



XLVIII. On the affinity existing between oxides of carbon and iron

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The inventor of these transparent fences has been engaged by Mr. Repton to erect them on several estates distinguished for extent and beauty.

I have the honour to be, sir,
your most obedient humble servant,

16, Lower George Street,
Sloane Square.

HENRY HOWELL.

XLVIII. *On the Affinity existing between Oxides of Carbon and Iron.* By DAVID MUSHET, Esq.*

[Continued from p. 241.]

Experiment X.

CHARCOAL from Norway Pine,		
Composed of oxide of carbon	98.179	
Ashes - - -	1.821	
	<hr/>	
	100	parts.

15 grains of this charcoal were mixed with 200 grains of oxide of iron. The fusion of this compound afforded a metallic button that weighed 40 grains, equal to 20 per cent.

75 grains of Norway pine, requisite to 15 grains of its charcoal and 200 grains of oxide of iron, produced a metallic button weighing - - - 62 grains.

Revived with charcoal as above - 40

Increase (equal to 11 per cent.) 22

Experiment XI.

Charcoal prepared from Lignum Vitæ,		
Composed of oxide of carbon	98.138	
Ashes - - -	1.862	

100 parts.

15 grains of this charcoal were mixed with 200 of oxide

* The Reader is requested to correct the following errors in Mr. Mushet's last communication in the present volume:—Page 160, line 2, for 41½ read 14½ grains of iron; page 160, line 11, read *one* part of Lynn sand; page 161, line 9, for *acid* of charcoal read *aid* of, &c.—Also in page 121, for *boiled* read *coiled* up and put into the retort.

of iron. The metallic result from the fusion of this mixture was 38 grains.

55 grains of raspings (equal to 15 grains of the charcoal and 200 of the oxide) gave

A metallic button weighing	58.73 grains.
Revived with charcoal	- 38.

Increase (equal to 10.371 per cent.)	20 $\frac{1}{4}$
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Experiment XII.

Charcoal prepared from Chestnut,	
Composed of oxide of carbon	98.20
Ashes	- - 1.80
	<hr/>
	100 parts.

15 grains of this charcoal and 200 of oxide of iron produced by fusion a metallic button that weighed 40 grains, (equal to 20 per cent.) from the oxide of iron.

83 grains of chestnut wood were found, by a calculation of the loss it sustained in charring, to be equal to 15 grains of charcoal: that quantity, in the state of raspings, was mixed with 200 grains of oxide of iron, and produced by fusion a metallic button (equal to 29 per cent. from the oxide)

Weighing	- - - 58 grains.
Revived as above with charcoal	40

Increase (equal to 9 per cent.)	18
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Experiment XIII.

Charcoal prepared from Laburnum,	
Composed of oxide of carbon	95.20
Ashes	- - 4.80
	<hr/>
	100 parts.

15 grains of this charcoal and 200 of oxide of iron yielded a metallic button of iron weighing 41 grains (equal to 20 $\frac{1}{2}$ per cent.).

73 grains of laburnum (being found equal to 15 grains of coal) and 200 grains of oxide of iron, mixed intimately together, produced a metallic button (equal to 25 $\frac{1}{2}$ per cent.)

Weighing

Weighing	- - -	52 grains.
Revived with charcoal	-	41
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Increase (equal to $5\frac{1}{2}$ per cent.)		11
		<hr/>

Experiment XIV.

Charcoal prepared from Scotch Oak,	
Composed of oxide of carbon	98.135
Ashes - - -	1.865
	<hr/>
	100 parts.
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15 grains of this charcoal and 200 of oxide of iron were intimately mixed, and fused together. A button of iron was obtained that weighed (equal to 27 per cent.) 54 grains.

65 grains of oak being requisite to form the above, 15 grains of this charcoal were mixed with 200 grains of oxide of iron. The fusion of this mixture was productive of a button of iron that was found to weigh (equal to $31\frac{1}{2}$ per cent.) - - - - - 63 grains.

Revived with 15 grains of charcoal	54
	<hr/>
Increase (equal to $4\frac{1}{2}$ per cent.)	9
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Experiment XV.

Charcoal prepared from the White Wood of the same Oak,	
Composed of oxide of carbon	97.325
Ashes - - -	2.675
	<hr/>
	100 parts.
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15 grains of this charcoal and 200 grains of oxide of iron yielded a metallic button that weighed 49 grains (equal to $24\frac{1}{2}$ per cent.).

96 grains of white wood, found by calculation from experiment to be equal to 15 grains of charcoal, were mixed with 200 grains of oxide of iron, and the compound reduced by fusion. The result was a metallic button that weighed (equal to $34\frac{1}{2}$ per cent.) - - - - - 69 grains.

Revived with charcoal	49
	<hr/>
Increase (equal to 10 per cent.)	20
	<hr/>

Experiment XVI.

Charcoal prepared from Ash,

Composed of oxide of carbon	95.727
Ashes - - -	4.273

 100 parts.

15 grains of this charcoal and 200 grains of oxide of iron were fused together, from which was obtained a metallic button that weighed 54 grains, or 27 per cent., from the oxide of iron.

80 grains of ash wood was found equivalent to the formation of 15 grains of this charcoal. To these were added 200 grains of oxide of iron. The fusion of the compound produced a metallic button of iron weighing (equal to 32.75 per cent. from the oxide) - - - 65.5 grains.

Revived with the charcoal	54
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Increase (equal to $5\frac{1}{4}$ per cent.)	11.5
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Experiment XVII.

Charcoal prepared from Bark of the same Ash,

Composed of oxide of carbon	93.55
Ashes - - -	6.45

 100 parts.

15 grains of this charcoal were mixed with 200 grains of oxide of iron and fused together, and there resulted a metallic button of iron that weighed 41 grains (equal to $20\frac{1}{2}$ per cent.).

78 grains of this bark were found requisite to form the above portion of 15 grains of charcoal. That quantity was therefore thoroughly mixed with 200 grains of oxide of iron. A metallic result was obtained by the fusion of the compound, and the resulting button weighed (equal to $33\frac{1}{2}$ per cent.) - - - - - 67 grains.

Revived with charcoal as above	41
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Increase (equal to 13 per cent.)	26
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Experiment

Experiment XVIII.

Charcoal prepared from Birch,

Composed of oxide of carbon 89·681

Ashes - 10·309

100 parts.

15 grains of this charcoal and 200 grains of oxide of iron yielded by fusion a metallic button of cast iron that weighed 62 grains (equal to 31 per cent. from oxide).

90 grains of birch-wood, being found equivalent to the above 15 grains of charcoal, were mixed, in the state of raspings, with 200 grains of oxide of iron. The result on fusion was a button of iron

Weighing (equal to 33 per cent.) 66 grains.

Revived by means of the charcoal 62

Increase (equal to 2 per cent.) 4

Experiment XIX.

Charcoal prepared from Sycamore,

Composed of oxide of carbon 94·593

Ashes - - 5·407

100 parts.

15 grains of this charcoal being mixed with 200 grains of oxide of iron and fused, a metallic result was obtained that weighed 50 grains (equal to 25 per cent. from oxide of iron).

79 grains of sycamore raspings (equal to 15 grains of charcoal) and 200 grains of oxide of iron yielded by fusion a metallic button that weighed (equal to $31\frac{1}{2}$ per cent.) 63 grains.

Revived by means of the charcoal 50

Increase (equal to $6\frac{1}{2}$ per cent.) 13

Experiment XX.

Charcoal prepared from Lime-tree,

Composed of oxide of carbon . 96·321

Ashes - 3·679

100 parts.

15 grains of the above charcoal and 200 of oxide of iron gave a metallic button weighing 51 grains (equal to $25\frac{1}{2}$ per cent. from oxide of iron).

$83\frac{1}{4}$ grains of raspings, as requisite to form the above quantity of charcoal, and 200 grains of oxide of iron, being mixed and perfectly reduced, afforded a button of iron that weighed (equal to $34\frac{1}{2}$ per cent.) 69 grains.

Revived by means of charcoal	51
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Increase (equal to 9 per cent.)	18
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Experiment XXI.

Charcoal prepared from Bragnut of the specific gravity of 1.1009,

Composed of oxide of carbon	96.250
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Ashes -	3.750
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	<hr/> 100 parts. <hr/>
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15 grains of this charcoal were mixed with 200 grains of oxide of iron, and the result by fusion was a metallic button weighing 36 grains (equal to 18 per cent.).

45 grains of bragnut were found equivalent to form 15 grains of charcoal. These in a state of raspings, and 200 grains of oxide of iron, were mixed together and fused; the result was a metallic button of iron weighing (equal to 21 per cent.) 42 grains.

Revived by means of charcoal	36
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Increase (equal to 3 per cent.)	6
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From the result of these experiments, it will appear at one glance, that the extent and purity of the carbonaceous matter in charcoals do not at all depend upon the absolute quantity of combustible matter they contain respectively.

The largest portion of revived iron is obtained with charcoal of birch, the quantity of combustible matter in which (by Experiment XVIII.) is 89.681. Iron revived 62 grains.

Combustible matter in oak	98.135	-	54
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In ash	95.725	-	54
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In walnut	96.048	-	36
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This contrast is quite sufficient to show that the different carbonating powers of charcoal of wood depend upon a principle different from any that has been developed in the foregoing experiments.

From the same experiments, however, we are warranted to conclude, that the carbonating powers of the matter of carbon contained in different woods in their natural state, are greater than when the same is reduced to charcoal by distillation or any other mode of operation. This curious fact, the reverse from what might have been expected, may be accounted for in three different ways.

1st, From the decomposition of the oleaginous or resinous juices of the wood by the oxide of iron; part of the carbonaceous matter of which, being set free, may either unite itself to the iron, or unite with the oxygen of the oxide, and by this means leave greater scope to the carbonating powers of the concrete carbon.

2dly, From a large surface being exposed by wood in the state of fine sawdust to the same bulk and weight of oxide.

3dly, And what seems to be the most permanent cause, this fact may arise from a certain degree of oxidation being necessary in the carbon, which facilitates its union with the oxygen of the oxide; and as the degree of oxidation in raw wood is greater than in charcoal, so in proportion to this degree of oxidation we find the affinity more speedily and more extensively exerted.

The following Table will prove a convenient summary and contrast of the foregoing experiments.

Table of 21 Experiments made with different Kinds of Woods.

No. of Exper.	Names of the Woods.	100 Parts of Charcoal composed of			Quantities of Iron revived with 15 Grs. of Charcoal.		Weights of Wood in the state of Rasps.		Increase of Iron with Raw, beyond that of Coated Wood.	
		Oxide of Carbon.	Ashes.	Weight in Grains.	Per Cent.	form 15 grs. of Charcoal.	Weight in Grains.	Per Cent.	Weight in Grains.	Per Cent.
1	Walnut	96.048	3.952	36	18	76	49	24 $\frac{1}{2}$	13	6 $\frac{1}{2}$
2	Elm	96.700	3.300	40	20	75	59	29 $\frac{1}{2}$	19	9 $\frac{1}{2}$
3	Holly	94.152	5.848	44	22	71 $\frac{1}{4}$	45	22 $\frac{1}{2}$	1	$\frac{1}{2}$
4	Scotch Pine	97.100	2.900	40	20	88	68	34	28	14
5	Beech	95.200	4.800	42	21	54 $\frac{1}{2}$	54 $\frac{1}{2}$	27 $\frac{1}{4}$	12 $\frac{1}{2}$	6 $\frac{1}{2}$
6	American Maple	96.140	3.860	50	25	76	61	30 $\frac{1}{2}$	11	5 $\frac{1}{2}$
7	Spanish Mahogany	96.154	3.846	40	20	55 $\frac{1}{2}$	43	21 $\frac{1}{2}$	3	1 $\frac{1}{2}$
8	Sallow	93.865	6.135	43	21 $\frac{1}{2}$	79	60	30	17	8 $\frac{1}{2}$
9	American Black Beech	95.165	4.831	36	18	69	48	24	12	6
10	Norway Pine	98.179	1.821	40	20	75	62	31	22	11
11	Lignum Vitæ	98.138	1.862	38	19	55	58 $\frac{1}{4}$	29 $\frac{1}{2}$	20 $\frac{1}{4}$	10.3
12	Chestnut	98.200	1.800	40	20	83	58	29	18	9
13	Laburnum	95.200	4.800	41	20 $\frac{1}{2}$	73	52	26	11	5 $\frac{1}{2}$
14	Scotch Oak	98.135	1.865	54	27	65	63	31 $\frac{1}{2}$	9	4 $\frac{1}{2}$
15	White Wood of Do.	97.325	2.675	49	24 $\frac{1}{2}$	96	69	34 $\frac{1}{2}$	20	10
16	Ash	95.727	4.273	54	27	65	63	31 $\frac{1}{2}$	9	4
17	Bark of Ash	93.550	6.450	41	20 $\frac{1}{2}$	78	67	33 $\frac{1}{2}$	26	13
18	Birch	89.631	10.369	62	31	90	66	33	4	2
19	Sycamore	94.593	5.407	50	25	79	63	31 $\frac{1}{2}$	13	6 $\frac{1}{2}$
20	Lime-tree	96.321	3.679	51	25 $\frac{1}{2}$	83 $\frac{1}{4}$	69	34 $\frac{1}{2}$	18	9
21	Bragnut	96.250	3.750	36	18	45	22	21	6	3

[To be continued.]