

William & Mary College
Williamsburg Va

1838

Lectures

H. O. ...

1981. 56

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8
16
32
64
28

John II



Thos R Dew

President

Wm Mary Cole

511

511

511

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Sophia
I can't
dam
me!

Islands

O. M. Smith

O. M. Smith

O. M. Smith

O. M. Smith

O. M. Smith



Islands

John M. Taylor

Com. Army college

W. M. Jones

T. M. Jones

John William Loby

taking off his hat to

Miss Lucey Jones

go it broke it's

Wice



J R Duns lectures on Blair 1837

Thomas A Duns lectures on Blair's Rhetoric
Delivered at William and Mary in the fall of winter of 1837
I commenced in Blair at the X lecture (1837 Oct 31)
The outlines of his lectures.

If we desire to court popular favour we must be
business men. The populace do not adhere to one
with that tenacity so characteristic of them unless
we are really business men. During the
revolutions of France, no business men could
be found and consequently no useful men.

Monarchical form of government, has furnished
more examples of splendid talents than
any other. Republican form of government
suits after useful men & business. Diversity
of dialect gives copiousness and beauty
to language; whence the high literary standard
of the Greeks. Young men are apt to make
no exhibition of their talents under a
monarchical form of government unless

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their debut prove successful; but if
a failure is made here they never rise
again. Different under a Repu. Grant
a young man may approve the literary
arena, with more confidence, & if he
should make a failure at his debut
he can try again & perhaps with great
success. A man may understand a subject
well and then perhaps not be able to
express himself clearly. Custom gives
law to language and orders it just as
suits herself. Socially the custom can
be proved unjust, but from Liberty
to order. The best criterion for words
is the use of such words as are
reputable, national, & present use.
Some have a genius for long sentences
some for short — only genius should
never be trampled. Take an example

The latter Boetius the Ancients poets
 remarkable for beginning a work with
 the most important word first Homer
 & Virgil a special example. Milton
 indignant to do the same thing
 but fails because our language can
 not so easily be changed about as the
 ancient. When speaking of a kind or
 particular race in oratory we should
 always, ~~we should~~ be special, for instance
 they sink down like lead is much
 more beautiful than, like metal.
 XIII, A great difference exists between
 the language of the North of Europe
 south, the former full of consonants the
 latter mixed with vowels, Our language
 a mixture of both. Four different
 modes of arranging letters to be observed
 in writing, namely

- 1st of - Imagination 2^d of a cordy
 3^d Grammer or a Grammatical arrange
 3^d Musical, 4th Metaphysical. In conversation
 Grammatistical should be consulted
 In poetry Musical, as "Amor Patrie,"
 You an Amo would put Amor first
 Musical also, Imaginations both ways
 metaphysical also, Antinomies where
 we put one of the genus or kind for all
 Onotopia where a proper name is made
 a verb, 5th Aphorism - Exclamation
 Litotes, for instance in the case of St Paul
 speaking of Rome of ~~the~~ least not least
 city, Metaphor a truncated comparison
 A metaphor should be used in preference
 to a simile. Beastly & Brutally different,
 brutally was cruel, viz used metaphorically,
 vein and artery thought so nearly allied
 are not both used metaphorically.

The language of the East is generally fond of Hyperboles,

Two kinds of Hyperboles a increasing & diminishing one,

(See Two lectures on the (17 & 18) of Blair)

Why does Shakespere call the mother of Coriolanus the moon of Rome and icicle of the purest kind hanging from Diana's temple in a circle circled ~~for~~ by frost from purest snow?

What is the motive in using parady? when there is a very great contrast,

What is the meaning of ~~and~~ wit?

Wit always expresses surprise or creates surprise. It is a development of dissimilitude

What is the difference between the concise and allusive styles? concise is a pruning off

of all superfluous things. What should determine us in the choice of the two?

Six definite reasons, why a Lawyer

should use the concise style

Should cultivate a diffuse style.
 1st Law is a very extensive branch.
 And his case may be obscure.

2^d Clients generally desire to see advocates
 in their principles, or diffuse or mundane.

3^d The client is generally apt to judge
 of the talents of the lawyer by the
 his loquacity, 4th A rivalry is
 excited between lawyers,

5 vanity of the lawyer himself,

6th The lawyer should find out
 the disposition of the jury and endeavor
 to adapt his discourse to the
 individual ~~sorts~~ opinions of each
 man of the jurors, the number
 lawful for a Jury. So hereafter
 let no man tell me that a lawyer
 talks too much; since I should
 certainly consider that man as

not knowing anything about a lawyer
 business. And no man should attempt to
 criticize on what he knows nothing
 about; but he should be branded with
 the opprobrious
ignominy, by no means an enviable title

To find the specific gravity of a body, Divide
 the weight in air by the loss in water and the
 quotient will be the Sp. Grav.

Grand division of Nature is in inorganic
 and honorables. & The latter is divided into
 Supporters of Combustion, & Combustibles.
 There are 5 elements, 42 metals, 5 supporters
 of combustion, 7 non metals combustibles, &
 3 impendables,

What is the purpose of taking the Grav? I understand
 through the body first - it becomes as much
 lighter as its weight. And is in
 the air, and is in the air
 - take down may this

8 8 8 I mixed and I was put to

can be still the one or the other

both in a bad and the comfortable 30

How can I have known before

What does an index by a base? that

which is most fixed,

What are the advantages of chemistry?

What is the principle upon which the

thermometer acts: expansion of the fluid,

is that expansion is by the thermometer

depends on expansion of air?

And we could have no fixed scale

with principle of solid & 1715

There shall be "constant air, How used

30 of Columbus only called differential?

London 1715

action of all bodies in nature upon

acquaintance with the universe A hypothesis

Chemistry is that science by which we know

Lectures on Chemistry 1838
Notes

How do you define chemistry? It is that science by which we become acquainted with the intimate and reciprocal action of all the bodies in nature upon each other.

It does it differ from mechanical philosophy? Mechanical philosophy treats of external characters only.

Who were the alchemists? Those who endeavoured in the third century to convert the baser metals into the precious. Ques:

did not chemistry labour under difficulty formerly from arbitrary and pleurality of names? ans: yes it did. Ques: Who proposed

and carried into effect the present nomenclature? ans: Lavoisier. Ques: Who assisted him in it? Berthollet, Guyton, Morveau,

and Fourcroy. Ques: what is the name

10.
By which all material substance is
called matter. Ques: How do you ascer-
tain the existence of matter? ans:
By its occupying and being seen, felt
and weighed. Ques: How do you conceive
such substances to be formed? By an
+ aggregation of particles or atoms. Ques:
By what name is that principle called
that holds atoms together? ans: Attraction of
cohesion. Ques: By what ratio is that amount
of attraction produced? Simply as the quantity.
Ques: In what direction does attraction act?
ans: Radially; By what law does it decrease
in power? Inversely as the squares of its
distance. Ques: Does the law apply to any
other influence than attraction? It applies
to light and all that radiates:— What do you
understand by the term gravitation?
ans: That tendency which bodies have to

fall to the center of the earth:— why do drops assume a round form? Because they are attracted on all sides— What is this principle called by old chemistry writers? Electric attraction.

— Does it take place between similar or dissimilar bodies? Things of the same kind. Between dissimilar bodies.

— What do you understand by a solution?

It is when two bodies combine— What are its characters? Ans. It will continue to act until it has attained to a certain point where the affinity for each other is overbalanced by the cohesion of the solid.

How does a solution differ from a mixture? In a solution the particles have an affinity for each other, whereas in a mixture the particles are suspended in the fluid and will soon fall to the bottom.

What is the usual chemical name for solvents? Menstruum— What point do you call that when the fluid will take up no more of a thing? Ans. Saturation— How do you

Know when a solution is saturated? and when
 the solution has its dose and particles of the
 solid are precipitated — Is there any process
 by which you can increase the menstruum
 and by increasing the quantity of both —

What do you mean by density? It is
 used in a comparative term, thus we say
 one thing is more dense than an other, but
 we know of no ultimate density — How
 do you increase the density of a body?

By hammering or diminishing the dimensions
 and not the quantity — What is the
 antithesis or opposite of density? Rarity

How do you judge of the quantity of water contained
 in any substance and by weighing — Explain the
 process of weighing, and weights of a known
 quantity are put in one scale, and the quantity
 to be weighed in the other, until a balance
 is the result and then this body is said to be

weight. What does this depend on? The principle of gravitation - How do you ascertain and what one fluid is heavier than another? By weighing equal volumes as in solids and by their power of flotation - How do you ascertain correctly the respective densities of different bodies? By taking their specific gravities - a comparison of its weight with equal bulks of water - Why was rain water selected as the standard of comparisons? Because of its purity - What are those instruments called which determine the density of ~~heavy~~ fluids? Hydrometers - What is evaporation? A change from a solid or fluid to vapor - Why applied? To increase density and prompt Crystallization - Explain the method of taking the specific gravity of heavy solids? By suspending in water the solid, and then taking its weight - What weight of water does a body that floats on the surface displace

Ans; a quantity equal to the bulk of the solid
 - What weight does every solid lose that sinks
 into the water? A portion equal to the ^{weight of} water it
 displaces. How do you take the specific gravity
 of a solid that is lighter than water? By
 its being under the water. How by a common
 bottle? After weighing the bottle filled with
 water a known weight of the solids is put
 into it which of course displaces, which of
 course displaces a quantity of water equal
 to its own volume, the exact weight of the
 displaced water is found by weighing the
 bottle again after its outer surface is
 made dry. How do you determine the
 weight of a cubic foot of any substance from
 knowing its specific gravity? By ascending,
 - What is the second object of a solution;
 and to prepare things for chemical purposes
 and to separate one from another,

What is the proper solvent for various gums and substances? The acids - What for oil and fats? Alcohol - What do you understand by a chemical laboratory; a room furnished with various articles for experiments - What mortars are best for delicate analysis? Thong or agate - Is thick or thin glass best when heat is applied? Thin glass is more preferable - Why are flasks made of green glass preferable in experiments? Because flint glass contains oxide of metal - How do you obtain salts from their solutions? By evaporation - What is the name that this salt takes up? a crystallized form. - Do metals ever take this form? Yes - What is sublimation, It is when a substance assumes that of vapour and when condensed presents a regular crystallized form - Name some of the sublimed substances, Arg. Arsenic, Sulphur Mercury and Benzoinic

Name a domestic instance of sublimation? Soot
 What is meant by precipitation? It is when
 a body will not remain suspended in a fluid
 but will either sink to the bottom or rise to
 the top, or precipitation is owing to the formation
 of a new body which happens to be insoluble
 in the liquids in which its elements
 were dissolved - What varieties of this are there?
 Per ascensum and per descensum - Give an
 instance? In a solution of the nitrate of silver
 place a piece of polished copper and
 it will soon be covered with metallic silver
 The ~~silver~~ ^{solution} will soon be decomposed and the
 silver precipitated or a solution of camphor
 in alcohol by adding to it water the camphor
 will be precipitated - How do you separate
 the precipitates from the fluids that hold them?
 By decantation or filtration - What is water
 of crystallization? In separating them from

The water in which they are dissolved the crystals of almost all salts carry with them a quantity of water, which is essential to the regularity of their form and can not be expelled without reducing them to a shapeless mass;

What term is applied to those salts that voluntarily lose their water of crystallization? Efflorescent salts. What name is applied to those that attract and take moisture from the atmosphere?

Deliquescent salts. What is the noise called caused by throwing salt into the fire? Descriptions - Why produced? Because their waters expand and cause them to burst. - What is said of those salts that ^{dissolve} ~~expand~~ by heat? At melting fusion is produced, an instance of which is nitrate of amoniac.

How do you accelerate the process of crystallization and form large crystals? By the application of heat.

Has the atmospheric pressure any influence

on the crystallization of bodies? It may,
 by taking three parts of sulphate of soda
 and two of water and ~~mixing~~^{boiling} together corking the
 bottle and after it has cooled, by removing
 the cork you may see crystals forming on
 the sides - What is the science of crystals
 called? Crystallography, who were the prin-
 cipal persons that laid the foundations of
 that ^{branch} science? Goussier, Lavoisier and Delafontaine.
 What are the instruments called with which
 you measure the angles of crystals?
 {Goniometers} What is the method of obtaining
 the primitive crystals? By cleavage - How
 many primitive forms are there? Six, name them.
 The Parallelepipedon including the cube and
 Rhombus, the Tetrahedron, the Octahedron, the Hexagon
 Prism, the Dodecahedron with equal Rhomboidal
 faces and the Dodecahedron with equal triangular
 faces - How many forms of integrant

Molecules to form these figures? These, Tetrahedron, Triangular prism and Parallelepiped including the cube and Rhombus.

What is the meaning of the word amorphous? A body is said to be amorphous when it takes up no regular shape by itself. — Are there any exceptions to the structure of crystals indicating their composition?

Isomorphous bodies Part 3

What is the difference between chemical and mechanical attraction? One acts on similar the other on dissimilar matter. —

What is name that has been applied to this principle? Electric Attraction - affinity —

What do you mean by an element?

The first or constituent principle of any thing.

Why are the four elements of the nature the ancients discarded? Because they were found divisible compounds —

What is the meaning of analysis?
 When a compound is retracted to its elements
 What is the meaning of synthesis? The opposite
 of analysis - How many elements did
 modern chemists reckon? 56 - Of these how
 many are indispensable? 4 - Fire light El-
 ectricity & Magnetism - How many
 gasses? 3 - Oxygen - Nitrogen and Chlorine
 - How many solid and gaseous? 103 Iodine -
 - How many combustible? 6 or 7 - Carbon, Phosphorus
 Sulphur Hydrogen and Fluorine this makes
 14 - What are the others? The metals or metallic
 substances, - What is neutralization? When
 bodies mutually disguise each others properties,
 - What is a neutral salt? It is a compound
 formed by the neutralizing power of an acid
 and an alkali? How is neutrality detected?
 By the test papers Litmus & Turmeric -
 What are the changes of color that appear?

It changes the vegetable blues into red of
 S. acid is tried, and if Potass is tried it
 changes them into green - In naming
 the acid, how do you designate the ^{principles} acidifying
 quantities? By the terms is & oz -

What is the base of Nitric and nitrous acids?
 The base of nitric acid is nitrogen and oxygen
 in the proportion of one in the former to
 4 of the latter with $3 \cdot 04 \cdot 3 \cdot 14 + 4 \cdot 0 = 5 \cdot 4 =$ Nitric acid

The Nitrous acid has for its base nitrogen &
 oxygen in the proportion of one of the for-
 mer to 4 of the latter ^{with 4.04} $14 + 3 \cdot 2 = 4 \cdot 6 =$ nitrous acid -

Do acids exist in a solid or fluid form? All
 are supposed solids, but some are ^{only} known as
 fluids, - What is the character of an alkali?

It changes the vegetable blue to a green -

How many alkalis are there? 3, Potassa, soda
 and ammonia - Are these alkalis designated by
 any other names? Fixed and volatile -

What name is applied to those things that unite with oxygen, but not in a sufficient degree to produce acidity? Oxides - Give an instance? Rust of iron - Do things unite with oxygen in different degrees? Yes - How are those things designated? Protoxide, Dutoxide, Trutoxide - Some substances that are inflammable unite with things without suffering oxydation - How are these things designated? Answer by the termination - uret.

Have all bodies the same affinity for each other? No they have not. - What do you understand by simple or single, complex or double decomposition? In simple one body separates another from its combination with a third, thus when Potassum is added to sulphate of zinc - The oxide of zinc is separated and sulphate of Potassum is produced - In double decomposition two new compositions are formed, Thus nitrate of Barilla added to

sulphate of Soda. The result will be the precip-
 itation of sulphate of Baryta and a solution of
 Soda. ~~Make~~ Make a diagram of the decomposition
 Soda $\left\{ \begin{array}{l} \text{Sulphate of Potassa} \\ \text{Sulphate of Soda} \\ \text{Baryta Sulphate} \end{array} \right\}$ Anhydrous Sulphate of Baryta
 After this decomposition
 do the two bodies remain neutral? Yes. What
 is meant by proportional representation or
 equivalent numbers? Numbers derived from the
 relation of bodies in their combining propor-
 tions - Thus Hydrogen being the lightest known
 substance is assumed as unity and called one
 Oxygen being sixteen times ^{heavier} lighter than
 Hydrogen in equal bulk should be 16 but
 as it unites with Hydrogen in $\frac{1}{2}$ bulk is called
 8 and as one proportional of Hydrogen with
 8 of oxygen to form water, The sum of
 these will be 9 the representation No of water
 16 is the No of sulphate and 3 atoms oxygen
 of 8 each or 24 makes sulphuric acid

And the sum 20 is the no. of sulphuric acid
 Do the same bodies ever vary in the propor-
 tions in which they unite? No; but as these
 numbers are ideal and proportional any num-
 bers may be taken so long as they are in
 the same proportion to each other. —

How are chemical equivalents or represen-
 tation numbers ascertained and determined?

By assigning in the first place a value or
 no. for Hydrogen and oxygen and then
 ascertaining experimentally how parts of
 other things are necessary to combine with
 them to form new compounds — thus one
 atom of Hydrogen contains with 8 of oxy-
 gen or 16 of sulphur or 36 of chlorine and it
 is found if these things combine with
 each other without the whole they will
 do so in the same proportion or in multiples
 of them thus one of Hydrogen combines

with 16 of Sulphur to make Sulphuric
 Hydrogen. — What is the atoms theory
 of Mr Dalton and the three principle
 laws based upon? First the fraction of
 an atom can not exist — 2^d when any only
 one combination of any elementary bodies exist
 he assumes they unite atom to atom singly
 and he called such binary compounds
 3^d that the combinations that take place
 chemically ~~between~~ between particles are
 always in a certain definite proportion
 which are multiples of each other, that
 the quantity of matter that combines
 will be multiplied by itself — for more
 compound combinations — Give an example
 of this? If one oz of A unites with B and
 A is capable of combining with a greater
 quantity of B it will take up 2 oz or 3 oz
 of B without any fractional quantities

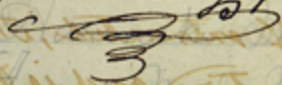
What is the principle of Dr. Wallaston's
 scale of chemical combinations being
 multiples of each other in going with the
 nature - What is the difference between
 speaking of atoms, atomic weights, and
 proportional or equivalent numbers? They
 all have the same meaning though
 differently expressed and are often used
 indifferently or synonymously bearing in
 mind that they are all but modes of
 expression to indicate the proportions
 and not the positive quantity in which
 bodies unite; - What is meant by the
 theory of volumes as introduced into chemis-
 try by Gay Lussac? This applies more
 particularly to aëiform and gaseous
 fluids and air and is the same in prin-
 ciple as proportional numbers - but
 while they are confined to weight only

this alone regards bulk or volume —
 How are volumes generally used & expressed
 to facilitate chemical explanation?
 By diagrams which are rectangular
 figures having sides proportionate to the
 volume of things which they are intended
 to represent — State an example, 36
 parts of Chlorine are equal by weight
 in bulk to 1 part of Hydrogen — therefore
 this combination therefore this combination
 would be represented by two contiguous
 squares of equal size with $\frac{36}{1}$ upon them
 The result will be a side which
 would be represented by one parallelogram
 equal to both squares $\frac{36}{1}$ — State another
 example such as the formation of water,
 Oxygen with in the proportion 25 to 1
 to form water, and yet water is said to
 be formed of one atom of each component

28 158 In 4 months board is out of all season we cannot
consume food sufficiently to justify demanding that
amount.
Therefore the atom of oxygen
must be 8 times as dense and heavy
as Hydrogen. But oxygen according
to the specific gravity is 16 times as
heavy as Hydrogen or as one to sixteen,
Now as 1 to 8 is the combining proportion
for water so this can only be explained
by one volume of Hydrogen uniting with
2 of oxygen or $\frac{2}{1} \text{H} \cdot \text{O}_2$ but in so much
as it has to make use of Hydrogen it
is better to call this a volume of Hydro
to one of oxygen which does not alter
the figure - What do you mean
by the approximate analysis of a
body? What do you mean by ultimate analysis?
Give an instance of the two? Sulphate of iron is
sulphuric acid combined with the oxide of iron
(proximate) ultimate 1 of sulphur to three of
oxygen in the acid. 1 metallic iron + 1 oxygen

433 450 found for 9 months is out of a 29
from that amount - reason we cannot form conclusions
in order the result is, 1 sulphur + 100 of oxygen
How is chemical analysis conducted? It is
conducted by obtaining a knowledge of the affi-
nity bodies have for each other and of the
circumstances most favourable for their union
which can only be acquired by study and
practice - What is meant by a favourable
circumstance for effecting a union?
Some bodies will not unite without heat of
greater or less intensity - some require cold
others bright light and nearly all a solution
to promote an ultimate admixture and
contact of particles - what are the principles
upon which analysis depends? The formation
of new compounds through the exercise of
affinity so as to leave the elements uncombined
in succession or put them into such new
combinations, as will admit of their being
weighed or ascertained or determined, This

process may be confined to the solution of
 an equation in mathematics - while known
 quantities are taken from the unknown
 in order to develop them - What is meant
 by decomposition? When a given substance
 is added to the compound of two other
 substances and it is found to exhibit a
 preference to unite with one rather than
 an other this called single elective affinity
 or single decomposition - What is chemi-
 cal Synthesis? It is forming a compound
 by uniting elementary particles.



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Caloric & W^m & Mary

Why has the term caloric been adopted instead of heat? Because heat in common language is ambiguous and includes the cause and effect = How has this heat a double meaning?

Because it includes the sensation produced on touching a hot body and the cause of that sensation — why is caloric best? Because it is the principle or cause of heat and its action is therefore it produces the sensation —

What is Caloric? It is a principle that exists in all bodies and at all times and can never be wholly extracted, it is so subtle as to elude examination and is the cause of heat — what are the characters of caloric as far as they are known? It pervades all matter but is imponderable or incapable of producing the sensation called heat until called into action,

What is it called when so disturbed or called into action? The sensible radiating or caloric - What are the characters of free or sensible heat? caloric? It affects internal bodies by producing heat and more or less, then according to its extent, -

It aims at equilibrium and when its extent is considerable it is usually attended with light. By what name are the effects of free caloric usually expressed by chemists? Temperature - How is the word temperature used? Raised lower and so - What once named effect does caloric produce on bodies?

It appears to be the great antagonist of cohesion and principle of repulsion.

It sets the particles of which all things are formed at a distance from each other therefore increasing their bulk or extension. Does caloric alter

The densities of bodies? yes - what is the
 cause of fluidity? Heat - If additional
 heat is added to a fluid what is the consequence?
 It will cause it to take the
 gaseous form. - What name is applied to
 the increase of bulk or dimension in
 bodies by heat? Expansion - How is the
 quantity of expansion measured? By a
 Barometer for solids and Thermometer
 for fluids - Do all things expand equally
 by equal elevation of temperature? No wood
 and glass expand very little zinc lead tin
 copper bismuth iron steel antimony
 Palladium and Platinum - Which
 among fluids? Those that are easily
 boiled expand most either water oil mercury
 or alcohol - What advantage is taken
 by the expansion of fluids by heat? The
 Thermometer - Describe it.

and the two fluids used to fill them?
 ? A glass tube of equal bore is selected
 with a spherical cavity in one end. By
 heating the bulb you cause the air to
 expand and while expanded you plunge
 the open end into a vessel of water - and
 it will be found as the air contracts the
 fluids will ascend. Then by having
 a graduated piece fixed to the tube you
 can ascertain the expansion of all
 fluids ascertain degrees of temperature.
 The two fluids most generally used are
 mercury and alcohol - what are the
 respective advantages of the spirit and
 mercurial thermometers? To ascertain
 the degree of heat by ^{mercury} ~~alcohol~~ and the
 degree of cold by alcohol. —
 what are the scales generally used?

How are the scales obtained? By ascertaining the point of solidification and congelation - It may small change of temperature occur when it is not necessary to know their exact extent - What thermometer is used? The air thermometer of Saunderson - What is the best air thermometer? Leslie's differential thermometer - What is latent heat and by whom discovered? It is that part of the caloric of a body which is supposed to be in a state of chemical combination when it lays aside the prominent characters and as it were concealed without evincing any signs of its presence - By whom was it invented? By Dr. Black - What degree of sensible heat can be communicated to water in open air? 212 - It is no uncommon thing to display some degrees of temperature to water in the open air - and what becomes of this superabundant heat? It passes off in steam - Steam is frequently passed through metal tubes in the inside of buildings for the purpose of heating them - Explain the principles of this process?

They are so fixed as to permit the steam to pass.

through the floor or any on the surface of it. Why does
 water boil in a covered pot without a fire under it, but not in
 a steed from a distant boiler is made to blow through it?
 Because this latent heat is called to action. What do you
 understand by the capacities of bodies for caloric? I think
 power of receiving and retaining ~~heat~~ caloric. Give an example.
 If you place equal quantities of mercury & water at equal
 distances from the fire, it will be found that the mercury
 will be heated and cooled quicker than the water,
 therefore water has the greatest capacity for caloric
 of the two. How do you ascertain the specific caloric
 of bodies? The absolute quantity of caloric that enters into
 the composition of bodies can never be ascertained. There-
 fore specific caloric is but a relative term to express the
 comparative quantity that any body contains over another.
 The comparison is generally made with water for an example
 is generally conducted by weighing different substances together
 and observing the different relative quantity of caloric necessary
 for one being then the same number of degrees, then
 equal quantities of water oil mercury agree

in the notes of 1, 14328, therefore their capacities for caloric
 are expressed by those numbers. — How caloric pops off
 to restore an equilibrium. How does it pop off?
 In two ways, by radiation & contact. — What is meant by
 radiation of caloric? That caloric like the radii of the
 circle is emitted from the surface of a hot body equally
 in all directions & in right lines; so that the thermom-
 eters placed at an equal distance on all sides will
 stand at the same point. — What are the laws of
 radiating caloric & the quality of it? It decreases as
 the squares — and is capable of depletion? What is
 cold? The absence of heat — How happens it that if a
 piece of ice is put into the focus of a mirror that will
 sum up the radiation? Because it abstracts heat from
 all surrounding bodies while dissolving. — Is any substance
 capable of stopping the radiation of heat? Glass
 reflects terrestrial, but not solar rays heat —
 Does the radiation of heat take place equally in
 the air and vacuum. — Three times as great in
 vacuum —

Has the nature of the surface of the heated body any influence on the quantity of facility of Radiation? Yes - Black surfaces radiate most. How is it with the reception of radiating caloric? Those that radiate it most freely, imbibe it most readily. - What kind of surface is most productive of radiation? Rough surface radiates much better than a polished one. - Does color effect radiation? Yes - all other colors approaching black are much more favourable to radiation than those approaching to white. How does this radiation of heat from the surface of a vessel affect the cooling of its contents. By endeavouring to keep up a new equilibrium the surface will radiate and the heat contained will continue to go to the surface until a cooling takes place -

Explains Dr Franklin's experiments with three pieces of cloths black, brown, & white on a snow after letting it remain on the snow a little while, he found that the black had sunk deeper in the snow than either of the other two colors.

and that the brown had fallen deeper than
 the white and that the white had sunk but
 very little - What do you mean by the conduction
 of caloric? A bar heated at one end will gradually
 conduct the heat to the other end and that means
 through which transmission takes place is
 called conducting power - What are the best con-
 ductors of heat? The metals - Do all of them conduct
 alike? No, gold silver copper & platinum in or-
 der of fine tin & lead - What are the worst conductors
 of heat? Glass wood & charcoal - How is
 their power of conducting examined & ascertained?
 By taking a piece of wood or charcoal while on
 fire and it will ~~not~~ ^{create} no degree of heat at the
 part held in the hand - What advantage
 is taken of this property? All of our copper or
 tin-pot & chandeliers are made of them or any handle
 where heat is used - We put charcoal and woollen
 cloth in our refrigerators in consequence of the
 nonconducting power -

As woolen clothes are bad conductors, they will keep off external heat, therefore how does it contribute to our comfort? By its being a bad conductor it prevents our animal heat from escaping and thus renders us comfortable—Why does a wooden table feel warm while a marble one is cold?

Because marble is a better conductor than wood and consequently the heat abstracted from the hand will produce a cold sensation—When heat enters any substance does it affect the density of it? Yes—Is water a good or bad conductor of heat? It is a nonconductor—If heat is applied to the upper surface of water in a vessel how will it affect the water it? It will have no effect on it—We know if heat be applied to the bottom of a kettle of water, it will not only heat it, but cause it to boil showing as heat will not descend & water a nonconductor of heat. How comes it that the water is heated and made to boil? Because it has a tendency to set at variance the particles and consequently to increase the dimensions

and this evence of dispersion will cause it to rise
 to the Top being lighter than the cold water above
 a constant amount of cold water will be heated until
 the whole is heated. When a solid body or bodies
 become liquified does it produce any change of temp.
 "nature? Yes - it produces cold because it abstracts
 cold from surrounding objects in order to its
 liquifaction. What do you understand by frigor
 "ific mixtures? Mixtures made to produce cold art
 "ificially - for instance snow & common salt - are
 made to make it increase. What is the most
 powerful freezing mixture made known? Equal
 weights of crystalized muriate of lime and snow will
 freeze mercury. Does freezing of water produce warmth
 or cold to surrounding objects? It produces warmth to
 surrounding objects, because it throws out a part of its own
 warmth. What do you understand by ebullition in boiling
 water? It is when heat communicated to the water
 is sufficient to overcome the pressure of the atmosphere

What do you understand by the boiling point of water? That point when the heat is sufficient to overcome the resistance of the atmosphere. What are the boiling points of Fahrenheit's scale of Sulphuric ether, alcohol, water, oil of turpentine & mercury? Sulphuric ether 96° , Alcohol 173° , water 212° , oil of turpentine 315° Mercury 580° - Is the boiling point of water and other fluids subject to any change and if so from what cause? Yes, they boil 1118° lower in a vacuum than in open air - & is owing to the presence of air. Can the height of mountains be estimated by a thermometer & boiling? Yes, By Wollaston's contrivance. - What degree of temperature can be communicated to water in the open air? 212° - How can this temperature be raised? By high pressure as steam engine, Papin's digester - What is the quantity of caloric that becomes latent in steam of boiling water according to Dr Black's investigation? 967° - Explain the principles of distillation? It is a common operation carried on

by so many different people that I conceive it useful to give an explanation. Explain the principles of the steam engine by means of the consideration of steam it is made to act & operate. Why does mist appear on the inner surface of a glass of cold water? Because in endeavouring to an equilibrium it abstracts heat from the air while it is charged with moisture. This settles on the surface of the glass - How is dew produced? By warm atmosphere coming in contact with cold bodies - How is rain produced? By the combination of these particles of dew in the atmosphere.

Light

What is light considered as a chemical agent? An elementary substance or principle capable of producing effects on palpible substances, but too small to admit of examination, therefore we know nothing of its intimate nature - What are the properties of light as far as they ^{can} be subjected to examination?

It has the power of illuminating bodies and
 rendering them visible by some action on the nerves
 of the eye. That it radiates into right lines into spa
 ce from the point of its production and its
 illuminating power on equal bodies, therefore is
 as the square of the distance. That it is subject
 to reflections refraction or bending. That it is the
 source of color it is frequently accompanied by heat
 and composing a chemical decomposing power.
 What are the opinions in respect to light generally
 entertained? There are two main theories, one sanc
 tioned by Sir Isaac Newton, light is an emanation
 from luminous bodies in inconceivable small
 particles, too small and subtle to exhibit the common
 properties of matter. That they pass through a
 space with inconceivable velocity & produce the
 sensation of light by entering the eye. The
 other theory denying any material existence
 to light and ascribes its effects to vibrations.

or undulation of subtle & the sense motions
 every where present in space by the luminous body
 and that the effects of illumination & seeing
 are produced by this motion in the same way that
 sound is transmitted through air - This was
 the theory of Descartes & Euler which fell into
 disrepute and gave way to that of Newton - but has
 lately been revived - Light passes through
 some bodies but is almost wholly thrown
 back by others - How are these two effects
 designated? By the terms Transmission &
 refraction - What name is applied to such as
 transmit light freely? Transparent - What
 to those that partially suffer light to trans-
 mit them? A semi transparent - What to
 those that wholly refuse transmission to light
 ? Opaque - What is the cause of our seeing things?
 Reflected light - Is the whole light reflected?
 No - What are the two laws by which reflection

is governed? By the angle of incidence & reflection. The angle of incidence & reflection are always in the same plane & perpendicular to the reflected plane. The angle of incidence is equal to the angle of reflection. Do the laws

apply to flat surfaces, or to convex & concave mirrors. Both to convex & concave. What is the bending of rays of light called - Refraction. Under what circumstances does it ^{occur} appear?

In passing from a ^{rarer} rare to a denser medium & vice versa. Does the density of media affect

the power of refraction? It ^{some times} generally increases with their density but this is not a general rule. What exceptions are there to it? That

inflammable substances though wanting in density are the most refrangible, for the Hydrogen gas

the lightest substance known has $\frac{6}{5}$ the refractive power of water. What induced Sir Isaac

Newton to suspect that a diamond was

was inflammable; Its refractive power 320
 What is the consequence of passing a ray of
 light through two angular sides of a triangular
 piece of glass called a prism? A subdivision
 into what are called the seven primary colors
 What is the bright colored spot called when
 thrown upon an opposite wall or convenient
 receiving medium? A color Spectrum —
 Name the seven colors & the order of their
 succession? R. O. Y. G. B. I. V. — Which
 color always appears at the bottom of the
 solar spectrum? Red — Why should the
 red color always be at the bottom & the
 violet at top of the solar spectrum?
 Because of their different refrangibilities —
 What is the consequence of admitting
 the whole of these rays through the
 focus of a lens? Heat will be produced
 What color is produced in the absence of all
 the rays? Black

How is it supposed that the primitive colors of light affect all objects? By absorbing all of the rays reflected except one & the object appears under that color. If all the rays are reflected what will be the apparent color of the body? White. If none are reflected what color will be produced? Black. Have all the colors equal illuminating power? No, very little in the violet most in yellow, & seen in orange next. What color is most penetrating in space? Red. Why is this supposed most penetrating? Because Red is the least refrangible & capable of giving away, it is supposed that its particles are either larger or have greater moving force & the same cause that enables the Red ray to resist refraction causes it to penetrate forth into space having all the colors

equal heating power? No. Red has most
 violet least - Which is the hottest part
 of the spectrum as ascertained by placing
 a thermometer in it? The Red, but it is
 also found that greater heat exists beyond
 How is it accounted for that this shade
 should be the hottest part of the spectrum
 Heat is found to be subject to the same law
 of reflection as light - but to be less use
 capable of bending - as the Red end is
 the hottest so must the violet ^{be the}
~~coldest~~ coldest - Has it any other proper
 ties that render it remarkable? Yes
 The violet possessing great chemical
 powers both of promoting union &
 decomposition. State an instance? ^{Common}
 indelible ink which is used in marking
 lined is a solution of nitrate of silver
 which is white & colorless as it turns,

black by exposure to the sun's rays —
 Thus exposed to the general rays of the
 sun why does it assume any color in
 particular? The salt will pick out the
 ray for itself when exposed to general
 light & the ray in which it becomes brown
 that the violet ind has greater power
 was that after salts were exposed in
 the Red ray without any effect after many
 hours trial while the change took place
 immediately in the violet ray — What is
 the effect of solar light on equal light
 volumes of Chlorine & Hydrogen gases
 confined in a transparent glass vessel?

Instant union & formation of muriatic
 acid gas — What action would take place
 with the same mixture kept in the dark
 ? They would combine about very slowly
 What effect has exclusion of light

on growing vegetables? It makes them
 very white and tender. - Their leaves give
 out oxygen in the sunshine Has the violet
 any power of producing magnetism
 in steel? This is very generally admitted on
 the authority of Dr. Meirichini of Rome
 who made the discovery & several other
 persons who have since tried & verified his
 experiments. - It takes about two hours to
 render a needle magnetic - Light is generally
 considered under two distinct modifications
 What are they? Natural as flint & steel
 & artificial as ~~beams~~ &c What are the
 instruments called that measure the com-
 parative brilliancy & intensity of light?
 The Photometer by Leslie & Count Rumford
 There is moreover an other kind of light
 called Phosphorescent. Name the circum-
 stances under which it is met with?

It never makes its appearance except in the dark when it becomes very luminous indeed. The third kind of phosphorescent light is found in the bodies of some animals whether dead or alive. The firefly of this country is one instance of this & the toad always shows signs of incandescence after death, but long before putrefaction takes place if the body is not too dry — if any other will produce the same effect also. What is flame? It is a gaseous matter in the state of ~~pos~~ combustion. Do those flames that produce the greatest light produce also the greatest heat? No quite the contrary — What causes flames to be luminous? The admixture generally of carbon or some combustible & oxygen with the inflammable gas that burns thus oil

tallow & wax all contain & furnish
 carbon. The brilliancy of the flame of
 gun-powder is derived from the nitre
 which furnishes oxygen gas for the
 combustion of the charcoal & saltpetre.
 Does flame require much heat for its
 production? Yes considerably above red
 heat & generally equal to white heat. Show
 by lighting a paper over the chimney of an
 oil lamp & try to do this the
 same at equal distances from a
 of red hot iron. ~~What~~ What ^{temp} tempera
 of iron heat is necessary to make hot
 iron visible in the dark? From 600 to 700
 What in broad day light? 1000. On what
 principle does fine metal wire gauze
 cut off the progress of flame & form an
 effectual barrier to it. By the good
 conducting quality of the wire & the

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and the distance of one wire from another
 which allows the passage & prevents
 a great accumulation of heat from
 a mass of metal. How can this prevent
 the accumulation of flame? Because
 admitting that flame required a 1000° for
 its maintenance the wire gauze becomes
 hot which abstracts 500° from the heat
 of the flame & the balance left is not
 enough to maintain it. What is the
 most powerful artificial light ever
 discovered? The combustion of lime
 in the oxyhydrogen Blow pipe

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 27
 14
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{ Electricity } 326

What is Electricity? It is an imponderable substance found in all bodies and may be called forth by friction - From whence was the name derived originally?

From Electron a Greek word meaning amber - because it was first observed in this substance.

How does Electricity show itself in its weakest form? By rubbing glass with black silk or sealing wax with flannel - What is the term applied to this production? It is said to be excited or electrified.

How is it excited or produced? By friction and by contact at different temperatures - What was the first discovery that led to the advancement and improvement made in Electrical science?

The discovery of conductors & non-conductors by Mr S Gray 1729 - What do you mean by conductors & non-conductors of Electricity?

It was found by Mr Gray that Electricity

passes with greater facility through some
 substance than others, to all such as facilitate
 its progress he gave the name of conductors
 and vice versa - Was any other name given or
 applied? Yes; Electric & non Electric - What
 is meant or infered by the names? By an Elec-
 tric is meant a substance that exhibits ^{signs of} Electric
 and non-Electric of vice versa - Are these names
 yet retained in the science? No. They are
 some times used but to express specific
 differences - State the names of a few of
 the best conductors? All the metals & hair
 coal & flux & Name some of the non-conduc-
 tors? Lac, Resins, Gasses and baked wood -
 What is the term used for a body supported
 upon a nonconductor? Insulation -
 What would be the consequences if you
 wet a silk thread considered as a non-
 conductor? It would wet & excited glass

tube be brought near - What effect would be
 produced? A continued attraction If the
 silk thread had of been dry what effect
 would have been produced? Attraction or
 repulsion - If two balls suspended by
 non conducting are electrified by a glass tube
 what will be the consequence? They will
 become attracted until they become charged
 with electricity by the glass tube but after
 charged will repel each other - If one of
 such silk balls be electrified by glass
 and the other by sealing wax what then? -
 They will attract one another - To what
 Hypothesis did the apparent differences
 of the effects of the Electricity produced
 by the substances give rise? That there was
 two kinds of Electricity vitreous & resinous
 Was any other hypothesis framed to account for the
 effects? yes - Explain the hypothesis of Dr

Franklin? That if it is positive it contains more it negative less than its natural quantity - Has one hypothesis any decided advantage over the other? Yes - What objection is there to Dupré? To the names rather than the principles because two kinds of Electricity can exist but can not be called vitrious & resinous - Is the one kind ever produced without the other? No - How do you distinguish one kind of Electricity from the other? Substances similarly Electrified repel each other those dissimilarly attract each other - What materials can be resorted to with a certainty of obtaining both the same kind of Electricity? Dry fur of a cat and glass with silk positive sealing wax & flannel negative - What are the instruments called with which these investigations are conducted? Electrometers - Describe the most

J. H. Taylor 1840

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common electrometers? With balls
gold leaf - Describe how they are
used? To measure the intensity of electricity
- Describe the electrical machine? It is
made of Cylinder & Plate which is made
to rub against a rubber but has a prime
conductor to convey away the electricity
◆ The cylinder is occasionally rubbed with
an amalgam of tin & zinc & quicksilver
What are the principles upon which the
machine acts? By means of chain attached
to the rubber Electricity is conducted from
the earth to the rubber & from this it is carried
to the prime conductor where it may be
used in any quantity - What is the difference
between the electricity produced by a tube and
the one here? Its production by the latter
is attended by a light, noise and a stronger
attraction sensation & elevation of tem

temperature and it sets fire to ether, Hydrogen
 &c - Can electricity produce an effect on
 neighbouring bodies with contact or
 actual transmission & what is the
 effect called? Yes - The effect is called
 induction - Explain what is believed
 to take place when a body is electrified
 by induction? Opposite states + at one
 end - at the other - Can ^{an induction} induction
 take place through nonconductive
 substances? Yes through air and thin
 glass - What is that instrument called
 by which a large number of sparks
 can be taken together & conducted so as
 to produce a much more powerful effect
 than can be obtained from the prime
 conductors? The Leyden jar -
 Describe the construction of this
 Leyden jar? It is a jar covered

Externally & internally with some conduc-
 tor except in a few inches of the top
 (for instance) with tin foil. The jar is
 stoped with some nonconductor as
 baked wood through the centre of which
 passes a metallic rod that communicates
 with inside of the jar. The jar is being
 held by the outside with the hand while
 the rod receives the spark from the conductor.
 Explain the principle on which it acts.
 The inside of the jar becomes positively electri-
 cised while the outside is negative and the
 equilibrium is restored by means of a conduc-
 ting rod communicating with the inside
 and outside. Can an insulated jar be
 charged? No. What is necessary to the dis-
 charge of a Leyden jar? A communica-
 tion with the outside of the jar.
 How do you measure the strength of an

electrical shock? By an electrometer -
 Name some of the principle of these? The
 quadrant electrometer of Mr. Helmholtz
 Gold leaf electrometer balance, a tiny
 G. weights to determine the repulsion
 and a small jar which is a mode of
 measuring out many small portions to
 make one large charge.

63.

{ Galvanism } *from*

What do you understand by the term Galvanism? A certain kind of electricity which affects the animal frame only as is supposed by Galvani the discoverer of it an Italian Physiologist - When was it discovered? 1789 - What were the experiments that lead to the discovery of it? By touching the nerves of frogs with zinc & silver - Had any affection of the nervous system of the human frame been previously noticed but not accounted for till they were found referable to the same class of causes? Yes - for instance the taste produced on placing the tongue between a piece of zinc and silver - How did Galvani attempt to account for the muscular action that occurred in frogs?

He supposed it to be electricity generated by the animal system that it had its origin in the brain and was conducted by the muscles the different parts of which were in opposite states and became charged like the Leyden jar & that the electricity took place when the electrical equilibrium is restored. Who was the next person that made any important discoveries in this branch of science? Volta Professor of Nat. Phil. at Paris - In what respects did his views principally differ from Galvani? He maintained that the production of the electricity supposed to be present in Galvani's experiments was due to the metals instead of the animal matter and that the muscular contractions were produced by its passage through them. How did he endeavour to establish the truth of this Hypothesis? By constructing an

apparatus with the metals capable of producing
 this contractible effect on animals by
 which he also proved that electricity was
 its real cause - What was the nature of the
 apparatus? The voltaic Pile - Did Volta
 proceed farther in the investigation of
 this science? He examined the effects produced
 by the contact of a great variety of
 things and clasped them into simple & compound
 galvanic circles or combinations he showed
 that the galvanic action might be increased
 to such an extent as to become visible and
 was thus enabled to prove the ^{identity} of
 Galvanism & Electricity - Did any change of
 name take place for this kind of electricity
 in consequence of this discovery and
 investigations? It was in compliment to
 him called voltaic electricity - What is
 the difference between voltaic & common

Electricity? They are the same things but
 are excited and set under different circum-
 stances - Common electricity is a comparat-
 ively small quantity brought into a state
 of insulation when it wants a single
 intensity and can force its passage thro-
 ugh media - In voltaic electricity we
 have a large quantity but weak intensity
 so that it flows through conductors in
 continuous and in so doing it pro-
 duces peculiar effects - What were the
 particular properties that appeared to pro-
 duce the most powerful effect? By the
 least and most oxidable metals coming
 into contact - What is the succession or
 order of metals capable of producing
 the most powerful effects? Platinum
 Gold silver mercury copper Iron
 Zinc ^{Lead & Zinc} ~~Iron~~ Among these metals

How would you produce the most voltaic action? By always taking zinc and the other metal farthest from it into the combination ^{to} ~~the~~ contact sufficient to produce an electrical action? Yes: but a very weak one. How would you increase electrical actions?

Does any chemical action appear to take place where these metals are in contact without the presence of an acid? No. What is meant by the single and compound circles of Volta? A single circle is a combined series or set of things capable of producing a visible electrical action as a plate of zinc one of copper & an acid or one metal and two acids of different strength put to it. What is a compound voltaic circle? Nothing more than a series of simple circles in a panted succession. Why called the voltaic circle? Because the electrical

has to pass from the positive to the negative pole - Are there any other materials besides those mentioned capable of producing simple voltaic circles? Yes Sir H Davy found that metals were not necessary but that any two perfect conductors with one imperfect conductor and the vice versa would form a circle - Thus layers of charcoal and plumbago or black lead of best ~~quality~~ and wood and even animal muscle and brain would form a circle (voltaic) - Is the simple or compound circle most used in making experiments? The simple only used to produce a great quantity of electricity for which great extent of metallic surface is necessary - What difference is produced by employing large or small ^{surfaces} circles? Large surfaces produce great quantity with little intensity small surfaces produce intensity without considerable quantity - What are the layers of voltaic series that have been constructed?

Mr of London used a series of whole sheets
 of copper & zinc 2 feet by four square. Dr Hare
 of Philadelphia contrived a plan by which the
 sheet of copper & zinc were coiled spirally together
 without contact & in this way he was able to use a
 plate of copper & of zinc 6^{ft} long by 2 wide —

What is the most permanent effect produced by the
 employing such large surfaces? Immense fusion
 and oxydation of all the metals. Was any particu-
 lar name given to this kind of apparatus by
 Dr Hare to express the great heating power?

^{calorimeter} Calorimeter. Describe the several modifications
 of compound voltaic apparatus which have
 been used for producing electricity? The pile of
 Volta was the first then that of Conogno de Tas.

The history of cricichunks the arrival of the same.
 What fluids are generally made use of to excite
 their batteries? Two measures of sulphuric
 acid mixed and two of water. What are the

Thomas R. Williams & Party

Difference in appearance and effect between the electricity produced by the batteries & the common electrical machine? The spark produced by these batteries is always comparatively small and wanting in brilliancy it makes a hissing instead of a snapping noise - Although the real appearance of these sparks are too weak and insignificant - What are the real effects they produce? Intense heat combustion with brilliant light of charcoal and all the metals the fusion of most refractory substances - The decomposition of water the galvanic piles and earth the production of many other effects producible with difficulty or delay by the most powerful batteries charged with common electricity - How was the decomposition of water first effected? Water was corked in tubes having two wires inserted (made a part of a circuit) on examination it was found that hydrogen & oxygen were

involved. What the second experiment? Two
 separate tubes were used with separate wires
 in each & open at the bottom. The water made
 the conducting medium. When 1 oxygen found
 at the positive end & 2 Hydrogen at the negative end
 in the exact proportion it takes to make water.
 - Which is the positive end of a voltaic battery? Zinc.
 When oxygen is contained in a body does it always
 go to the positive end of the battery? yes. Did it
 Do you infer any general rule from this circumstance
 as applying to oxygen & the other supporters of ^{fire}
 combustion? yes: That all supporters of combus-
 tion would go to the same end which he found to be zinc
 & therefore called them electric negative substances.
 What do you understand by a supporter of combus-
 tion & what are the things that have this name?
 They are fire air number. They are in themselves
 not combustible or taking fire, but no combustion
 can take place without one of them being
 present

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Oxygen, Chlorine, Bromine, Iodine & Fluorine
 In the act of burning does the combustible unite
 in an union with these supporters of combustion
 and form a new compound. What is the
 action of the voltaic electricity on the compound
 formed by the combustibles & the supporters of
 combustion that while the supporters of
 combustion always go to the positive side
 as before stated. on this account does Sir


Henry Davy de saign - no mistaking wishing name
 (electrical) to this? yes he gave them the name
 of Electro positive substance - What are
 some of the most common elementary combus-
 tibles? Hydrogen, Nitrogen, Sulphur, Phospho-
 rus, Carbon & the bases of the metals, Although
 these substances are combustible are they
 capable of burning either pure or mixed alone
 ? No: as far as experiment has gone they
 all extinguish flame unless in


combination with some supporter of contact
 Is there any reason to believe that chemical
 affinity exists between different substances
 and is governed or at any rate is influenced by the
 electrical status of those bodies? Yes this
 is proved by many experiments - State one
 of them? If two saucers each containing
 sulphuric acid be connected by a bent
 tube filled with water and one of the saucers
 is connected with the positive & the other
 negative end of the battery the sulphuric acid
 of the collection will pass through the tube
 into the opposite saucer while the soda will
 in like manner pass the acid & the alkali
 thus transposing the tube in opposite direc-
 tions without any action on each other In what
 direction would the transmission take
 place? The acid would go to the
 positive & the alkali to the negative end
 of the battery

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- Does this effect take place under all circumstances? It does with ordinary power of electricity such as are not sufficient to separate a base from its acidifying principle or to produce an ultimate analysis - The stronger electrical attraction will overcome the weaker therefore the oxygen carries the sulphur of the acid with it to the positive pole & the sodium in like manner carries its oxygen to the negative pole and proximate analysis alone is produced - How did Sir H. Davy discover that the fixed alkalis Potassa, Soda, with several of the earths were metals mixed with oxygen? After his recovering the powerful unsuspected ^{decomposing} power of the voltaic battery, he tried its power on a great variety of substances exposed to it between plates of Platinum. One of his earliest experiments was on caustic

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Lectures of his Excellency on light,
Light moves at with great velocity, about
11,000 feet a second, All bodies are capable
of reflecting light, but some colors are
more adapted to it than others for instance
white than black, the latter absorbs light,
the former does not. When the rays of
the sun are reflected perpendicularly down
upon a smooth surface, we always have
the angle of incidence equal to the angle
of reflection as in the figure Let  $\angle i$
be a smooth surface & the angle of incidence
is equal to $\angle r$ the angle of reflection.

But when the light is reflected upon
a concave surface they are brought to
a focus as in the figure following,
 two parallel rays are brought - to a

Potassa he found evolved oxygen very freely at the positive and that a very soft metallic coating & very inflammable substance was left at the negative pole this very rapidly recombined with oxygen from the air and it again became Potassa. He therefore concludes ^{that} Potassa was the base combined with oxygen and gave the name of Potassium to the metallic base in the same manner as the other bases discovered. What power of battery was used in these primitive investigations & discovering? 200 pair of 4 inch plates. Can the same decomposing effects be produced by common electricity? They have been partially produced by very strong shock of very powerful battery but never with very satisfactory results. How did Dr. Woollaston succeed better than his predecessor in producing decomposing effects by common electricity? By imitating Voltaic electricity.

Instead of using powerful shocks he
 employed constant streams from the
 prime conductor passing them through
 very fine wires enclosed in capillary tubes
 and only exposed their ends so that a
~~the~~ very small spark of peculiar energy
 was produced. On what principle is
 the action of the voltaic pile accounted
 Volta supposed that the electricity was set
 in motion and the supply kept solely by contact or
 a communication between metals without chemical
 action & Sir H Davy went to try between the
 two & says that the operations commenced
 without chemical action & is afterwards main-
 tained by it. This is true but the action is always
 very weak except when chemical action
 is in operation

Oxygen

Oxygen was discovered by Priestly in 1774; and by Scheele a year or two afterwards. Priestly called it dephlogis-
 =ticated air; empirical air by Scheele; and vital air by
 Lavoisier. The name it now bears, is derived from the
 Greek words to generate acid proposed by Lavoisier
 from the supposition of its being the sole cause of
 acidity. The substances commonly employed for its
 production are peroxide of manganese, and chlorate
 of Potassa. By pounding Peroxide of manganese, and
 putting it in a flask with its weight of sulphur
 =ic acid: a portion of the Oxygen will escape, and
 Sulphate of the Protoxide of manganese will be
 left. Every 44 grains of Peroxide will lose 8 grains
 of Oxygen and 36 of Protoxide. - The gas obtained
 from the Peroxide of manganese is hardly ever
 pure, owing to the presence of iron, carbonate
 of lime and other earthy substances - but when
 Oxygen of great purity is wanted it is best to

produce from Chlorate of Potassa. This put in to a retort made of green glass, and heated beyond redness, is converted into pure Oxygen with a residuum of Chloride of Potassium. The theory of decomposition is as follows. Chlorate of Potassa is made of Chloric acid 16 or one proportional and Potassa 48 or one proportional = 124.

These compounds are thus constituted.

| | | |
|---------------|-----------------|------------|
| Chloric acid, | } Potassium 40. | } Potassa. |
| Chloric acid, | | |
| Chloric acid, | } Oxygen 8. | } Potassa. |
| Chloric acid, | | |

Chloric acid, } Oxygen $\frac{40}{76}$.

The Chlorine and Potassium are both separated from Oxygen, and then unite together, so that 124 grains of the salt = 76 are resolved into Chloride of Potassium and 48 into Oxygen gas.

Oxygen gas is colourless, tasteless, an inodorous, is not affected by the imponderable, refracts light very feebly, and is a non-conductor of Electricity. It is the most perfect negative

Omit this page a question 813

Boyle, No Mullington
Lectures on Chemistry 1838

Combinations. How do you find out
the representative numbers?

How would you find a number for
water? Ans 9, 1, Hydrogen & Oxygen
or $H + 80$ in chemical symbols.

How do you find a number for Carbon
ans, 22. viz $6C + 180$, Why should they
be called equivalent? Because one
quantity is capable of uniting with
another. How are you able to change
representative numbers? Although we
are allowed to change numbers of these
yet they exist in the same propor-
tion # text comes the subject of light;

Omit this page and turn to the next

written by Jm Smith Farmington
County Virginia

Electric that we possess, always appearing at the negative pole, where any compound that contains it, is exposed to the action of Galvanism. It unites light and heat, when compressed suddenly and forcibly. Oxygen gas is heavier than atmospheric air. - Dr. Thomson estimates its weight at 60: & 30 of the Barom. = eter, to be 33.888 grains; specific gravity 1.111. Oxygen is very sparingly absorbed by water, 100 cubic inches of that liquid absorbing only 3 or 4 inches of the gas. It has neither acid nor alkaline properties, for it does not change the colour of blue flowers, or does it evince a disposition to unite directly with the acids or alkalies. - The act of combining with Oxygen is called oxidation, and bodies which are united with it, are said to be oxidized. The compounds so formed, are called acids & Oxides. All substances derive their power of combin-

Experiments of Ino Millington 83

ation from the presence of Oxygen. Oxidation is sometimes produced with great rapidity, and with an evolution of heat, light (for instance) or ordinary combustion is an example of rapid Oxidation. On other occasions it takes place slowly without an appearance of light or heat, as is exemplified in the rusting of iron when exposed to a moist atmosphere. A piece of wood with a spark of fire on it when plunged into a jar of Oxygen gas, will burst into a flame. Phosphorus burns with great brilliancy in this gas, as to hurt the eye. Even iron & steel which are not ranked among the inflammibles, burn with rapidity in Oxygen gas. The reason why a taper when lighted and put into a jar of this gas, will after a while be extinguished, is that all the Oxygen is consumed. For this reason it is called a supporter of combustion.

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C. P. Smith R. C. Phillips R. C. Phillips R. C. Phillips
Phil. Soc. Phil. Soc. Phil. Soc. Phil. Soc.

The consumption of this gas may be proved by the ascent of the water in the gass containing it, when Phosphorus is burnt in it.

It is an error to suppose that bodies lose any thing while they burn, - for the materia-

ls of our fire & candles disappear, still they are not destroyed, and it will be found that

the combustible matter, than before combustion, and that the increase of weight, is equal

to the quantity of Oxygen that has disappeared during the process. - Oxygen is necessi-

-sary to life. no animal can live without it. If a ~~small~~ bird be confined in a lim-

-ited quantity of atmospheric air, he will at first find no inconvenience. but after

a while respiration will cease altogether. If a candle then be immersed in the gass under

which the bird was confined, it will be ~~extinguished~~ extinguished. very pure Oxygen has been found to be quite deleterious. O. S. Smith

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L. P. 1855

L. P. 1855

On the theory of combustion

The term combustion implies the rapid union of oxygen gas and combustible matter accompanied with heat and light. For many years prior to the discovery of oxygen the phenomena was explained on the phlogistic doctrine, all combustible bodies according to Stahl contain a certain principle called phlogiston to the presence of which he ascribed their combustibility. He supposed a burning body to evolve phlogiston. The discovery of oxygen proved fatal to the phlogistic doctrine. Lavoisier had the honor of overthrowing this doctrine and substituting the antiphlogistic system or theory to account for the light and heat attendant on burning a body he had recourse to Dr Black's latent heat. Heat is always evolved when one substance without change of form passes from a rarer to a denser form or when a liquid solidifies. Because the latent caloric is set free

Hydrogen

Describe the general properties of Hydrogen? It is a colorless Gas without taste or smell - What is its power of attraction? It is a powerful refractor of light - What is its weight and specific gravity? One hundred cubic inches of the Gas at 60 and 30 inches of the Barometer weight 9.118 grains. It is the lightest substance known. Its specific gravity is 0,068400 stated by Prout - Has it any effect on the vegetable color? No; Is it ^{at} soluble in water and is it capable of supporting respiration? It is sparingly absorbed by water. 100 cubic inches absorbing about one 1/2 of the Gas. It can not support respiration Is it inflammable? It is in the highest degree though like all combust it requires the assistance of a supporter of combustion. What effect on plunging a light taper? It will be immediately extinguished - What quantity of atmospheric air is necessary to explode it?

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The best proportion is 2 measure of Hydrogen to 5 of air - When mixed with oxygen will they combine? They will not at ordinary temperatures and may be kept together for a considerable time without any sign of combination - What is the effect of mixing oxygen and Hydrogen together? They may be made to unite slowly when exposed to a temperature above the boiling point of Mercury or by forcing them into a strong metallic vessel with a condensing syringe and suffering the gases to escape through a tube the setting the gas or fire will be and the combustion will be increased; This is called the oxyhydrogen blow pipe. Describe the Lussac's tube of oxyhydrogen? He proposed that the gas should pass through a tube filled with oil or water before it reached the point of burning. Hennings's safety tube was a tube in which was placed a bundle of fine wire. Describe Childers double cone? It was a ring of Hydrogen made to play into oxygen in the form of a cone

How do you explain the tone produced by
 the C Permet candle in a tube? It is owing to the
 successive vibrations of the air in the tube. To
 what valuable purpose was this applied? To the
 the burning of oxygen gas by Mr Cavendish in 1766
 Describe his first experiment? He burned the gas
 in a dry glass vessel when a quantity of pure water
 was generated exactly equal in weight to Hydrog
 which had disappeared. What proportion of oxygen &
 Hydrog does it take to form water? By weight
 it takes 8 of oxygen to 1 of Hydrog by volume
 ratio of 1 to 8. What is Lavoisiers experiment?
 He found that iron heated to redness decomposes
 water the oxygen of the water uniting with the
 metal and Hydrogen gas set free and that zinc
 or iron when put into a retort with dilute
 sulphuric acid would evolve the same gas
 carrying the oxygen of oxide of zinc when
 zinc was used and sulphate of the Protoxide

of iron when iron was used - What is the effect
 of putting green leaves in an inverted glass jar
 and set it in the jar leaves of a glittering lustre are
 found to be the best - What do you call the process
 through which water must be carried before it
 is pure? Distillation - It is conducted through
 a spiral tube called a worm which is placed in
 a tub of cold water for the purpose of reconde-
 nsing ~~it~~ the fluid Alcohol when distilled twice
 is called rectified spirits. water obtained from
 melted snow also Rain water caught
 before it touches the earth or houses is by far
 the purest kind of water. How do you account
 for the disagreeable smell produced by throwing
 water in the fire?

Hydrogen Gas was first termed Florigiston
 from the supposition that it was the matter
 of heat. This Gas may be set on fire by
 the electric Spark.

The composition of water was satisfactorily proved by the Richardson & Carlisle in their researches on Galvanism five measures of oxygen is mixed with three of Hydrogen one measure of Hydrogen is left - on the contrary if two of each are mixed & set on fire one of each of oxygen will be left - but when 1 of oxygen and 2 of Hydrogen are mixed and set on fire by the electric spark, the gas will disappear. The composition of water by weight was ascertained by Berzelius and Dubourg, 1811, of Hydrogen now this proportion will be 11.188 g :: 1.8.00g which will justify the proportion of 1 to 8 for water. Water (8 oxy + 1 Hydro) = 9 - Sulphuric acid = 40. Iron = 28 Protox of iron = (28 of iron + 8 oxy) = 36 and Sulphate of the Protoxide of Iron (40 + 36) = 76. Zinc decomposes water at common temperature with great slowness; but as soon

a sulph^{ur} acid is added the decomposition
 is increased. Water is a colourless transparent
 fluid which has neither taste or smell
 it is a powerful refractor of light and a
 conductor of heat very slowly and is an
 imperfect conductor of electricity. Its specific
 gravity is one & 832 times heavier than the
 atmosphere. Water is one of the most powerful
 chemical agent in nature owing partly to the
 extensive range of its affinity and nature of
 its elements. It combines directly with many
 bodies

-
- John Nottingham Pickel Stie
 - Timothy Lassiter North Carolina
 - Edmond W Jones Gauleton N Carolina
 - Thomas Seary Francis Barying
 - Williamsburg Virginia
 - John Lyle Richmond Va
 - Walter Smith Petersburg Va

Deutoxide of Hydrogen

What is a combination of Hydrogen called?
 Deutoxide of Hydrogen. It was discovered by Thénard
 in the year 1818. It is obtained from Baryta to 6
 or 7 ounces of pure water - add so much concentrated
 muriatic acid as will dissolve 230 grains of Baryta &
 after having placed the mixed fluid in a glass vessel
 surrounded in ice add in successive portions 185 grains
 of powdered deutoxide of Barium and stir it well.
 When the solution is complete sulphuric acid is added
 in a sufficient degree to precipitate the whole of
 the Baryta. Another portion of Baryta is added muri-
 atic acid acts upon and as soon as it is dissolved the
 Baryta is again converted into sulphate by adding
 Sulphuric acid. The solution is then filtered to separate
 the sulphate of Baryta and sulphate of silver is
 added to remove the muriatic acid and the sulphuric
 acid removed by Baryta. What are its characters
 after produced?

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Its specific gravity is 1.452 it is a colorless, transparent liquid without odour. What is necessary for its preservation? It must be surrounded by ice as it will be converted into ~~an~~ water and oxygen gas at 55° Fahrenheit. It changes colour gradually into white. It irritates the skin producing a pricking sensation - If you give it greater heat than 55° what will be the consequence? Immediate expansion - What effect on the metals? All the metals will decompose except iron tin antimony and tellurium. What will put a stop to effervescence on the metals? The addition of any of the strong acids - What is the effect of carbonic acid? It has no effect being one of the weaker acids -

John B. Taylor
J. B. Taylor

Nitrogen

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Nitrogen was first discovered by Dr. Rutherford
in the year 1772. Lavoisier found in 1775 that it
was a compound part of the atmosphere, he called
it azote because it is incapable of supporting
animal life. The more appropriate name of
Nitrogen was applied because of its being an
essential ingredient of Nitric acid. In what
proportion does it unite with oxygen
to form ^{air}oil? Is of the former to one of the
latter - How is it most conveniently applied
? By burning Phosphorus in an inverted
jar of common air over water. The Phos.
steals the oxygen from the air and the
phosphoric acid is ~~formed~~ absorbed by the
~~Nitrogen~~ water and Nitrogen set free
by agitating the water to clear it of carbon
ic acid. If a stick be left in the cold
atmosphere a white effect will be produced

It will steal the oxygen from their
 until consumed. Do you recollect
 any other process by which it may be
 obtained? By breathing a jar of air
 our lungs will consume the oxygen
 and set out you free and it may also be obtained
 by mixing iron filings with Sulphur with
 equal parts made into a paste with water
 it may be obtained from flesh by the action
 of Nitric acid. What is its character
 produced? It is colourless & has
 devoid of taste or smell it does
 not change the colours and may be
 distinguished more by its negative
 character than any other striking
 quality, a non supporter of
 combustion, no animal can
 live in it water when deprived of its air
 supports about 1/2 of Stomach Gravity, 1772 on the
 presumption that air contains one of Hydrogen
 to 4 of oxygen and that 1/11 the S. Gravity is 1/299 c.

On the Atmosphere

The earth is every where surrounded with
 a ^{map of} gaseous matter called ^{Atmosphere} ~~matter~~. It is colourless &
 invisible excites neither taste or smell and is insen-
 sible to the touch except when in motion. It is an
 elastic fluid of the first order and its specific gravity
 is unity 100 cubic inches weigh 31.5^{017} lbs. The pressure
 of the atmosphere was noticed early in the 17th century
 by Galileo and was afterwards demonstrated by his pupil
 Torricelli to whom science is indebted for the Barometrical
 Its pressure at the level of the sea is 15th
 to the square inch of surface and is capable
 of supporting a column of water 34 feet high
 and one of mercury 30 inches high. 34 feet of water
 30 inches of mercury are of the weight of one 15th
 By the ~~Barometrical~~ ^{Barometrical} we find the pressure
 variable on this principle we can ascertain
 the heights of mountains this shows that
 the pressure is variable and thus it
 becomes a whether $\frac{1}{2}$ less

Atmospheric air is highly compressible and elastic and may be compressed to a great extent and expanded to an extreme degree of rarity. It has been found experimentally that ^{the} volume of air so long as it retains its elasticity is inversely as the pressure to which it is exposed. Thus a portion of air which occupies a 100 inches when compressed by force of one pound when the pressure is doubled it will be diminished to 50 and will be expanded to 100 when the pressure is half a pound. It is uncertain at what pressure air is condensed. It is subject to the laws which characterize elastic fluids in general. It acts equally on all sides and when put in motion & when put in motion by the ^{pressure} of the colder particles on the warmer it is called wind and an undulating vibration sound. The atmosphere is not of equal density at all its parts this is obvious from that position nearest the earth being the support of the whole atmosphere while the upper strata only supports a part.

Its height is supposed to be about 45 miles
 The atmosphere receives its atmospheric warmth
 wholly from the earth, consequently that
 nearest the earth is the warmest. The atmosphere
 is pure it is ~~never~~ contaminated with Carbonic
 acid and watery vapour. Saussure found Carbonic
 acid on the top of mount Blanc. The chief
 chemical properties of atmospheric air owing
 to oxygen. The warmth of places does
 not depend on the want of oxygen but to
 noxious vapours that lie beyond the
 reach of the chemist. Since oxygen is necessary
 to combustion and respiration it is obvious
 that its quantity would diminish unless the
 tendency of those causes was counteracted by
 some compensating process. The only process by
 which it is supplied is by the process of grow-
 ing plants a healthy plant absorbs carbonic
 acid in the day and evolves oxygen in the
 night

Compounds of Oxygen & Nitrogen

Chemists are acquainted with 5 combinations of Oxygen & Nitrogen as deduced from the researches of Sir H. Davy & J. Berzelius

| | Oxygen | Nitrogen | Height of column | Volume |
|------------------|--------|----------|------------------|--------|
| Nitrous oxide | 100 | 50 | 14 | 8 |
| Nitric oxide | 100 | 100 | 14 | 16 |
| Hyponitrous acid | 100 | 150 | 14 | 24 |
| Nitrous acid | 100 | 160 | 14 | 32 |
| Nitric acid | 100 | 250 | 14 | 40 |

Protoxide of Nitrogen

Protoxide of nitrogen was discovered by Priestly who gave it the name of dephlogisticated nitrous air Sir H. Davy called it nitrous oxide

What are its qualities? It is a colourless gas which does not affect the blue vegetable colors Recently boiled water absorbs nearly its bulk at 60°, it is a supporter of combustion - a candle with a red wick will be lighted when immersed in it Sir H. Davy found

that it might be taken into the lungs with
 safety and that it supports respiration for
 a few minutes. A few respirations are
 followed by the most agreeable feelings of
 excitement similar to the first stages of
 intoxication. This is shown by a strong
 propensity to laughter by a rapid flow
 of ideas and by an exertion of muscular
 power. Can it be taken to any extent?
 No; too long a respiration might be dan-
 gerous - How is it generally produced? By
 putting nitrate of ammonia on a retort
 and exposing it to a heat of 4 or 500° it
 liquefies with the escape of bubbles of gas.
 The sole product when carefully conducted is
 water and protoxide of nitrogen. The theory
 may be thus explained; Nitrate of ammonia
 is composed of nitric acid 54 parts or one
 proportional ammonia is equal = $\frac{17}{71}$ parts

or one proportional nitrate of ammonia
 These compounds are thus constructed
 Protoxide of nitrogen

| | | | | |
|---------|---|----------|----------|---------------|
| ammonia | [| nitrogen | nitrogen |] nitric acid |
| | | hydrogen | oxygen | |
| | | Water | | |

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A list of the members of
The N Law Class under Tuckers

| | | | | | |
|--------|---|---------|----|---------|----|
| Barry | 1 | Holcom | 18 | Tells | 35 |
| Beatty | 2 | Yerliay | 17 | Raaford | 38 |
| ... | 3 | Dones | 21 | Riadict | 37 |

| | | | |
|------------|----|-----------------------|--------|
| Warren | 50 | John A Taylor | Nickle |
| Whitehead | 51 | Col Thomas Jones | |
| Williams | 54 | Col Thomas R Williams | |
| Wootton | 55 | Col Joseph A Harper | |
| J Wright | 56 | William T Mason | |
| J T Wright | 57 | William T Mason | |
| Winnam | 58 | William T Mason | |
| Mason | 59 | William T Mason | |
| Ferguson | 60 | William T Mason | |
| Hannon | 61 | John A Taylor | |
| McKenzie | 62 | Thomas R Williams | |
| Mason | 63 | Thomas R Williams | |
| Ferguson | 64 | William T Mason | |
| Scott | 64 | John E Moore | |
| Crenshaw | 65 | Anderson T Miller | |
| J Scott | 66 | Nottonay County Va | |
| | | Nottonay County Va | |
| | | Thomas R W | |

METALS Page 222

Ques. What is the general description given of the metals? Ans. a distinct set of natural elementary substances which possess properties peculiar to themselves.

Ques. What is the common & distinguishing Characters of the metals? Ans. They are all conductors of heat and electricity. They are all combustible. Some or all of the electronegative elements, as Oxygen Chlorine and when the compounds are decomposed by electricity, they all go to the negative pole & consequently all are Electropositive and combustible all opaque and reflect light & they all have a peculiar lustre. Called the metallic lustre. Ques. When they are polished do they all reflect in an equal degree? No. Brass most. Silver next. tin. Steel & cast

Ques. What number of metals were known.

in the year 1800? Aug 21. How many
 were added in the last 38 years. Aug 21
 Total 42 now. Dens Is great weight an
 essential characteristic? No. ^{Two} ~~Two~~ of them
 Potassium + Sodium will float on water.
 What is the range of their specific gra-
 vity) from the heaviest to the lightest?
 Platinum heaviest 21.50 - Potassium lightest
 0.865 - What is meant by malleable? any
 capable of being extended under the ham-
 mer in thin leaves, the order of their mal-
 leability is Gold Silver copper tin. Pla-
 tinum Lead Zinc. Iron. Are any of
 the metals brittle? yes. Slate arsenic
 Bismuth. What is meant by ductibility
 ity? Capable of being drawn into wires
 order of ductibility, Gold silver Plati-
 num. Iron copper tin Lead. Are those
 metals most malleable. The most ductile

No. Iron cannot be made into thin leaves but may be made into small wires. What is meant by their tenacity? Their cohesive strength or weight wires can support an Iron wire can support 530 lbs
Copper 300 Platinum 275 Silver 187
Gold 150 Zinc 100 Tin 35 Lead 27 lbs

What is their comparative hardness?
Palladium, Manganese, Iron, Antimony
Platinum, Copper, Silver, Gold, Zinc
Tin, Lead, Leadium & Potash. What is meant by an alloy and why made?

It is combination of two metals. Are all the metals fusible by heat and what degree? Mercury is fluid at common temperature, but solid below 40-10 are fusible below red heat
Potassium, Sodium, Calcium, Tellurium, Tin
Bismuth, Lead, Arsenic, Zinc, Antimony
But red heat Gold, Silver, Copper, Iron

white heat Iron, Nickel & Cobalt, 2 at
 intense white heat Magnesium & Palladium
 with difficulty in any furnace Molyb-
 denum Niobium Tungsten ^{and Chromium} and the rem-
 aining seem so refractory that they
 were long thought impossible. but they
 were found to yield to the oxy + Hydro-
 gen Blow pipe and to the heat of Galva-
 nism. Are any any of the metals volatile
 by heat not do they admit of distillation
 Yes 1 Cadmium Mercury arsenic
 Tellurium. Potassium. Sodium, Zinc.
 What is the appearance in conducting they
 operation in open air or close vessels
 with air excluded. first lost by
 oxidation 2nd by distillation. Is it prob-
 able that all the metals are volatile
 and the most of them are fixed -
 Platinum and Gold are fusible by heat

Bismuth, Molybdenum, Titanium
 Copper Antimony, Chromium Tungsten
 Tellurium Vanadium Columbium Uranium
 Cerium. What are the 3^d order?
 8 metals, the oxides of which are
 decomposed by a red heat, mercury
 Palladium Gold Rhodium Silver Cerium
 Platinum & Iridium, Potassium
 & Sodium are so much alike in
 their characters that they may be
 examined together. Fine

POTASSIUM & SODIUM

Question. By whom was Potassium and
 Sodium discovered? Ans By Davy in the
 year 1807 within a few days of each other
 What process did he use with caustic
 Potassa & Soda? Galvanism & sp. int. The
 attraction between two Platinum plates

which by combining with oxygen be-
 come alkalies or earths. What is the
 first order? 3 metals oxides all real
 alkalies. Potassium Sodium & Lithium
 What is the second order? 4 metals
 whose oxides are all alkalies earths -
 Boron Strontium Calcium Magnesium
 What is the 3rd order? metals whose
 oxides are earths and not alkalies Alu-
 minum Calcium Silicon Zirconium
 Thorium &c. What are the second
 class - 29 metals the oxides of which
 are neither earths nor alkalies. What
 is the first order of the 7 metals which
 decompose water at red heat?
 Iron Tin Zinc manganese calcium
 Cobalt Nickel. What is the 2nd order?
 14 metals which do not decompose
 water at any heat? Arsenic Lead

Potassium & Sodium

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The Oxygen went to the positive pole and the metals left. Q describe the metals when produced? Ans. The Specific Gravity of metals Potassium is 0.865 & Sodium 0.972. They have a strong affinity for Oxygen, floats upon water and decomposes it. The Hydrogen burns and the Potassium is left behind in solution. This proves that potassium & Soda which were before known as alkalis & Salts, are metals, which the names of Potassium & Sodium has been applied & that oxygen is capable of producing alkalis as well as acids. Q What process did Gay Lussac and Thenard of Paris afterwards invent for producing these metals more abundantly? Ans. By bringing fused Hydrate of Potassa into contact with turnings of Iron heated to whiteness in a tube Gun Barrel, Hydrate

gen escapes. Q Why are these metals
 kept under Naptha? Because of their
 great affinity for Oxygen. Q at what
 temperature are they fluid like Quick
 Silver? Arg Potassium at 150 Sodium
 at 200. Q Do Potassium & Soda unite
 with one or more proportions of Oxygen?
 Arg Potassium with one $\frac{1}{2}$ to form
 Protoxide and with $\frac{3}{2}$ to form peroxide
 and Sodium $\frac{1}{2}$ of Oxygen to form Pro-
 toxide and $\frac{3}{2}$ of Sodium + $\frac{3}{2}$ of Oxygen
 to form peroxide. Q What is Protoxide
 of Potassium? Common Potassa Potash
 Pearlash. Kali preparatus. Salt of
 Tartar and wormwood. Q What are
 its properties? It unites with all
 acids and forms neutral Salts - it has
 a strong affinity for Carbonic acid -
 used generally in a state of Carbonat-

very deliquescent, is fixed or viscid action
 of fire. Therefore calca fixa alkali &
 when made red hot becomes a Hydrate
 it is cast into sticks, called vegetable
 alkali. because got from wood ashes

SOME GENERAL QUESTIONS

Some general questions

Question How many acids do modern Chemists
 admit? ans 168. Q How are acids composed
 ans of some base & various acids by an acidifyer

Q What is the peculiar characteristics of
 acids? generally speaking they have a sour
 taste redam litmus paper and neutralize
 alkalis. It is very difficult however to define
 an acid in such terms as will apply to all
 their varieties. because some of them are
 deficient in sour taste, but have a pleas-
 ant bitter aromatic taste as Benzoic acid

& These again are so perfectly insoluble as
 to have no taste at all - as arsenous acid
 and all such acids as are soluble or nearly
 so - either have no effect on litmus paper or
 the vegetable blues, or at any rate a very weak
 one. They again have so slight an effect on
 the alkalis that they will not neutralize
 them as is the case with Carbonic & Sulphuric
 acids. Webster says in page — They have
 induced Chemists to consider all compounds of
 acids when they are found to unite with Potash
 or ammonia & give rise to bodies similar in
 their constitution & general characters to
 the salts which sulphuric or some well
 known acid forms with these alkalis. &
 What do you understand by alkalis how
 defined? substances which are caustic
 and act on animal flesh and which will
 combine with animal fat or fixed oil

has a peculiar pungent acid taste will
 restore the blue vegetable colour, that
 have been reddened by an acid or will
 make red vegetable colour blue or green
 and the yellow of Timerie acid ~~is~~
~~with~~ which have the strongest
 affinity for the acid & will unite with and
 neutralize them or rather produce a
 neutral neutralization for the equalities
 of both acids & alkalis are lost and produce
 neutral salts. Their characters all apply
 very well to what are always called, by way
 of distinction, the alkalis or alkalies
 proper. How many alkalies proper are
 known or acknowledged by chemistry? 3 only
 Potassa, Soda & Ammonia - a fourth is also
 acknowledged but very little known - viz
 Lithia. What is these alkalies? all salty
 crystallizable wolve the invisible gassy -

Carbonic acid & 2 volumes of Ammonia
 will become solid and crystallize. & are
 the alkalis soluble in water? Yes
 very soluble. Although the definition
 given above applies very well to the 4
 real or proper alkalis, yet it does not
 apply to the next class of bodies to be
 examined & which by way of distinction
 are called alkaline earths

The only distinctive difference between the
 real alkalis and the alkaline earths, (which
 are four in number, viz, Barite, Strontia
 Lime, and Magnesia) is that the first
 are only to be met with in the form of body
 soluble salts which crystallize even when
 pure, while the latter are earths and not
 salts, that never crystallize when pure
 or mixed, they are quite opaque & have
 an earthy appearance and are nearly

insoluble in water, if it were not for this
 difference the alkaline earths would be
 as much entitled to be called alkalis as
 the alkalis themselves, if not more so.
 For sulphuric acid is one of the strongest
 acids we have, and one that has the
 strongest affinity for the real alkalis
 and yet the earths Baryta or Strontia
 will take this acid from any of the
 proper alkalis and Magnesia for
 from having caustic properties is
 often administered as a medicine to
 Infants. It has no acid taste and is so
 insoluble in water that it produces no action
 on litmus paper or any of the vegetable
 colours. yet for neutralizing acids it is
 the most powerful of all the alkalis. 20
 parts or grains of Magnesia will neutralize
 as much sulphuric acid as 47 grains

of caustic potassa. It deriving its value
 as a medicine from this circumstance
 (explained) - we see that although
 the characters already given of an
 alkali apply to the alkalies them-
 selves, yet it does not to the alkaline earths
 and hence chemists are compelled to narrow
 the definition of an alkali to any thing
 that will neutralize an acid and combine
 with it so as to produce a neutral salt &
 Why are Potassium & Sodium called fixed
 alkalies? Because they will not go off in
 vapour. & are there any other general names
 by which the alkalies are designated?
 viz Potassa pinguis, Soda mineral
 Ammonia Vol & Lythia may also be
 called mineral being attained from
 minerals of Tourmalin species. It was
 given the name Lythia also Litho-geo

phy & How is Potassa produced? any
 wood ashes boylea & Crystallized. & What
 is the first product call'd? ash or Pot
 ash. & What is the second after purify^{on} call'd
 any Pearl ash. & How would you conduct
 such a purification? The plant most
 esteem'd for burning to make Potassa is
 an annual call'd *Salsosa* or glasswort
 of which there are 3 species. The first of
 which was by all Botanists call'd *Kali*
 and accordingly among the older Chemists
 Salt Potash was call'd *Kali preparatum*
 and from which no doubt our word alkali is
 deriv'd. Our text Book informs us that
 the word is Arabic and al is the inaff
 inite article in that language & also
 in Greek signifies na or salt & *Kali*
 name of Plant. & What is the purest form
 in which we get Potash? Hydrate or

What is composed of 1 ^{eq} Pot & 1 of
 water no carbonic. & What is prepara-
 tion or common Potassa? A carbon-
 ate of Potassa. & How is Soda prepa-
 red? By burning sea weeds from
 sea salt & By what name are the
 first product of Soda? Kelp ashes the
 worst from Scotland Barilla the best
 from Spain. & In what form is Soda
 met with generally, and carbonate of
 Hydrate - & What is the distinction
 difference between them. One large
 and the other small crystals one
 deliquescent & the other efflorescent
 & What are are soda and potassa
 now found to be an oxide of a
 metal & What call? Sodium &
 Potassium & At what time and
 by whom was the discovery

made & done by Davy in 1807
 Describe the mode of decomposition
 by electricity? The alkali to be
 decomposed is put between two plates
 of Platinum and then the
 poles of the battery is made to come
 in contact with the alkali when
 the oxygen goes to the positive pole
 which the metal remains between the
 plates? What is the appearance of
 Pot^m when produced? Soft and Plastic
 at ordinary temperatures but brittle
 when frozen fluid at 150°; sublime at a
 low red heat without change, if air be
 excluded it has a strong affinity for oxygen
 & kept under naphtha for that reason
 because naphtha contains no oxygen
 & what does it become if exposed
 to the air? & what is Anhydrous Pot^m?

Q What is the effect of throwing on water and Protoxide is produced or not?

Q What is the specific gravity - Ans 6.84

Q What decomposition takes place when thrown on water - Ans Water is decomposed

Oxygen solidifies great heat produces which sets fire the Hydrogen produces

Q How do you prepare a solution of Potash for the laboratory to use, Ans by adding the alkali in excess to the water while white hot.

If Potassium is burned in oxygen what is the result? Protoxide of potash

P₂O₃ oxygen Q what are some of the principal compounds of Potash as given in the table (page 283) Ans with oxygen chlorine

Iodine Bromine Fluorine Carbon Sulphur Selenium Phosphorus and Cyanogen

Q what is stick Potash in the highest state of purification & causticity?

Describe the metal Sodium when
 produced? It has a bright metallic lustre like
 silver quite soft or plaitic fusing at 200°
 rises in vapour at red heat Spec Gravity
 0.97. Sodium tarnishes in the air. decomposes
 without combustion, and if cold produces
 peroxide of Soda called by some Wetrow
 the new name is now applica to it. also per
 oxide of $\frac{1}{2}$ of Sodium with 3 of oxygen &
 How is Soda distinguished from Potassium?
 Alkaly salts are soluble, it gives a rich yellow
 colour to flames. Potash giving a purple. com
 municating no colour to its gases if deliquescent.
 does not throw down yellow precipitates with
 the chlorides of Potash. Palladium and is
 tripple salt or chloride of ~~the~~
 & What is common table salt? formerlyly ~~meas~~
 ure or hyperchlorate of Soda. Now chloride of
 Sodium called Rock Bay Fishery &

from its mode of preparation. What
 are its preservation qualities supposed to
 arise from and from combining with
 chlorine as one of its elements & this
 has a strong pulverulent power &
 what is the form of its ^{crystals} crystals & is
 cubical. How is common salt
 prepared. By burning Sodium in
 chlorine. Why dehydrate in fire
 Because it has water mechanically
 enclosed between its crystals & that
 expands when heated & causes dehy-
 dration & Is anything peculiar about
 its solution in water - it requires $2\frac{1}{2}$
 times its own weight and the solvent
 power is not affected by heat or cold
 - What is chloride of soda - produced
 by sending a stream of chlorine
 gas through a cold saturated

Solution of caustick Soda as the ingredients are held together by a very weak affinity, the fluid will bear evaporation to produce crystallization with out the escape of chlorine hence it must be retained in a liquid state in well stopped bottles is called the disinfecting liquid of What are its uses - For purification to disinfect sick rooms prevent contagion it may also be used for bleaching - It gives out its chlorine so gradually when exposed in open vessels as not to effect sick persons - What is Sulphate of Soda Glauber salts What phosphate of Soda -

LITHIUM

What is Lithium? It

What is Lithium? It is a metal on combining with oxygen forming a fixed alkali called Lithia. Discovered by a Swedish Chemist in the year 1818 & found in 2 or 3 minerals. What are the quality & appearance of Lithium when produced? It is a crystallizable salt much resembling potash, deliquescent and very soluble in water and some tests, acts powerfully on vegetable colours this distinguishes Lithia from Potassa. It neutralizes a great quantity of acids than the other Potassa and Soda and by producing a red flame when fused on a platinum wire by the blow-pipe. Some of the salts of Lithia are likewise fusible in alcohol a property not belonging to any other alkali. Lithium

Questions on Baryta Strontia
Lime & Magnesia

What is the Character of the metals compo-
 und in the 2nd order of the 1st class of
 metals according to the Turnery arrangement?
 The oxides of which form alkaline earths
 How many metals included in this order
 and what is their name? 4. Barium
 Strontia Calcium & Magnesia. How does an
 alkaline earth differ from a real alkali,
 any Alkaligene salts. The latter earth want-
 ing solubility, transparency & crystalline
 form when pure. ^{BARYTA} Who discovered Baryta
 to be a metallic oxide and when? Davy in 1808
 What process is employed to procure a composition
 any Galvanism would not act alone. Berzelius
 suggested amalgamation with mercury put into
 a cup of pure Baryta and the mercury after
 several distillations away. What is the appearance

ana. character of the metal Barium?
 when produced? Dark Gray metallic lustre
 inferior to cast Iron. It is such that it sinks
 even in sulphuric acid attracting oxygen
 rapidly from the air. Changed into a
 white powder which is pure Baryta
 fuses below red heat and above that is
 volatile. What occurs on throwing Barium
 into water? It decomposes it. Hydrogen gas
 is evolved. Oxide or pure Baryta falls - does not
 appear to burn like pure potash - What is the
 equivalent no for Barium? formerly 70, Turner
 68.7 - What the purest state in which Baryta
 is found? Hydrate or protoxide of Barium or
 $1 \text{ eq of Baryta} + 1 \text{ Ox}^2 + 1 \text{ water}$ - Can it be
 made to part with its eq of water by heat? no
 This is called pure Baryta - What are its
 qualities? Gray or white opaque powder -
 spec Grav 4 - very difficult of fusion -

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strong attraction for water in which it
slakes like lime - is soluble in 20 times
its weight of cold water and in 3 of boiling,
but deposits it on cooling, - insoluble in
alcohol. Has strong alkaline properties -
affects vegetable colours - neutralizes all
the acids completely - has an acrid
taste but less corrosive or caustic than
Potash or soda - Is Baryta a common or
scarce substance? common in many
districts particularly in lead mines
called Cawke by miners and Terra
ponderosa or heavy spar - From
what is the name Baryta derived? Barus
In what state is it always found
naturally Sulphate or carbonate
Sulphate most commonly in
flat tabular crystals - Is there
any peculiarity in sulphate
of Baryta - perfectly insoluble

even in the acids when burnt and ground
 It is an excellent paint. As the insoluble
 sulphate is the most common form in which
 the mineral is found (can pure Barytes
 be obtained from it and how? Boil it in
 water in a state of vapour, with 3 times
 its weight of Carbonate Potash, a mutual
 decomposition will take place produ-
 cing carbonate of Barytes and Sulph-
 ate of Potash. The former being insol-
 ule, may be washed off and purified
 by heat when it protoxide of Barium
 Does Barium unite with one or more atoms
 of oxygen One of oxygen & one of Barium
 = Protoxide two of oxygen & one of Barium =
 = Peroxide Is the peroxide of any use or
 interest? It was used by Thénard for pre-
 paring the antioxis Hydrogen which was
 described under the head of Hydrogen

How is the process of Barium prepared
 and By passing oxygen gas over
 powdered Baryta in a tube a
 little low red heat. Does Barium
 unite with the supporters of
 combustion - Ans Yes Producing
 chloride Iodide Bromide and fluo-
 ride also with sulphur producing
 a sulphuret and with cyanogen
 producing cyanide of Barium and
 the salts of Baryta distinguished
 by any obnoxious gas etc. all
 poisons except sulphate
 (They are insoluble) Is Baryta
 of any use in chemistry or the
 best test known for Sul^{ph} acid
 from its strong affinity &
 compound being insoluble
 also for carbonic acid which

it takes from all other things. Mr. Madwood used the natural Sulphate for his Tasper ware as by heat it fuses into an opaque white enamel. It is getting in to great demand in England as white house paint. called permanently white needs only to be calcined ground & mixed with oil.

How can Baryta be distinguished from all ^{other} ~~other~~ ~~stances~~ ~~stances~~ - 1st By forming alkaline solution with water or Barytic, Ba^{co} . By acids soluble salts being precipitated as white carbonate of Baryta - which is soluble both by alkaline acids. By Sul^{phuric} acid or any soluble acid Sulphate - 3^d By the characters

of chloride of Barium when Hydrochloric acid is added to Baryta - 4th
 It tinges flames of alcohol yellow
 Barytic acid is an excellent test for free or combined Carbonic acid - also for Sulph. acid in all its combinations & it will separate Strontia from Baryta. Muriate or nitrate of Baryta are also very valuable tests for the same purposes & acetate of Baryta for ascertaining the nature and quality of alkalies and alkaline sulphates in fluids.

STRONTIA

Q What is strontia? ans The name of a peculiar earth found in Strontian

Scotland afterwards discovered to be a protoxide of metal called Strontium. has also a peroxide of str. - Who discovered it to be an oxide of metal? Davy in 1808

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soon after Barium. What is its charact
 er when obtained? The same as Barium.
 What is the ρ of Ox of Strontium? for
 merty 44 Turner 33.8 - What is the usual
 form in which strontium is found? Carbonate
 of the peroxide of strontia, & Sul
 phate. Does it agree in any of its propo
 ties with Barytes? In all, nor until the
 last 30 years, the two were always confound
 ed, but it is not poisonous in any of its com
 pounds & has its specific gravity being 3.66
 and the form of its crystals different. It unites
 like Barium with chlorine Fluorine Soda
 lime & Sulphur, but not with any of its
 alkalis. What is the purest form in which
 it is obtained? Hydrate of strontia. This fuses
 readily at red heat, but no heat will decom
 pose it. Soluble in 600 times its weight of
 cold water, deposited in crystals on cooling.

but soluble in Alcohol - found naturally as
 a sulphuret - & called Celestine from its pale
 blue colour - but is a scarce earth and has
 not been applied to any useful purpose
 in manufactures. It is known in Prussia but
 little known in the U. States. it is distinguis-
 hable from Barytes. None of its salts are
 poisonous. has less attraction for acids. therefore
 all strontian salts are decomposed by Barytes.
 The salts of Barytes are less soluble than those
 of Strontia. but pure Strontia less soluble than
 Barytes, pure Barytes being 10 times more soluble
 than pure Strontia. all the salts of Strontia
 communicate a beautiful red flame. Red
 fire is composed of dry nitrate of Strontia 13 of
 Sulphur & Chloride Potassa & sulphur of
 antimony $\frac{1}{2}$ of lamp black all in
 fine powder - The salts of Strontia
 would answer nearly as good a

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purpose for tests as those of Baryta
 but it is a scarce material and
 having a less powerful affinities
 is not so certain and therefore is
 seldom used. Finis of 1st Volt

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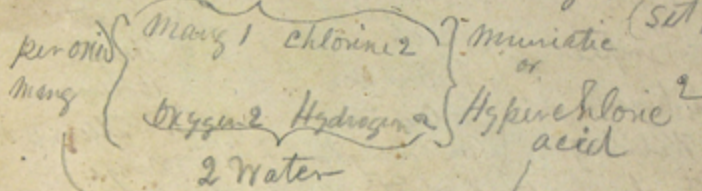
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John Millington M.D.

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Professor of Northway College

$1M + chl = Chlorate$ Mang & Chlorine



per oxide = 1 Mangise & 2 oxygen

Muriatic or Hypochloric = Chlorine 2 Hydrogen 2

Oxygen 2 Hydrogen = 2 Water

Mang 1 Chlorine = $1M + chl = 1 Water$

exquisite

The patriot, the statesman & a Chlorine
the hero: may his memory be embalmed
in the affections of his countrymen
and cherished as identified with the
national character and consecrated by
the noblest impulse of patriotism.

Blank

Not worth a word

150 A list of the members of the Chemical class.
John Millington
in 1835

Mr. Fox
H. C. Temple
J. Skinner
W. C. Williams
E. Taylor
W. Ratford
Baker
A. L. Pogram
J. F. Jones
L. Bullock.
B. Seawell
J. H. Edmunds
G. Richardson
J. Jarvis
H. Rawlings
W. Young
W. Glen
J. E. Brooks
O. Harrison
R. Smith. 20

Mr. Dupuy G. R.
Coke W.
J. Harrison
W. Overton.
G. Nottingham. 25.
J. Nottingham.
W. Shield
J. Peachy
J. Willis
Barziza. 30.
J. Leary
W. Goby
P. Wood W. R.
L. Hendly
M. E. Candlish 35.
W. Pollard
D. Daly
A. Hill
E. Edloe
Lapsiter. 40.
Hamilton
meade
Booth
W. Robinson
S. Smith 45.

J. Turner
W. Pratt.
H. Hall
W. Coleman
C. Waller. 50.
Minge
E. Randolph
J. Watson
Johnston
O. Smith. 55.
L. Stanard.
W. Drinkard
W. Scott
W. Royal 99
W. Street. 60.
L. Sims
J. S. Smith
J. Taylor.
E. Murdaugh. 64.
L. M. Searson. 66.
W. Camry
W. Camry
W. Camry
W. Camry
W. Camry

Mr. Fox
Mr. Temple
Mr. Skinner
Mr. Williams
Mr. Taylor
Mr. Ratford
Mr. Baker
Mr. Pogram
Mr. Jones
Mr. Bullock
Mr. Seawell
Mr. Edmunds
Mr. Richardson
Mr. Jarvis
Mr. Rawlings
Mr. Young
Mr. Glen
Mr. Brooks
Mr. Harrison
Mr. Smith

Mr. Dupuy
Mr. Coke
Mr. Harrison
Mr. Overton
Mr. Nottingham
Mr. Shield
Mr. Peachy
Mr. Willis
Mr. Barziza
Mr. Leary
Mr. Goby
Mr. Wood
Mr. Hendly
Mr. Candlish
Mr. Pollard
Mr. Daly
Mr. Hill
Mr. Edloe
Mr. Lapsiter
Mr. Hamilton
Mr. Meade
Mr. Booth
Mr. Robinson
Mr. Smith

Mr. Turner
Mr. Pratt
Mr. Hall
Mr. Coleman
Mr. Waller
Mr. Minge
Mr. Randolph
Mr. Watson
Mr. Johnston
Mr. Smith
Mr. Stanard
Mr. Drinkard
Mr. Scott
Mr. Royal
Mr. Street
Mr. Sims
Mr. S. Smith
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Mr. Murdaugh
Mr. Searson
Mr. Camry
Mr. Camry
Mr. Camry
Mr. Camry
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North



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440
 $\frac{900}{800}$
 $\frac{12372}{12372}$

24th

J. H. Taylor

Thomas R. Williams

LIVERDLE

24th

