**RI MS HD/20/C Transcription**

**RI MS HD/20/C, p. 000**

front cover

**RI MS HD/20/C, p. 000v**

20c

Clifton  
1800  
From August to Nov[superscript]r[/superscript] -  
10.6  
2  
12.6

**RI MS HD/20/C, p. 001**

1  
Exp[superscript]t[/superscript] 4  
Zinc [?side] with sulphuric acid - Silver potash  
hydrogene & - I beleive oxygene.-

[Horizontal rule]  
- [?~~x~~] Aug[superscript]t[/superscript] 6[superscript]th[/superscript]-

1  
[?~~xx~~] Zinc side in ammoniac Silver side  
in water gave gas - Zinc least. no examination  
- When Silver was made the broken  
circuit hydrogene was given out whilst no cloudiness  
was produced <[?on] the other side> in this way fulminating  
silver may undoubtedly be produced

[Horizontal rule]

2  
When Silver & Zinc were both in Sol: of  
Ammoniac - Gas was given out very  
rapidly from ~~Zinc~~ silver less quick from  
Zinc -  
~~Augt~~ 3  
Pure [?Caustic] Ammoniac - oxygene 1  
Hydrogene [?~~5~~] [?6] - 72 [?o]

[Horizontal rule]  
in a second exp[superscript]t[/superscript] made to determine  
whether absorption took place oxygene  
[?~~x~~] 1 Hydrogene 6.

The exp[superscript]ts[/superscript] of to day will give the  
composition of Ammoniac distinctly [unclear]Sp[superscript]ts[/superscript][/unclear] of  
wine & oil of Turpentine decomposed. -

[Horizontal rule]  
[?~~in~~] mem put in one tube green Sulphate in  
the other red. here will be a compleat  
series of decompositions & recompositions –

**RI MS HD/20/C, p. 002**

2  
& I cannot close this notice without feeling  
grateful to M[superscript]r[/superscript] Volta M[superscript]r[/superscript] Nicholson &  
M[superscript]r[/superscript]Carlisle whose experience have placed  
such ~~an~~ wonderful & important instrument  
of Analysis in my power.-

[Horizontal rule]  
Quere would not potash dissolved  
in spirit of wine become a conductor  
- Aug[superscript]t[/superscript] 7[superscript]th[/superscript]. -  
Sol[superscript]n[/superscript] Ammoniac oxygene [?wire] 1 hydrogene nearly six  
the same proportions as yesterday the water  
being saturated by three processes. -  
mem to day to try Nitrous acid  
muriatic acid . -& sulphuric acid -  
sulphates of iron. impregnated & not [Ink sketch] we shall be  
able to ascertain whether bodies are at their minimum  
or maximum of oxydation or no. -  
- Aug[superscript]st[/superscript] 8.-  
Common water gave oxygene wires 41/4 hydrogene  
nearly 8 & half. - the hydrogene by the test  
of detonation proved nearly pure the  
oxygene was lost  
2

Sulphuric acid gave oxygene wire 41/3 hydrogene  
11/2 much sulphur was thrown down from  
the very beginning & apparently no Nitrous acid  
formed -  
3  
When Ammoniac is employed some of the  
oxygene probably is combined with the gold, the

**RI MS HD/20/C, p. 003**

3  
hydrogene is pure.-

[Horizontal rule]  
Aug[superscript]t[/superscript] 9  
Examined at 9 the oxygene. 41/4 from  
sulphuric acid. the nitrous gas contained  
by muriate of iron 1/26 Nitrogene - ~~25~~ 11  
of Nitrous gas with the 41/4 exposed to  
sulphate of iron left about half a measure  
of Nitrogene.- ergo the oxygene was  
pure.- - the 1.1/2 of hydrogene  
detonated with three & half of common air  
left nearly ~~three~~two & three quarters  
therefore it was nearly pure. -  
Mem[superscript]n[/superscript] - to try fluid muriate of Tin  
as a Eudiometer.-

[Horizontal rule]  
The oxygene wire in Nitric acid gave five &  
quarter, these 5 & quarter with  
9 of the above Nitrous gas left  
not quite ~~half a~~ [?~~me~~]. a measure  
when two more of Nitrous gas were  
added but little red fumes were  
perceived the residuum washed in sol[superscript]n[/superscript]  
of sulphate of iron left not quite  
half a measure very little more  
in [?short] than 1/3. – the acid  
became very green at the hydrogen wire  
but not more than 1/20 of a measure  
of gas was disengaged from it this did  
not apparently diminish with oxygene & but

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4  
very little [?in] agitation most probably it  
was hydrogene Nitrous acid appeared a  
very bad conductor

[Horizontal rule]  
In the solution of Ammoniac the oxygene  
wire 2 2/3 the hydrogene 15. 1/2 the gold  
very much corroded & something like  
yellow deposit upon it in the oxygene wire  
the oxygene wire gas was composed  
of 1 2/3 oxygene. This gas residual  
did not inflame with oxygene was  
not absorbable by water & ‘as there  
is every reason to beleive was  
cheifly composed of Nitrogene

[Horizontal rule]  
on boiling twice a strong solution  
of caustic Ammoniac I obtained  
x from it nearly 1/20 of its bulk

of air which was apparently Nitrogene  
during the whole process air bubbles  
rose

[Horizontal rule]  
diluted Nitric acid poured upon the gold  
produced no change; but when  
concentrated ~~Nitric aci~~ muriatic acid was  
employed gas was given out the matter  
was dissolved & the gas did not diminish  
with Nitrous gas -

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5  
Sulphate of iron in solution impregnated  
with Nitrous gas I have found the best conductor

[Horizontal rule]  
When impregnated sol[superscript]n[/superscript] of sulphate of  
iron was used no gas was given out  
from either wire –

[Horizontal rule]  
When muriatic acid of commerce was  
used no gas was given out & the  
Silver wire gave clouds -  
When pure muriatic acid was used  
hydrogene was apparently given out  
from the silver wire whilst a globule  
of gas only was disengaged from

the zinc wire. -   
[Horizontal rule]  
10  
The gas from the hydrogene wire  
of Ammoniac [?x] to 3 with 1  
of Nitrous gas gave no diminution

[Horizontal rule]  
When muriatic acid was put  
in contact with the hydrogene wire  
& Ammoniac with the oxygene wire  
gas was given out from both about  
six times as much from the oxygene  
as from the hydrogene.

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6  
the three of gas from the hydrogene wire  
in Ammoniac with 1 1/2 of oxygene left  
rather more nitrogene than prexisted in  
it but not more than 1/2 1/12 or 1/13  
of the whole quantity. -  
[Horizontal rule]

Aug[superscript]t[/superscript] 10  
in solution of caustic potash two gold wires

were made to communicate till near  
a quarter of a cubic inch of gas  
was produced of this gas the whole  
acted on by the electric shock left  
very little not 1/40 of the whole  
[Horizontal rule]  
The hydrogene from the muriatic acid inflamed  
with oxygene gave great diminution

[Horizontal rule]  
When the galvanic influence was  
passed through muriatic acid in two  
separate vessels gas was given   
out in the hydrogene; but none  
from the oxygene wire, the gas from  
the hydrogene wire was apparently partially  
absorbed, when suffered to [?rest] about 1/4 of  
it. –

[Horizontal rule]  
When the galvanic influence was made to  
pass thro the hydrogene wire muriatic  
acid, the oxygene wire water 2 1/8  
of oxygene nearly pure was pro~~duced~~<duced> from

**RI MS HD/20/C, p. 007**

7  
the oxygene wire & 4 nearly from  
the hydrogene wire

[Horizontal rule]  
these 4 with two of oxygene left  
nearly 2 which gave no diminution  
with Nitrous gas & were not absorbed  
by water . The electric spark  
passed through them with  
two of oxygene left rather more  
than two. -

[Horizontal rule]  
The circumstance that most struck me on  
the perusal of M[superscript]r[/superscript] Nicholsons account  
of his curious exp[superscript]ts[/superscript] & those of M[superscript]r[/superscript]  
Carlisle on the decomposition of water  
X by means of the galvanic influence,  
was the apparent fixation of oxygene  
~~at the point of an oxydable wire~~  
at the point of one wire & the  
production of hydrogene from the  
other the intermediate distance  
being very great.- It was difficult supposing  
the water decompounded at one point  
to suppose that one of the elements  
of it could be carried through  
water in a condensed & invisible  
state

[Horizontal rule]  
sulphurated by hydrogene.-

**RI MS HD/20/C, p. 008**

8  
In pursuing a course of [?~~xxx~~]exp[superscript]ts[/superscript] on  
the galvanic influence ~~it has~~ occured to

~~me to observe~~ some ~~unnoticed~~ <new>phenomena.  
have occured to me.

**RI MS HD/20/C, p. 009**

9.  
- Observations on Galvanism -   
In perusing M[superscript]r[/superscript] Nicholsons account of  
his curious experiments & those of M[superscript]r[/superscript] Carlisle  
on the decomposition of water by means of  
the galvanic battery of Volta I was particularly  
struck with the phenomenon of the fixation  
of the oxygene at the point of one wire  
~~whilst~~ & the <extraction of the> hydrogene ~~was given out at~~  
~~the~~ round the surface of the other the  
intermediate distance being nearly two  
inches. ~~In~~ Whilst pursuing a  
course of exp[superscript]ts[/superscript] with a view of collecting  
facts which might lead to an explanation  
of this phaenomena I have ~~met with~~ made  
some new observations  
In pursuing a course of experiments on the  
galvanic influence cheifly with a view to  
collect facts towards an explanation of

a curious phaenomenon noticed by M[superscript]r[/superscript] Nicholsons  
~~in the~~ account of his curious exp[superscript]ts[/superscript] & those  
of M[superscript]r[/superscript] Carlisle on the decomposition of  
water ~~by [?an]~~ namely the ~~oxydation of the~~  
~~wire~~ fixation of oxygene ~~&~~ at the point

of one wire & the extrication of hydrogene  
from the other, the intermediate distance  
~~betw~~ between them being considerable I have  
~~been a~~ met with ~~some~~ new phaenomena  
as some of them lead to a new  
application of this extraordinary power

**RI MS HD/20/C, p. 010**

10  
The batter~~y~~ies employed in these experiments  
was constructed at the request of D[superscript]r[/superscript] Beddoes &  
consisted of from sixty to 118 plates. -  
I found the shock much more severe  
when the communication between the  
wires was made when the hands were  
moistened with a solution of sulphate  
of iron than when they were wetted  
either with water or sol[superscript]n[/superscript] of common  
salt.- On building up a pile  
with ~~the~~ pieces of cloth wetted with  
this solution the ~~shock were much~~  
power of it was at first apparently  
much increased –   
When I made the communication between the  
two batteries by means of muscular fibre  
&c.

**RI MS HD/20/C, p. 011**

11  
Sir  
In pursuing a course of experiments  
on the Galvanic influence I have been  
able to make some new observations  
which as they are connected with  
the ~~valuab~~ curious facts detailed by  
yourself & others in the last numbers  
of your journal I [?~~xx~~] request you to  
communicate ~~them~~ to ~~the public~~ <Exp[superscript]ts[/superscript]> through  
the medium of that valuable publication.

[Horizontal rule]  
The apparatus that I employed was  
constructed at the request of D[superscript]r[/superscript] Beddoes  
& consisted of 118 sets of Zinc & silver.-  
I found the galvanic shock very much  
increased when the parts through which  
it passed were moistened with solution  
of green sulphate of iron. A pile  
erected with pieces of cloth wetted  
~~with~~ <in> this substance acted for a short  
time much more powerfully than a  
similar pile erected ~~with cloth soaked~~ <in the usual mode>  
~~in solution of salt, it rapidly however~~

~~lost its powers in consequence of~~  
~~the decomposition of the sulphate of~~  
~~iron by the oxide of zinc~~  
it seemed however to lose its powers  
in a shorter time perhaps the solution

of sulphate of Zinc or other metallic

**RI MS HD/20/C, p. 012**

12

salts may be employed with greater  
advantage. -  
~~Exp[superscript]t[/superscript] 1~~1  
~~Two gla~~ Struck with the curious phaenomena  
noticed by M[superscript]r[/superscript] Nicholson namely the fixation  
[X] of oxygene at the point of one wire & the   
liberation of hydrogene from the other  
~~I~~ my first researches ~~ma~~ were directed  
towards ascertaining; if oxygene & hydrogene  
could be separately produced from  
quantities of water not in contact with   
each other –

1  
~~Either two glasses of water were made~~  
~~to communicate one with the zinc end~~  
~~of the apparatus & the other with~~

~~the with each other by means of~~  
~~a when a wire communicating with~~  
~~the Zinc end of the apparatus was~~  
~~introduced into one vessel of water~~  
~~& another metallic wire from the~~   
~~silver end into another separate vessel~~  
~~When were~~ Two <silver> wires one from the  
Zinc end of the machine & the other  
from the silver <end> ~~were~~ <~~being~~> <were>introduced ~~into~~  
[/pencil notation]~~separate quantitities of water~~ separately  
into the two ~~vessels~~ <glasses> of water ~~when the~~  
~~communication between the vessels was~~  
~~made eithroughtby the bodies of two~~ or[/X]

**RI MS HD/20/C, p. 013**

13  
~~three persons provided the wires were~~  
~~easily oxydable oxygene was fixed~~  
~~in combination with that metal of~~  
~~the Zinc side & hydrogene given out~~

[X]~~of that on the silver side, but~~  
~~if the wires were of gold~~  
~~oxygene was liberated~~  
Knowing from the previousexp[superscript]ts[/superscript] that  
the living animal was a good conductor  
I dipped one ~~of~~ of the fingers of the  
right hand into one of these vessels  
& those of my left hand into  
the other, immediately after I received  
the shock the ~~silver~~ <Zinc> wire began  
to calcine very rapidly & white  
~~white~~ clouds fell from it, the silver  
~~wires~~ from the silver wire gas was  
extruded with great rapidity, this gas  
examined after the experiment had continued  
for a great length of time proved  
to be hydrogene mingled with a  
small quantity of common air which  
had been previously contained in the  
[/X] water - When the communication  
was made by means of muscular  
fibre living vegetable fibre or  
moistened cloth or chord, the  
same effects were produced as  
likewise when the communication  
was made by means of three persons.-

**RI MS HD/20/C, p. 014**

14  
the gas appeared to be disengaged  
~~more~~ rapidly when muscular fibre was  
employed, when a metallic wire  
was used the same phaenomena  
took place as M[superscript]r[/superscript] Nicholson has  
described  
2  
~~Two or~~ into one end of each two  
hollow tubes a small piece of <pure> gold  
wire was hermetically sealed they  
were filled with boiled water ~~&~~ inserted  
- into two vessels of water that had  
been just boiled & was yet warm. -  
~~gas was given out~~ when the communication  
was made between the two glasses by  
means of muscular fibre gas was given  
out very rapidly from the silver  
but very little from the ~~g~~ zinc it being  
at first cheifly dissolved &c -  
3.  
Thus hydrogene was obtained pure from  
one quantity of water whilst oxygene  
was produced from the other, there was  
not the slightest appearance of the  
liberation of gas from the animal ~~of~~ <or>  
vegetable fibre

**RI MS HD/20/C, p. 015**

15

3  
To the Zinc end of a galvanic battery <one end of> a  
piece of dry; but fresh muscular fibre  
was attached the other end being inserted  
in a vessel of water. Another  
piece of similar fibre was made to  
communicate with the silver end &  
placed in contact with a second  
vessel of water, ~~the~~ <When> the communication  
was made between these two vessels  
by means of a bit of gold wire  
~~as soon as it~~ oxygene was given  
out in one vessel & hydrogene  
in the other at the points of  
contact of the wire with the moisture.  
When the communication was made  
by means of muscular fibre or  
moisture & pieces of metallic wire  
placed beneath the surface of the  
water no gas was given out  
from them but when ~~the pieces~~  
of ~~metal gold wire were made to~~ <one piece of gold was>  
~~communicate by means of the~~ <held in the right hand & the>  
other in the left & inserted respective  
ly in the two vessels of water oxygene  
was fixed upon one of them &  
hydrogene given out from the other. -  
4  
[?~~Then the~~] The communication between the  
[?~~wa~~] vessels of water & the battery

**RI MS HD/20/C, p. 016**

16  
being made as in the last exp[superscript]t[/superscript] by  
muscular fibre, I introduced into one  
glass a piece of silver wire &holding  
the upper part of it in my dry right  
hand into the other glass I plunged  
one of ~~my~~ the fingers of my other  
hand no gas was given out in either  
glass & the silver wire rapidly  
calcined - when my right hand  
hydrogene -  
This exp[superscript]t[/superscript] is the most extraordinary  
of any that have occurred to  
me &c

**RI MS HD/20/C, p. 017**

17

~~In these From the results of these experiments~~

~~it seems most probable~~  
In the exp[superscript]ts[/superscript] on the sulfuric acid & Nitric  
acid it is most probable that the  
acids were decomposed by the combination  
of their oxygene with nascent hydrogene  
given out in the silver tube-  
In the exp[superscript]ts[/superscript] on the muriatic acid &  
Ammoniac the gold in <the> Zinc tube was  
most probably oxydated in consequence  
of ~~what may be called~~ predisposing affinity  
none of the compound bodies appear to  
have been immediately decomposed in consequence  
by the galvanic influence - The difference  
in ~~my ex~~ the results of my exp[superscript]ts[/superscript] & those M[superscript]r[/superscript] Henry may be accounted for from  
the different modes in which we operate  
I suspect however ~~that if~~ that ingenious  
chemist ~~will compare~~ <on [?re] repeating> his exp[superscript]ts[/superscript] on the  
~~solution~~ solution of potash under new  
circumstances ~~He~~ will find reasons for  
altering his conclusions with regard to  
the decomposition of potash by the galvanic  
influence  
[X]probably phosphoric acid [?~~xx~~] & other acids  
dissolved in water may be decomposed <when> exposed  
to the nascent hydrogene extricated under  
the galvanic influence, ~~it is probl~~  
If as is probable the quantity of [?Zydrogene]

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~~extricated~~ <produced> from the silver wire bears always  
the same ratio to the oxygene produced  
from the Zinc wire whatever <different> substances  
are dissolved in the quantities of water  
connected with them, it will become an  
X an accurate & elegant instrument ~~of~~ <for the>  
analysis of such oxydated bodies as are  
soluble in water. -

**RI MS HD/20/C, p. 019**

19

Observations on the Nitric acid.  
D[superscript]r[/superscript] Priestley long ago observed that the substances  
distinguished in the modern chemical nomenclature  
by the names Nitric & Nitrous acids were  
capable of ~~exi~~ being exhibited in the [?~~xx~~] aëriform  
state. The most elegant & convenient way  
of producing aëriform nitrous acid is by  
throwing into an exhausted balloon about  
two parts of Nitrous gas & one part  
of oxygene gas. in this ~~case~~ <exp[superscript]t[/superscript]> a great  
diminution of volume takes place & ~~the~~  
<increase of temperature is observed &> an orange gas is formed which  
remains permanently aëriform at the   
temperatures of the atmosphere.  
The affinity of Nitric acid in the aëriform  
state for Nitrous gas is so great  
that altho as superabundance of oxygene  
gas <much> more than sufficient to saturate  
the Nitrous gas is thrown into the globe  
yet stile it retains its yellow color &  
when condensed by water is evidently  
more or less phlogisticated.  
‘Indeed Nitric acid itself may be considered  
rather as a binary compound of Nitrous gas &  
oxygen gas than as a binary compound  
of Nitrogine & oxygene and as aeriform  
Nitrous gas has a very strong affinity for  
Nitrous & holds it in solution so aeriform

**RI MS HD/20/C, p. 020**

20  
Nitric acid has a strong affinity for Nitric  
gas there are then in the [?composition] of  
Nitric acid many nice affinities concerned  
Nitric acid in the aeriform state contains  
a considerable quantity of water & this

quantity reasoning from analogy must be  
greater in proportion as the temp[superscript]e[/superscript]  
is higher. -  
It has long been considered as a matter  
of importance in chemical [?~~xx~~] science  
that the quantity of real or true  
nitric acid in solutions of nitric acid  
in water be ascertained M[superscript]r[/superscript] Kirwan, &  
Wenzel a mode. -  
But as Nitrous acid gas at low temperatures  
contain~~ed~~ing in a globe containing a superabundance  
of oxygene must always be of similar composition  
The absorption of this by water

[Horizontal rule]

**RI MS HD/20/C, p. 021**

21

Common Nitrous acid is 1.46. -  
50/74 (1.48  
50  
240  
200  
400

50/74 (1.  
50/50  
24

[Horizontal rule]  
Common <temp[superscript]e[/superscript] 65°> Nitrous acid 1.47.-  
ten grains of water were added -  
then the whole filled a space equal  
to 58  
58/84 (1.448  
58  
260  
232  
280  
232  
480

[Horizontal rule]  
31 grains of water more were added

[Horizontal rule]  
then 87/125 (1.321  
89  
280  
261  
190  
174  
160  
87/125 (1.4  
87  
380  
348  
32

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22  
42 grains more of water were added  
now the space was equal  
to 125. grains. -

115

42

125 / 157 ( 1.264

125

320

240

800

750

500

100  
Common Nitrous acid  
is 1.47. 50 grains <measures> of it  
weighed about 74 grains  
to this was added 83 grains  
of water when it filled  
a space equal to 125 grains  
consequently  
This acid is of 1.264

157

74

83

157

31

156

[Horizontal rule]  
100 grain measures of it weigh 126.4 grains  
- consequently it is of 1.264 -

[Horizontal rule]  
60 of it [?~~fill~~] ~~a~~ <in> space  
equal to 76 <in [?xxx]> to these 76 were  
added

[Horizontal rule]

126

49

60/ 70 / 1.260

60

160

120

400

[Horizontal rule]  
21 added filled a space nearly  
equal to 80. & 1/2  
20.5 / 970 / 1.204 specific gravity

805

1650

1610

4000

**RI MS HD/20/C, p. 023**

23

42 <more> fills a space equals to 120

97

139

74

63

157

120 / 139 / 1.158

120

190

120

700

600

1000

[Horizontal rule]  
10 more filled a space nearly equal  
to 130

130/149/1.146

130

190

130

600

520

800

139:350 [?xx] 25

278

720

76:35:139

35

695

76. 4865  
at ~~77~~ 65 will become at 84  
[Horizontal rule]

74 grains

83

157

76 give 35

35

41

41

21

42

10

114

149:350/25

298  
520

35

114

149

910

Y157: 74: 76

45 74

304

532

157 / 56 24/ 35

431

**RI MS HD/20/C, p. 024**

24  
Water diminishes in specific gravity in   
proportion as its temp[superscript]e[/superscript] is higher  
so do the Nitric acids -  
100 parts of [?~~pale~~] Nitrous acid of 1.144  
at temperature 65° contains rather more  
than 25 1/2 of Nitrous acid of specific  
gravity 146 which is nearly the common  
specific gravity of the acid of commerce.  
And as ~~it is~~ [?~~part~~] concentrated Nitric  
acids expand more on increase  
of temp[superscript]e[/superscript] than diluted ones supposing  
the temperature about 90° it would  
follow that 100 parts of acid of  
1.144 contains near 26 of acid of  
1.46. consequently an ounce of  
this acid would equal ~~nearly~~ rather  
more than two drachons by weight

**RI MS HD/20/C, p. 025**

25  
1

aeriform Nitrous acid. -  
D[superscript]r[/superscript] Priestley long ago observed that Nitrous acid was [?capaflable]  
of being existed in the aeriform state when deprived  
by heat of a certain portion of the water that  
adheres to it in the fluid form & placed  
out of the contact of bodies ~~in~~capable of  
decomposing or absorbing it. -  
The most elegant & convenient mode of procuring  
Nitrous acid gas is by the introduction of  
Nitrous gas & oxygene gas nearly in the proportion  
of 2 to 1 into an exhausted glass balloon  
furnished with a glass stop cock. In this  
case\* a great contraction of volume in  
the gases takes place increase of temperature  
is produced & an orange colored or deep  
red aëriform fluid generated which remains  
permanently aëriform at [?~~xx~~] all known  
temperatures. –

**RI MS HD/20/C, p. 026**

26  
mem[superscript]m[/superscript] to try potash, sedative salt  
phosphoric acid nitrate of ammoniac  
nitre rendered fluid by heat

**RI MS HD/20/C, p. 027**

27

The importance of the knowledge of the constitution &  
use of the atmosphere has been too often insisted

upon by philosophers to need any new exhibitions  
that the body of elastic fluids surrounding the  
earth capable of ballancing a body of mercury  
equal to 30 inches in height is cheifly constituted  
as far as chemical instruments have been able  
to reach of two elastic fluids oxygene gas  
or pure air & Nitrogene gas in phlogisticated

air have been fully demonstrated by the researches

of Priestley, Lavoisier & others -  
But whether these bodies are bound together  
by ~~a~~ a chemical affinity or whether they are  
kept in mechanical mixture from the motions  
of the Atmosphere has not been clearly determined  
~~Of the experiments~~ Bodies of different specific  
gravities may continue so as to form a compound  
nearly of the ~~same~~ mean specific gravity this  
is the case in the mixture of many  
of the weaker acids with water & in  
the combinations of many of the more diluted  
acids with water Hence Atmospheric air though  
nearly of the spec: gravity of a mixture of

oxygene & Nitrogene many still be a chemical

mixture amongst the most decisive of the exp[superscript]ts[/superscript]  
which I have invented for the purpose of ascertaining  
whether Atmospheric air is a compound is the  
solubility of Atmospheric air in water & other  
fluids as compared with the solubility of its

**RI MS HD/20/C, p. 028**

28  
constituents -. 2[superscript]dly[/superscript] the mode of its production  
3[superscript]dly[/superscript] the use of aqueous vapor in the atmosphere  
to carry down in rain ammoniac Nitrous  
acid & other noxious matters that would be  
otherwise perpetually accumulating  
-mem[superscript]m[/superscript] to get a pluviometer [?-]  
Air which I procured from rain thrown  
down in a thunder storm cheifly  
phlogisticated. - Every shower of rain carries  
down some carbonic acid. test of the carbonic  
acid in the atmospheric <water> solution of strontian  
Quere is there any difference in the constitution

of the atmosphere in hot & cold weather in  
winter or summer - in the days of  
June after a dryness of near three months  
the atmosphere contained about of oxygene  
&c. &c. –

Exp[superscript]ts[/superscript] on vegetables to ascertain whether  
the air they give out under the influence of the  
solar light is capable of becoming atmospheric  
air.- Quere does the serum of the X  
blood give out atmospheric air, is the  
sea air purer than that of the land.-  
Is not the Nitrogene perpetually formed by the   
respiration of fishes [?still] held in solution by  
the water & this confirmed with nascent  
oxygene from the marine cryptogamia. -  
Mem[superscript]m[/superscript]to make an exp[superscript]t[/superscript] on vegetation to  
ascertain whether plants give out oxygene when they are

**RI MS HD/20/C, p. 029**

29  
in contact with Carbonic acid. [Two ink sketches]

[Horizontal rule]  
In the exhausted receiver little or no  
oxydation of the Zinc plates was produced  
quere was this in consequence of the  
abstraction of oxygene of atmospheric air  
or was it in consequence of the non  
conducting electricity of vacuum.-  
Quere would the ~~spark~~ <effect> be produced in  
~~vacu~~ carbonic acid. - no acid is  
apparently present when the effect  
is produced in distilled water.  
Charcoal when long exposed to a great heat  
becomes a perfect conductor of electricity quere  
will it conduct galvanism & if so ~~enable~~  
will it be enabled by means of it to decompose water  
- [?Modo] of preserving water from the  
contact of atmospheric air by covering  
it with oil. - Quere will the  
affinity of water for air enable it  
to combine with air dissolved in  
oil mem to try this -  
Mem to put the water or the  
inside of the exhausted receiver  
& the galvanic pile on the outside  
Charcoal seems to be a better  
conductor ~~than~~ when heated red than  
when ~~white~~ cold

**RI MS HD/20/C, p. 030**

30

hydrocarbonate & carbonic acid from  
the charcoal both apparently dissolved  
in ~~distilled~~ <boiled> water, gas given out by  
charcoal in common water. -   
2 of Oxygene containing 1/3 oxygene  
2 1/4 of gas from the hydrogene side  
of the charcoal diminished to   
two & quarter ie 1 of detonating take  
2/3 of oxygene with about 4/3 of 3/20 ( 6.-  
2/3 2 <hydrogene> ought to diminish ~~to~~ 2 small

measure  
[Horizontal rule]

3 of Atmospheric air was added when  
they equalled 2 x quarter a new detonator  
was occassioned after which they equalled 1. 2/3 -

[Horizontal rule]  
[?~~xx~~] These underwent little or no   
diminution when agitated over time water  
& did not perceptibly cloud it.-

[Horizontal rule]

when lime water was used, gas was  
given out round the ~~charcoal~~ <brass> wire  
& round the charcoal ~~carbonic acid~~  
~~was produced~~ - air was produced &  
but a very slight  
[Horizontal rule]

precipitation perceived. –

**RI MS HD/20/C, p. 031**

31  
When charcoal was put into strong solution  
of caustic potash no gas was given out  
when silver was made to combine  
with the oxygene it became brown  
round the silver, No gas was given  
out from the hydrogene. -  
gas was gradually given out from  
the silver. -  
No gas was given out from the  
charcoal though it came from the  
silver in torrents

[Horizontal rule]  
No gas was given out from them  
even when a compleat circuit was  
made & two pieces of silver wire connected  
with charcoal attached to the tubes. -

[Horizontal rule]  
No prussic acid is formed in this  
exp[superscript]t[/superscript]. –

[Horizontal rule]  
When silver was the oxygene no  
gas was given out from it  
but [?none] from the charcoal  
when silver was the hydrogene  
gas was given out from it  
but [?none] from the charcoal

**RI MS HD/20/C, p. 032**

32  
when Ammoniacal solution was employed  
gas was given out from the Zinc side  
but ~~left~~ none from the silver side -  
when Ammoniac was used silver  
the hydrogene side gas was given  
out mem to examine this

[Horizontal rule]  
Sepr 20 Examination of gases produced  
from rain water by charcoal  
Under the galvanic influence  
& from ammoniac by  
charcoal <oxygene> silver wire silver or hydrogene

[Horizontal rule]  
Nitrous gas contains about 1/16 Nitrogen.  
2.8.1  
oxygene contains about 1/10 Nitrogene –

[Horizontal rule]  
1 2 Eudiometer measures were produced from  
the water connected by charcoal with the hyd  
rogene wire, but though gas had been  
given out evidently from the water  
during the process it did not give the  
slightest dim[superscript]n[/superscript] with nitrous gas –

[Horizontal rule]  
2 <Ed> of the unknown gas & [?~~xxx~~] 1. 1/6  
of oxygene after detonation left  
1/4 of the whole quantity

**RI MS HD/20/C, p. 033**

33  
ie 1/4 of 3 1/6  
on introducing ~~on~~ to [?~~this~~] the remainder  
lime water a considerable & rapid absorption  
took place at first & afterwards a slighter  
absorption with cloudiness. –   
the whole quantity of gas remaining after  
this absorption was equal to 1/7 of the  
whole quantity. -

This [?~~xx~~] 1/7 was cheifly oxygene.-

[Horizontal rule]  
The air given out from the oxygene  
side was not equal to 1/40 of that from  
hydrogene side - this air was  
not absorbed by lime water & mingled  
with a bubble of nitrous air equal  
to about twice its bulk gave such  
a diminution as directed it to  
be common air –

[Horizontal rule]  
2 The silver wire of the hydrogene side in  
ammoniac produced three measures <& 2>3 of gas  
ie E M by silver.- This gas detonated  
with oxygene proved to be hydrogene  
nearly pure - of ~~Nitrogene~~ gas from  
1/6 of a measure was produced  
the oxygene side was produced. –   
when the electric spark was passed  
thro this mingled with 10 of oxygene  
no ~~percepti~~ inflammation took place

**RI MS HD/20/C, p. 034**

34  
-Ammoniac-  
When two pieces of charcoal were  
made the medium of communication  
gas was given out only from  
the Zinc side and none from the

silver side  
when charcoal was the silver side  
& silver the Zinc side -  
gas was given out from neither

side. The tinge of green was

not enough when the solution  
was examined by means of red sulphate  
of iron to denote the existence of

prussic acid  
[Horizontal rule]  
Air pumps water [?xxxxx] and  
spill out. mem

**RI MS HD/20/C, p. 035**

35  
During ebullition-  
When silver & ~~Zinc~~ <wires> were introduced into  
water deprived of its air by boiling  
& yet very warm gas was given  
out . ~~mem~~ calcination took place. -   
When it was boiling ~~less~~ the process  
apparently ceased & but little gas was  
given out even from the hydrogene  
were mem serum of the blood  
oil. subsequent oxidation. –   
- though it was yet so hot as  
to be intangible -  
mem the silver & zinc in  
ie under water -  
the process went on whilst the  
boiling was continued but on account  
of the great motion no oxide  
could be seen ~~but~~ [?~~in~~] & gas  
was formed round both wires

**RI MS HD/20/C, p. 036**

36

[Blank page]

**RI MS HD/20/C, p. 037**

37  
the inventor of the galvanic pile long ago observed  
that <well burnt> charcoal was a conductor & excitor of the   
common galvanic <influence> ~~& though this fact was~~  
~~for sometime contested its authenticity was~~  
~~finally determined by various exp[superscript]ts[/superscript]  
I [?x] exposed~~ When  
conjecturing that this substance might exibit  
some new phaenomena I **[deletion]made[insertion]when[insertion][deletion]** made part  
of the [?~~gla~~] galvanic circle I connected <~~each of~~> two  
thin slips of charcoal with the ends of  
the pile of sixty plates, whenever they were  
brought in contact with each other  
a vivid  
The [deletion]inventer[/deletion] inventor of galvanic pile long ago  
noticed the power of charcoal to conduct  
the common galvanic influence, I have  
found that when two pieces of well burn’t  
charcoal are made the medium of  
communication between the pile & the  
human body  
Coals - Elliots two fills -  
M[superscript]r[/superscript] Dwyers bill, Guinea pigs & meat  
M[superscript]r[/superscript] King owes me 3 guineas. I owe him 7 S

**RI MS HD/20/C, p. 038**

38  
That <well burnt> charcoal is a conductor of the <common influence> galvanic  
has long been known the following experiments  
~~upon its~~ will prove that it is  
possessed of powers similar to <those of the> the metals  
~~of produci~~ in producing the galvanic  
shock & in decomposing water when  
made part of the ~~galvanic circle~~. -  
when made the medium of communication  
The earlier experimenters in galvanism discovered  
that charcoal possessed in common with the  
metals the power of conducting & exciting  
that influence, ~~in making some experiments~~  
~~on this substance with the new galvanic~~  
~~pile I have met with some facts which~~  
~~appear to me worthy of detail in~~

~~laying the foundation serving as bases~~  
~~for interesting researches.-~~  
I have found that this substance conducts  
the electricity of the new galvanic  
pile nearly as well as the meta  
ls. -  
When two pieces of well burnt charcoal  
are connected ~~with~~ separately with  
the Zinc & silver ends of the machine  
<when they are touched by the hands> the shock is transmitted ~~through them~~  
by means of them through the human  
body

**RI MS HD/20/C, p. 039**

39

by means of non conductor

If they are made to compleat the

circle by touching each other provided

the ~~electr~~ pile be powerful to produce

sparks by means of metals

The earlier exp[superscript]ts[/superscript] in ~~galvanism~~ <Animal electricity> discovered

that well burnt charcoal was a conductor of

the common galvanic influence. ~~I have~~

~~when two pieces of this substance~~

~~found that this substance~~ ~~when perfectly~~

~~are connected with the ends of the galvanic~~

~~dry & even when red hot communicates~~

~~the galvanic shock & produces~~

~~sparks to the same extent as~~

~~most of the metals when two pieces~~

~~of it are made the connectors~~ of

~~the silver & Zinc in the galvanic~~

~~circle of M[superscript]r[/superscript] Volta.-~~

In making some experiments on [?xxxxx] <substance>

with the ~~galvan~~ new metallic pile

I found that it not only ~~produced~~ <communicated>

the shock to the human body when

~~piece~~ pieces of it were made the

medium of communication ~~between~~

~~the plus end~~ & minus ~~end~~ connected with

the plus & minus ends but likewise

that when these pieces were brought

in contact they produced the spark

with a degree of vividness not inferior

to the metals. -

**RI MS HD/20/C, p. 040**

40  
To ascertain the power of charcoal  
to conduct the intense .e  
1 Two <long & slender> pieces of charcoal burnt & dry  
~~were~~ connected separately with ends of  
a galvanic pile Touched with the  
<wetted> fingers they produced a [?~~xx~~] galvanic  
shock nearly as powerful as if the  
metals themselves had been the medium  
of connection. - <whenever they were> Brought in contact  
with each other by means of non  
conductors, sparks as vivid as from  
the metallic wires were perceptible

**RI MS HD/20/C, p. 041**

41  
The earlier experimenters on ~~galvanism discovered~~ <animal electricity noticed>

the ~~conducting~~ power of well burnt charcoal

to conduct the common.  
with ~~regard~~ to this influence I have  
found that this substance possesses the  
same properties as metallic bodies  
in producing the shock & spark when  
made the medium of communication  
between the ends of the galvanic pile  
of signor Volta <[?~~Also~~]> ~~like the metals~~

~~connected~~ in the circuit by water  
~~when acted on~~ ~~by galvanism it~~

~~affects the~~  
~~decomposes water & that with peculiar~~

~~or by aqueous solutions it~~   
~~effects in them peculiar changes.-~~   
I have likewise found that <it> ~~when~~

evolves gases from water [?~~xxxx~~] aqueous solutions  
~~connected in the galvanic circuit by~~  
~~water or aqueous solutions~~ when made  
to communicate with those substances  
in the galvanic circuit. -  
Two long & thin slips of <dry> charcoal were connected  
~~by~~ with silver wires these wires were separately  
made to communicate with the ends of a  
galvanic pile of about 60 pieces - The ~~bottom~~ <points>  
of the charcoal slips were ~~plunged~~ <immersed> ~~into a~~

at the distance of the globules of air ahering to

glass of water & ~~after immersion carefully~~  
~~freed from air~~ about halff an inch from each other> & then carefully removed.  
The communication being made sure ~~globules of air~~   
In about a minute ~~globules~~ <particles> of ~~air~~ gas began   
to be liberated round the point of

**RI MS HD/20/C, p. 042**

42  
the charcoal connected with the ~~Zinc~~ <silver> side  
of the app[superscript]s[/superscript] - A considerable time lapsed  
before any air was given out from that  
on the silver side, In half an hour however  
a few globules had formed about it. -  
During the whole of which time gas  
was given out rapidly ~~from the silver~~  
~~wires~~. - on the other side  
Reasoning from the common phaenomena of the  
action of red hot charcoal on water & on  
the analogous galvanic facts it was reasonable  
to conclude that ~~the gas evolved from the~~  
<charcoal on the> ~~silver side of the apparatus was~~ hydrocarbonate  
~~was evolved from the charcoal~~ & that <the carbonic> carbonic  
acid ~~had been~~ produced on the Zinc side  
~~which were~~ <had been> cheifly absorbed by the water

[Horizontal rule]  
In a former communication muscular

[Horizontal rule]  
To ascertain the truth of the conclusion two  
small tubes about 1/4 of an inch in diameter  
& three inches long were provided into one end  
of each of them tubes [?~~xxxxx~~] then piece of finely <hard &>  
[?~~xxx~~] polished charcoal was introduced & fastened by  
cement: - The tubes were filled with distilled

<inserted with glass of>  
water & the charcoal connected with  
~~The~~ [?~~xxx~~] ends of pile. - <The [?xxxxxx] was continued>   
for 14 hours <when> the gas <produced> from silver side was ~~equal~~  
in volume 50 times greater than that produced  
charcoal of willow can ~~be more~~ easily ~~cut~~ & polished & reduced  
to a point -

**RI MS HD/20/C, p. 043**

43  
from the Zinc side. - The tube ~~containing the~~   
gas from the Zinc side was <with its water & gas> introduced into  
a vessel of lime water. On agitation the water  
became clouded but ~~no~~ <the gas was not> perceptibly ~~quantity~~ of  
~~the gas was~~ diminished mingled with   
double its bulk of nitrous gas it gave <such> an  
~~light~~ absorption. ~~Hence it was probably~~   
~~common air which had been liberated from~~

~~the water in consequence of the stronger~~

~~affinity of carbonic acid from that placed~~.   
as denoted it to contain about the same  
quantity of oxygene as common air. –   
The gas produced from the silver side of the  
pile did not <at all> diminish with nitrous gas  
12 measures of ~~it~~ [?~~fixed~~] it mingled with  
7 measures of oxygene <in a detonating [?tube]> & acted on by the  
electric shock inflamed & left a residuum  
[?~~xx~~] equal to rather more than three measures  
Lime water ~~added~~ <introduced> to these became a little  
clouded & a slight absorption took place. -  
~~But~~ After this absorption <At least> two measures &  
half of gas remained which contained oxygene  
as they gave red fumes mingled with  
nitrous gas. –   
Surprised at these results from which it appeared  
that the gas from silver side of the apparatus  
contained very little charcoal [?in] solution & was  
not different in the quantity of oxygene required  
to destroy it from the inflammable air   
produced from the results I repeated the exp[superscript]t[/superscript]

**RI MS HD/20/C, p. 044**

44  
making use of water that had just been   
boiled. - In this instance I was surprised  
to find <that> no gas <was> given out from either  
piece of charcoal for near an hour though  
the communication was perfect. At the end  
of an hour gas was given out as  
before from the silver end but none  
from the Zinc end. - At the end   
of six hours <during which time no gas had formed in the Zinc> the gas from the silver [?tube]  
charcoal was examined [~~detonated in~~ it  
did not diminish with nitrous gas, [?~~xxx~~]  
detonated with oxygene gave nearly the  
same absorption as inflammable air from  
metals & ~~produced~~ occasioned but a  
very slight precipitation in lime water. -

As I was walking up the street  
In pleasant Burny town  
In the high road I chanced to meet  
My cousin Matthew Brown

My cousin was a simple man  
A simple man was He  
His face was of the hue of tan  
And sparkling was his eye. –

His coat was red for in ~~old time~~ <his youth>  
A soldier He had been.  
But He was wounded & with ruth  
He left the camp I ween -

**RI MS HD/20/C, p. 045**

45  
Quere  
will oil of turpentine or any other oil  
by being saturated with carbonic acid  
or any kind of air give it out  
to water –   
olive oil I have found almost wholly  
prevents carbonic acid from being  
absorbed by water. -   
quere will lime water  
placed in contact with oil  
containing ~~lime water~~ <carbonic acid>form  
soaps or will it form  
carbonate of lime

[Horizontal rule]  
~~The residuum~~ When Nitrous gas & oxygene  
gas are mingled over water of any kind  
during the absorption of the acid by water  
an immense quantity of gas is produced from

the surface of the fluid but this takes place  
equally in water that has been just boiled  
& in common water, It is not owing to  
the disengagement of carbonic acid or  
Azote but owing to the disengagement  
of Nitrous gas When the <concentrated> acids are  
dropped into common water in small  
quantities no air is given out  
When Nitrous gas & oxygene gas are  
mingled over mercury the nitrous acid  
formed is partly decomposed & partly

**RI MS HD/20/C, p. 046**

46

combined with the Nitrous gas reformed   
in consequence of an equilibrium  
of affinity. –   
mem. To repeat priestleysexp[superscript]ts[/superscript] on  
the pretended conversion of hydrogeni into  
Nitrogene. - [Ink sketch of a small face in profile]  
Mem  
To examine the [?on] the inside of  
the sea weed & on the inside of  
rushes &c. –

[Horizontal rule]  
His wound was cured by Doctor John  
Who lives upon the hill  
Close by the rock of grey free stone  
And just above the **[deletion]hill[deletion]** rill. –

He then became a farmer [?~~xxxxxx~~] <true>  
[deletion]And wed[/deletion] [insertion]And took[/insertion] to [deletion]give him[/deletion] [insertion]him for [deletion]for[/deletion][/insertion] aid.-

A wench who though her eye was blue  
Was yet a virgin maid. –

He married her & had a son  
Who died in early times  
As ~~may~~ <is> in the churchyard <is> made

known.  
[deletion][unclear]Th[/unclear][/deletion][/unclear] By poet Wordsworths [?~~lays/lines~~] Rymes

**RI MS HD/20/C, p. 047**

47  
In considering the constitution of atmospheric air  
it becomes a ~~ques~~ question of considerable importance  
whether the light & heat produced during its  
decomposition by combustible bodies were combined  
with it whether they in a specific manner  
belong to oxygene or whether they are found  
between the interstices of all elastic fluids. -   
As far as we can reason from analogy  
all bodies whatever when combined  
with other bodies so as to have their  
volume diminished have their power of  
gravitation increased. Thus Hydrogene gas  
which is 12 times lighter than common  
air when condensed in water becomes  
800 times heavier. - Supposing then that  
any specific fluid is combined in atmospheric  
air it follows that it might to gravitate  
to ascertain whether it gravitates  
sensibly - I made the followingexp[superscript]ts[/superscript] -  
combustion of phosphorus slow & quick. -  
In the phaenomena of combination however  
rapid we can discover no law but a  
law of approximation, nothing is more  
easy than to conceive that during this  
approximation the ether between the particles  
is pressed out with great velocity  
& in proportion to its velocity becomes  
heat or light –

**RI MS HD/20/C, p. 048**

48  
~~Eudiometry~~ [?~~xxxx~~] The test of the purity of  
gases containing oxygene by means of nitrous gas  
is the most speedy that we are acquainted   
with & if it were possible to make  
the necessary corrections [?~~xx~~] would be  
of admirable application in cases where  
the slow & more accurate tests cannot  
be applied – The difficulties that present  
themselves are 1 the <[?~~times]~~> different absorption  
[Pencil marking X] of ~~both the~~ [?~~xxxxxxx~~] ~~of absorption~~ in tubes  
of different diameters in consequence  
of the Nitrous acid formed containing  
more nitrous gas in proportion as  
the surface of water it is presented  
to being greater, the larger the  
[/Pencil marking X] tube the greater the diameter-  
2dly in consequence of agitation  
absorbing a more phlogisticated acid  
3dly in consequence of the increase  
of residuum from gases liberated during  
the process. -  
3dly in consequence of the absorption  
of the nitrous gas of the residuum  
in certain cases. -  
To ascertain all these differences we  
must first observe that spring water  
is a fluid containing [?in] minute portions  
~~of~~ earthy salts amongst which the  
carbonates are the only ones that can affect

**RI MS HD/20/C, p. 049**

49

the results & holding in solution a minute  
quantity of carbonic acid & about 1/16 of  
Atmospheric air -  
When Nitrous gas is exposed to Water  
it decomposes the common air of the  
water combines with the oxygene of it  
to form Nitrous acid the Nitrogene being  
liberated - No carbonic acid is given  
out during this process for not only  
if Nitric acid (concentrated/ be poured  
into common water no liberation of  
gas is perceived but likewise if  
solution of Strontian & Barytes be  
exposed to it no precipitation takes   
place. Cavendish –   
Now if water saturated with Nitrous  
gas could be used in water which  
has a slight affinity for atmospheric  
oxygene, the corrections on account  
of the liberated gas would be

[Horizontal rule]  
Water holding in solution Nitrous  
gas has its power to absorb Nitrous  
gas increased in consequence of  
its combining oxygene of atmospheric  
air into nitrous acid.-

**RI MS HD/20/C, p. 050**

50

Exp[superscript]ts[/superscript] made on September 28 to  
ascertain exactly the different quantit~~y~~ies  
of <[?Nit]> ~~water absorbable~~ Nitrous gas  
absorbable by water of different  
Kinds -   
Nitrous gas contained immediately  
before trial 1/20 Nitrogene

[Horizontal rule]  
to 91 measures A of rain water  
that had been long exposed to the  
atmosphere ( ie 15 hours -   
B of common pump water -  
9 measures of Nitrous gas of  
above composition were exposed

[Horizontal rule]  
The 29 at 9 ~~123~~ five measures  
remained as each

[Horizontal rule]  
The 30 at 100: 30.5 : 77 305 = 385  
1 still five in each

[Horizontal rule]  
~~231=23.485~~31 23.4=7.6

If 31/7.6 24.-

62

140  
Oct[superscript]r[/superscript]. 4. three only in  
the ~~pump~~ <rain> water glass & of this two were  
nitrous gas -   
two only in the pump water glass &  
of this at last 11/4 [?was] 1 1/2 were [?N S]

**RI MS HD/20/C, p. 051**

51  
750 grains of this water gave  
out in the exhausted receiver  
ie the pump water –

[Horizontal rule]  
4. of that air with 5 of nitrous  
gas diminished to five in 70  
tube - 4 of that air with rather  
more than four of NG of common  
air likewise give 70 –

[Horizontal rule]  
if phosphorus ~~&~~ in water  
& over mercury should give different  
diminutions with Atmospheric air  
it would be a good mode of [?ascertaining]  
&c - the solutions of phosphous  
in ~~Nitrous gas~~ - air & ternary  
combinations of air, water & phosphous  
&c

[Horizontal rule]  
They all give very nearly 23 P[superscript]r[/superscript] cent oxygene  
or at most 24 apparently increase after  
their greatest diminution but this  
uncertain.

[Horizontal rule]  
The piece of phosphorus should be  
put in the upper part of the   
vessel - Quere is phosphorous  
at all soluble in Azote  
is it not an [?odorant] [?xxxxxxx]

**RI MS HD/20/C, p. 052**

As long as this fair wife did prove  
To him a wife most true  
His red coat He away did shove  
And wore a [deletion][unclear]x[/unclear][/deletion] coat sky blue

-  
~~But when the parson wicked man soul~~

~~Did preach to her [unclear]as[/unclear] how~~

~~He ought to have the tythes of all~~

~~Een of their marriage vow~~

-

**RI MS HD/20/C, p. 053**

53  
Whether we suppose Atmospheric air to  
be a simple or a compound body  
whether [?~~xx~~] or no we suppose light to  
enter into its composition still we  
can every where trace the immense  
influence of the solar light; its  
action upon vegetables & upon the   
atmosphere the production of  
winds by means of it, the mingling  
of the air on the ocean with   
the water of the seas. -  
I this day observed what I have often   
observed before namely that phosphorus  
taken out of the Azote which it  
has produced very soon begins to   
smoak & inflames –

[Horizontal rule]  
80 of the air from the mouth  
of the Severn wave exposed to  
phosphorus on Oct[superscript]r[/superscript] 4[superscript]th[/superscript] 1800  
on Oct[superscript]r[/superscript] 5 gave after compleat & in 73.5  
Quere will not phosphure in strontian  
or of lime make a good eudiometer.

[Horizontal rule]  
supposing the sulphure of strontian a compound  
of sulphurated hydrogene & alkaline sulphure  
it would follow that if the sulphure  
was oxygened in Eudiometry sulphurated  
hydrogene ought to be given out.

**RI MS HD/20/C, p. 054**

54

As often as I have transferred  
~~phosphorus~~ Nitrogene that had been long  
in contact with phosphorus into a  
mercurial cylinder & admitted to it  
common air no luminous appearance  
was visible, though when I admitted to  
it common air in the cylinder  
in which it was formed whether  
~~over~~ <in contact with> water or mercury the ~~common~~ light  
air ~~was still~~ <very> visible –   
memm to get tomorrow some

~~sol~~ Bismuth –

[Horizontal rule]  
The air of the seaweeds gave  
exactly the same as atmospheric  
air ie their bladders 80 gave  
17.

[Horizontal rule]  
mem M[superscript]r[/superscript] Tanner phosphorus

D[superscript]r[/superscript] Beddoes's exp[superscript]t[/superscript] on sulphure  
of lime & c as galvanic or  
as alkaline –

**RI MS HD/20/C, p. 055**

55  
Immediately after I [?~~read]~~ had perused Colonel  
Haldanes paper in which it was said  
that the galvanic phaenomena ceased under  
the exhausted receiver [?~~I commenced with~~]  
a series of experiments were instituted  
by the assistance of my friend M[superscript]r[/superscript] King  
for the purpose of determining the influence  
of the atmosphere on these phanomenon  
We found the fundamental exp[superscript]t[/superscript] accurate  
We likewise found that the oxydation continued  
though in a much less degree when  
the pile was evaculated & the wires  
atmosphered-  
we found that little or no oxydation  
went on though gases were given out  
from both copper & zinc when  
the wires only were in vacuo-  
A pile inclosed in cement & made  
airtight acted very powerfully for a few  
hours & when its wire were  
covered with resin acted wholly immersed  
under water-  
these powers were lost by the  
morning Oct[superscript]r[/superscript] 7 when it ceased to  
act ~~altogether~~ almost as an excitor  
of sensible influence. -  
= if pile was made to decompose  
water in common air this air was  
driven out by carbonic acid & nitrous

**RI MS HD/20/C, p. 056**

56  
gas admitted till no more  
red fumes were perceived it  
still went on slowly but at last  
ceased - when air was admitted  
it did not go on again. - -  
The process stopped in vacuo  
at an inch. - Oct[superscript]r[/superscript] 8  
A pile was made to decompose  
water in common air & this air  
displaced by nitrous oxide any superabundant  
oxygene being destroyed by Nitrous gas  
it ceased to act though when  
common air was admitted it  
continued to act again. –

[Horizontal rule]  
The apparatus with silver cloud by  
cement made to communicate  
with tubes wholly cemented went  
on in hydrocarbonate just as  
well as in ~~as~~common air  
though it did not go on  
at all under water – [?seeing]

[Horizontal rule]  
Decomposition  
This ~~app~~~~s~~ <decomposition> scarcely went on at  
all when the wires were on  
the outside & the gage at [?13] /10  
though when common air was  
admitted it went on as well   
as could be

**RI MS HD/20/C, p. 057**

57  
the business went on in Nitrogene  
just as well as in common air -  
this nitrogene was mingled from <[?fosile]>  
choice with a small quantity  
of Nitrous gas ie about 1/12

[Horizontal rule]  
In Carbonic acid apparently pure  
the process went on just as  
well as in common air for some   
time –

[Horizontal rule]  
In Nitrous gas it likewise  
went on as well as in atmospheric  
air

[Horizontal rule]  
It will probably go on in  
oil of turpentine & spts of  
wine at [?1]

[Horizontal rule]  
To prevent the oxygene included  
between the Zinc & silver from  
influencing at all the results the  
next set of exp[superscript]ts[/superscript] were made with  
the common pile having at one  
of its edges a little cement to keep it  
together -  
This pile introduced into Nitrogene  
mingled with about 1/50 of its bulk

**RI MS HD/20/C, p. 058**

58

of Nitrous gas went in nearly in the   
same way as in Atmospheric air -  
at first gradually however, the cloud  
diminished & in about an hour  
the globules of air round the hydrogene  
wire were but barely perceptible –

[Horizontal rule]  
In Nitrous gas it went on rather   
more slowly that at first in atmospheric  
air gradually still more slowly  
in about half an hour the  
cloud was but barely perceptible -  
- few globules of air only came  
from the hydrogene wire at intervals  
& some small globules of gas collected  
round the silver wire at last in   
an hour & quarter it appeared  
to stop altogether –

In hydrocarbonate scarcly any  
effect could be perceived ie. the gas

was much smaller in quantity & globules formed  
[Horizontal rule]  
In hydrogene <likewise the effects were scarcely> ~~scarcely any effect~~   
~~was~~ <were> perceptible-

[Horizontal rule]

[Ink sketch of a phoenix]

**RI MS HD/20/C, p. 059**

59  
When the process had ceased  
in hydrogene & 1/50 part of  
common air was admitted it went on  
again. –

[Horizontal rule]  
during the communications between  
the ends in hydrogen globules of air  
appeared to be given out round  
~~the~~ point of the oxygene wire  
& the precipitate formed upon it  
previously became brownish. –

[Horizontal rule]  
[Pencil marking X] That Man must indeed be badly organised  
whom Nature is incapable of instructing  
The theorising habit in a sound mind can  
counteract for a short time only the love of  
seeing things in their real <light> & the illusions  
of the imagination in proportion as they  
often occur & are destroyed by facts will  
be come less vivid & less capable  
of permanently misleading the mind. -   
[/Pencil marking X] Perceptions will make themselves perceptible  
to the accurate observer. & unless the  
laws of human nature should undergo  
alterations the facts which form  
the basis of every science must be  
similarly discovered & similarly reasoned  
upon by [?~~you~~] men who are disinterested  
with regard to every thing but  
fact

**RI MS HD/20/C, p. 060**

60  
The feeling generally connected with new  
facts enables to reason more rapidly  
upon them & to perceive anagies  
where analogies to the sound mind  
do not [?~~xx~~] exist.

[Horizontal rule]  
In Azote mingled with a small  
proportion of Nitrous gas in the course  
of a night a considerable quantity  
of <whitish> green oxyde had formed round  
the silver wire some hydrogene  
had been produced & the hydrogene  
wire was covered all over with  
blackish clouds –

[Horizontal rule]  
Oct[superscript]r[/superscript] [?16]. A pile acted very powerfully  
when introduced into hydrogene from  
water at first it gradually however  
became weaker & in about half  
an hour the oxydation had almost  
ceased & globules were only now  
& then liberated from it through  
the water, When the gas  
was exposed to water even  
it did not go on again

[Horizontal rule]  
In Nitrous gas it continued to go  
[?xxx] it was introduced into it immediately  
from hydrogene -

**RI MS HD/20/C, p. 061**

61  
1 Atmospheric air  
3 Azotic gas - scarcely at all  
2 Nitrous gas but little  
4 Hydrocarbonate scarcely at all  
Hydrogene [?8°] –

[Horizontal rule]

A pile that has acted for half an  
hour in Nitrous gas without  
having apparently lost ~~much~~ <any> power  
was introduced t into Nitrogene in  
which it <previously> had ceased to act  
it immediately began to act again  
& continued to act through half an  
hour –

[Horizontal rule]  
the water in contact with the  
piles could not be the cause  
of the action, because after the  
action had ceased in Nitrogene  
& hydrogene it could not be  
carried on again by the [?~~xx~~] immersion  
in the water of the trough –

[Horizontal rule]  
It continued to go on but yet very  
slowly in Nitrogene

[Horizontal rule]  
After it had ceased in nitrogene  
it was immediately restored by agitation  
in water

**RI MS HD/20/C, p. 062**

62  
Water most probably the great  
agent - by dissolving atmospheric  
air -  
[Horizontal rule]  
In exp[superscript]ts[/superscript] of turpentine the galvanic  
influence continued apparently  
but little diminished for two  
hours –

[Horizontal rule]  
Oct[superscript]r[/superscript] 10 Endeavoured to ascertain  
by exhausting both oil of turpentine  
& [?~~x~~] water of their superabundant  
air & then they were exposed  
to the atmosphere

[Horizontal rule]  
Mem to wet a whole pile  
to tomorrow in [?xxxxxxx] so  
as to ascertain the rationale-

**RI MS HD/20/C, p. 063**

63  
A pile acts when all its surfaces  
are moistened  
[?ura]  
consequently the gases can only  
act through the medium of  
Moisture -   
Oct[superscript]r[/superscript] 11.[superscript]th[/superscript] found that the water  
under oil of turpentine that had been  
exhausted of air - in the airpump  
at 8/10 yesternight at 6 gave  
out to day at 1 O Clock  
air from the very bottom of the  
cylinder at [4?] /10ths –

[Horizontal rule]  
In hydrogene no effect could be more  
constant than that of the renewal of  
X the galvanism phaenomena by immersion  
of the pile into water holding atmospheric  
air in solution & the incapability of  
renewing it by plunging it into ~~certain~~   
water holding in solution Nitrous oxide

[Horizontal rule]  
In Nitrous oxide the renovation  
was constant; but not so ~~frequent~~   
rapid

**RI MS HD/20/C, p. 064**

64  
( the renovation was not produced  
when the pile was introduced   
into Nitrous oxide water

[Horizontal rule]  
Muriatic acid Nitrous acid &  
the new pile quere will not  
the effect be wonderfully increased  
by muriatic acid gas –

[Horizontal rule]  
~~pure~~ zinc incapable of decomposing  
pure water predisposing affinity  
necessary.-

[Horizontal rule]  
water dissolves ~~oil of turpent~~ <air when>  
beneath oil of turpentine

[Horizontal rule]  
ie it attracts it from oil  
of turpentine. –

**RI MS HD/20/C, p. 065**

65

Immediately after I had perused Colonel Haldanes  
paper of the galvanic phaenomena in which  
it is said that the decomposition of  
water by the galvanic pile ceases  
in vacuo I began a course of exp[superscript]ts[/superscript] on  
the influence of the atmosphere &c -  
- 1.  
- Of the galvanic phaenomena in vacuo-  
2  
Of the galvanic phaenomena  
in nonrespirable airs [?~~xxxxx~~]

& in oxygene 3  
[?~~x~~] ~~Galvanic~~ <[?~~xxxx~~]> 3  
Galvanic phaenomena in

[Horizontal rule]  
Galvanic go on slowly for an  
indefinite length of time in Nitrous  
gas. –

[Horizontal rule]  
There is no necessity for the  
plates to be in contact with  
the atmosphere provided the  
water is witness the exp[superscript]t[/superscript]  
in the new battery

**RI MS HD/20/C, p. 066**

66

[Blank page]

**RI MS HD/20/C, p. 067**

67  
Notice of experiments & observations on the  
causes of the galvanic phaenomena by  
H Davy. -  
That the phaenomenon of galvanism dependest upon  
certain chemical changes cheifly produced by  
the combination of atmospheric oxygene or oxygene  
from water with Zinc has long been a favourite  
opinion with many philosophers. It ~~was~~ <first> systematic  
cally advanced by Fabroni & it is ~~defended~~ <adopted>  
by Colonel Haldane in his last paper on  
galvanic electricity -  
Immediately after I had perused an [deletion]exp[superscript]ts[/superscript][/deletion]<observation> of  
this gentleman on the non excitement of  
galvanism in the common vacuum  
I began a series of exp[superscript]ts[/superscript] with a view  
of ascertaining with precision the influence  
of the atmosphere on these phaenomena  
In prosecuting these experiments I have  
met with many important facts  
which admit of a tolerably perfect  
arrangement & which appear to me  
to point out the causes of the  
[?~~x~~] galvanic appearances with as much  
precision as we can reasonably exp[superscript]t[/superscript]  
in so abstruse a subject.- of these  
facts <& of some conclusions> without farther introduction  
I shall give a short <& methodical> detail without  
giving a history of the progress of the

**RI MS HD/20/C, p. 068**

68  
investigation with regard to order of time  
or of the difficulties I have had to  
encounter –  
Some Zinc whether alone or in contact  
[?1[superscript]st[/superscript]] silver or other metals & [?~~x~~] ~~capabable~~  
~~oxydable when~~ ~~every~~ <every where> defended from the  
contact of the atmosphere either by water  
or a substance  
1 Zinc whether alone or in contact  
with other metals undergoes no oxydation  
when placed in contact with pure  
water ie water holding in solution  
no foreign substance.  
By pure water is more immediately meant  
water holding no ~~gas~~ <substance> containing loosely combined  
oxygene in solution.  
a A perfectly polished plate of Zinc was  
~~introduced into the [?xxx]~~ put <under a receiver> upon the  
plate of an airpump & a <large> drop of  
distilled water which had just been warm  
placed upon it - another plate of  
Zinc was placed upon a surface  
of silver & likewise moistened -  
The receiver was exhausted & kept  
below [?11[superscript]th[/superscript]] of an inch till the  
water too had ~~evaporated~~ disappeared -  
After the exp[superscript]t[/superscript] no oxydation had  
appeared on the zinc –

**RI MS HD/20/C, p. 069**

69  
A smell of Ammoniac pretty strong  
was perceived when the appt[superscript]s[/superscript] was  
taken out of the vessel containing  
common air & a diminution  
of about 1/[?in] had taken place  
this app[superscript]s[/superscript] held over muriatic  
acid gave very distinct white  
fumes

[Horizontal rule]  
1 Zinc whether alone or in contact with silver  
is incapable of oxydating itself when placed  
in contact with water holding no oxygene  
or no substances containing oxygene  
in solution.-

~~- Some Zinc plates fastened together were~~

~~introduced into a vessel containing hydrogen~~ <~~through~~ water that had been just boiled>  
a some polished Zinc plates moistened with  
water that had been long boiled were  
introduced thro ~~boiled~~ water that had  
been boiled into hydrogene- Examined  
after sixteen hours there ~~was no change~~ <brilliancy was>   
not altered & no perceptible quantity  
of oxide had formed upon them  
b. A galvanic pile of sixteen plates having  
the cloth moistened with pure water after  
remaining in hydrogene for 12 hours  
had undergone no perceptible oxidation.-  
c The phaenomena <plates of galvanic pile galvanic pile> were exactly the  
same in hydrocarbonate & Nitrogene. -

**RI MS HD/20/C, p. 070**

70  
d. The exp[superscript]t[/superscript] in vacuo –

[Horizontal rule]  
2. The oxydation of Zinc <whether it is in contact with other metal or no> takes place  
whenever it is exposed to water  
holding either atmospheric air oxygene  
or Nitrous gas Nitrous acid marine  
acid &c in solution  
a - ~~That Zinc oxydates in~~ The common  
phaenomena of the oxydation of ~~the~~   
~~calex of Zinc~~ polished Zinc when water  
is dropped upon it in the atmosphere  
is well known. - the oxydation  
of the ~~galv~~ Zinc of the galvanic  
pile in the atmosphere is likewise  
well known -  
b. A galvanic pile was exposed for  
<the> two hours to oxygene gas at the  
end of this time, the oxydation of  
the ends of the Zinc plates could  
be distinctly seen through the glass  
bell in which it was confined  
& on examining the plates they  
were almost covered on the outside  
of the moistened cloth with ~~the~~ oxide -  
c- I have proved that Zinc becomes

oxydated in Nitrous gas - the plates  
the galvanic pile became oxydated &c  
d In Nitrous acid muriatic acid  
&c

**RI MS HD/20/C, p. 071**

71

~~4<~~3> When zinc <in contact with water holding in> is oxydated ~~by~~ solution oxydated  
gases is decomposed, the oxydated substances  
are altered or they exert some peculiar  
affinities  
a ~~Atmospheric air is di~~ I exposed a plate  
of Zinc ~~to a small~~ over mercury in a  
water just sufficient to moisten it &c  
& a galvanic pile exposed for 12 hours ~~to~~  
in atmospheric air diminished it 1/12  
& a smell of ammoniac was perceived. -  
b in oxygene  
c In Nitrous gas : &c -  
Nitrous acid marine acid  
3d the <free> contact of the Atmosphere or of  
other bodies with [?~~x~~] that part of the zinc  
~~whether alone or in contact~~ not moistened  
when alone or with the silver & Zinc  
when in contact is not essential to  
or connected with the oxydation of the  
Zinc  
a Zinc <placed>in contact with pure water  
on a non conductor in the [?~~x~~] exhausted  
receiver [?~~underwe~~] &. connected with a silver  
communicating with the external air  
underwent no alternation ~~in four hours~~ <examined after the water>  
<had evaporated underwent no [?sensible].->  
in there exp[superscript]ts[/superscript] a large drop of water is necessary  
in emergence of evaporation-  
b. this galvanic pile was introduced into

**RI MS HD/20/C, p. 072**

72  
under the receiver <having its poles communicating> [?~~x~~] with a view to  
ascertain a peculiarity of its action   
after three hours it was examined without  
however taking it to pieces; but no  
~~more~~ the edges of the piles had  
~~not~~ been dull before the exp[superscript]t[/superscript] &  
they were not apparently more  
oxydated in consequence of it. -  
c Twenty pieces of polished Zinc were  
cemented seperately to 20 pieces  
of silver & ~~the wet cloths being~~   
~~introduced the whole pile inclosed in~~   
~~cement so as to be airtight~~ &   
orifices being left between each pair  
of plates the sufficient to introduce  
water the whole covered with cement  
The [?~~x~~] surface of the Zinc plates  
that had been in contact with  
the water examined the next day  
were considerably oxydated. -  
[Horizontal rule]

II  
[?1] The galvanic pile of Volta does not  
act ~~when its plates are moistened~~   
~~with~~ unless the water between the -  
plates hold some oxydated substance  
in solution  
& the galvanic pile of Volta does  
not act in vacuo  
[?~~x~~] The galvanic pile Does not act

**RI MS HD/20/C, p. 073**

73  
in hydrogene except for the time  
it holds ~~water~~ air  
Or in Nitrogene -  
or in Nitrous oxide  
or in carbonic acid -  
2 Its action is capable of being reproduced

for an unlimited number of times  
by immesion in ~~pure~~ water holding  
air in solution or ~~Nitrous~~ marine  
acid & greater in the acids  
3 Its action <is constant> in At[superscript]c[/superscript] air in oxygene  
probably it would be constant in  
oxygenated marine gas. -  
4[superscript]th[/superscript]. The galvanic pile acts when  
completetly moistened.-  
5 The poles of the galvanic apps act  
equally powerfully whether in contact  
with the atmospheric or deprived of  
its influence. -  
6. The action of the galvanic pile   
is constant in any non conducting  
substances capable of holding at  
mospheric air in solution –

[Horizontal rule]  
When dry silver & Zinc are put together   
& the Zinc made to touch  
the tongue by means of gold no  
oxydation ought to the perceptible

**RI MS HD/20/C, p. 074**

74  
Conclusion  
The precedence to & uniform connection ~~with~~  
[Large cross in pencil] of one series of phaenomena with any  
other series & their coexistent  
modifications are the foundation  
upon which we establish the reasons  
of their ~~coexistence~~ <being cause & effect> the galvanic  
phaenomena cannot be produced  
independently of the fixation of oxygene

[Ink sketch of apparatus]

**RI MS HD/20/C, p. 075**

75  
concentrated Nitric acid produced most  
wonderful effects. - X  
five pairs shocked as powerfully as

[Horizontal rule]  
20 pairs in the usual mode  
though they were moistened on  
the sides -  
mem[superscript]m[/superscript] to try iron filings -  
To try nitrous acid gas & oxygenated  
marine gas with an apparatus of 20  
plates made on purpose  
over mercury. -  
1. Of the oxydation of Zinc  
2 Of the excitement of the galvanic  
influence in the pile of Volta  
3 Of new modes of exciting the  
galvanic influence. --  
[unclear]xxx[/unclear] charcoal & silver [?~~xx~~] with Nitrous  
acid –   
That metallic bodies at low temperatures  
are incapable of decomposing pure water  
Has long been known but as  
Mem[superscript]m[/superscript] to try Nitre quere is it a  
conductor when fluid -  
To try if galvanism may not be excited  
by metals such as gold & silver when  
Nitrous acid is made the medium  
of communication -

**RI MS HD/20/C, p. 076**

76  
The galvanic pile of Volta does not  
act unless the Zinc be perpetully oxydating  
& its ~~oxydati~~ powers are proportional  
to the rapidity & of the oxidation -  
1. Zinc whether in contact with silver  
or deprived of its influence does not oxydate  
intself unless the water it contains  
holds some loosely combined air in  
solution

**RI MS HD/20/C, p. 077**

77  
1 The galvanic pile of Volta does not  
act ~~unless~~ when the communication  
between the plates is made by pure  
water –

[Horizontal rule]  
1 The galvanic pile does not act   
in vacuo. -  
2 I have found that the galvanic pile  
~~does n~~ acts in hydrogene, nitrogene  
~~&c~~ Nitrous oxide &c only [?~~xxx~~]  
till the atmospheric air held in solution  
by the water between its plates is decomposed  
It ceases to act in those gases in  
about a quarter of an hour; but  
it can be made to act again  
by immersing it in water holding  
atmospheric air in solution -  
[?1[superscript]st[/superscript].] of the galvanic pile. –

**RI MS HD/20/C, p. 078**

78  
On these ~~facts~~ <preceding facts> I shall not pretend to  
speculate, A number of new exp[superscript]ts[/superscript] must  
be made before we shall be able to   
~~ascertain arrange our observations~~ <~~generalize; or~~ discover these lawes.  
~~from~~ <in consequence of> which one quantity of chemical  
action <in the galvanic series> ~~is capable of exerting~~ <~~exerts~~ generates> an influence  
capable of increasing all analogous actions  
& of producing new similar actions:-  
[Marginal note in pencil] A number of new exp[superscript]ts[/superscript] must be made probably  
even before we shall be able to ascertain  
whether water is decomposed in ~~the~~ galvanic  
processes. Supposing its decomposition  
we must assume that at least one of  
its elements is [?~~x~~] capable of passing  
in an unknown & invisible form  
through metallic substances or through  
water & many ‘organic bodies - &  
such an assumption is incommensurable  
with ~~none no~~ <all> Known facts. -  
[Marginal note in pencil] ~~The~~ philosophers ~~of~~ <in> the eighteenth century  
~~have~~ beheld with wonder solid & fluid  
substances assuming new ~~forms~~ <modes> of existence  
in different gases. ~~Those of the ninteenth~~

[Marginal note in pencil] ~~century are probably destined to behold~~

~~gases assuming the forms of new unknown~~

~~ethereal fluids~~- Do not the new facts  
encourage ~~the hope~~ us to hope that  
in the ninteenth century they will  
behold <even> those gases undergoing novel  
changes & existing in new forms as ethereal

[Marginal note in pencil] fluids

**RI MS HD/20/C, p. 079**

79  
The <3> nature of this communication / is <2> incompatible  
with / a <1> detail of the opinions prevailing amongst  
philosophers respecting the causes of the galvanic  
phaenomena: they have been generally supposed  
to depend on the different powers of bodies  
to conduct electric fluid; Fabbroni is the  
first who systematically attempted to prove  
that they were chemical effects.  
Immediately after I had perused an <interesting> observation of  
Lieut Colonel Haldane on the non excitement  
of galvanism in a boylean vacuum I began  
an investigation with the view of ascertaining  
precisely the influence of the atmosphere on  
the phaenomena; In carrying on this investigation  
I have met with some new facts, which  
are capable of arrangement & which  
~~appear to~~ will probably lead to a compleat  
explanation of the galvanic effects  
Of these facts ~~&~~ & of some conclusions that may  
be drawn from them I shall give a brief  
account; [?~~But~~] I must <however> previously state  
that the piles I employed for ascertaining  
the influence of factitious airs on the  
~~galvanic phaenomena~~ galvanic influence  
were [?~~xxx~~] erected <horizontaly> in the usual mode <but> to  
prevent the plates from separating when  
in an oblique posture their edges were  
cemented together in two or three points

**RI MS HD/20/C, p. 080**

80  
sufficient interstice being preserved to admit  
of a free circulation of air. - the gases  
when any were produced were received  
in small tubes containing wires covered  
externally with wax & communicating  
with the ends of the pile. The piles were  
introduced into the air through water  
& elevated above the water by ~~a~~ metallic  
plate cemented to their ~~under~~ lower   
extremities. –

1 Zinc whether connected with silver in  
single galvanic circles or in the galvanic  
pile does not oxydate <at the common temperature as long as> [?~~in~~] the water  
in contact with it be pure-  
now supposing the galvanic influence a cause

& not an effect  
By pure water is more immediately meant  
water holding in solution no free oxygene  
no atmospheric air & no acids. It has been  
for some time known that many of the metals are incapable

of oxydating themselves if the water in contact  
[?xx] I exposed silver & Zinc in contact with

temp[superscript]e[/superscript] being between 55 & 58

each other & both in contact with  
distilled water in the receiver of  
an air pump they remained the  
gage being between 7/10ths & 13/10ths  
some hours till the water was evaporated  
[?~~no~~] when no oxide had formed on  
x the Zinc though a similar plate  
exposed with silver and much less water  
to the atmosphere was covered where  
the water had touched it by white oxide

**RI MS HD/20/C, p. 081**

81  
A galvanic pile <the cloths of which were wetted with simple water> introduced into hydrogene  
through water that had been just boiled  
underwent in eleven hours no perceptible  
oxidation though in the same time <~~from~~ the> a  
<edges of the plates of a> similar pile in the atmosphere ~~exibited~~   
~~soda soda was produ~~ were [?~~xxx~~] covered  
with white matter ~~& chryst~~  
I found that the Zinc plates of a pile  
that had been kept in nitrogene for  
fourteen hours <over common water only a little> ~~scarcely at all~~ tarnished  
& no where covered with white oxide  
[?&] ~~I have found that the galvanic~~   
~~pile undergoes~~ The plates of a galvanic  
pile that had been Kept for many  
hours in the exhausted receiver  
had undergone no oxydation. -  
A pile erected in the usual mode &  
~~excluded~~ having its ~~water~~ <wetted cloths> excluded from the  
contact of air by means of cement  
introduced between each row of plates  
examined at the end of five days  
exhibited very little oxide of Zinc  
& what was formed was ~~in~~

~~the~~ about the centres of the plates  
& [?~~x~~] owing most probably to the  
small quantity of common air  
excluded by the cement.-

**RI MS HD/20/C, p. 082**

82  
By pure water is more immediately meant  
~~water holding~~ water holding in solution no  
free oxygene no atmospheric air & no  
acids It has long been known that  
[?~~7~~] metallic bodies do not oxydate in  
~~water free from airs~~ <in such water x x ~~this oxydates &c more~~ & included from the atmosphere> this I have observed  
is particularly the case with regard to  
Zinc, It has likewise long been noticed  
that [?~~Til~~] <in the atmosphere> Zinc when in contact with  
silver <forming with it a circuit by means of> ~~de oxydates itself much more~~  
water oxydates itself more rapidly  
than when simply in contact with  
water; supposing the more rapid oxydation  
to be the effect of a peculiar ~~influence~~ <primary action>  
~~action~~ between the Zinc & silver it was  
reasonable to conclude that Zinc in  
single circles with silver & pure water  
or at least in the galvanic pile erected  
<with cloths moistened ~~with~~ in pure water would be> would be enabled to oxydate itself.  
[?~~xxxxxxx~~] That it does not oxydate itself will  
appear from the following observations. -  
[Ink sketch of a small face in profile] ~~A pile~~ a A <small> galvanic pile was erected with  
distilled water <that had been just boiled> & introduced into hydrogene having  
<the ends connected> After remaining in it for fourteen hours  
it was examined the plates of Zinc  
were scarcely at all tarnished & no  
white oxide had formed upon them  
\* Fabbroni.. [Sign in ink] Ash, Humbolt Ritter. -   
see Ritter

**RI MS HD/20/C, p. 083**

83  
though <the zinc of> A a similar pile exposed in the atmosphere  
was covered with white spots wherever it  
had been in contact with water.-  
b. A ~~zinc~~ pile the ~~plates~~ <cloths> of which  
been moistended with common water were  
examined after being nine hours in  
nitrogene, the plates were a little  
tarnished but no white oxide had formed  
upon them - The slight tarnish ~~might~~ <may>  
be easily reformed to the ~~common~~ Atmospheric  
air dissolved by the common water. -  
c - ~~The effects were sim~~ The plates of a pile

exposed in hydrocarbonate for three hours  
were not perceptibly tarnished  
d. <The> a pile <with ~~common water~~ water & salt-> exposed in the vacuum of  
an air pumps <the gage being at 9/10> having its ends connected

together by wires passing thro them into  
<for pile> the atmosphere: were but very slightly  
tarnished, the same pile <underwent no additional> oxydation in hydrogene  
e A plate of sliver & a plate zinc were exposed in  
vacuo each connected with the atmospheric  
<The gasses were employed by wires but free from>  
~~That no influence & effects but chemical~~   
effects can be produced by atmospheric  
air [?~~xxxx~~] or oxydated substances in water  
will be clearly seen hereafter. -  
It is impossible to be certain that minute  
quantities of air were no present & in all  
of <them> the zinc was slightly tarnished; but the  
general prop[superscript]n[/superscript] will be proved by many other facts

**RI MS HD/20/C, p. 084**

84  
2. The oxydation of Zinc <at common temperatures> takes place whether  
it is in the galvanic pile or not  
whenever the water in contact with   
it holds atmospheric air or oxygene   
[?or] & in rotation. -  
The fact of the oxydation of Zinc  
in the atmosphereis well known  
I found that a [?~~xxxxx~~] galvanic pile   
exposed in oxygene became oxydated  
much more rapidly than in  
~~Nitrous g~~ atmospheric air - I found  
that Zinc filings exposed to nitrous  
gas over mercury became  
oxydated & The oxydation of Zinc  
in ~~mari~~ solutions of marine  
acid <nitrous acid & sulphuric acid> in water is well known.-

[Horizontal rule]  
3dly When Zinc in contact with water   
holding in solution oxydated substances   
is oxydated these substances are   
decomposed or they ~~exert~~ some ~~affinities~~ <influence>

[Ink sketch two faces in profile]

[Ink sketch a face in profile]  
which may be called chemical & no primary electrical.   
a A galvanic pile exposed to <about 36 cubic inches of oxygene> oxygene  
for two days diminished it nearly  
~~wi be~~ effected a dimiminution of   
it which might have equalled 1/12 but  
which was not exactly ascertained   
a similar pile ~~exposed to atmospheric~~   
~~air~~ that had been for some time  
in action, exposed to Atmospheric air  
The

**RI MS HD/20/C, p. 085**

85  
pretty considerably diminished it <~~air~~> to 1/13, & when  
the including cylinder was removed gave a   
~~strong~~ <faint> smell of ammoniac, the pile itself  
[?~~xxx~~] exposed to marine acid without being  
passed through water gave dense white fumes  
In another exp[superscript]t[/superscript] [?~~some~~] the constitution of air  
diminished by a galvanic pile was ascertained  
It was found to contain much less  
oxygene than common air, the hydrogene  
if any existed was too small in quantity  
to be ascertained by the inflaming test.-  
~~A pile~~ <after> ~~in Nitrous gas~~ I have noticed  
before that <wetted> Zinc placed in contact  
with ~~water~~ nitrous gas upon mercury slowly  
converts it into Nitrous oxide & ammoniac  
a ~~Z~~ small pile exposed for four days.  
to Nitrous gas diminished it 1/4  
hence ~~first~~ there can be little doubt  
but that the same chemical changes  
took place-  
The formation of <Nitrous gas> ammoniac Nitrous oxide  
& ammoniac when solutions of Nitrous  
acid are made to act upon Zinc clearly  
prove the decomposition of the acid  
We have no proofs for the decomposition  
of sulphuric & marine acid in the oxydation  
of Zinc in solutions of these bodies in water  
this phaenomenon must be ref~~f~~ered to   
the peculiar affinities called predisposing.-

**RI MS HD/20/C, p. 086**

86  
4. The galvanic pile of Signor Volta does not  
act when the water between the pairs  
of plates is pure. NB the gases were not examined  
The word pure is here used in the same  
sense as in 1 I have found that the  
galvanic pile introduced into ~~Nitrogene~~ Hydrogene  
[insertion]through common water[/insertion] ceases to **[deletion]act[/deletion] [insertion]evolve gas in the tube[/insertion]** in about five or six  
minutes, ie in the time required to  
consume the common air confined in  
the water between its plates-  
The phaenomenon is exactly the same  
in Nitrogene, hydrocarbonate, Nitrous  
oxides & I beleive carbonic acid  
though my exp[superscript]t[/superscript] on this last was  
less often repeated than those ~~of~~ on  
the other gases - A pile ceases to  
act in [?N.H.] &c nearly in  
the same time & the action cannot  
be restored by admitting fresh gases  
of the same kind, it is however as  
will be seen in the next immediately  
restored by immersing the pile for  
a moment in water saturated  
with atmospheric air. - I have found  
<by numerous> ~~The galvanic pile ceases to act in~~ <the> ~~vacuue~~   
exp[superscript]ts[/superscript] ~~made in conjuction~~ with the assistance  
of my friend, M[superscript]r[/superscript] King, that the galvanic  
pile even when its poles are connected  
by wires with the atmosphere ceases to

**RI MS HD/20/C, p. 087**

87  
act in vacuo at about 6/10 of an inch  
At nine tenths the shocks from wires  
~~introdu~~ <of a pile of more than thirty> connected with the atmosphere  
~~were~~ feeble & sensibly diminished.-  
The cement to come in here.-  
The galvanic pile acts when the water between  
its ~~pl~~ double plates holds either Nitrous gas  
~~or~~ Atmospheric air, ~~or~~ oxygene, muriatic  
acid or sulphuric acid or nitrous acid  
in solution ~~&~~   
The facts I have proved by ~~many~~ <numerous> exp[superscript]ts[/superscript]  
a pile acted in Nitrous gas for <three>

seven hours, during this time the silver wire  
in the tube was giving out ~~small~~ <minute>  
single globules of air & a small quantity of oxide  
formed on the silver wire a pile  
introduced into Nitrous gas through water  
immediately after it had been exposed  
to hydrogene ~~acted~~ <~~evolv~~ evolved gases from water> for a considerable  
length of time - the Zinc plates slowly  
oxydating & the gas diminishing -  
The atmospheric air ~~the~~ included in a  
cylinder the action was constant  
through two days & infinitely  
more [?~~raised~~] <gas was evolved & more oxide formed-> than in nitrous gas  
In ~~oxygene~~ & the air was deprived of much  
of its oxygene & apparently ammoniac  
formed.-

**RI MS HD/20/C, p. 088**

88  
That the influence of the elastic air  
~~could~~ has no independant power is evident  
from the uniform & constant restoration  
of the powers <after they had ceased in hydrogene> of a pile by  
immersion in ~~Atmosp~~ water [?~~x~~] saturated  
with atmospheric air - In these exp[superscript]ts[/superscript]  
the piles were plunged for a moment  
in the water confining the gas without  
NO being brought <even> partially ~~or wholly~~  
in contact with the atmosphere  
& instantly elevated in the gas again  
& it could be <only to> ~~the water~~ impregnation  
of the water with atmospheric air  
that the phaenomenon was owing  
because when the pile was plunged  
into water saturated with Nitrous  
oxide a gas which as I have  
proved expels much of the oxygene  
from water the power was not  
restored. - The oil of turpentine  
b A galvanic pile inclosed in a  
cylinder containing <about> 35 inches of oxygene  
acted much more powerfully than  
a similar pile in atmospheric  
air. - & the gas was diminished  
a After a pile had ceased to act in  
hydrogene it was immerged <for a moment> in water  
impregnated with marine acid ~~it acted~~   
~~for many~~ after this it acted for  
no shock when the ends of a pile were touched

**RI MS HD/20/C, p. 089**

89  
many minutes full as powerfully as  
it would have done in the atmosphere  
- A similar pile in hydrogene was immerged  
for two or three seconds in a  
very dilute solution of Nitric acid  
It acted more powerfully than if it  
had been in an atmosphere of  
oxygene.  
6: The <power of> action of the pile of Volta is  
proportional to the ~~quantity of oxygene~~   
~~composition~~ power of the conducting  
fluid substance between the double plates  
to oxydate the Zinc. -  
This seems sufficiently proved in the ~~following~~ <[?foregoing]>  
sections, the Zinc oxydates more rapidly

in Nitrous gas than in common air  
& the power of the pile in ~~nitrous gas~~   
~~oxygene~~ is ~~greater~~ <less> than in common  
air It oxydates more rapidly in  
oxygene than in common air &  
its power of decomposing water is  
infinitely greater & the shock  
stronger ~~when~~ after it has been   
dipped in muriatic acid or diluted  
nitrous acid than [?~~x~~] when it has  
been simply exposed to the atmosphere  
& both those bodies enable the  
Zinc more rapidly to oxydate  
itself. - It will be hereafter  
proved that Nitrous acid which [?x]

**RI MS HD/20/C, p. 090**

90  
- Conclusions - -  
[Marginal note in pencil] Of two phaenomena or of two series  
of phaenomena we can only affirm  
cause & effect because the one uniformly  
precedes the other & because when  
the one is modified the other  
is likewise modified; but it appears  
from all the foregoing facts that  
~~the the powers of~~ the galvanic  
pile of Volta acts only when  
the conducting substance between its  
plates is capable of oxydating  
the Zinc & that in proportion  
as a greater ~~proportion~~ <quantity> of oxygene  
is combined with the zinc in  
a given time so in proportion  
~~are~~ is the galvanic power of  
the machine to produce water   
[Marginal note in pencil] & to give the shock greater- -  
We may therefore affirm that the  
fixation of oxygene in the Zinc  
in the pile of Volta is the   
cause of the galvanic or electric  
effects it produces - I have  
not ~~been~~ [?~~xxx~~] <~~yet [?have]~~>observed so many  
phaenomena without forming a  
theory of explanation of the part  
the silver acts in the process   
mem[superscript]m[/superscript] poles

**RI MS HD/20/C, p. 091**

91  
& of the manner in which negative  
& positive electricity are excited  
~~by the chemical effects~~ in the circle  
Whether ~~it is chemical~~ the silver acts  
by chemical attractions or whether it  
possesses a peculiar power of producing  
a new equilibrium of electricity future

exp[superscript]ts[/superscript] must. It cannot be supposed  
that the oxydated bodies essential  
to the galvanic effects communicate  
any specific electric influence except  
in consequence of their chemical affinities  
& changes it is evident from 1  
that they all undergo fixation.  
it is likewise evident that their  
effects are the same in all  
mediums ~~in~~ I have found by exp[superscript]ts[/superscript]  
that a pile does not act when  
its poles or even its plates are  
exposed to the Atmosphere unless its  
water be likewise exposed to it. -  
Whether different chemical fixations of  
oxygene will produce different influences  
can only be ascertained by future exp[superscript]ts[/superscript]  
<it is possible though not probable-> ie possible different products may be  
evolved from water when the ~~conducting~~   
the oxydating fluid is water saturated, with  
at[superscript]c[/superscript] air, Nitrous gas &c I could not  
perceive any shock. When the ends of a  
gaseous bodies

**RI MS HD/20/C, p. 092**

92  
pile were touched in hydrogene--  
[I?] of a new mode of constructing a  
pile. -  
It ~~was~~ <is> easy to conceive from these  
~~principles in the~~ conclusions that a  
pile more powerful than any erected  
might be produced supposing that  
the Zinc could be more rapidly oxydated  
it was however possible that the evolution  
of hydrogene might essentially connected  
with the success of the process to  
ascertain this ~~twenty plates of silver~~ <small plates>  
~~&~~ Zinc & silver rather more than an  
inch & 2/10s square were cemented together <with a mixture of wax & resin>   
~~& carefully fastened~~ <eighteen of these> to each other by   
cement so as to leave water tight  
~~orifices~~ <partitions open at one side> between each pair of plates. –

<when water was poured onto this machine>  
~~when eighteen of these had been~~  
~~the shock was [?xxxx]~~ produced efforts barely perceptible  
~~fastened together~~ muriatic acid  
poured into this machine enabled it  
to decompose water, with much more  
rapidity than a common machine  
& 30 plates & to give a greater  
shock, diluted Nitrous acid  
produced similar effects.  
When concentrated Nitrous acid was  
introduced into it ~~acted with so~~

~~much power as to render it highly~~

~~[?painful] for me to make~~

**RI MS HD/20/C, p. 093**

93  
oxydability of metals, observations  
on Muriate of Ammoniac  
The first shock was so powerful as   
to numb my fingers & I did not  
dare to take another I was almost  
immediately obliged to introduce the  
pile into water to prevent it  
from being destroyed so that there  
was no time for ascertaining its  
powers to decompose water. -  
~~[Pencil marginal note]The comparative <great> strength of a pile~~  
~~in which the intermediate pile fluid~~   
~~nitrous acid was <is> between the~~   
~~plates wmay be [?C]~~ In a second  
exp[superscript]t[/superscript] I used only five plates  
in this case the shock was  
full as strong as from the  
common pile of 30 -  
Three pairs gave a very sensible   
shock. -  
I have ordered an account of the loss  
of silver when this substance is  
part of the pile with nitrous acid large  
copper & iron plates reasoning from  
the former phaenomena I exp[superscript]t[/superscript] to  
[/Pencil marginal note]be able to produce effects equal  
to those of the strongest Leyden  
battery .. - I design speedily to  
try if ~~Nitre~~ when rendered fluid by

**RI MS HD/20/C, p. 094**

94  
will not become a good conducting medium  
- General observations-  
It is easy in the foregoing principles  
to explain why muriate\* of soda &  
~~muriate of~~ ammonia & sulphate  
of iron increase the galvanic  
effects. It is likewise easy to explain  
the ~~great~~ different exciting powers  
of metals which will be found nearly  
in the ratio of their affinity  
for oxygene. -  
I cannot close this notice without  
observing that ~~not only a new~~ <the preceding facts> not  
~~field is opened~~ only opens a

new field for investigating the  
connection between heat and light &  
electricity in their ultimate nature  
but likewise presents us with  
new analogies between the  
chemical changes & the organic  
functions. - but here speculation will  
be vain I may however venture  
to predict that the <properties & powers> etherial

fluids will not long remain  
unknown to us. –   
i.e. from their predisposing affinity enabling  
the Zinc to combine with oxygene -

**RI MS HD/20/C, p. 095**

95

On oct[superscript]r[/superscript] 18- exposed two plants of dogs  
mercury & one of groundsel -  
~~21~~ 19 Exposed to the garden  
five 1 day sunshining - 2 [?partly] [?no] rain  
in the morning. 3 [?partly] no fourth  
cloudy ( grass two /plants/ on Novr 3[superscript]d[/superscript]

[Horizontal rule]  
the grass in one cylinder had a little   
[?PS.] When I showed D[superscript]r[/superscript] Beddoes the phaenomenon  
of the renovation of the galvanic pile after it  
had ceased to act in Hydrogene, Nitrogene  
Hydrocarbonate &c by momentary immersion  
in water containing atmospheric air. He  
requested me to try the powers of oxygenated  
marine acid gas sol[superscript]n[/superscript] Nitre &c in  
increasing the effects - The fear of destroying  
the silver in the pile prevented me at the  
time from trying the exp[superscript]t[/superscript] I have since  
however in endeavouring to investigate  
~~the method in which the ele~~ ascertain  
whether the electrical phaenomena of  
galvanism could be produced when the  
plates of the pile were oxydated ~~but~~   
~~not con~~ in contact ~~only~~ with an  
aeriform fluid only & separated from  
each other by a non conductor been able  
to observe the extraordinary powers  
of oxygen[superscript]d[/superscript] M G in increasing the  
galvanic effects of the pile [?~~xxxx~~] [?at] pile

[Horizontal rule]  
diminished it & was healthy & perfectly green

**RI MS HD/20/C, p. 096**

96  
of the pairs of plates of silver & Zinc connected <in contact>  
<by cement> ~~of the same size as those used~~ in  
[Marginal note in pencil] ~~were connected by cement in such a way~~   
~~manner so that every~~ were connected by  
cement so as to prevent the alternate  
contact of the metals as <is done by water> in the common  
pile <but space was left between the cement> & ~~with the ends of this pile~~ a  
to admit of a free circulation of air  
tube with silver wires [?~~were~~] adapted to  
the extreme plates. -- This pile was  
introduced into a vessel <having copper> filled  
with oxygenated marine acid gas  
without being moistened; but no oxydation  
of the wires & no disengagement of  
gas took place, though the oxygenated  
marine gas was supposed to remain  
in contact with it for near two  
hours. -  
The same pile was now moistened by  
immersion in water. <[?therefore]> After it had been  
[?wiped] it did not show any signs  
of action in the atmosphere; but on  
being introduced into oxygenated marine  
acid gas the silver were connected with  
[Marginal note in pencil]the Zinc began to oxydate with  
the greatest rapidity whilst gas was  
given out plentifully from the silver  
wire.-  
This exp[superscript]t[/superscript] not only ~~confirms the~~ arranges  
with the facts I have before stated; but likewise

**RI MS HD/20/C, p. 097**

97  
seems to prove that the <cheif use of> large surface  
water <~~in the~~ increases> required is for the oxydation of the  
Zinc it appearing from the exp[superscript]t[/superscript] that  
the ~~slightest~~ smallest quantity of moisture  
between the plates is sufficient to  
enable the electrical currents to ~~pass~~  
form the circuit.- for the contact of  
water could not have been in more  
than on two points. -  
I am at present engaged in endeavoring  
to ascertain whether any differences exist  
in the gases evolved from water when  
the oxydating substances between the  
plates are of different composition.-  
At a future time I shall probably  
offer some observations on the peculiar  
affinities which enable iron, Zinc &c  
only to decompose water when it  
contains atmospheric air ~~or~~ acids &c.-  
Nothing is more easy than to explain  
the use of sulphate of iron, muriate  
of soda muriate of Lime &c in  
increasing the ~~oxydability of the pile~~  
powers of the pile. -  
The pile that Chemists will find it  
convenient to use for rapid processes  
will probably be ~~either that I have~~

M[superscript]r[/superscript] Cruikshanks or that I have described  
X ~~pages in my last com~~ page. –

**RI MS HD/20/C, p. 098**

98  
muriatic acid very diluted will enable  
us to use such a pile till all  
the oxydable metal is destroyed  
without the common trouble of  
~~building & rebuilding it~~ <every now and then destroying it>cleaning

it plates & rebuilding it.-  
~~I could with pleasur~~ It is to be

observed that the quantity of power  
will be in proportion to the  
quantity of oxydation. [?~~xxx~~]  
I could with pleasure expatiate   
[?~~but~~] on the assistance physiology  
is likely to receive from the  
new elucidations of galvanism  
; but I hope on this subject  
soon to be acquainted with some  
facts. -

**RI MS HD/20/C, p. 099**

99  
Zinc & probably iron are incapable of oxydating when  
the water in contact with them is pure  
When the water in contact with them is pure no  
galvanic effects are produced. -  
Quere can any but a fluid substance an  
imperfect conductor of electricity form the medium  
of communication between the piles- Qu: muscular  
fibre; nitre, manganese. - nitrate of copper. -  
Quere will not nitrate of copper with  
tin foil & silver make a good.  
pile. - Quere is a second  
rate conductor necessary between the  
piles & must this contain water.-  
Quere what will strong sulphuric acid  
do.-  
Quere  
None of the metallic bodies produce  
galvanic effects but those which are  
capable of combining with oxygene &  
water at common temperatures. -  
[X] Quere when Zinc & iron & iron & Tin  
are combined will both the metals  
oxydate or only one.-  
[X] The solution of this problem  
will lead perhaps to the rationale  
X of the process-  
Quere silver & charcoal silver &  
gold

**RI MS HD/20/C, p. 100**

Quere will a pile cease to act when  
diluted nitrous acid is the medium  
of communication in the exhausted

receiver, the cups must be used  
for ascertaining the different

powers of the acids, alkalis &c-

[Horizontal rule]  
Hints for experiments that occurred Oct[superscript]r[/superscript] 29. 1800  
1 As the question concerning the necessity of elastic  
oxygene is not yet determined it will be  
worth while to expose a pile with contrated  
sulphuric acid in the exhausted receiver  
& to ascertain whether it will not act.-  
Then to try nitrous acid - & marine

acid-  
2 To try nitre in small crucibles. -  
3 To try the leg of a frog deprived  
of free oxygene.-  
4 - To examine whether hydrogene is  
given out. -  
5 - To attempt to take the galvanic  
spark in the common vacuum. -  
[Horizontal rule]

On heat  
To try ice in the Torricellian vacuum  
& a thermometer & a piece of  
gold or platina - to ascertain whether  
light would not be longer in giving

**RI MS HD/20/C, p. 101**

101

[?The.]  
out. -

[Horizontal rule]  
Sulphuric acid very strong enabled a  
pile of 11 pairs of Zinc & iron to act -

On Oct.[superscript]r[/superscript]31[superscript]st[/superscript].-  
I endeavoured to ascertain the influence  
of the atmosphere on a pile made  
to act by means of sulphuric acid  
& nitrous acid -  
I found that a pile would not  
act at all when sulphuric acid  
was poured into the partitions  
nor, I beleive when oxyd sulphuric  
acid was poured in -  
A pile acted with Nitrous acid in  
vacuo; but I found it difficult  
to bring the gage below - 11/10 v -   
It ought to be remembered that  
in vacuo, the galvanic phaenomenon  
procured when the pile is on the  
outside with as much vigor as ever  
ie the silver is oxyated  
To notice that the communication between  
the metals may by made by gold, but  
not so the other communication

**RI MS HD/20/C, p. 102**

102  
Mem the exp[superscript]t[/superscript] on the iron to  
determine if nitrous acid be formed. -  
Mem the exp[superscript]t[/superscript] on the double   
pile put two ways annihilating all  
effect. -  
Nov:[superscript]r[/superscript] 1[superscript]st[/superscript]. The airpump being in good order  
I introduced into it a galvanic pile of  
10 plates cemented <with nitrous acid> with common water  
air was given out very rapidly from  
the wires & on account of this rapid  
liberation the exp[superscript]t[/superscript] could not be  
accurately observed but when it had  
evidently ceased to give out air  
in vacuo it gave: no oxydation  
when exposed to the atmosphere  
2d:-  
A pile of 10 plates with nitrous acid  
was introduced up on the plate of an  
air pump - well boiled water  
was connected with ~~it~~ the silver wire  
the brass or hydrogene wire was  
fastened to a copper wire passing  
through the neck of the airpump  
when the exhaustion was to an inch  
the hydrogene ~~water~~ <wire> was introduced  
the process went on as ~~before~~ rapidly  
as in the atmosphere the gage was  
then brought to 6/10 6/10 it still went

**RI MS HD/20/C, p. 103**

103

on after some minutes it became   
feebler. the atmosphere was then  
admitted; but no effect followed  
the air liberated from the hydrogen  
was ~~scarcely~~ perceptible & the  
oxydation was not more than  
before. NB- the numerous exp[superscript]t[/superscript] I   
made before attention must be  
paid to the magnitude of the  
globules of hydrogen ie to their  
increased bulk as this may otherwise  
occasion errors.- It obliges  
us the use small quantities  
of fluid. -  
3  
Into a ~~pile~~ <[?range]> of 10 pieces that had  
just been wetted a drop of sulphuric  
acid was introduced into each cavity  
this was introduced into the vacuum  
& it continued to decompose water  
when at 6/10 6/10 but with rather remarkable   
phaenomena ie as fast as before  
but the silver not only oxydated  
but gave out globules of gas  
& no gas came from the hydrogene  
wire, it was however compleatly  
moistened by the effervescence. -  
it went on for more than ten  
minutes & when the atmosphere

**RI MS HD/20/C, p. 104**

104  
was admitted the silver oxydated more  
rapidly than before & no gas was given   
out from either wire; - on wiping  
the wire the same results as ~~before~~   
usual though in a less degree <~~with~~ as to the gas NB little was given out> were  
obtained in the atmosphere; the  
exp[superscript]t[/superscript] repeated in vacuo answered as well  
as before - it went in well at 7/10  
for half an hour - Two or three days ago  
I observed that a pile of copper & zinc  
which would not act with the cells  
filled with sulphuric acid acted  
the moment [?~~xx~~] water <in drops> was introduced  
into it. -  
~~This process went on for near half  
an hour~~

All the galvanic facts uniting to  
prove that the oxydation of the  
Zinc was the immediate cause   
of the electrical effects &c I began  
on Nov[superscript]r[/superscript] 1- To build glasses   
after the manner of Volta in order  
that I might observe the   
facts with more accuracy-  
Zinc & silver were fastened together by  
brass wire & plunged into glasses  
in the mode mentioned, sixteen  
of these gave a pretty brisk shock

**RI MS HD/20/C, p. 105**

105  
When muriatic acid was poured into  
one of the glasses it acted as usual  
upon the Zinc & no hydrogene could  
be seen to evolve itself from the silver  
some of the brass wires were under water  
& some above it . -  
Small zinc plates about 1 2/10 long  
& 1/4 broad were now introduced  
into tubes ~~cemen~~ & silver of

the same diameter into other tubes  
these were connected in the usual  
order. one with a disk of silver  
& another with a wire of silver  
were made part of the circuit  
( hydrogene was immediately given  
out from the ~~hydrogene~~ wire  
They were suffered - to remain all Night  
quere will not wires do wholly  
for the silver - ?  
quere will not glasses with silver  
& Zinc connected simply by brass do?  
[X] Is Hydrogene attracted by the silver disk  
& oxygene by the Zinc disk is it combined  
[X] when the disk is compleat & given  
x out when it is pointed?

[Horizontal rule]  
All the disks forming the circle

**RI MS HD/20/C, p. 106**

106  
gave out hydrogene  
It is by the ready use of the instrument of thought  
that language which stands for ideas & feelings  
that we~~re~~ are able to predict future phaenomena  
~~our~~ we use Words for Ideas as we use  
signs for collections of units in algebra  
& we likewise use words for other  
words collectively, in short if we were  
to analise; if we were accurately to examine  
the progress of intellect we shall find that  
the most important of all discoveries- The  
arranged facts which have been denominated  
the Laws of the universe have owed their  
origin more to the combinations of  
terms & propositions than to the perpetual  
consideration of ideas representing facts. -  
I have particularly enlarged on this subject; because  
the science of which I am at present  
treating is the most capable of all others  
of being expressed by Language

**RI MS HD/20/C, p. 107**

107  
M[superscript]r[/superscript] Cruikshank rests his hypothesis of the  
~~decomposition of the acid upon the~~

formation of an alkali ie ammoniac  
in the decomposition of Nitrates &  
sulphates of Magnesia I will try  
muriates

[Horizontal rule]  
Sulphuric acid did not act at all  
in the pile of 20 pairs. - sulphuric  
oxymuriatic acid not at all at first &  
<very little afterwards>

1 Whenever silver and Zinc or any of the bodies  
called galvanic excitors are connected in  
pairs ~~the metallic surfaces oxyda~~ & with  
each other so that ~~their surfaces may~~ <so that the greater number of>   
~~be in contact with water~~; of their surfaces  
may be in contact with water holding in  
solution &c the Zinc is oxydated  
& hydrogene is protruded from the  
surface of the silver & these phaenomena  
take place whether they are disks  
or points. -

**RI MS HD/20/C, p. 108**

108  
It is perhaps difficult to repel the charge  
of cruelty which has been more than once urged  
against galvanic exp[superscript]ts[/superscript]. The larger portion of  
the investigations at present connected with the  
science are <however> capable of being wholly  
performed upon dead matter & in our  
own simple sensations & in metallic oxidation  
[X] we have perhaps a more accurate  
test of galvanic power than could be  
afforded to us by the ~~warm~~

cold blooded animals - If however we  
can without remorse daily sacrifice  
[X] thousands of unnecessary victims upon the  
altars of luxury. Why should we hesitate  
to deprive animals of life when they are  
capable of teaching us useful truths  
They a

**RI MS HD/20/C, p. 109**

109  
Nov[superscript]r[/superscript]: 3[superscript]st[/superscript] 3[superscript]d[/superscript]  
The air exposed to grass which  
had remained green; the quantity  
was a little diminished perhaps  
1/30 at least the quantity of air  
was 240 cubic inches  
it was exposed Oct[superscript]r[/superscript] 19.  
Nitrous gas 100 parts of it gave rather less  
than 1 residuum- -  
This air was nearly of the same  
purity as that of the atmosphere –

[Horizontal rule]  
Charcoal & Zinc shall be tried tomorrow  
mem[superscript]m[/superscript] D[superscript]r[/superscript] Wells' observations on friction & on the  
equal powers of charcoal & gold  
5 plates shall be likewise tried in the  
glasses with nitrous acid  
Mem. to make Robert clean the  
copper & iron plates to try whether  
hydrogene protrudes from iron when it forms  
part of the circuit with Zinc

**RI MS HD/20/C, p. 110**

110  
In physical science the imperfection of our  
instruments of investigation; the fallacies to  
which we are liable from the modifications  
of impressions by the state of feeling & the  
[X] minute nature & complicated ~~nature~~ <relations> of the  
objects of research prevent us from attaining  
to that state of certainty afforded by  
the results of the science of quantity. -  
In proportion as the facts which form the  
bases of a science are few, ~~so <&> in proportion~~  
must the expressions of those facts simple

so in proportion must the science approach  
nearer to certainty: The science of  
quantity is nothing more than a connexion  
of a few simple expressions of facts  
by means of various instruments of language  
the formulae of which are simple &  
founded on received meanings of words  
[/X] In the physical sciences new instruments  
of language must be employed in connecting  
every new expression of facts: & the science  
admits ~~only~~ only of partial generalisations  
Extending to all impressions & to all  
relations of impressions it involves the  
universe ~~of~~ [?~~its own~~] : & ~~& its subjects~~ man  
& nature whether in their simple states   
~~of existence; or in their obvious changes~~   
~~to~~ [?~~xxx~~] in all their modifications &  
all their newly acquired forms; are ~~the~~

**RI MS HD/20/C, p. 111**

111  
at once the instruments & subjects of  
its examination. -  
probabilities are the most we can hope for in our  
generalisations & wherever we can trace the connexion  
of a series of facts without being obliged  
~~fill up some [?of]~~ imagine certain relations  
we may esteem ourselves fortunate in  
our approximations.-  
Sulphuric acid is a good conductor of the  
galvanic influence, I have ~~presented~~ in a former  
paper that <sulphur & hydrogene are evolved from [?connexion]> when it is exposed to the hydrogene  
wire of a galvanic pile ~~it is decomposed~~ sulphur  
[?~~being~~] ~~precipitated~~ – ~~sulphuric acid~~

Mem[superscript]m[/superscript] Nitrous oxide less readily decomposable than  
Nitrous gas on account of anamoly.-  
~~& hydrogene~~ & connected <by means of muscular fibre> with water communicating  
with the Zinc pole. [?~~xxxx~~] I have since found  
that the shock from sulphuric acid when unconnected  
portions of it ~~are~~ are in contact with the  
ends of the pile ~~communicates a stronger shock~~   
~~than water~~ is stronger than from water -  
A pile erected in the mode I ~~have just stated~~  
Quere will the pile act when the water is boiling

[Ink sketch of ?grass]  
stated in my last paper of 20 plates with  
cement containing large proportion of wax  
had its cells which were about 1/8 of an  
inch in diameter filled with sulphuric acid  
did not act at all NB the acid was  
very concentrated

**RI MS HD/20/C, p. 112**

112

[Blank page]

**RI MS HD/20/C, p. 113**

113  
Nov. 6[superscript]th[/superscript]. A range of 20 glasses with wire  
& Zinc were set up - some of the Silver  
wires at least one half of them gave out   
hydrogene two of them seemed to oxydate &  
<to give gas> to what could this be owing?

,-  
The leg of a healthy toad was separated  
[X] from the living animal & the crural  
nerve suspended in the receiver - silver <& zinc>  
strong contractions followed when   
contact was made the receiver   
being full of air -  
- it was exhausted to 6/10 still  
strong contractions took place -  
to 4/10 still the contractions were  
visible after five minutes the  
gage being still at 4/10 the contractions  
were ~~very perceptible~~ <still very> ~~though weak~~  
[X] strong after [?x] 10 minutes. the contractions were  
still very perceptible & not much  
diminished since ~~from~~ the last [?notation] -  
after three hours this leg  
still contracted in vacuo though  
not quite as strong as before  
To try sulphure with solution  
see whether a frog in contact with  
that will be galvanized-  
To build a pile with that

**RI MS HD/20/C, p. 114**

114  
( & to break the circuit with  
water – [?~~&c]. after~~  
After four hours the leg of the  
frog contracted; though not near  
so strongly as before - in five hours  
a little in six hours it had lost all  
its power - & neither contracted  
in vacuo or in the atmosphere -  
The leg of a frog contracted pretty  
briskly when sulphure of potash was  
the medium of communication  
even after heating -  
When sulphure of potash ie  
a string wetted in it was made  
the medium no contraction  
when water apparently no  
contraction  
below contraction

**RI MS HD/20/C, p. 115**

115  
The motive power in the galvanic pile appears  
to be the oxidation of the Zinc; the silver &  
the alternate series of plates & water is essential  
both to the evolution of gases from water  
& to the negative and positive electricity  
but these series must be connected in  
a circle. thus silver & Zinc & water  
silver Zinc & water ~~in~~ & so on in  
any ratio in a line appear to produce  
no effect th~~r~~o ~~in a~~ <when in a> circle hydrogene  
is given out from every surface of  
~~Zinc~~ Silver & oxygene ~~from~~ <fixed on> every surface  
of Zinc, but the Zinc & Silver form  
no galvanic circle when in a line  
though when in a circle the medium  
of communication is through the whole  
of the alternate circles; & wherever  
the place of Zinc & silver is  
supplied by a [?~~xxxxx xxx xxx~~]  
single arc either of charcoal or

of metals; hydrogene is evolved from

one side ie the place of the  
silver & oxygene fixed & evolved  
from the place of the Zinc: this  
shows that the process of chemical  
action is owing to certain increase  
of power ie to certain accumulation

**RI MS HD/20/C, p. 116**

116  
of power enabling oxygene to be evolved  
where it cannot be fixed in  
the alternate circles of gold or platina  
Let us now form on hypothesis  
Suppose when the Zinc is oxydated it  
becomes positively electrified & that in  
[X] consequence the silver becomes negatively  
electrified & the water is the medium  
of connection in the common galvanic  
circle; then it is a law of  
electricity that light bodies [?~~were~~] are  
are easiest charged with electricity it  
consequently follows that the hydrogene  
[?~~will~~] rather than be elicited from the  
water will pass to the silver  
[X] give out to it is [?xxxxxxxxxxx]  
electricity & be eliccited in  
the form of gas its equilibrium  
being restored –   
Suppose when the Zinc is oxidated it  
becomes positively electrified & the silver  
negatively in the double circuit then  
when a ~~compleat~~ line is formed  
the water is the medium of connection  
then the positive electricity of the Zinc acts  
upon the water & produces negative  
~~electricity~~ but as it is impossible  
that in [?~~a]~~ circles separated by water

**RI MS HD/20/C, p. 117**

117  
The negative electricity excited ~~b~~ in one plate  
can be exactedly restored by ~~that excited~~   
the positive electricity in the plate separated  
by water it follows that the plate must  
be less electrified than the first

[Horizontal rule]  
mem  
The exp[superscript]t[/superscript] Nov[superscript]r[/superscript] 7[superscript]th[/superscript] when marine acid  
was first into about 7 of 14 glasses the  
other 14 decomposed water in the usual mode

[Horizontal rule]  
I mentioned in a former paper that the  
~~pile~~ series of plates with Nitrous acid acted  
much more powerfully than any other combination   
I have since that time tried many of  
the metallic combinations with acids  
particular difficulties attend those exp[superscript]ts[/superscript] on  
account of the heat produced & the  
rapid evolution of gases - A pile of  
ten plates in which the cement was  
very high & the bottom of the pile  
immersed in water gave strong shocks  
Iron & Zinc forming ten pairs did  
not give even a sensible shock with   
nitrous acid: though when sulphuric   
acid was poured into them afterwards  
they gave a feeble shock. -  
X In my expectations to make very powerful  
piles with Nitrous acid I h~~ave been~~  
much disappointed

**RI MS HD/20/C, p. 118**

118  
mem[superscript]m[/superscript] to try plates in the glasses tommorrow  
& [?prp[superscript]d[/superscript] Sol[superscript]n[/superscript] of ~~Nitr~~ muriate  
& hydrosulphure-  
Mem[superscript]m[/superscript] to stop up the holes with charcoal-  
& to try charcoal tomorrow -

**RI MS HD/20/C, p. 119**

119  
[Ink sketch of ?box]

Sir  
In persusing my paper in your last  
number I have observed two errors which   
I request you will notice pa 6/40 is  
to be found instead of 6/10 & proportional  
instead of in great measure  
proportional. –   
Sir  
In my last communication which  
in consequence of [?~~x~~] hasty composition contains  
some inaccuracies of expression I concluded  
that the electrical effects produced by  
the pile of Volta somehow depended  
on the oxydation of the Zinc  
Since that paper has been written I  
have spent a portion of my time  
in searching for other facts on the  
same subject -   
In searching for facts either commensurable  
or contradictory to those I stated in my last

communication I began by experimenting on  
the substances which were good conductors of

**RI MS HD/20/C, p. 120**

120  
secondary conductors of the galvanic influence  
but which were incapable of oxydating the   
Zinc highly concentrated sulphuric acid  
is a good secondary conductor of galvanic  
as is evident from the evolution of  
gases though. it possesses but little  
power of action on Zinc when in  
a highly concentrated state  
a <the dry cells of> A range of twenty galvanic <pairs of silver & Zinc> plates  
constructed ~~with ce~~lls <in the manner> by means of cement  
cheifly composed of wax were filled  
with sulphuric acid of specific gravity  
rather more than 1:9 but it gave  
no shock & the wires connected  
with ~~effected no ch~~ it underwent  
no change in water.  
A galvanic range consisting <12 pairs> of copper  
& silver ~~filled with sulphuric acid~~ <did not act at all when>  
filled with sulphuric acid of this  
kind tho when a drop of water  
was added to this ~~wires~~<acid> in each   
of the cells; the ~~wires~~<silvers> wires  
connected with the glass of water  
immediately began to decompose  
the water pretty vividly. -   
This exp[superscript]t[/superscript] ~~not only~~ seems to prove  
that the great use of the acids are  
not as being better secondary conductors  
than water; but from their power of oxydating

**RI MS HD/20/C, p. 121**

121  
It was reasonable to conjecture that solutions  
of hydrosulphures would be unable to oxydate  
Zinc &c & they gave no galvanic effects  
though when but into Nitrous acid very stong-  
2 No fact is so <&c> constant as <the> cessation  
of the galvanic decomposition of water ~~it~~<in> about  
7. or 6/10 supposing this cessation to be  
be <simply> in consequence of the privation  
of atmospheric air from the water  
it follows -  
Quere the heat  
3 Sulphure of potash is a good conductor  
4 hydrogene is given out from sulphuric hydrosulh  
solution but no oxygene it conducted  
very well -  
When ~~sulpho~~ sol: of hydrosulphure was  
made to break the circuit of the oxygene  
but gas was given out from the wire  
exactly the same as if no ~~gas~~ break  
had been made  
When sol[superscript]n[/superscript] of <common> sulphate of iron impregnated  
with Nitrous gas was made to break the  
circuit of the hydrogene - gas was still  
given out.-  
When a gold wire was introduced into  
muriate of Magnesia it was very rapidly  
dissolved & a brown powder was thrown  
down & hydrogene was given out; when

**RI MS HD/20/C, p. 122**

122  
silver the fluid became milky  
but when the hydrogene wire was introduced  
into muriate of magnesia & the ~~gold~~ silver  
wire into water & the two connected by

muscle

hydrogene was given out & no  
milkiness could be observed  
Tomorrow in the morning without fail  
to put together the single galvanic circle. -  
& the silver & Zinc - in wires  
& next day the zinc & iron wire

**RI MS HD/20/C, p. 123**

123

1[superscript]st[/superscript].  
The Additional proof of the former conclusions  
~~2~~1 probability that water is essential; but that  
free oxygene is not -  
2 Minute examination of the process with  
glasses - Zinc & disks, Zinc & wires  
effects of marine acid; of other excitors  
producing the same effects of sulphure  
of potash & charcoal of silver & charcoal  
3 On the modes of increasing the  
effects of a pile & the causes of this  
increases of the different metallic substances  
4 Does there exist animal electricity  
& is the oxidation of Zinc the cause  
of all galvanic phaenomena doubtful  
either animal electricity exists & is  
owing to the same causes as galvanic  
electricity; or bodies of different conducting  
powers  
Appendix to [?the] supporting water to be  
decomposed the hydrogene must pass through  
the water or through the metal~~lic~~s  
if it passed through the water  
in a condensed state it ought to  
be absorbed by metallic solutions  
To one it ought to be remembered  
that when the pile is made to act  
upon one plate in pure water

**RI MS HD/20/C, p. 124**

124  
the effects are at [?ante].-  
Mem[superscript]m[/superscript]. Ammoniac & Nitrous acid.-  
Pour Nitrous acid upon a great superabundance  
of iron  
Diluted sulphuric acid enables the pile to

act  
Sulphuric acid highly concentrated potashes  
little action upon Zinc though it is  
~~is~~<an> excellent conductor of galvanic  
electricity supposing the principles  
laid down true it follows  
that strong sulphuric acid made  
the [?~~xxxx~~] connecting medium between  
the plates of Zinc ~~supposing~~ <ought> to produce  
little or no galvanic effects - a pile of  
twenty plates. That sulphuric  
acid is ~~enabled~~ is a conductor  
of that Kind which enables the  
circuit to be formed is evident  
from the following fact a  
pile of copper & silver plates which  
produced & so on-  
HydroSulphures of ~~potash~~ [?~~are~~] appear to be  
at least equal if not better conductors  
than water a ~~pile~~ the ends of  
a pile of 25. were connected with  
a small glass by wires on dipping my  
fingers the shock was very sensible

**RI MS HD/20/C, p. 125**

The facts before mentioned prove that  
a certain quantity of oxidation only is essential  
supposing that the mass of the plates  
are oxidating: the increasing nature of   
the process will enable the others to act  
Zinc & silver acted very well in water  
deprived of air ie one or two plates-  
I long ago observed that the spark  
is equally visible in air & in oil of  
turpentine; I attempted to inflame  
a mixture of atmospheric air by taking  
sparks visible in the day time  
it ~~this~~; but no inflammation took  
place

[Horizontal rule]  
A gold zinc wire gave out no gas but  
it was very plentifully given out from the  
silver wire -  
Nov[superscript]r[/superscript] 18 M[superscript]r[/superscript] [?Nex] began to vex  
tried over the exp[superscript]ts[/superscript] on Nitrous acid  
with cloths. It gave a very strong shock  
more acute than the common shock  
from thirty or forty plates & not  
felt to so great on diameter  
five gave a pretty strong shock

**RI MS HD/20/C, p. 126**

126  
all these plates were wet -  
After being agitated for some time  
in water they still continued  
to act  
After being well washed in lots  
they still acted, though after  
they were taken to pieces  
washed and built up with cloth  
moistened in common water  
they scarcely acted at all -  
Heat cannot be the agent because  
the power is not much diminished  
when the pile is cooled by  
immersion in water –

[Horizontal rule]

**RI MS HD/20/C, p. 127**

127  
On Nov[superscript]r[/superscript] 9[superscript]th[/superscript] set up at 1/2 past  
one a galvanic circle-

[Horizontal rule]  
On this day a ~~pile~~ <[?range]> with wires  
set up with all except two  
warm water did not act powerfully

they were 24. -  
The expected phaenomena were  
produced: but very slight it was  
difficult to judge of the quantity  
of the hydroene produced on account  
of the air given out from  
the water. -   
Marine acid put into eight produced  
but little effect into 24 produced  
~~into~~ the other eight the expected  
effects -   
Into five of the eight remaining  
the mixture of green and red sulphate  
of iron < made by nitrous acid> was put; the effects  
were most wonderfully increased-  
little or no gas was given out from the wires  
in the sulphate they became blackish-  
the other gave out gas in immense  
quantities- 10 of the ~~marine~~ caps  
were taken away still the action

**RI MS HD/20/C, p. 128**

128  
continued almost as powerful as  
before -  
Mem[superscript]m[/superscript] <in> the exp[superscript]t[/superscript] on muriate  
of magnesia & muriates of gold -

magnesia precipitated -  
Likewise the exp[superscript]t[/superscript] to day  
on new acid breaking the  
circuit - hydrogene given  
out as before though it was lost

[Horizontal rule]  
5 with impregnated solution acted  
very powerfully

[Horizontal rule]  
This proves that the absorption  
of hydrogen very much increases the  
effect  
Yellow precipitate formed upon  
a Zinc [Ink sketch of a wire?] which when wiped  
of acted very well; the hydrogene  
- wires gave out no gas & became blackish  
when ten pairs with solution of common  
~~muriate~~ <Sulphate> of iron were used -~~but~~ little  
gas was given out; yet a little was  
given out from the hydrogene wires  
& they were here & there slightly blackened  
ie this proves that the red oxyde of

**RI MS HD/20/C, p. 129**

129

iron is the only one hydrogen is  
capable of decomposing - .  
The zinc was covered with globules  
of gas and were here and there  
blackened -  
A little of the solution into which  
Nitrous acid had been poured added  
to the rest very much increased the  
effects. -  
Mem[superscript]m[/superscript] the white matter formed by  
the silver. Quere is the muriate of  
silver ~~of~~ or fulminating silver

[Horizontal rule]  
To try to say the sensible galvanic  
effect by interposing sulphure of potash  
& c. -  
to try red cabbage juice

**RI MS HD/20/C, p. 130**

130

[Blank page]

**RI MS HD/20/C, p. 131**

131

I  
1 [deletion]Highly concentrated[/deletion] sulphuric acid <when concentrated> possesses but little power  
of action upon Zinc at ~~high~~ <common> temperatures though <when> diluted it  
~~sulphuric acid~~ dissolves it with the greatest rapidity  
supposing ~~therefore~~ <what I attempted to prove in my last paper> that the powers of the pile of Volta  
to ~~depend~~ <are primarily excited by> chiefly on the oxidation of the Zinc  
~~as I stated in my former communication~~ it ~~would~~  
follow that ~~sulphuric~~ diluted sulphuric acid  
ought to produce much greater affects  
than concentrated acid when made the   
medium of connection of the pairs of plates. -  
This I have found is actually the case.  
When the cells of a range of plates <silver & zinc> constructed  
with cement cheifly composed of wax were  
filled with concentrated sulphuric acid <of rather more [?xxxxx]> it  
~~produced no shock~~ The completion of the  
circuit <through the body> was connected with no shock; [?~~xxx]~~

~~more [?xxxxxxxxx] was pro~~ & wires introduced  
from the poles into water produced  
during ten minutes [?none] <of the usual> ~~perceptible~~ phaenomena

~~though~~ when <minute quantities of> diluted sulphuric acid were  
~~was poured in small very minute~~  
~~quantities~~ made the connecting medium  
of the cells the poles produced  
a pretty brisk shock- & a silver wire  
~~made~~ connected with the zinc oxidated very  
xThe quantities must be very minute  
because of the effervescence which is [?xxxx]  
x eight drops in the cells are enough  
~~They w~~ If they had been sufficient to remain  
for a long time the pile would probably have  
become active on account of the water of the atmosphe

**RI MS HD/20/C, p. 132**

132  
very fast whilst the other connected with  
the silver produced ~~much~~ gas. -  
That sulphuric acid is not of that order  
of <high> galvanic conductors which <when> interposed  
between the plates are capable of  
destroying the circuit is evident from  
the following fact. <The cells of> ten pairs of  
plates of copper & zinc constructed with  
~~cells~~ by waxen cement <were> filled with an  
sulphuric acid of the ~~same~~ [?spec] gravity  
just noticed: but the range did  
not in the slightest degree act.  
a ~~very minute~~ small drop of water  
was then poured upon the acid  
in ~~the~~<each> of the cells: the pile  
immediately began to act & to  
effect the usual changes in   
water. -

~~2~~  
2 Polished Zinc <[?x]> introduced into liquid  
sulphuret of strontian or Barytes is very  
slightly acted upon & evidently undergoes  
no oxydation; ~~but~~ Liquid suphuret  
of alkali is ~~as good~~ as good <~~a~~> ~~if~~

~~not a better~~ conductor <[?x]> of galvanic  
electri if not a better one than water.  
~~for~~ <I found that when the fingers were plunged into> ~~wires connected with the ends~~  
sulphuric acid is a better conductor  
than water as I shall prove hereafter

**RI MS HD/20/C, p. 133**

133  
~~vessels~~ glass <connected with the ends of the pile & containing> containing the substances

~~of a pile were plunged into~~ <separate> ~~vessels~~ containing <-this substance>  
~~& circuit compleated by the fingers~~ the  
shock was ~~equally~~ <~~rather more~~ full as> as sensible as if the  
communication had been made by  
means of water & <I likewise ~~when~~ found that when> the galvanic current  
made to act on this substance by  
means of silver wires.- gas was elicited  
from the silver= wire & the Zinc wire  
became blackened . – but polished  
Zinc &c see first we ~~should~~<might> to  
conclude then that a pile erected with  
cloths moistened in sulphurect ough not  
to act .- I found that a pile  
of 25 pairs erected with cloths moistened  
in sulphur of Barytes was not  
possessed of the slightest power of action  
through after it had been immersed  
for a moment in water & its  
external plates moistened with a  
little nitric acid it ~~acted as~~   
~~powerfully as~~ gave shocks full  
as powerful as a similar pile  
erected with ~~nitrous acid~~ cloths  
moistened in solution of salt. -  
.3 No phaenomenon is more constant  
than the cessation of the powers  
of the common galvanic pile below  
six or seven tenths of an inch  
supposing the sole action of a vacuum

**RI MS HD/20/C, p. 134**

134

to be that of depriving the air  
of the water it holds in solution  
it follows that <a pile might to act in vacuo> diluted sulphuric

acid or nitrous acid is the   
medium of connection between the plates-  
~~A pile of three cells~~ into each of  
the cells of a pile of 12 plates.  
that had just been moistened by water  
a single drop of Nitrous acid was  
introduced; this made it decompose  
water pretty vividly in the atmosphere  
it was introduced under the receiver  
of an air pump & ~~the [?which];~~  
~~was~~ ~~exhausted~~ & the ~~oxygene~~ <~~Zinc~~ [?xxxxx]> we are  
wire ~~from~~ from its Zinc pole  
~~introduced~~ <connected with> a vessel of water likewise  
that had been long boiled; the wire <under the>  
from its hydrogen pole was fastened  
to a sliding [?~~xxxxxxxx~~] [?brass] wire  
passing through the top the receiver  
that it could be plunged at  
pleasure into the water when the   
vacum was made.- The receiver  
was exhausted till the gage  
wood at 6/10 when the circuit  
was compleated; the Zinc wire  
oxidated \* & gas was given out  
from the silver wire- The process

**RI MS HD/20/C, p. 135**

135  
when on for many minutes & when  
it had ceased it was not sensibly  
revived by introducing the atmosphere  
~~possibly it~~ In another exp[superscript]t[/superscript] the  
same effects took place though the oxidation  
appeared less vivid than in the atmosphere  
~~& this was probably owing to the~~ <But in the atmosphere fresh nitrous acid was>

~~expulsion from loss of the~~  
~~[?flames]~~ ~~of of some of the acid~~ & <in the>  
<aeriform state from the diminution of pressure>

to the non formation of fresh Nitrous  
[Marginal note] But this

is easily

accounted

for when

we

consider

that in

the atmosphere

fresh Nitrous

acid would

have been

be

[?xxxxx]

from

the

Nitrous

gas

disengaged

between

the plates

which –

could not

have been

the case

in vacuo.

& in

Vacuo

In consequence of the dim press some of the [?xxx] assumed prob the aeriform [Marginal note]

acid as it was decomposed  
between the plates - the hydrogene  
appeared to be given out in much

larger quantities; but this was  
owing to their ~~expansion~~ <great dim of pressure upon them>

The oxidation was evidently less

A drop of sulphuric acid poured into   
each of the moistened cells of  
the plates enabled the wires <from the poles> to  
~~decompose water~~ effect the usual  
changes in <pure> water ~~at less than 6/10~~   
<in a vacuum of less than 6/10> for rather more than a half  
hour; the oxidation when on  
as vividly as in the atmosphere  
~~but very little gas was given o~~ &  
 \*what is rather remarkable

some gas was giving out from the  
oxidating wire; though very little  
was ~~given~~ <produced> out from the [?by] silver = wire - -

This ~~last~~ exp[superscript]t[/superscript] is interesting <not> only from  
its arrangement with the other facts.

**RI MS HD/20/C, p. 136**

136  
but because it affords proofs the  
presence of oxygene in that loosely  
[X] combined <in the [?peculiar]> state ~~in which~~ <it> ~~appears~~  
~~capable of inflaming~~ ~~bodies~~ combustible  
~~bodies in [?each] essential to the~~   
~~oxidation of the produ~~ in which  
in my [deletion]boyish[/deletion] [insertion]infant chemical[/insertion] speculations I  
supposed it to be combined with  
[X ]light is not essential to the  
process. Whether ~~Water is~~  
water is absolutely necessary  
we shall find some difficulty  
in determining as it exists in  
smaller or larger quantities in all  
the ~~fluid~~ <~~secondary~~ non metallic fluid> galvanic conductors that  
have yet been experimented upon  
The following fact is in favor  
of its essentiality, the compound  
of [?~~u~~] concentrated sulphuric acid  
& oxymuriatic acid which I discovered  
in July 1799 & which may  
be formed by introducing & so  
on. slowly oxidates both Zinc  
& silver the [?oxymarine] acid  
being decomposed - I expected that  
it might produce galvanic effects  
~~but in this~~ when made the   
communicating medium between the

**RI MS HD/20/C, p. 137**

137  
cells of a pile; but in this I was  
disappointed 20 piles ~~one~~ pairs connected  
by it produced hardly any sensible  
action. -  
If any one wishes to repeat [?of] exp[superscript]ts[/superscript]  
I have just detailed in vacuo -   
they must be cautious in introducing  
very minute quantity of acid between  
the cells ~~&~~ ‘as otherwise the effervescence  
~~will~~ highly increased by taking off  
the pressure will carry out of them  
sufficient fluid to form a  
communication & thus spoil the  
exp[superscript]t[/superscript]. For want of introducing  
minute quantities I ~~made~~ faild  
in many ~~unsucessful exp[superscript]ts[/superscript].~~-  
~~They must likewise make~~ <[?some]> ~~use~~ of  
<employed in vacuo> water deprived of its air for <by boiling or>  
<previous [?xxxxxxxx]> compleating the circuit or otherwise  
~~they will meet with many~~   
~~difficulties~~ - the air liberated  
from the ~~water~~ will much disturb  
the results -   
- -2d -  
signor Voltas observation on the cemented  
pile

**RI MS HD/20/C, p. 138**

138

2  
These facts compared with those I  
narrated in my last paper sufficiently  
warrant the conclusion of the dependance  
of the powers of the pile of Volta  
on the oxydation of the metals  
particularly when we consider that the  
most powerful primary galvanic excitors are  
those which have most affinity for oxygene.  
& that the ratio of power is  
proportional to this affinity.   
chemical changes the only causes of electricity <but are>

what &c.  
But what is the influence of the  
silver in the process how are the   
[X] negative & positive electricity exited  
when the exciting bodies are in  
perfect communication; ~~the~~ & from  
what causes do the different poles  
[?~~xxxxx~~] elicit from separately portions  
of water oxygene & hydrogene  
apparently pure.- The solution  
of these <& other> interesting problems ~~it was~~   
I was convinced could not be   
learnt by speculations; particularly  
as the <fundamental> facts were analogous to  
no others; I endeavored to collect  
[X] observations from a minute examination  
of the whole of the process –

**RI MS HD/20/C, p. 139**

139  
The first problem that I attempted to solve  
was Whether ~~in every part of~~ the oxygene  
~~of the was fixed in the every part of~~   
~~the galvanic~~   
smaller holes were made in

2. A plates of silver & Zinc of 12 inches diameter  
were <at one of their corners> fastened by means of a loop wire

& brass wires were passed through ~~these~~ <~~a~~> holes  
~~so as to fasten together~~ made at the  
~~their~~ edge of one of their angles. -   
20 to these were introduced into  
glasses filled with spring water so that  
the Zinc of the first pair was in the first  
glass & the silver in the second & the  
Zinc of the second pair in the second glass  
<The brass wires not being suffered to come in contact>

& the silver in the third ~~&~~ so on after

the manner described by Volta  
~~till~~ the circle was compleated by the  
Zinc of the last pair being in  
the last glass ~~in~~ <&> the silver in  
the first, ~~When the circle was compleated~~

~~by the fingers a very faint shock was~~

~~perceived & when it was compleated by~~

~~means of a silver wire oxygene was~~  
~~given out~~ When the series ~~gave a faint~~

~~shock when~~ was broken by the removal  
of one of the pairs & the fingers introduced  
to compleat the circuit a slight shock  
was felt when Silver wire was introduced  
that part of it in the glass with the  
silver of the last pair oxidated

**RI MS HD/20/C, p. 140**

140  
whilst hydrogene was given out in  
that part of it connected with the Zinc  
qlass. -  
This ~~pile~~ range produced feeble shocks  
& effected the ~~usual changes~~ <silver> & wires

connected with it effected the usual  
changes in water; the oxygene being  
fixed in the flask containing the [?last]  
silver disc & plate & <the> hydrogen  
being liberated in that containing  
the last Zinc plate -  
~~For the minute observation of the~~   
that a circle analogous in all its parts  
~~phaenomena the circle was made~~  
might be made the end glasses

Compleat by connecting the two last  
glasses by a pair of plates. [?~~xx~~] It that in  
every glass them was silver & Zinc  
After occasional attention to the   
process for many hours I perceived the  
Zinc beginning to oxidate in some  
of its points though no gas formed  
upon it on was perceptibly given  
from it no gas had formed upon  
the silver: but the water in contact  
with each of the discs became  
white with its surface & covered  
with a thin follicle.-. The silver  
plates were not ~~clean~~ <perfectly> polished this might have disturbed

the results  
[?~~xx~~] it was <likewise> possible that some gas might have  
been produced which escaped my ~~attention~~   
notice. I ~~inclosed~~ <~~now~~> ~~some silver & Zinc plates~~ -  
that the whole operation might go on in  
closed vessels

**RI MS HD/20/C, p. 141**

141

~~cut~~ <cut> off the ~~tops~~ <bottoms> of some phials of different sizes  
( from one to four [?by] capacity/ & ~~inc~~ cemented  
in the tops ~~of half of them~~ ~~plates~~ <pieces of polished> of Zinc  
of different sizes all of the same length  
as the plates ~~used~~ in the ~~former~~ [?~~xxxxx~~]   
glasses but of different diameters: ~~the~~ & made

small & bored at the top so as to ~~admit~~

be capable of connection with silver plates  
~~introduced in the [?x]~~ <placed in the same manner in other similar> ~~of the same length~~   
~~some~~ <phials> ~~of which were round otheres triangular~~  
These silver plates were ~~perfectly I~~ well polished  
~~&~~ [?~~xxx~~] & as the form might influence  
the results some of them were made  
circular others oblong one was ~~triang~~ular.  
an isosceles triangle having the angles at  
the base nearly 80 ~~& another was~~. -  
& another was a parallelogram hardly  
the 16 of an inch ~~in diameter~~ <wide>; they were  
all more than an inch in diameter. -  
~~Four of these were connected~~  
Four of the Zinc bottles & four of the  
silver bottles <at the metallic points> were connected ~~<by brass wire>~~ ~~in the~~   
protruding into the atmosphere by brass wires ~~[?well] common~~–  
by trade with galvanic order- ~~& being~~ < They were> filled with  
water ~~&~~ inverted in glasses containing  
that fluid & connected in a

perfect galvanic circle with the  
series of 20.-  
~~the Zinc bottles~~ containing one square plate  
two oblongs of [?~~xxx~~] ~~inches long~~ & 3,4 inches wide &  
By the perfect galvanic circles is formed when every  
glass contains unconnected silver & Zinc-

**RI MS HD/20/C, p. 142**

142  
one triangle, 5 wide at the base  
In a few seconds gas began to appear  
on the small silver slips 1/16 wide & in  
~~& was <afterwards> gradually liberated from it~~ soon  
~~about a minute~~ a constant stream  
~~passed~~ globules ascended from it into  
the neck of the phial -  
In a few minutes large globules  
of air began to form on the  
triangle & to ascend from it -  
An hour ~~was required~~ passed before  
any perceptible quantity had formed  
upon the paralle<lo>gram ~~some however~~   
In four hours ~~the circle had given~~   
~~out no gas~~ a ~~quantity~~ <few globules> of gas  
~~hardly perceptible~~ <only had> had formed upon  
the circle; but a <~~minute~~ portion> a whitish matter were

by minute inspection perceptible on  
its edges.- This whitish matter was  
very distinguishable on ~~the plates~~ <points of the>  
other plates; In 13 hours the Zinc  
plates had given out no gas: but  
were much tarnished on their edges  
& parts of their surfaces - At the  
end of this time the gases collected  
in <the> bottles with the[?xxxxx] ~~the triangle~~  
& ~~parallelogram~~ were<was> examined  
the slips had given out much more  
gas than the triangle, the triangle [?xxx]  
than the parallelogram & in the

**RI MS HD/20/C, p. 143**

143

bottle with the circle only a few minute

globules had formed. - These gases

~~inflamed~~ <detonated> mingled with atmospheric air &  
acted on by an inflamed body.  
They were not examined by a more  
delicate test: ~~On all the plates~~ a  
~~little whitish matter a little of the~~   
~~white matter~~ <~~collected from~~> ~~collected on one of the~~  
~~plates~~ <~~afterwards~~> ~~was soluble~~ <~~dissolved~~> ~~with effervescence~~  
~~in nitrous acid~~. -  
I now broke the connection between

the four inclosed pairs & distributed them

in different parts of the circle -   
but still the same effects were

produced; <the large plate gave out no gas while from the small ones it appeared> thinking that the globular

figure of the large <inclosed> plate might  
influence the result. I inclosed

a polished [?sqare] of silver of 1. 2 inches

diameter in a bottle & connected  
it with Zinc in the <compleat> circle I likewise

connected an inclosed <small> circle of silver

of ,3 inches only diameter in the circle  
~~But~~<&> in this instance ~~the circle gave~~

~~out gas &~~ the square gave out

no gas whilst it was plentifully  
liberated from the circle In short  
[Horizontal rule]  
to be in <some measure> the inverse ratios of their surfaces

**RI MS HD/20/C, p. 144**

144  
after a number of exp[superscript]ts[/superscript] <of> which it will  
~~would to~~ laborious & unnecessary to  
give a minute detail I found  
that ~~no gas perceptible [?x]~~ all the  
Zinc plates ~~which~~ oxidat~~ed~~ing in  
the galvanic [?circuit] <with ~~common~~> ~~gave out~~   
<without giving out any gas> ~~no~~ perceptible quantity of gas -  
that the production of gas from  
the silver did not at all depend  
upon the form of the plates  
but upon the <measure of ~~exposed~~ surface exposed to the water> ~~quantity of their~~  
surface; ~~being~~ the quantity being  
in some measure inversely as the  
quantity of surface - The large plates  
giving out very little gas whilst it  
was liberated plentifully from the  
smaller ones & that in all exp[superscript]ts[/superscript]  
with common water the silver  
became more or less incrusted.-  
2. Considering these singular facts  
[X] I could not but conclude that oxygene  
was fixed on the Zinc <in every part of the pile> & hydrogene  
~~either~~ produced & either condensed ~~of~~ or

liberated <from> ~~on~~ the surface of the silver  
& when I considered the signs of  
the presence of Ammonia which I had  
perceived when a pile was made  
[X] to act in inclosed common air

**RI MS HD/20/C, p. 145**

145  
[X] the [deletion] exp[superscript]ts[/superscript][/deletion] <facts> of M[superscript]r[/superscript] Cruickshank I began to  
~~suspect~~ <[?connect]> that the hydrogene given out ~~from~~   
on the large surfaces was cheifly condensed

by the Nitrogene of the atmospheric  
air dissolved in the water; whilst on  
the smaller surfaces being less exposed  
it was partly condensed & <but chiefly> ~~partly~~   
liberated whilst from wires it was  
liberated all together. These [?conjectures]

<were known> In all these exp[superscript]ts[/superscript] I used common  
water it was consequently easy to  
[X] conceive that the white incrustation  
or precipitate on the silver might  
be owing to the decomposition of  
the magnesium salts dissolved in  
that water.-  
To ~~oxidation~~ ~~the~~ measure those conjectures  
by facts, I made ~~several~~ <many exp[superscript]ts[/superscript] on different circles> circles consisting

of from 17 to 30 ~~series of~~ p glasses  
In some of these glasses the silver  
plates were very small in others they  
were of the same size as the  
Zinc - some of the glasses contained  
distilled water others common water  
~~& a few red cabbage juice~~ <some> ~~mixed~~  
~~with~~ both of which were occasionally  
tinged with red cabbage juice. -  
~~The same exp[superscript]ts[/superscript] a silver slip was~~The general results were that in

**RI MS HD/20/C, p. 146**

146  
the common water & in the distilled  
water. The cabbage juice ~~in a great~~  
~~length of time~~ <slowly> became green where  
it was in contact with the silver  
Whilst that part of it in contact  
with the Zinc underwent no change  
of color - In the common  
water a white film always formed  
on the surface of the water near  
the silver; <sometimes a slight white precipitate> whilst in distilled water  
such an appearance was hardly

ever perceptible. The anomaly of  
its being new & then perceptible I  
am inclined to refer to the  
accidental impurity of the Vessels-  
with effervescence particularly as it was soluble without cloudiness  
<& ~~with~~out effervescence in marine acid-.>

In one exp[superscript]t[/superscript] a silver slip forming  
part of a <powerful> circ~~uit~~le was introduced into

a small vessel containing muriate  
of magnesia <& to prevent any interference in the result> connected with the next  
Zinc glass by means of muscular  
fibre - In the course of a night  
this slip gave out much gas & became  
was incrusted with a white matter  
which was soluble with <slight> effervescence in nitrous  
acid, a precipitation had taken  
place in the fluid. -

**RI MS HD/20/C, p. 147**

147  
These ~~facts~~ <results> left no room for doubting  
that Ammoniac was formed on  
the silver in every part of the circuit  
& ~~the former facts~~ consequently <left no room for> ~~that~~   
<doubting but a> conjectures fundamental to these exp[superscript]ts[/superscript]  
were ~~not unfounded~~.- commensurable  
~~3d.~~ Quere Nitrogene [?~~with]~~ <in vacuo-> facts.-  
~~As it must be supposed considering~~

~~our present stock~~ It will be interesting  
to ascertain whether ~~nitrogene~~ ammoniac  
~~It is not improbable that the metallic~~  
~~oxides may become colered by absorbing oxygene~~ <[?xxxx]>

~~from the air~~ - can be formed  
in vacuo. -   
When the circuit   
is broken pure water is decomposable -  
Mem[superscript]m[/superscript] note on the   
rapidity of oxidation - & effect.-  
Mem Marine acid. –

**RI MS HD/20/C, p. 148**

148  
3 M[superscript]r[/superscript] Cruikshank who first ~~attempted~~ <noticed> to prove  
the <probable> formation of ammoniac ~~in the comi~~   
at the ~~hydrogene~~ <silver> wire ~~of~~ in the well  
known exp[superscript]t[/superscript] on the decomposition of  
water by the pile has offered some  
some ingenious arguements to prove  
that Nitrous acid is formed at the Zinc  
wire, Reasoning from analogy it would  
be reasonable to infer ~~that~~ if it  
~~existed~~ <produced>in one ~~part~~ <of the series> of the oxydating  
metallic ~~plate~~ it ought to be produced  
in all. I have not however  
been able to perceive any <decided> change  
of color <to red> in ~~tincture~~ water tinged with  
~~red~~ cabbage juice ~~when placed~~ in contact  
with the oxydating Zinc plates This however  
may possibly be owing to the great  
extension of the surface & <the feeble powers of the pile> some facts

indeed have occurred to me which  
seem to render doubtful even the  
formation of Nitrous acid at the  
oxydating pole in the common pile. -  
Without attempting to decide the  
question which is of much importance  
I shall detail these facts . -  
a Whenever Nitrous acid <whether> in a concentrated <or very diluted state> state   
is made to act upon iron; it is ~~partly~~ <never>  
wholly decomposed in oxydating the iron; some of it

**RI MS HD/20/C, p. 149**

149  
uniformly combines with the red or green oxide  
of iron formed so that <& I know of no mode> is impossible to

make nitrous acid <in former> act upon iron without  
having a residual ~~fluid~~ <nitrate> which gives either  
a blue or green tinge to <alkaline> prussiates

supposing nitrous acid formed at the  
oxydating wire in the pile it would  
-it would follow from analogy  
that <when> this oxydating ~~wire~~ was iron  
it ought to produce in a minute  
quantity of fluid a <the property> ~~tendency~~ of~~to~~  
giving prussian blue with alkaline  
prussiates -  
A iron wire connected with <the Zinc> a pile of sixty  
plates was introduced into about a drachm  
of <pure> ~~water~~ distilled water ; this water was  
connected by a moistened thread  
with a ~~vessel~~ <glass of water> ~~connected~~ containing  
the silver so as to prevent the  
processes going on at the different  
poles from disturbing each other  
In the course of a night the iron  
wire had been very much acted upon  
& had thrown <much> down green & yellow  
oxide of iron ; but prussiate of potash  
mingled with it produced no sensible  
change of color.-  
[?xxx] Girtanners speculations <on the composition of Azote> are founded upon  
assertions ~~too vague &~~ so contradictory to

**RI MS HD/20/C, p. 150**

150  
known facts as to demand but little  
attention from enlightened chemists. -  
At present therefore supporting the formation  
of Nitrous acid we must conclude that   
it is produced by the union of nascent  
oxygene from the oxidating base -   
with nitrogene existing in common water.-  
But I have found that when  
the silver wires of ’a pile <exposed to the> [?wire]  
made to act in distilled water  
In the vacuum of an air pump  
the gage being at 6/10 the ~~pile~~  
oxydation of the silver & the liberation  
of hydrogene proceeded as in the   
atmosphere; now suffering the oxidation  
to have depended on the formation  
of nitrous acid by the nitrogene  
of common air dissolved in the  
water <& its decomposition> it might at least to  
have been diminished. -  
b. ~~When~~ [?~~xxxx~~] The colors of the oxides produce  
at the ends of wires may possibly  
depend upon carbonic acid it is  
impossible; at the moment distilled  
water is <cannot come in contact with the> cold it begins to  
have small quantity of carbonic  
acid from the atmosphere; They may  
be produced when lime water  
used by ~~the~~ a new combination. -  
The strongest argument in favor of the

**RI MS HD/20/C, p. 151**

151  
3 Considering the probable formation of   
Ammoniae on all the silver plates  
it became a subject of enquiry whether  
this formation was connected with  
the increase of power of the pile.-  
~~& what would be the effect~~   
To ascertain whether <wh> ~~would be the effects~~  
X ~~if~~ <~~the surface~~> ~~wires were substituted for discs~~ -  
whether diminution of the quantity of   
x surface of silver in the pile would  
much diminish its effects. I fastened  
some [?~~x~~] silver wires ~~of about~~ <in> 1/20 of  
~~an inch in~~ circumference <& [?~~xx~~] length [?xxxx] [?xx]> to some  
~~polished zinc plates & introducing~~  
~~23 of them into glasses in~~ the  
inch & half to three inches to  
some polished Zinc plates & arranging  
27 of them in the galvanic  
order <so that alternate of different sizes> in glasses filled with

Zinc & silver were distant from each other

At lease an inch or  
common water - I was greatly

surprised when I made the communication

by receiving a feeble shock - & when

~~I afterw~~ [?~~xx~~] afterwards compleated

we may consider then the   
galvanic prods

formation of oygene Nitrogene &c.  
Nitrous acid is M[superscript]r[/superscript]. Cruikshanks. –

**RI MS HD/20/C, p. 152**

152  
The circle by a silver wire - I perceived  
~~A~~ gas forming & eliciting itself from  
the greater number of the wires  
It seemed to be given out in larger  
quantities where the wires were  
shortest in ~~some few~~ <five or six> no perceptible  
quantity was produced; that <[?some] of the> silver  
wire supplying the place of the  
Zinc seemed to oxydate vividly  
& what much surprised me ~~white~~  
~~clouds seemed to pull~~ a cloudiness  
appeared at the point of other of  
the wires giving out hydrogene -  
This range of wires was however  
soon deranged & I could never  
produced <with simple water> another equal to it in  
power  
A range of 28 Zinc plates & silver  
wires gave ~~feeble~~ shocks <but> hardly  
perceptible to the <moistened> fingers & most  
of the wires inserted but a little  
way into the water gave out  
gas - from the others none was  
liberated the cloudiness at the point  
of some of the wires could not  
be perceived as in the last exp[superscript]t[/superscript]-   
When a little muriate acid was  
poured into each of 16 of the glasses  
the Zinc in these glasses began to give  
out gas

**RI MS HD/20/C, p. 153**

153  
Mem[superscript]m[/superscript] the bottle scheme -  
the powers of the ~~the~~ range were much  
increased - gas was disengaged from  
the Zinc by the action of the acid  
& [?~~x~~] all the silver wires gave  
~~out~~ apparently gave out gas---  
A pile in which warm water was  
used instead of common water had  
its powers of action but very little  
increased. [Horizontal rule] & all the wires  
not deeply inserted in the water  
gave out gas  
All there exp[superscript]ts[/superscript] proved that wires were

<somewhat> inferior to <large> disks in common water  
~~What~~ To ascertain whether this inferiority  
~~depended upon the smaller formation~~

~~of ammoniac~~ <condensation of hydrogene> or <upon> their ~~less~~ <smaller> capacity  
for ~~electrical influence~~   
Supposing this inferiority rather to   
depend on their ~~less~~ smaller ~~powers~~   
of hydrogene condensed upon their  
rather than to their smaller capacities  
for the electrical influence it was  
reasonable to conclude that their  
power <of [?xxxx]> would be much increased if  
the hydrogene produced upon them  
could be condensed in its nascent state

**RI MS HD/20/C, p. 154**

154  
On the supposition I filled ~~some~~ 13  
glasses with solution of Red suphate  
of iron [~~mixed with a little green~~ <mixed with a little solution of green>  
~~sulphate~~ <sulphate of iron & Nitrous gas> formed by pouring nitrous   
acid in small quantities into  
common sulphate of iron ~~as I knew~~   
~~from former exp[superscript]ts[/superscript]~~ a substance  
which former exp[superscript]ts[/superscript] had informed  
me was capable of absorbing hydrogen  
Thes~~e glasses~~ range gave very sensible  
shocks & its power of evolving  
gases from water seemed equal  
to that of a pile of 20  
plates.-  
When ~~four~~ this ~~circle~~ <series joined to another> was compleated  
~~<compleated> by four~~ <eight> glasses containing plates of  
Zinc & silver wires with common water: hydrogene  
was disengaged from ~~all~~ the wires -

no gas was disengaged in any of  
the glasses containing the solution but  
<in a long time> the silver wires became blackened by

the precipitation of a substance (~~probably~~   
~~red oxide of iron~~ upon them (which

as there was every reason to beleive

was green oxide of iron; ~~the Zinc plates~~   
~~gradually produced~~ a dense cloud gradually  
surrounded the Zinc plates ~~& yellow~~   
~~& green oxide of iron were both~~

~~precipitated & incrusted upon~~ them

**RI MS HD/20/C, p. 155**

155  
the powers of the series gradually diminished  
& in a day they were destroyed -  
The Zinc plates examined at the  
end of their time were found  
incrusted with green & red oxide  
of iron but they had given out

no gas After being wiped with

a cloth they acted as powerfully  
as before -  
~~Common~~ This exp[superscript]t[/superscript] repeated with  
red sulphate of iron; with common  
sulphate of iron & other substances  
capable of <~~at the same of~~> absorbing nascent  
hydrogen & oxydating the Zinc  
gave always the same results.-  
So that it would seem that the  
powers of a pile were much  
increased by ~~the~~ [?~~fixation~~] ~~of the~~ <absorption of.>  
hydrogen before it <assumed the elastic state> When common sulphate  
of iron was captured but a slight  
precipitation took place on the silver  
wires & they gave out a little  
gas , ~~black~~ <green> oxide of iron was [?precipitas]  
on the Zinc plates & ~~they gave out~~   
~~small quantities of~~ <globules gas which I found to be> inflammable ~~gas~~.-  
collected ~~before~~ upon them [Horizontal rule]

**RI MS HD/20/C, p. 156**

156  
NB the facts about pure  
water gold wires &c

4. Hydrogene was apparently produced  
on the surface of the silver plates  
in every part of the <~~galvanic~~> ~~circle~~ &  
oxygene fixed on the Zinc in every  
part of the galvanic circle, It was  
reasonable to conclude that copper &  
Zinc gold & Zinc & all the series  
composed of <easily> oxidable metals & [?~~xxxx~~]  
difficultly oxidable ones <would follow> but as from  
the interesting exp[superscript]ts[/superscript] of Colonel Haldane  
it appeared that iron & Zinc were  
very little inferior to any other  
galvanic excitors & as [?xxxx] is  
but little inferior in Zinc in  
Attraction for oxygene it became  
[?serious] subject of enquiry what   
would be the habitudes of those  
metals <in effecting changes in the water in the> 16 Zinc plates of the  
usual size were connected <at the angles> with  
<in the same way as> sixteen piece of thin iron wire   
~~& plunged into glasses containing~~  
~~air water~~ about two inches long  
~~these pie~~ They were ~~connected together~~ <arranged>  
in <a galvanic line> glasses ~~as a galvanic~~   
circuit six of which were filled

**RI MS HD/20/C, p. 157**

157  
with common water & the remainder  
with water holding in solution a  
little red sulphate of iron.-  
When the line was converted into

a circle by the fingers ~~no effect~~   
~~was sensible except [?xx~~] a very  
slight sensation was perceived; when  
the tongue was made part of  
the circle the shock & caustic  
sensation was very perceptible   
When silver wire ~~was connected~~  
~~with it~~ [?~~termin~~] connected the ends  
of the curve it oxidated at that  
end in ~~contact with the~~ the glass  
with the iron wire & gave  
out gas in that <end in> ~~connected~~ <the zinc glass>  
with the Zinc - When the

perfect circle was made with  
iron & Zinc; all the iron  
wires in the common water  
gave out gas without oxidating  
& those in the solution ~~produced~~  
exibited the ~~same~~ phaenomena <arising from the absorption> ~~at the~~  
<of the hydrogene - in the same manner as the wires in> silver wires - in the last  
The Zinc every where oxidated  
without giving out gas. –   
The process continued to go on <in this way>  
& the iron wire not in the slightest degree tarnished  
for many hours. -

**RI MS HD/20/C, p. 158**

158  
I found that whenever <a few <only of> the connected> a powerful  
galvanic circle was broken in any  
of its parts & single metallic wires  
~~or metallic wires of any kind~~ - connected

~~introduced~~ made to ~~supply the~~   
<the glasses [?when] oxidable metals wereemployed> place that oxygene was always  
fixed or disengaged in the place  
of the Zinc & hydrogene disengaged  
in the place of the silver &  
oxidable metals ~~produced~~ such as  
Zinc in the place of the  
silver lost all its power of oxidating  
I likewise found that ~~gases were~~ the  
same changes were effected in vacuo  
as in the air when the   
powers of the pile were once produced  
by the oxidation of the Zinc -  
When part of a powerful circle  
was placed in vacuo the same  
~~changes~~ took place oxygene was  
fixed in them &c -  
~~A silver wire plunged~~ whether wires  
occupying the place of the silver  
& Zinc were exposed to the atmosphere  
or covered with cement the same  
changes took place   
A silver wire ~~plunged~~ <interposed under water> between the  
~~Zinc & silver in a glass~~ [?~~xx~~]

**RI MS HD/20/C, p. 159**

159  
at the distance of about the eighth  
of an inch from each of  
of Zinc & silver wire in a glass gave  
a faint cloud of oxide & produced  
a little gas  
When we consider that no effects take place  
except in a compleat circle -  
& when we consider the signs of  
attraction & repulsion the shock &  
the spark we cannot <during the completion & the  
fixation of oxygene in every primary  
galvanic exciter, & the production  
of hydrogene we cannot ->

~~but conclude~~

~~that an electrical influence~~

~~perpetually increasing is perpetually~~

passing through the circuit

This influence it appears evolves  
~~[?xxx] supposing Are we to suppose that~~   
We must suppose that the oxydation  
of the Zinc  
Gold & silver –  
We must suppose that all the silver  
is negatively & all the zinc positively  
electrified  
Item the <inclined> pile with/ resin-  
[X] When we consider these facts we cannot but  
x conclude that <when a certain quantity of oxidation is produced> an influence capable of eliciting  
or fixing oxygene from water & of evolving hydrogene  
Whenver a series of plates are formed so as  
to produce rapidly changes in water  
[X] We cannot but conclude that when an oxydating metal

**RI MS HD/20/C, p. 160**

160  
when Nitrous acid is made the medium  
of action gas seems to be given  
out  
The supposition of Ammoniac  
being formed on the upper part of  
the wire is [?strongly] in favor  
of the atmosphere

[Horizontal rule]  
is in contact with a secondary excitor  
in one point & secondarily connected  
with it - that when Zinc & silver  
plates imediately in contact with each  
other

[Horizontal rule]  
Whenever in powerful galvanic circles one <metallic coin> or  
or disk ~~connected~~ a chain composed of two or more metals

or ~~two metals~~ whether in the form of wires  
~~or disks are~~ is made to supply the  
place of a pair of the primary excitors. -  
Whatever be the habitudes of the metals  
oxygene is fixed <or disengaged> at the place of the  
Zinc & hydrogene ~~disengaged~~ produced  
at the place of the silver

[Horizontal rule]  
A series of glasses having plates in  
galvanic order but not made in into  
a circle were suffered to remain for  
some hours at the end of this  
time some globules of gas appeared  
in some of the Zinc plates  
which were evidently oxidating but  
not the slightest change appeared upon  
the silver -

**RI MS HD/20/C, p. 161**

161  
Having set up a powerful circle <of 27 glasses some ~~Zinc~~ with water> composed ~~of silver~~ <& some>  
red sulphate

~~wire~~ <with> ~~some [?glass]~~ in which Zinc & silver wire were   
[X]the excitors, I found that when ever I  
supplied the place of a pair of plates  
either by a single metallic wire or  
a chain composed of different metals. -  
x whatever were their habits of oxydation  
hydrogen was always ~~disengaged~~ <produced> in the  
place of the silver & oxygene fixed  
or extricated at the place of the Zinc. -  
When many wires were introduced  
into the circle in new places so as  
preserve the ~~same~~ original number  
of exciting plates the powers of it  
seemed to be but little diminished  
a ~~hydrogene~~ <gas> was ~~apparently~~ ~~produced~~  
x on all the silver wires in the  
[X] glasses with common water & on all  
the ~~silver~~ wires in the place of the  
silver.- <~~when those wires of Zinc>~~ ~~Two gold wires connected~~  
Three of these were covered with cement the same changes  
~~with~~ ~~each of which was introduced~~   
every where above their points of contact took place -  
~~into two tubes filled with water~~  
with the water  
When ~~two~~ glasses of a circle ~~were<as>~~   
placed in vacuo <the [?gases] its> ~~the powers of the~~   
~~[?zinc]~~ being at 7/10 the powers of the  
whole were not at all diminished  
& the silver gave out hydrogene exactly as  
in the atmosphere  
I tried iron copper silver brass gold charcoal-

**RI MS HD/20/C, p. 162**

162  
in single galvanic galvanic circles an ~~oxydable~~  
~~metal &~~ two metals of different degree  
of [?arc] ~~connected~~ <brought in contact on one point> immediately in one  
~~point~~ & connected by water or  
~~acids~~ substances containing water\*  
that single galvanic [?~~xx~~] circles effect  
no <apparent> change in water unless it holds  
in solution & when it holds atmospheric  
air in solution I expect from <the appearance> some  
exp[superscript]ts[/superscript] now in progress that oxygene  
is fixed on the Zinc & hydrogene  
~~disengaged~~ produced <on the silver> & either condensed in  
ammoniac or liberated.-  
In the pile <or circle> of Volta the silver & zinc  
or the metals of different degrees of  
oxidability & [?~~xxxxxxxx~~] immediately in contact  
as pairs <in one point> & ~~but the same time~~ &  
at the same time connected in other  
points by <means of> water ~~&~~ <~~through~~ with> the whole of the  
~~remaining~~ series. ~~&~~ from all the  
facts it appears that the ~~oxidation~~   
[?x] circle possesses no action unless  
a certain number of the ~~series of~~  
oxidable plates of the series are oxidating-  
~~at their points of their~~ & when they  
are oxidating [?and] ~~power~~ <influence> is generated  
increasing the ~~power of~~ oxidability of  
the whole series of oxidable plates  
in Volta

**RI MS HD/20/C, p. 163**

163  
Quere when iron is oxidated  
will Zinc become the gaseous pole -  
<capable of producing> hydrogene is ~~produced~~ on the silver  
in contact with them ~~& a power~~ <on that part connected>  
~~produce increasing the oxidability~~ <with water>  
~~of all~~ & enabling the other ~~oxidable~~  
plates of the series or metals  
in the plates of these plates  
to produce oxygene from water  
at one of their poles <surfaces of contact with that> & hydrogene  
<fluid &> at another -  
When we consider the shock the spark  
& the signs of repulsion produced during  
the completion of the circle - We  
cannot doubt but that <the opinion of> this influence   
<the philosophers who have first attended to this subject-> is [?~~ana~~] the same with or highly  
analogous to the electrical influence -  
~~Its peculiar~~ [?~~xxx~~] It evidently however  
owes its primary excitement to chemical  
changes & the laws of its motion through  
~~[?dire] metals~~ <different conducting> of different conducting powers  
& the changes affected in it ~~by~~   
organic & inorganic bodies - will long  
constitute a curious subject of enquiry  
<chemical> electricity amongst philosophers - It is probable  
that changes will be found to  
produce similar effects-  
That these conductors do not conduct streams  
of electrical fluid without ~~the~~ equilibrium in one  
[?~~&~~] this is [?destroyed] appears from all the phaenomena

**RI MS HD/20/C, p. 164**

164  
.. 5 In a former paper I stated that  
when these portions of water [?~~connect]~~   
including the wires at the ends  
of the galvanic circle were ~~included~~  
connected by <a series of persons> or by

muscular fibre   
oxygene was produced in one  
& hydrogene in the other in  
the same manner as if the  
communication was simply made  
by water; & there is every reason  
to beleive that if the waters  
in the galvanic circle at the  
end of the wires were connected  
in the same way the same  
effects would follow - The ponderable  
~~A subject <question> of great importance~~[X]   
~~whether oxygen~~ <in> ~~water is decompound~~  
~~in those exp[superscript]ts[/superscript].~~  - & hydrogene <matter of this oxygene> must there is

<every reason to believe be supplied by the water but>  
~~supposing it is decomposed it is evident~~   
that the hydrogene must pass

in an invisible & unknown form  
through the water or the wire.  
must either as an external fluid  
or combined with an etherial fluid  
pass throu the water  
Supposing the hydrogene to pass in

an invisible form through the water  
D[superscript]r[/superscript] Beddoes suggested the probability  
of its being absorbed or altered [X]

**RI MS HD/20/C, p. 165**

165  
charcoal the most powerful  
of all excitors –   
when the portions of water through which  
it might pass were connected [?~~xx~~] by  
a substance capable of absorbing  
hydrogene - I connected the zinc  
<& silver gold> wires of a pile with two glass of  
water ~~& connected~~ ‘& made the  
communication between them by means  
of two ~~wires~~ pieces of muscular fibre  
each partially immersed in a solution  
of a mixture of red & green   
sulphate of iron containing nitrous  
gas, [?~~xxxxx~~] but the hydrogene  
was liberated exactly the same  
manner as if no - such thing  
had been -  
Before I had found the

[MS torn]

**RI MS HD/20/C, p. 166**

166  
I shall conclude this long paper  
- By offering some observations  
on the power of the metallic  
bodies &c -  
It would seem that the powers of   
piles cannot be increased beyond a  
certain extent when Nitrous acid  
is made the medium of communication-  
Observations on the powers of  
different galvanic circles.-  
1 Additional ~~remarks~~ < exp[superscript]ts[/superscript]> to prove that  
on the causes of the galvanic phaenomena  
Minute Observations on the galveranic  
phaenomena  
Remarks on the different powers  
of galvanic circles.

[MS torn]

**RI MS HD/20/C, p. 167**

167  
An Account of some exp[superscript]ts[/superscript] & observations  
on galvanism.  
eight <small> pieces of well burnt charcoal were  
falstened  
Volta's observation on the cemented pile -  
I have lately wholly given up the use  
of piles. - & have used galvanic  
circles <constructed with common sulphate of iron> on which the pairs of metals  
are either Zinc plates & silver or  
iron wires: The great advantage  
of circles are that you can interpose  
a great number of bodies which  
you wish to act chemically  
upon in different part of the  
circle -  
In a former paper I mentioned  
that Charcoal gave the shock -  
that eight pe  
Dr Wells in an ingenious p

**RI MS HD/20/C, p. 168**

168  
The silver plates were not perfectly polished; this  
might have influenced the results & some gas  
might have escaped my observation- [?~~xx~~] That  
the operation might go on in closed vessels  
I cut off the bottoms of some ~~phials~~ <bottles> with  
a ~~phial~~ so that they could easily be  
fastened on again by cement, Into one of  
these bottles I introduced a plate of  
Polished Zinc & into another a plate  
of polished silver . The plates were  
~~joined~~ <connected> by a wire att ~~one~~ <ached> [?~~xx~~]to their <upper> angles  
which protruded into the atmosphere thro  
an orifice made at the ~~points~~ <place> of junction  
of the ~~phials~~ <bottoms of the phials ~~with~~> ~~separated parts of the~~  
~~phials their sides~~ - which were carefully  
~~cemented~~ <fastened> to the sides & rendered air  
tight by <chement> Four apparatus of this kind pump  
were constructed <filled with water mounted in glasses> & made part of a  
<~~connected~~ of water in the galvanic order & in> ~~galvanic~~ series of 20 glasses.-  
& made [?fast]  
After more than twelve hours the Zinc  
plates had become tarnished but had given  
out no gas- In two of the  
bottles with the silver plates globules of  
gas too small to be examined were  
collected - The silver plates examined  
in the atmosphere were here & there  
incrusted with a <little> whitish manner which  
of 1.2 inches square this size used in the  
preceding exp[superscript]ts[/superscript]

**RI MS HD/20/C, p. 169**

169  
from its ~~dissolving~~ <solubility> with slight effervescence <& without cloudiness>  
in ~~Nitrous~~ <marine> acid ~~was probably~~ <appeared to be a slightly carbonated> an earth -   
Unable to account for the non appearance of hydrogene  
during the oxidation of the Zinc I could not  
but conclude that it was ~~absorbed~~ condensed  
or absorbed in some new compound on the   
surface of the silver <or the zinc> guessing that the quantity  
of surface might be connected with the  
phaenomenon of ~~dis~~ <its non> appearance I substituted in <three>  
<of> the phials for the square silver plates  
oblong ones of the same length & about   
, 3 inches wide - These had not been

long connected with the series before  
gas began to form upon them & in  
five hours sufficient was collected  
to examine <from the [?cause] that of [?inflammability]> it ~~proved~~ <appeared> to be hydrogene  
13 pairs of the <connected> series of twenty five glasses  
were now composed of square Zinc plates  
& silver oblong plates of different sizes  
some of them being about , 3 ~~inches~~   
~~wide~~, & others not more than ,1 inches  
wide - - ~~All the oblong plates appeared~~

~~to give out gas~~   
Gas ~~appeared to b~~ was given out from   
almost all the oblong plates & in largest  
quantities from the smallest. From the  
[?slips] of ~~one~~ , 1 ~~inch~~ indeed a constant

**RI MS HD/20/C, p. 170**

170

stream of globules ascended through  
the water. -  
Small ~~oblong~~ oval ~~&~~ [?~~arc~~] square & circular  
plates of equal surface with the  
slips, connected in the circle ~~all~~   
~~gave~~ in the places of some  
of them produced exactly the same  
effects - In short whenever the surfaces  
of silver did not exceed 1/4 of the  
quantity of the surface of the Zinc  
whatever were their forms; they always  
produced gas & both large and small  
surfaces in common water, ~~became~~ <~~produced>~~  
~~increased either a white film at the~~  
~~points of their contact [?wi] surface~~ <in a great length> became  
of time <became> covered at some of their points of contact  
with that fluid with a whitish film -  
The substitution of oblong <silver> slips for many of  
the plates did not apparently much diminish  
the power of the series - I therefore  
constructed a series of twenty seven glasses  
wholly composed of Zinc plates atracted  
to silver wires - This combination  
gave ~~of~~ very feeble shocks & acted  
less powerfully than the common  
series of eighteen; but ~~almost~~ all  
the ~~silver~~ <wires> not deeply inserted in the  
water gave out gas & the Zinc plates  
slowly oxidated

**RI MS HD/20/C, p. 171**

~~In another~~~~exp[superscript]ts[/superscript] all the wires of a series  
of thirty glasses produced gas~~In another exp[superscript]ts[/superscript] in which a series with  
thirty glasses containing wires & Zinc plates  
were used; the wires not only gave  
out gas but after some time a few  
of them produced a <film on the> slight <white> precipitation  
in the water. -  
<When> Small Zinc oblong plates <were> introduced into any part  
of the series; instead of the larger  
plates they oxidated rapidly without  
giving out any gas -  
~~Considering~~ <Speculation> these facts <seemed to show> from ~~which it appeared~~

that the quantity of hydrogene produced was  
<in a series> in some measure & to a certain point  
in the inverse ratio of the quantity of  
the surface of the silver [?~~x~~] ~~of the series~~. -  
Speculating upon them & comparing them  
with the ~~facts~~ of exp[superscript]ts[/superscript] of M[superscript]r[/superscript] Cruikshank  
& those which I noticed in my last paper  
on the ~~for~~ signs of ammoniac perceived  
during the action of a pile in common  
air I could not but conjecture that <hydrogene> [?~~ammonical~~]

**RI MS HD/20/C, p. 172**

172

was ~~formed~~ <produced & on the larger ones almost wholly condensed by the nitrogene>on all the silver plates from the  
combination of nascent hydrogene with <the> ~~condensed~~  
Nitrogene ~~dissolved~~ of atmospheric air  
dissolved in the water ; & this conjecture  
was strengthened when I considered the  
white ~~film~~ <matter> cheifly formed round the silver  
at the surface of the water & its  
solubility without cloudiness in acids -  
which might easily have arisen from the  
decomposition of magnesian salts contained  
in the pump water [Horizontal rule]  
The power of the series with ~~Zinc plates~~ &  
silver wires was less than that with plates  
Supposing the formation of ammoniac it  
was probable that the larger quantity  
produced upon the plates might be  
connected with their greater powers & if  
so it was probable that if the  
nascent hydrogene was condensed  
upon the wires an increase of power  
would follow ; This I have found  
is actually the case , a ~~pile~~ <series of 13> of wires  
~~set up with~~ in which the fluid  
in the glasses was <solution> red sulphate  
of iron mixed with a little <solution> of  
common sulphate of iron & Nitrous  
gas acted as powerfully as the series  
~~of plates~~ of 20 plates & the wires  
gave out no hydrogene but occasioned

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a precipitation in the fluid. -  
The phaenomena were the same when other  
metallic solutions capable of absorbing hydrogen  
& giving at the same time oxygene  
to [?have] ever employed

[MS torn]

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the exp[superscript]ts[/superscript] of Mess[superscript]s[/superscript]

[X] These facts compared with those noticed in my last <the former paper of this work>

paper [?seem] to prove - that ~~whenever~~ a<n> ~~certain~~   
~~number~~ quantities of ~~chemi~~ primary chemical action is  
~~generated,~~ <exists> in the galvanic circular series  
an influence is produced capable of ~~producing~~ <generating>  
<not only capable of increasing other similar, chemical actions>  
analogous chemical actions in parts of the   
series not primarily capable of undergoing  
them -  
But the laws of its chemical excitement  
& the laws of its motion whilst effecting   
chemical changes will long constitute  
an interesting subject of enquiry  
that an influence is generated <by each> not only  
~~capable of increasing those quantities~~   
producing general increase of similar action  
These facts compared with those Noticed by Mess[superscript]rs[/superscript]  
[deletion]Nicholson[/deletion] he preceding number of [deletion]M[superscript]r[/superscript] Nicholsons[/deletion] this Journal  
seem to prove that whenever a certain

quantity of chemical action exists  
[X] in the galvanic series

-

5 - Indian soy}  
1 & Ketchup}

2 :. 3

8 “3

[MS torn] But whenever

quality of peculiar chemical action exits in any

[MS torn]ular series ~~it produces~~ [?x] an influence

[MS torn]<& of being reciprocally increased by> all similar chemical actions & of

[MS torn]actions in bodies not apparently

[MS torn]ery action ~~&~~ the exp[superscript]ts[/superscript] of Mess[superscript]s[/superscript]

[MS torn]prove that this influence in its

[MS torn]the electrical influence

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[Ink sketches of apparatus]

[Ink sketch of two faces in profile]

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