydrogen is the lightest body with which we are acquainted, and might more properly receive its name from its levity, than from its forming a constituent part of water when combined with oxygen. It constituted only one part in 7½ of water. He mentions M. Cavendish as the original discoverer of the composition of water. The remedy of experiments by which this composition had been apparently proved, rendered the conclusions drawn of water highly probable; but still it was only an opinion, for all the Phen.ª could admit of an explanation on the hypothesis which supposed that a portion Elect.ª united with a certain portion of water formed hydrogen; and negative Elect.ª united with the other portion forming oxy.ª and when the two Elect.ª were united or exploded, the water was deposited. In the present state of the science we could not be certain that Hydrogen or Oxygen were themselves simple bodies, it was therefore wrong to decide absolutely on the question.

Hydrogen combines readily with sulphur, Phosphorus, Carbon and some of the metals, and also with some other bodies. Its combinations with sulphur have very peculiar properties, exactly resembling those of acids. They redden litmus paper, and combine readily with alkalies. Mr. D. considered sulphuretted Hydrogen as a true acid, and observed that oxygen was a term founded on a false theory which supposed that it was the

dirty acidifying principle.
On the contrary Chlorine and Hydrogen (both simple substances) possessed, in some of their combinations with other simple bodies all the properties of acids, without the presence of Oxygen.
Sulphur is separated from Sulph: Hydrogen gas by the action of the Voltaic battery, and deposited on the side of the vessel in which the experiment is made. Phosph: combines readily with Hydrogen gas. The compound inflames when it comes in contact with Atmospheric air. In oxygen gas it explodes with intense light. Phosphoric acid and water are formed. Carbon also combines with Hydrogen gas, and forms carbonated Hyd: which inflames in Atmospheric air, in Oxygen and Chlorine gas. When burned in Chlorine gas, Muriatic acid is formed and Charcoal is deposited in a solid form, as Charcoal will not burn in Chlorine gas.

The other combination of Carbon with Hydrogen was called olefiant gas, from the oily product that is formed out when mixed with Chlorine gas; that D.D had discovered that it was not oil but a peculiar compound of Chlorine, Hydrogen and Carbon. Oils and almost all vegetable matter contain both Hydrogen and Carbon, in different proportions. These gases form the basis of all the solid parts of plants, and are contained in sufficient quantity in the Atmosphere and Water to nourish & support some species of Vegetables without the necessity of any supply from the decomposition of Vegetable or animal matters.
The most remarkable combinations of Hydrogen are those which it

forms with some of the metals. Arsenic, in a metallic state may be dissolved in hydrogen, and form a transparent invisible gas. When the Arseniate of Hydrogen is mixed with Chlorine gas, the Chlorine unites with the Hydrogen and forms Muriatic acid, and the Arsenic is deposited in a metallic state on the sides of the vessel in which the experiment is made.

The newly discovered metals Tellurium and Sodium also form invisible gass when combined with hydrogen. These metallic gass inflame when they come in contact with atmospheric air, and the metal is deposited in a solid form. D. O. said that the stones, which had fallen from the air, might be explained on the supposition that they were metals deposited in Hydrogen that had exploded in the Atmosphere; but he was inclined to believe that they owed their origin to another cause which he should more fully explain in a future lecture.

Hydrogen has by the Phlogistic chemists been supposed to form the principle of inflamability in all combustible bodies. It was not improbable but future discoveries would ascertain that all inflammable are compounds, and perhaps that Hydrogen would be found to be a constituent part; but still it could be improper to call it the principle of inflammability. Combustion was not the result of the condensation and combination of oxygen, as the French had supposed, or of the presence of hydrogene; it was produced by the chemical action of all bodies which had different

Electricities and strong chemical opposites for each other

The theory of Lavoisier, which had made combustion depend on the presence of Oxygen, could be as short lived as the theories which had preceded it. The progress of science and the light of succeeding discoveries must overthrow all systems which are not agreeable to facts; still however we are bound to respect the memory of their founders, and to feel grateful for their labours. The systems which they formed, when overthrown, may be venerable like the ruins of ancient temples that have been formerly devoted to the purposes of superstition. They remain to afford valuable information, which may assist us in constructing Edifices less splendid but of more real use

Obs

Tuesday — 19th March 1811

Chem! Phil Lect 10th —

— Inflam. bodies. Sulphur, Phosphorus, Charcoal. Experiments which shew that they are compounds, and contain hidrogen. Combination of these bodies with oxygen. Decomposition and composition of the Boracic acid. New experiments on the fluoric acid; its decomposition. Remarks upon many the inflammable bodies

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— D. Davy considers Sulphur Phosphorus and carbon as compound substances contrary to the received doctrines of the French chemists, who rank them amongst the most simple bodies with which we are acquainted.

Sulphur during combustion in atmospheric air, or with oxygen gas, combines with the oxygen, and forms sulphurous acid. It is believed that Sulphurous acid combines with a larger portion of oxygen and forms Sulphuric acid. This opinion, according to D. Dr is erroneous. Sulphuric acid in the common process of making it (by burning Nitre and Sulphur together) is formed by the combination of Sulphurous and Nitrous acids. Now, Provincial modes of preparing it might be adopted. D. D exhibited a drawing of an apparatus for that purpose, which without a plate, cannot be described. The purest Sulphur is obtained by the distillation of iron pyrites; It has a bright green colour. Sulphur of the purest kind, when acted on by the Voltaic battery gives out a great quantity of Hydrogen gas. The quantity of gas thus produced leads to the conclusion, that Sulphur is a compound consisting of hydrogen united to some unknown base, Sulphur unites with definite proportions of oxygen & Hydrogen. When united with hydrogen it forms sulphuretted hydrogen gas, having all the properties of an acid as described in last lecture—

Phosphorus also combines with definite portion of oxygen: with one portion it forms Phosphorous acid. When phosphorus is acted on, in vacuo by the Voltaic battery, like

Sulphur it gives out a large quantity of hydrogen gas. Carbon, when burned in Oxygen gas, forms Carbonic acid gas, and the volume or quantity of gas remains the same as before combustion. Two parts of Carbonic gas and one of Oxygen combine and form an inflammable substance called gaseous oxyd of Carbon. This gas contains no hydrogen: this is contrary to the common opinion Carbon forms the principal part of plumbago or black lead as it is called, and is said to be contained in a pure uncombined state in the Diamond. The most experiments both of the French and English chemists have led to the conclusion that the Diamond is pure charcoal. D. D. said that when he considered the different qualities of charcoal and Diamond he could not but hesitate in admitting their conclusion. Their Electrical properties are quite opposed, the diamond is a non conductor and charcoal is a perfect conductor of Electricity. The Crystallization and brilliancy of the diamond are so opposed to the qualities of pure charcoal. He believed it would be found, that the diamond was a compound of carbon & oxygen. He had made some experiments on the diamond with protoxide of a substance which has the greatest attraction for oxygen: when they are heated together a perfect decomposition took place, and

Diamond was coated with combustible matter. This experiment would lead us to suppose that the diamond was an oxyde of carbon. It might not be impossible for future discoveries to ascertain the means by which diamonds may be artificially formed; but he thought that the discovery would not reward the attempt, for it was probable that artificial diamonds would have neither the lustre nor hardness of natural ones. He had attempted to ascertain, by combustion, to determine whether any substance like the diamond could be formed, but it was obliged during the operation - Carbon also gives out a great quantity of hydrogen gas, when heated in vacuo; hence

Dr. D. was of opinion that it could only be considered as an unknown base united with hydrogen, which would be believed, however true * with respect to the metals and all inflammable bodies; and also that water forms a part of all the acids, according to the hypothesis of Mr. Cavendish. — The Earths Zircon, Silex, and Calcine were also compounds, and in some respects analogous to diamond. This would be the subject of a future lecture.

The Boracic acid has been decomposed by the Voltaic Battery It consists of oxygen united to a base whose properties are yet unknown. It is of a deep olive green colour, approaching

black. When heated in Oxygen Gas it again forms Boracic acid. Fluoric acid is formed by passing sulphuric acid on Derbyshire Fluor Spar. The Gas runs in Cap: and is absorbed by Water. If very fuming sulphuric acid be used in the operation the fumes and come over in a liquid state and is most potent. It immediately inflicts a deep wound wherever it touches the skin. When combined with Silex it may be decomposed by the Voltaic Battery and contains a Base whose properties are yet unknown. Dr. D applauded for bringing them thus far forward in so imperfect a form, but he considered them as strong enough hints which would soon lead to more important results. Dr Wollaston fancied he observed

might be composed to the green branches of trees, which the Mariner meets with in the Seas. They are called as the captain informs of approaching land

Obs.

Saturday 23d March 1811

Chem: Philo: Lect: 11th

Metals; their general properties. Numbers representing them. Their combinations. Metals anciently known; their combination and relations to Oxygene and Hydrogene.

The general character of metals as substances possessing specific gravity and opacity, &c. observed did not apply to the newly discovered metals, formed from the alkalies and earths. Potassium is lighter than water Sodium Calcium and Barium are all lighter than the weight which was supposed to form an essential quality of metals. All the known metals are opake Metals are also inflam:

D. D. exhibited the combustion of titanium, cobalt, nickel and magnesia; on charcoal by means of a stream of Oxygene Gas. This is the first time the experiment has been made. Titanium burned with a white flame, and rose in vapour; Cobalt, nickel and Manganese burned like iron throwing out sparks, but do not deflagrate. The metals also inflame spontaneously in Chlorine gas; but in the new gas formed by with a combination of Chlorine and Oxygene, they will not burn till the oxygen be separated. A piece of copper leaf was melted in a vessel filled with the new gas: it remained unaltered; but when a stream of Nitrous gas was thrown into it, the oxygen was separated from the Chlorine,

and the copper then took fire, which shews that oxygen is not necessary for combustion in all cases, but on the contrary prevents its taking place. The Metals already known are 39, the greater part of which have been newly discovered: The Ancients were acquainted with only 9 metals, Prior to the era of Alexander, the Phenicians procured Tin from Cornwall; it was mixed with copper, and used by the Egyptians, and the nations of the East, for the manufacture of Armour. In the time of Homer it was employed to make edge and offensive Defensive Armour was chiefly made from brass of copper and Zinc; this is supposed to have easily wrought their brass made of copper and tin.

Corinthian brass was made of different proportions of the two last metals. — M. Marsh shows Antiquarian remarks on the well known, brought from the plains of Troy an ancient helmet with this remarkable inscription "Won by Hector in the battle with Diomedes, made of Corinthian brass". It would seem to have been taken from the valuable relics of the Trojan age: it has been analysed, and is found to contain no other metal than copper and tin. Gold, silver, platina and copper are sometimes found in a native state; but in general all the metals exist in nature in the state of ores, which either consist of the metals united to sulphur, these are called alloys of metals combined with

Sulphur with oxygene and with acids. The separation of the metals from these combinations are for the purpose of commerce, effected by heat and the application of substances which have a strong attraction for the bodies with which the metals are combined. For more refined analysis, the separation of the metals and reduction to a state of purity is effected in the humid way, by chemical agents, such as the acids and Alkalies

The properties of fulminating Gold and fulminating Silver were exhibited. The latter exploded with the slightest friction, and cannot be taken out of the vessel in which it is formed without danger, if the quantity exceeds a few grains

The experiments which had been made on Ammonia prove that it is capable of forming a solid amalgam with mercury like Zinc or other metals. Hence its metallic nature is ascertained. Ammonia is a compound of two gaseous ~~Elements~~ Elements, Hydrogen and Nitrogen. Hydrogen is also found in other metals; hence their compound nature is rendered highly probable: This would be the subject of a future lecture. A question, however, might here with propriety be asked. If metals be compound bodies, is it impossible or impracticable to combine the elements of which they are formed, and produce by artificial means, silver and gold?

No enlightened chemist would answer this question in the negative. Van Helmont, Stahl and Boyle believed that Gold might be compounded. The principles on which this opinion rests are distant from the received doctrines of the Antagonists, and have nothing in common with the pretended discovery of the Philosophers Stone or the Powder of projection. They were formed on a just and comprehensive view of Nature. In proportion as our knowledge is enlarged by experience, many of the bodies considered as simple, are discovered to be compounds and the approach nearer to a few elementary principles from which other substances are formed

In the present abundance of paper money, the probability of making Gold may not perhaps alarm us so much as it did our ancestors during the Regency in the 14 century. at that time an act of parliament was passed both by the Lords and Commons to prevent Raymond Lully and another Adventurer "from Multiplying the precious metals". The reasons alledged for passing this act is honourable to the Patriotism of our Ancestors. It is this "That the Realm may not gain prosperous of the

"quest and obtain money with-
"out raising it from the people
"by the aid of Parliament". This
act is now unrepealed, but
happily for the progress of
experiment, the alarm lest
the precious metals should
be too abundant is much
abated at the present time;
nor need the Chemist fear the
burst of public indignation,
should he discover the means
of reducing our taxes by reducing
other substances to Gold. —
Obs:

Wednesday 27th March 1811

Chemical Phil.y Lect 12th —

Decomposition and recomposition
of the Alkalies. Metals of the fixed
Alkalies; names expressing
them. Properties to which the
Chemist has given rise. Properties
of Potassium and Sodium

Potassium may be separated
from Potash by a Voltaic
Battery of 200 plates 2 Inches
square — Two chemists produce
it by iron &c. — as the process
Potassium is white and similar
to tin in its appearance, it is
easily cut with a knife, it a-
malgamates with mercury and
acts as a solder to other metals.
It oxides with it self by exposure
at the temperature of the At-

sphere. Spec. Gravity when
solid as 7, and when fluid as 6
to water 10. It is the lighter solid
substance known. When thrown on
water it swims and burns with
a vivid flame. It will even burn
if confined under water. It speedily
deliquates and can only be preserved
by keeping it in Naptha, a fluid
which contains very little oxygen.

Sodium, the metal from Soda,
in most of its properties, resembles
Potassium; but if pure, it does not
inflame when thrown on water,
but moves in a round globule
rapidly
on the surface, and decomposes the
water. — Potash in the purest
state in which it is commonly
obtained by Chemical means,
contains 17 P. Cent of water, even
after being kept at a red heat
for a considerable time.

When Potassium is burned in
oxygen gas, it forms the per oxyd
of Potassium, a substance dif-
fering in some degree from Potash.
It is hard and scarcely fusible;
Potash is soft and fusible. This
difference consists in Potash
containing less oxygen and hold-
ing a certain quantity of water in
combination. When the per-oxyd
of potassium has parted with some
of its oxygen, and acquired the same
quantity of water, it does not differ
in its properties from Potash, which
substance should be called a
hydrat of potash. Potash will
combine with oxygen by the ac-
tion of heat and form a peroxyd
of Potash: in this operation
it parts with its water of Combina-
tion. Several Experiments are made to
prove this, by heating potash in
oxygen gas, and in oxygen gas

combined with Chlorine. Potassium was inflamed when thrown into a small cavity in a cake of ice. The water deposited by the combustion had all the qualities of an Alkaline solution, changing the yellow colour of turmeric paper to red. Potassium is volatile in Hydrogen gas. When this gas comes in contact with atmospheric air it inflames. The French Chemists Guay Lussac and Thenard had denied the metallic nature of Potassium and Sodium, which they considered as Hydrurets of Pot ash and Soda. Further Exp.ts have led them to the conclusion that they are simple metals, as Davy discovered three years since. An account of this discovery was given in the Observer of the 17 Feb.y 1811

In considering Potassium & Sodium as simple substances, I was only intended to express that they were as much so as the other metals in former systems, he had admitted to the compound nature of all the metals, and in the succeeding ones, he should advance such advancement experiments and Arguments as he thought rendered the opinion probable that Hydrogen was an essential constituent part of each. This was a question quite distinct from the inquiry whether Potassium and Sodium were Hydrurets of the Alkalies. The combustion of Potassium and Sodium in Oxygen gas is the only known means of procuring the Alkalies in a pure state. When we consider the great use of Alkalies in arts and Manufactures, it is not impossible that their application in a pure state may be attended with important improvements, when ever a cheap mode of obtaining Potassium and Sodium, on a large scale, shall be discovered

For purposes of destructive warfare, their high degree of combustibility in water may render them the most potent agents that have ever been invented. As the instruments of war become more destructive they were become less bloody and ferocious. At present Potassium and Sodium are reserved in granulation too small to admit of their application to any other purposes than those of chemical experiments.

Dr. D. said he had sometimes been asked by his friends "what is the use of these metals? If a question were put to a parent, respecting any of his favourite children "of what benefit will they be to society" he would feel a little embarrassed by the enquiry To consider every subject of investigation as a mere matter of gain, would be to degrade the temple of Science into a market place. The same question might apply to a poem,

a statue or a picture. What is their use? Every thing which has a tendency to raise us above gross animal sensation, is some degree useful and exalts the character. To gain even the only object of desiring human pursuit, Galileo ought, instead of directing his attention to the heavens, to have confined him to the manufacture of spectacles; and the time which Newton employed in the investigation of the laws of Nature, would have been better employed in making optical instruments for sale. — The discovery of new facts in Nature, which can be made use of in the progress and simplicity of the operations, enlarge the sphere of human power, and multiply the sources of enjoyment. The discovery of Dr. D. each establishment that was followed by

improvement on the steam Engine, and its extensive application is an infinite variety of useful purposes. The discovery of the qualities of the different earths has led to the discovery of improved processes in the manufacture of Potters and Porcelain, and we have been enabled to convert the dust on which we trade into forms combining use, elegance and beauty. Observe

Saturday 30th of March
Chemical Prelt Lect. 13 M Davy
— Mode of procuring potassium and sodium. Decomposition and recomposition of the earths. Names representing them. Volcanic fires. On Meteoric Stones. History of their appearance.

— Mode of preparing potassium and sodium. Berzelius mode by Amalgamation, and the French method by iron Steam
— Earths divided into Alkaline Earths, and earths proper, Alkaline earths are Barytes Strontites Magnesia and Lime, The Earths are Alumine, Silex, Yttria Glucine and Zircon — The former are called Alkaline earths,

because they Rubralage acids, and turn the blue infusion of vegetables to red green; the latter produces neither of these effects.

— Decomposition of the Earths by amalgamation with mercury, and by potassium —

— Experiments on Barium and Strontium —

— D. D. then proceeded to explain the phenomena of Earthquakes, Volcanos, Meteoric Stones &c from the properties of the new metals —

— Representation of a Volcano. An artificial mountain of clay, in which was inclosed a composition of potassium, iron and lime. On pouring water into a fissure which led to the composition it took fire exploded and stuck down the entrude of the Crater. —

— A motion was presented by throwing up into the air a little potassium and water —

— M. D. Gave a long history of Meteoric Stones — Exhibited a number of various sizes which fell in different parts of the world among others that which fell in Yorkshire in the year weight 56 pounds. —

— He then took notice of the different modes of accounting for Meteoric Stones — He concluded with Sir John Herschel's opinion that they are bodies in our system moving round the sun, and no doubt answer some great and important purpose. (from the Phil: Transac.) —

— M D adopts this opinion.

He thinks it liable to fewer objections than any of the others

— The lately discovered fixed stars are very small when compared with those formerly known. The difference in magnitude between Ceres and some Stars that have been observed is much less than between Ceres and the moon

— As the mean Sp: Gravity of the earth is found to be about double of the water on the surface that is about 4½ times that of water Mr D. thinks it probable that the interior of the Globe is composed of metals which taken all together old and new will correspond nearly to the above Sp: Gravity

— Geological phenomena explained on this Hypothesis. The present surface of the earth is perpetually wearing down, and is daily washed into the sea. The highest mountains are decomposing & disintegrating, and it is probable that there is some grand process of nature, by which all the apparent decays are repaired. The metals of the interior may combine with the Oxygen of the water, and be thrown out as earths to the surface, forming new Islands and new continents to be the abode of sentient and intelligent beings, when the present Continents are buried in the Ocean

— The evidence for the fall of meteoric Stones is so abundant and so unquestionable, that no doubt of the fact can be entertained, and the external Evidence is, of itself

still more satisfactory.

By analyses they are all found to ~~contain~~ consist of nearly the same materials, and to form compounds different from any bodies or Earth

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\+ The metals of the Earths are harder and preserved with more difficulty than those of the Alkalis.

\+ In converting cast iron into Malleable iron there is separated from it in hammering a brittle metallic substance, which is, according to Mr D. the metal of silica united to some silex, he conceived would add hardness to iron, where it was wanted. — A peculiar kind of ~~steel~~ iron is brought from the East, so hard as to cut glass.

Wednesday 3d April 1811

Chem: Phil: Lect. 15 Dr. Davy

— General analogies of all metallic substances. Metallization of Ammonia: Nitrogene; its nature and combinations. Number representing it. The great question, are the metals simple or compound bodies discussed. Analogy in favour of their being compounds. Ideas concerning the future progress of chemistry. Conclusion of this course.

Nitrogen or Azote (Dr. D. prefers the latter name. The former is a theoretical term — compounded with oxygen, Atmospheric air, Nitrous gas, Nitrous oxyde, Nitrous and Nitric acids, by only varying the proportions of Ox: and Azote. Azote with Hydrogene forms ammonia. Berzelius's experiment

Experiment on the amalgamation of amᵃ. shewn — This is perhaps the most wonderfull fact in Science. The mercury is increased five or six times in bulk, and its specific gravity of the amalgam is reduced to about 2½ — The quantity of the mercury is only about 1/1000 part of the compound — This Expt proves that Amᵃ has a metallic base, for Mercury will not amalgamate with an alkali — But amᵃ is composed of Azote & Hydrogene — What connexion has the metallic base with these? This is a very important, but difficult question.

— D. D. is inclined to think that metals are compound bodies — His opinion is founded on some phenomena where Hydrogene appears to have been separated from metals. It is probable that all metals may be compounds of Hydrogene and some other substance, but whether that substance be the same in all the metals, and differing only in the proportion of component parts, or be different ones in different metals the present state of our knowledge will not enable us to determine — D. D. is inclined to adopt the last former opinion, to which however he attaches no importance, nor should he consider it as fully established 'till some one metal shall have been decomposed, and its constituent parts ascertained — D. D had lately perused the principal writers on Alchemy, hoping that some useful hint might have been obtained but he was quite disappointed. — Their Expts were so rude and their Notations

or manuals and observing that no information could be derived from them

— The progress which Chemistry has made, as a Science, during the last forty years, may excite great hopes with respect to its future advancement. The beautiful generalizations which Lavoisier introduced into the ~~science~~ his system were owing to the state of the science at the period in which they were formed. But the French Nomenclature, in many instances, formed on theory, and not on Facts, tended to perpetuate error. Theories have their use as serving plans for the investigation; but they should always give place to newly discovered facts. Chemistry can at present, compared with Astronomy, may be considered in the same state in which we find the latter Science in the days of Ptolemy, when Epicycles and Excentrics were introduced to explain the motions of the planetary system. Since that time Galileo, Kepler, Newton and La Place have made Astronomy a branch of Mathematical Science, and developed the magnificent simplicity of the Mechanism of the Heavens. Thus certainly Dr. D. thought that after no very long period the same certainty would be introduced into Chemistry

— Mr. D. concluded the Lecture and the present course with an Eulogium on Chemistry — For almost all the comforts of life we are indebted to chemistry — Arts and Manufactures improved — The Monk who made a mixture of Nitre, sulphur and Charcoal to make Gun powder made an entire revolution in the art of war, demolished its security and made it a branch of Math: Science.

to Science advance and the sphere of light extends, the more extended also is the boundary of darkness by which it is surrounded, and the more we possess of the immensity of nature, the more is our curiosity raised to know what exists beyond the present range of our search— Science, like Nature, is ever young, new objects unperceptably presented, hills on hills, and Alps on Alps arise.— When we consider the limited duration of man, and compare it with the infinity of Nature, we perceive that the human intellect is inadequate to grasp the universe. In this state of things we can at most [suffering] enough of the wonderfull operations of Nature, to impress us with humbleness, sincere devotion, and early ardent curiosity; nor is it unreasonable to hope that all our faculties are intended to exist a higher degree of perfection in a future state of existence— The newly fledged bird tries its pinions for a higher region, the humble Lot rest, then ascends its wings and soars aloft from the earth.

Saturday 27th April 1811

Geology Lect 1 Mr. Davy

Introduction. Objects of the Course. Arrangement of the Globe. Relations of the Atmosphere. Water, and Solid Crust. Importance of this branch of Science. Its uses and applications.

Recd 3 April 1811

Chem. Philosophy Lect 14.

— General Analogies of all metallic substances. Metallization of Am.
Nitrogen; its nature and combinations. Number representing it. The great question are the metals simple or compound bodies discussed. Analogy in favour of their being compounds. Ideas concerning the future progress of Chemistry.

Conclusion of this course.