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Notes

on

Chrysothrix

Royal Instⁿ

14 Feb

1811

Royal Institution 1811

Saturday 9th Feb^r at 2 o'clock
Chronical Philosophy Lect. 4th

- Radiation of heat, its connection with
light, difference of their effects, Pro-
perty in light analogous to Potency.
Note Experiments on this subject.
Connection of heat and light with
Electricity. Hypothesis respecting
heat and light illustrated by Exp^s.
The refined doctrines of Chemistry,
how connected with this various
subject.

In this lecture Mr. Davy
established the Experiments of
Prolet and Leslie on the Ra-
diation of heat and apparent
Radiation of Cold. - Doctor Re-
sch's experiments on the Solar
Spectrum were described -
- Leslie thinks that heat is

radiated by vibrations or pulses
in air like sound. M. D. disproves
this hypothesis by showing that
heat is radiated in vacuo.

Expt. Charcoal burned in the
exhausted receiver of the air pump
by the Voltaic battery, radiates from
a small mirror and causes an
air thermometer —

Expt. with ice was not performed

— also Leslie's experiments with
cannisters were only described

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

— M. D. in some articles that
the Leduc allowed that a silver
leaf was preferable to a black
carbon one, and he always
found great regard to the colour
of the Leduc!!

Saturday 16 Feb. 1811

Chemical Philosophy Lect. 5th
Electⁿ in its application to Chem^y
General properties of Electric
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 fusion
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} ~~metals~~, Silver
Gold, Platinum - fusion - oxidation
- a thick coat of platinum fused
- Effects on fluids - Spark on
Water - on Gases.

The room was darkened for the
purpose of experiments which
had the best effect.

— Mr D. then proceeded to give
an account of common Elecⁿ &
construction of the Electrical
Machine and apparatus

— Attraction repulsion, Positive
negative. — Induced Electricity
or probably — Resemblance of Elecⁿ
to Magnetism — like poles repel
and unlike poles attract each
other

— Large Tin conductor, negat^e
at the end next the Cylinder,
positive on the opposite end,
and neutral in the middle.
Shewn by both balls very
imperfectly.

— A 25 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 D.'s 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 re-
specting the Identity of Chemical
and Electrical actions.

Great and small plates com-
posed of the common troughs
of 2 inch plates, — and 6 troughs
of 11 by 1 1/2 inches, mounted all
alike in platinum troughs.

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

by two, three to all the six.

Experiments with the great plates
to ascertain the power of equator
with respect to the number
of plates. A platinum wire was
stretched on a brass rod or tube
divided into equal parts, by
which the length of wire equate
could be measured. The lengths
were, for one, two, three and four,
nearly as the squares of the N^o.
of triangles, but for five and still
more for six the proportion was
less. If the number was greatly
increased, the quantity of wire re-
quired would be less in the ratio
probably of the square root
of the number!!!

The position is probably as the
cubes of the surface
What is the cause of this difference
between great and small plates

in the shock and power of equi-
tion? Terms quality. Intensely
explained - applied to the Comm-
-Electric Apparatus - Small qu^{ty}
thrown over a larger surface, the
intensity is diminished - I. G.
Change 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, being 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 n^o of unequal plates - generally 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 were ignited in vacuum gave a strong light - brighter as the vacuum was more perfect because said M. D. there was nothing to carry off the heat - Hence heat radiates in vacuum. This completely disproves Lavoisier's theory of radiation by pulsation or vibration of air.

- Gold Leaf and other leaf burn then did not appear to advance

Platina more easily ignited than any other metal by Electricity Exp! Two wires one platinum the other zinc of the same length and thickness ^{1. wire} with, connected lengthwise with each other, and the charge of the six troughs of large plates sent through both - The platina wire were red hot before the zinc had acquired almost any sensible heat.

+ M. D. after these Expts^s proceeded to give a history of the rise and progress of Discoveries in Electricity -

+ This was the best interesting history of the science which I have ever heard. He was more intent in determining 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 Sect 7th —
Chemical arrangements of bodies
Oxygen; its properties. Numbers
representing the proportion in
which it combines. New views
respecting combustion. Constitution
of the Atmosphere.

— Great variety of the bodies
on Nature — Clapnet
would appear at first im-
possible. — Number great
in several bodies. Hence
Groups & classes &c. —

— Elementary bodies, war-
mly embraced by the au-
thor on this subject — Water
the origin of all things, other
inasmuch that fire was

The primary element &c
At length four - Earth, water,
Air and fire - Modern Che-
mistry has extended the No.
to about 40. —

— The Voltaic Apparatus
has effected a new division
of bodies, those which range
round the positive, and those
round the negative pole of the
battery - Of the former - Oxygen,
acids & all bodies which con-
tain much oxygen - Hydrogen
alkalis, earths and Metals
except mercury, surround the negative
pole

— Now it is probable that
all bodies may be formed
or consist of only two Ele-
mentary Substances Oxygen
and Hydrogen. —

Oxygen - Method of pre-
paring oxygen gas - Black
oxide of manganese - Oxygen
of foot ash - Only described.

- Principal property that
of increasing light and flame
of inflamm^{ble} bodies -

Experiment with Paper in a
jar of oxygen gas - Iron wire
burnt in Dillo, in the com-
mon way - It ~~is~~ then tried
in another Experiment of the
same kind, to light the wire
by the voltaic battery, but it
did not succeed. -

- Combustion - Various theo-
retical - Stahl's theory
captured and illustrated
by Expt. of burning Sulphur

combining Sulphur and
- Lavoisier's ^{System} Pneumatics - Expt.
on Mercury &c &c -

+ Atmosphere - It has
long been known that but
a small part of the atmos-
phere air is employed in sup-
porting both life and flame

Mayo - Boyle's Work &c.
- here the history of this dis-
covery given. -

+ Several numbers expressing
the proportion in which
oxygen combines with other
bodies - Water - air - vitriol and &c

Expt. Carbonic acid &c
compared - Phosphorus and
Potassium exploded violently

- Potassium and Arsenic heated
in a glass retort, burnt brilliantly
and in Nitrogen Gas. Hence
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 con-
sidered by Chemists as simple. In the
infancy of the science, salts, acids,
alkalis and earths &c. were con-
sidered as simple substances, but
as our knowledge improved by
experiments, it was discovered
that these substances were com-
pounds, and we are still progres-
sively advancing in our know-
ledge 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. May's

appears to have been the first who discovered that a part of the Air or phlogiston was necessary to support life and combustion, and that metals gain in weight during their calcination.

To Dr. 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 Emphyreatic air.

The discovery of Scheele the subsequent to that of Dr. Priestley, was made without any knowledge of the Dr. Experiment - The name of Oxygen gas was given to it by the French from its communicating a quality to Sulphur, phosphorus, zinc and other bodies which are burnt in it. The property of the name Dr. P. opposed. He said it might as well more justly be

called Hydrogen, as it formed the greatest part of water. (Dr. P. stated at some length the leading parts of the Phlogistic and Antiphlogistic theories, and admitted that the latter, when it was formed, agreed better with Phenomena; but for the discovery he said would ^{make a} material alteration in the new nomenclature, necessary, and produce a change in the whole theory of Chemical Science. According to Lavoisier bodies during combustion absorb Oxygen, and the Oxygen becoming free gives out its light and heat in passing from the gaseous to a solid state. This system was not supported by recent experiments, for some substances could be burned when no oxygen was present and gave out intense light and heat. It exhibited the combustion of potassium in carbonic acid gas, which gave out a brilliant red flame. The gas was

was decomposed and charcoal
found in the retort. The metals
were also capable of combining with
out the presence of Oxygen and
during their combustion they by
heat were given out. Potassium
and Strontium were placed in a
closed retort containing Nitrogen
gas. They were ignited by the
flame of a spirit lamp, and
during their combustion gave
out a brilliant light. - It is
considered heat and light as the
results of Chemical action, the
particles of bodies being violently
excited by this action are se-
parated by their potent repulsion
and moving through free space,
produce radiant heat and light
- Such also were the opinions
of our illustrious countrymen
Hook and Boyle; and it was a
great satisfaction to find that their
Doctrines.

Doctrines after being disregarded
for more than a century, were
now found to be more conform-
able to nature than the System
by which they had been displaced.
It was a duty we owed to the
memory of our own Philosophers
not to suffer the merits of their
Discoveries to be lost by the pre-
tensions of foreigners. This he con-
sidered 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 boasting of
their Discoveries, and the Germans
always asserting their own Phil^{os}
and it was the more necessary
on this account that we should
not suffer the honours of our coun-
trymen 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 strait in Bristol

As had also been taken from the Slave coast, from Egypt and from Paris, but the proportion of Oxygen 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 Miasms which are subtle to be detected. From a variety of experiments it had been proved that the Azote or

Nitrogen 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 Lavoisier's opinion that Nitrogen and Oxygen were both absorbed during the act 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. Lavoisier exhibited an experiment in which a stream of Oxygen gas ~~was~~ introduced 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. Lavoisier concluded by observing that the stream of electricity was rapidly advancing to a state of simplicity

in which the number of molecules would be reduced to a very few, and in which it was probable that we should be able to anticipate its results in all cases with certainty and precision.

Saturday 9th March 11

Chromat Photo: "Lent &"
Osmometric Gas or Chromat
Its properties. Number

representing the proportion
in which it combines, a
body as yet uncombined
compounds of it with extra-
ordinary detonating power.

Theory of Chromat. New
view on this subject.

New compound of this gas
and Oxygen. Singular pro-
perties.

In this lecture D. 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 it both
by future experiments. The French
in forming a new nomenclature
of Chemistry, had founded it on
opinions instead of facts; and when
their opinions were expressed the
terms of the new language had only
served to perpetuate error. The
pneumatic gas discovered by Scheele
which he called *dephlogisticated*
marine acid, the French had after-
wards called *Oxygenium acid gas*
from a supposition that it was
a combination of oxygen
with *maric acid*. This gas I
said he should prove, did not con-
tain a particle of oxygen, but was
a peculiar simple substance,
sui generis, possessing like oxy-
gen, an acidify, any principle
when combined with oxygen. sub-

What is called *maric acid*
is a combination of this gas
with Hydrogen.

He next directed his properties
of this gas. In some instances it
supports combustion; but is always
fatal to animals. Most of the
metals inflame in it spontaneously
which he exhibited by several
experiments. In all the treatises
upon Chemistry it is stated that
the combustion of charcoal takes
place in this gas. This I did say
was not true. When charcoal is
ignited in this gas the Hydrogen
contained in the mixture of the char-
is inflamed, but the Char: remains
unaltered. A piece of very dry
charcoal was enclosed in this gas
and ignited by the Voltaic Battery.
The light given out was entirely
~~lightest~~ ^{bright} but no decomposition
of the Char: or the gas took place

In the experiment the light with
continues for any length of time
without destroying the Channel.
G. D. then proceeded to show by a
variety of experiments, both anal:
and Synthetical, that this gas is a
simple substance. Perfectly dry
Oxygen gas and Hydrogen gas were
burned together, without the least
water being produced, which must
have been the case had it contain
oxygen. The result was merely air
and 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 inflammable substances
burned in this gas, produce com:
binations quite distinct from
any of the same substances.
When Potassium is inflamed in
oxygen or at the Hyperoxy: M.
of Potash is produced. When the

Alkalies and Alkaline earths,
which are metallic oxides, are
heated in this gas, the substance
called Muriatic of Soda of Pot ash
and of Lime are produced and the
oxygen of the Alkali and Potash
is given out. Muriatic of Soda is
held by chemists to be a more
compound substance than Soda,
the G. D. however, Soda is a metal
combined with water and Oxygen.

What is called the muriatic of Soda
is the form metal combined with
what is improperly called the Oxy:
muriatic acid. The same is true
with respect to the muriatic of
Potash and Lime. Oxy: M: a: f: s:
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 increase
of the temperature. Light and heat

are given out, tho' the gases
after the separator occupy more
space than before which D. D. con-
sidered as a proof that light and heat
are produced by the shown action,
and it is not requisite that the sub-
stance 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 impor-
tance in the process of bleaching,
Schubert supposed that it deprives
substances of colour by depriving
them of their phlogiston. Ber-
thollet attributed this effect to its
supplying them with Oxygen.

J. D. states that it produces the
effect by forming, with the Hy-
drogen of water, mineral acid, which
acts on the vegetable fibres, and the
oxygen of the water acts on the
coloring matter. J. D. observed
that the mineral acid thus form-
ed corrodes the vegetable fibres; that
its effects, in this respect were
less prejudicial to linen than to
cotton, and were considerably less
in both, when the Oxy mineral
of lime was employed. He was
well however convinced, from his
own experiments, that it was
prejudicial to the vegetable fibres.
He had tried a variety of sub-
stances to obviate this effect, and he had
found that Oxy. m. of potash was
the least prejudicial, but he was
opposed the price would prevent its
application to the purpose, of which
Niel to pot ash he found the
Oxy. m. of Magnesia least injurious.

to cotton and linen. The black
operation was rather slow in its
power, but its superiority in pre-
serving the softness of the fibre
was such that he believed it
would become an article of com-
mon use; and it had three ad-
vantages, that it parted with its
Hydrogen by applying a slight
degree of heat, and might there-
fore be restored, after being used, to
its former state and serve re-
peatedly for the same purpose.

J. Davy concluded, that
for the name of oxygenic acid
he would propose that of
Chloric acid gas, from the
Greek word Chloris green, one
of the properties of this gas.
He should however be ready
to adopt any other that might
soon be designated it better.
He regretted that theory by which
the name of oxygenic acid gas

was found, should have retarded
the progress of Chemical Science.
The poet was a creature of the
Imagination; but the ye, as one
of the Ancients had observed, were
children of heaven, and ought also
to be regarded as the supporters
of Science. The poet was like
the large and full blown flowers
of the hot house, yielding neither
fruit nor seed; facts were like the
grapes, the flowers of which were
scarcely perceptible, but whose roots
supplied abundant nourishment
for the sustenance of Mankind.

Saturday 16th March 1811
Chemical Philosophy Lect 9th
- Inflammable gas or Hydrogen;
its properties; proportions in which
it combines; relations to other
inflam^{le} bodies. Experiments on
its combinations. Hypothesis
that it is the principle of Infl?
discussed.

G. D. began with observing
that the opinions which he
had before opposed, that oxygen
was the only supporter of com-
bustion, were also contrary to
a variety of Phenomena at-
tending the combination of hy-
drogen. It was found that all
bodies which were in a consi-
derable degree, in the opposite
States of Electricity, had a strong
Chemical action on each other,

and the effects of their combination were exactly analogous to common combustion, Hydrogen is the lightest body with which we are acquainted, and ought 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 $7\frac{1}{2}$ of water. It was discovered by W. Cavendish as the original discoverer of the composition of water. The variety of experiments by which this composition had been apparently proved, rendered the compound nature of water highly probable; but still it was only an opinion, for all the Phil^s could admit of an explanation ~~rest~~ on the hypothesis which supposed that positive Elect^s united with

a certain portion of water formed hydrogen; and negative Elect^s united with the other portion forming oxyⁿ and when the two Elect^s 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 render litmus red paper, and combine especially with alkalies. Dr. D. considered sulphuric Hydrogen as a true acid, and observed that oxygen was a name founded on a false theory which supposed that it was the

only acidifying principle.

On the contrary Chlorine ^{gas} and Hydrogen (both simple substances) possess, in ~~the~~ 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. Phosphorus combines readily with Hydrogen gas. The compound inflames when it comes in contact with Atmospheric air. In oxygen gas it catches with intense light. Phosphoric acid and water are formed. Carbon also combines with Hydrogen gas, and forms carbonated Hydrogen which inflames in Atmospheric air, in Oxygen and Chlorine gas. When burned in Chlorine gas, Muriatic acid is formed and Chlorine

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 supposition that it formed oil when mixed with Chlorine gas; but Lavoisier had discovered that it was not oil but a particular compound of Chlorine Hydrogen and Carbon. Oils and almost all vegetable matters contain Oxygen 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 Arsenic of Hydrogen
is mixed with Chlorine gas, the
Chlorine unites with the Hydro-
gen 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 gas when com-
bined with hydrogen. These me-
tals give inflammation when they
come in contact with atmospheric
air, and the metal is deposited
in a solid form. It is said
that the ~~metals~~ ^{metals} stones, which
had fallen from the air, might
be captured on the supposition
that they were metals dissolved

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 had, by the Phlogistic
chemists, been supposed to form
the principle of inflamⁿ in all
combustible bodies. It was not
improbable ^{that} future discoveries
would ascertain that all inflam-
bles were compounds, and ~~that~~
perhaps that Hydrogen would be
found to be a constituent part;
but still it would be improper
to call it the principle of in-
flamⁿ. Combustion was not the
result of the condensation and
combination of oxygen, as the
French had supposed, or of the
presence of hydrogen; it was
produced by the chemical action
of all bodies which had different

Electricities and strong che-
mical affinities for each other
The theory of Lavoisier, which
had made combustion depend on
the presence of Oxygen, would 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 ve-
nerable like the ruins of ancient
temples that have been formerly
devoted to the purposes of super-
stition. These remains may
afford valuable information,
which may assist us in con-
structing Edifices less splendid
but of more real use. O.

Tuesday - 19th March 1811
Chem. Phil. Lect 10th -

- Inflamm. bodies. Sulphur, Phosphorus, Charcoal. Experiments which show that they are compounds, and contain hydrogen. Combination of these bodies with oxygen. Decomposition and composition of the Boracic acid. New experiments on the fluoric acid; its decomposition. Numbers representing the Inflammable bodies

- G. Davy considered Sulphur Phosphorus and carbon as compound substances, contrary to the received doctrine 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 sulphu-
rous acid. It is believed that
Sulphurous acid combines
with a larger portion of oxygen
and forms Sulphuric acid.
This opinion, according to P. D.,
is erroneous. Sulphuric acid
in the common process of
making it (by burning Nitre
and Sulphur together) is formed
by the combination of Sulphu-
rous and Nitrous acids. Now,
economical modes of preparing
it might be adopted: P. D.
sketched a drawing of an ap-
paratus for that purpose, which
without a plate, cannot be de-
scribed. 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 &
in vacuo, 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 de-
finite proportions of oxygen & of
Hydrogen. When united with
Hydrogen it forms sulphu-
rated hydrogen gas, having all
the properties of an acid as
described in last lecture -
Phosphorus also combines with
Hydrogen definite portion of oxy-
gen: with one portion, it forms
Phosphoric acid. When phos-
phorus 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 gasous 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 free uncombined state in the Diamond. The recent experiments both of the French and English Chemists have led to the conclusion that the Diamond is pure

Charcoal. G. D. said that when he considered the different qualities of charcoal and Diamond he could not but hesitate in admitting this conclusion. Their Electrical properties are quite opposite; the Diamond is a non conductor and charcoal is a perfect conductor of Heat. The Crystallization and brilliancy of the diamond was so opposite 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 protoferric, a substance which has the greatest attraction for oxygen: when they were heated together, a partial decomposition took place, and

Diamond was coated with con-
comaceous matter. This experi-
ment would lead us to infer
that the diamond was an oxide
of carbon. It might not be im-
probable 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 probably of
artificial diamonds would have
within the texture no hundred
of natural ones. He had attempted
to crystallize charcoal by
fusion, to determine whether
any substance like the diamond
could be formed, but it was re-
solved during the operation
- Carbon also gives out a
great quantity of hydrogen gas,
when heated in vacuo; some

of it was of opinion that it
could only be considered as
an unknown base united with
hydrogen, which would be be-
lieved, prove true with re-
spect to the metals, and all
inflam^{le} bodies; and also that
water formed a part of all the
acids, according to the hypothesis
of Mr. Cavendish. - The Earth,
zircon, Silica, and Salamine
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

back. When heated in Oxygen
gas it again forms Boracic acid.
Fluoric acid is formed by passing
sulphuric acid on Derbyshire
flour Spar. The gas rises in Oxi-
gen and is absorbed by water. A very
fine sulphuric acid be used in
the operation the fine acid comes
over in a liquid ^{state} and is
most potent. It immediately in-
flames a deep wound wherever it
touches the skin. When combined
with Selas it may be decomposed
by the Voltaic Battery and con-
sists of two whose properties
are yet unknown. Dr. D. appears
grieved for bringing these two ^{properties}
forward in so imperfect a form,
but he considered them as offering
useful hints which would soon
lead to useful important re-
sults. Detached facts, he observed,

might be compared to the green
branches of trees, which the ma-
riner meets with in the Ocean.
They are heeled as the captain
comes of approaching land.

obs^d

Saturday 23^d March 1811
Chem: Philo^y Lect: 11th

Metals; their general properties. Numbers representing their their combinations. Metals anciently known; their combination and relations to Oxygen and Hydrogen.

The general character of metals as substances possessing specific weight and opacity, &c. observed did not apply to the newly discovered metals, formed from the alkalis 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 opaque Metals are also inflamm^{le}:

J. D. exhibited the combustion of Lithium, cobalt, nickel and Magnesia; on charcoal by means of a stream of Oxygen Gas. This is the first time the experiment has been made. Lithium burned with a blue flame, and rose in vapour; cobalt, nickel and Magnesia burned like iron throwing out sparks, but do not volatilize. The metals also inflame spontaneously in Chlorine gas; but in the new gas formed by a combination of Chlorine ~~and~~ with Oxygen, 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,
what thing that oxygen is not
necessary for combustion in all
cases, but on the contrary pre-
vents its taking place. The
Metals already known are 39,
the greater part of which have
been recently discovered: The Ancients
even represented with only 9
metals, Prior to the era of
Alexander, the Phoenicians procure
Tin from Cornwall; it was mixed
with copper, and used by the E-
gyptians, and the nations of
the East, for the manufacture
of Mirrors. In the time of Rome
it was employed to make swords
and spears. Defenseur Armon
was chiefly made from brass of
Copper and Zinc; this is softer &
more easily wrought than brass
made of copper and tin.

Corinthian brass was made of
different proportions of the two
last metals. — Mr. Murriet whose
Antiquarian researches are so
well known, brought from the
plains of Troy an ancient hel-
met with this remarkable in-
scription "Worn by Menelaus in
the battle with Laomedon, made
of Corinthian brass" A small
piece of it has been taken from the
valuable relic of the heroic age:
it has been analyzed, and is
found to contain no other metal
than copper and tin. Gold,
silver, platinum, 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
together; these are called alloys,
or of metals combined with

Sulphur with oxygen 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 following way, by chemical agents, such as the acids and Alkalis.

The properties of fulminating Gold and fulminating Mercury and 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. Am^a is a compound of two gaseous substances, 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, may be now worth properly be asked, If metals be compound bodies, is it impossible or impracticable to combine the elements of which they are formed, and produce by subsequent 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 were derived from the visionary Decrees of the Alchemists, and had nothing in common with the pretended discovery of the Philosopher's Stone or the powder of projection. They were formed on a just and comprehensive view of Science. In proportion as our knowledge is enlarged by experience, many of the bodies considered as simple, are discovered to be compounded and the approach nearer to

a few elementary principles from which other substances are formed

In the present abundance of paper money, the possibility of making Gold need not perhaps alarm us so much as it did our Ancestors during the Reign of 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 Alchemist "from multiplying the precious metals". The reason alledged for passing this act is honourable to the Patriotism of our Ancestors. It is this "that the King may not gain possessions of the

"secret and obtain money with-
out raising it from the people
by the aid of Parliament". This
act is now unrepentable, but
I happily for the progress of
experiment, the alarm lest
the precious metals should
be too abundant is much
abated at the present time;
no 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 re-composition
of the Alkalies. Metals of the fixed
Alkalies; numbers representing
them. Descriptions to which they
are given use. Properties
of Potassium and Sodium

Potassium may be separated
from Potash by a voltaic
Bath of 200 plates 2 Inches
square — This chemist produces
it by iron &c. — in the group
Potash is whole 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 welds with itself by pressure
at the temperature of the Al-

atop here. Sp. Gr. Gravity when
solid as 7, and when fluid as 6
to water at 10. It is the lightest solid
substance known. When thrown on
water it swells and burns with
a vivid flame. It will even burn
if confined under water. It speedily
oxidates and can only be preserved
by keeping it in Naphtha, a fluid
which contains 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 globe
^{superficially} on the surface, and decomposes the
water. — Potash in the purest
state in which it is commonly
obtained by chemical means,
contains 17 $\frac{1}{2}$ 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 oxide
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-oxide
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
hydrate of Potash. Pot ash will
combine with oxygen by the ac-
tion of heat and form a peroxide
of Potash; in this ^{operation} ~~combination~~
it parts with its water of combination.
Several Experiments were made to
prove this, by heating potash in
oxygen gas, and in oxygen gas

combined with Chlorine. Potassium
is inflamed when thrown into
a small cavity in a cake of ice.
The water deposed by the combustion
has all the qualities of an Alkaline
solution, changing the yellow colour
of turmeric paper to red. Potassium
is soluble in Hydrogen gas. When
this gas comes in contact with at-
mospheric air it inflames. The
French Chemists Guay Susse and
Thouard had denied the metallic na-
ture of Potassium and Sodium,
which they considered as Hydrates
of Pot ash and Soda. Further Exp^s
have led them to the conclusion
that they are simple metals, as Dr
Davy discovered three years since.

An account of their report was given
in the Observer of the 17 Feb 1811

In considering potassium &
Sodium as simple Substances, it was
only intended to express that they
were as much so as the other metals

In former papers he has adverted to
the compound nature of all the
metals, and in the succeeding ones,
he should advance such advance-
ment experiments and arguments
as he thought rendered the opinion
probable that Hydrogen was an
essential constituent part of each.

This was a question quite ^{ad-}verse
from the inquiry whether Potassium
and Sodium were Hydrates of the

Alkalies. - The combination of Po-
tassium and Sodium in Oxygen
gas is the only known means of pro-
ducing 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

~~advantages~~ when ever a cheap
mode of obtaining potassium and
Sodium on a large scale, shall be discovered

In purpore of destructive warfare,
their high degree of combustibility in
water may render them the most
potent agents that have ever been in-
vented. As the instruments of war be-
come more destructive, the war be-
comes less bloody and furious.
At present Potassium and Sodium
are possessed in quantities 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 an investi-
gation as a mere matter of gain,
would be to ^{degrade} ~~lower~~ 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 sensations, in some degree
refines and exalts the character.
If gain were the only object of de-
sire, even ^{to} the pursuit of Galileo
sight, instead of directing his at-
tention 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 enlarged upon
Wear of the Magnifying and Sim-
ilarity of her operations, enlarge also
the sphere of human power, and
multiply the sources of enjoyment.
The discovery of Dr. Black related
to latent heat were followed by

improvements on the Steam
Engine, and its extensive applica-
tion to an infinite variety of useful
purposes. The discovery of the quali-
ties of the different earths has led
to the discovery of improved processes
in the manufacture of Pottery and
Porcelain; and we have been enabled
to convert the dust on which we
tread, into forms combining use,
elegance and beauty. Observed

Saturday 30th of March
Chemical Phil^{os}ophy. 13. M. Davy
Modes of preparing Potassium and
Sodium. Decomposition and recom-
position of the earths. New bases re-
presenting them. Volcanic fires.
On Meteoric Stones. History of their
appearance.

Mode of preparing Potash
and Soda. Bergius's mode
by Amalgamation, and the
French method by iron shown
- Earths divided into Alkaline
Earths, and earths proper. Alk:
earths are Barytes Strontites
Magnesia, and Lime, The Earths
are Alumina, Silica, Yttria
Glucina and Zircon. The former
are called Alkaline earths,

because they neutralize acids,
and turn the blue infusions of
vegetables to red green; the latter
produce neither of these effects.

Decomposition of the Earths by
Amalgamation with mercury,
and by potassium -

- Experiments on Barium and
Strontium -

- J. 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 ^{included} a
composition of potassium,
iron and lime. On passing water
into a figure which led to the
composition it took fire exploded
and black lava ran down the
sides of the crater. -

- A meteor was represented
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
amongst others that which fell in
Yorkshire in the year
1783 weighed 56 pounds. -

- He then took notice of the
different modes of accounting for
Meteoric Stones - He concluded
with Sir John Pringle's opinion
i.e. that they are bodies in our
system moving round the sun,
and no doubt answer some
great and important purpose.
(From the Phil. Trans.) -

- M. D. adopts this opinion.

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

- The lately discovered ^{offshoots} ~~strata~~ are very small when compared with those formerly known.

The difference in Magnitude between Comets and some Meteors is that have ^{been} observed is much less than between Comets and ^{the} moon

- As the mean Sp. Gravity of the earth is found to be about double of the leaden on the surface that is about $\frac{1}{2}$ 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. Grav} ~~density~~

geological phenomena explained on this Hypothesis. The present

surface of the earth is perpetually wearing down, and so 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 her 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 fact of Motive Stones is so abundant and so respectable, that no doubt of the fact can be entertained, and the internal Evidence is, if possible

still more satisfactory.

By analyses they are all found
to contain nearly the same
materials, and to form compounds
different from any bodies on Earth.

+ The metals of the Earth are
found and procured with more
difficulty than those of the Al-
kalies.

+ In converting cast iron into
malleable iron there is sepa-
rated from it in hammering,
a brittle metallic substance,
which is, according to M. V., the
metal of silica united to iron.
Silica, he conceived would add
hardness to iron when it was
worked. - A prismatic kind of
steel is brought from the East,
so hard as to cut glass.

Wednesday 3rd April 1811

Chem.¹ Phil.² Lect. 14 D. Davy

- General analogies of all metallic
Substances. Metallization of Am.³;
Nitrogen; its nature and com-
binations. 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 (D. Davy prefers
the latter name. The former is a
Theoretical term - Compound - with
oxygen, Atmosphere air, Nitrous
gas, Nitrous oxide, Nitrous and
Nitric acids, by only varying
the proportions of O₂ and Azote.
Azote with Hydrogen forms a
Muriac. Berzelius's experiment

Experiment on the amalgamation
of am^{a} , shown. This is perhaps the
most wonderful fact in Science.

The mercury is increased five or
six times in bulk, and its specific
gravity of the amalgam is reduced

to about $2\frac{1}{2}$ — The quantity of
the mercury is only about $\frac{1}{1000}$
part of the compound — This Expt
proves that Am^{a} has a metallic
base, for Mercury will not amal-
gamate with an alkali —

But am^{a} is composed of Azote &
Hydrogen — What combination 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
This opinion is founded on some
phenomena where Hydrogen
appears to have been separated

from metals. It is probable
that all metals may be com-
pounds of Hydrogen and some other
substance; but whether that sub-
stance be that the same in all
the metals, and differing only in
the proportion of ^{the} component parts,
or be different ~~in~~ in different metals,
the present state of our knowledge
is to determine — D. D. is inclined
to adopt the latter former opinion,
to which however he attaches no
importance, nor should he consi-
der it as fully established till some
one metal shall have been decom-
posed, and its const. parts ascertained
— D. D. had lately perused the prin-
cipal writers on Alchemy, hoping
that some useful & hint might
have been obtained but he was
quite disappointed. — This Expt
was so rude and thin that it was

so inaccurate and obscure, 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 were suited to the state of the Science at the period in which they were formed. But the French Nomenclature, in many instances, founded on theory, and not on Nature, tended to perpetual error. Theories have their uses, as resting places for the imagination; but they should always give place to newly discovered facts. Chemistry even 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 Lyellus and Epicurus

were introduced to explain the motions of the planetary System. Since that time Galileo, Kepler, Newton and Laplace have made Astronomy a branch of Mathematical Science, and developed the magnificent simplicity of the Mechanism of the Universe. This certainly ^{is} ~~is~~ thought that after no very long period the same certainly would be introduced into Chemistry.

M. 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, demerited its perjury and made it a branch of Math. Science.

The Science advances and the sphere
of light extends, the more extended also
is the boundary of darkness by which
it is surrounded, and the more we
perceive of the immensity of nature, the
more is our curiosity raised to know
what exists beyond the present range
of our research. Science, like Nature,
is ever young, new objects are per-
petually presented, better seen better,
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 hu-
man intellect is inadequate to grasp
the universe. In this state of being
we can see ^{sufficient} enough of the wonder-
ful operations of Nature, to impress
us with awe, inspire devotion,
and excite ardent curiosity; nor
is it unreasonable to hope that all
our faculties are intended to reach a
higher degree of perfection in a future
state of existence. — The newly fledged bird
takes its plumage for a whole round
before it has its nest, then spreads 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 Strata. Im-
portance of this branch of Science
Its uses and applications.

Wed. 3rd April 1811

Chem. Philosophy Lect 14.

- General Analogy of all metallic
substances. Metallization of Am.
Nitrogen; its nature and combi-
nations. Number representing
it. The great question, are the
metals simple or compound bodies?
discussed. Analogy in favour of the
being compounds. Ideas concerning
the future progress of Chemistry.
Conclusion of this course.