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

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plant for the ensuing year. This operation is called *ravallément*, and is very different from the pruning practised in the department of the Marne.

An intelligent proprietor, who has a large extent of vineyard, should bury some vines (*ravaller*) every year, in order to have a sure and constant supply of plants for replanting.

The methods of treatment are in every respect the same with high and low plants.

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

IN my late communications to the Philosophical Magazine, a number of experiments were adduced to exhibit the universal diffusion of carbon, and to convey a tolerably correct idea in what proportions it enters into the composition of animal, mineral, and vegetable substances.

The affinity that exists mutually betwixt iron and carbon is every day manifested as the basis of one of our greatest national manufactures : in particular, in the various modifications of cast iron, steel, plumbago, &c.

Any inquiry that has for its object the investigation of those means, and of their peculiar modes of formation, to which we exclusively owe the existence of the most widely diffused and most useful metal that has hitherto been known in civilized society, commands attention, not only as a matter of curiosity, but as an object of the highest importance.

The natural mutual affinity of iron and carbon is such, that they may be reciprocally used as tests and agents of each others existence respectively ; and upon this principle, chiefly, the experiments which are to follow were performed.

The first object to be ascertained, in pursuing this investigation, was the nature of oxide of carbon, whether in the state of charcoal, coke, plumbago, &c. ; and wherein, and in what, it differed from the matter of carbon that existed naturally in the substances from which these were obtained.

If any two oxides of carbon were taken similarly compounded

pounded as to the alloy of foreign matter, and employed under the same circumstances, to revive equal quantities of the same metallic oxide, Would in not be just to infer, that if the quantities of metal were equal, so were the qualities of the oxide ; and the reverse if a different result were obtained? And does it not appear equally fair to deduce, that where the greatest quantity of metal is revived, the appropriated oxide is of superior quality? The former deduction holds universally correct ; but the latter, if admitted, would often lead into error, particularly where the oxides exist in the state of coal or coke.

I was once of opinion that the carbonating powers of any oxide depended upon the real quantity of combustible matter which it contained ; and that the substance found to yield the largest portion of coal or coke, and to contain the smallest portion of ashes, would, every thing else being alike, revive the greatest quantity of metallic oxide ; or, in other words, would be found to contain the largest quantity of pure carbon, or diamond : but upon investigating the nature and properties of a variety of carbonaceous oxides, chiefly obtained by the distillation of pit coal, with a view to fix an unerring list whereby to judge of coal fit for iron making, it was found that not only this conclusion was of itself erroneous, but that, in general, the very reverse of this theory took place. It not only appeared that the carbonating powers of the oxide depended upon some other cause, remote from the actual quantity of combustible matter, but that the process of distillation, or of coking, subjected the oxide to new laws, the very reverse of what at first view ought to have taken place. This, then, was at once attributed to the state of oxidation of the oxide ; and a direct probability inferred, that that coke or coal that revived the greatest quantity of metallic oxide would be the least oxidated ; or, in other words, approach more nearly to the state of diamond.

This theory, however plausible, was found incompatible with practice ; and in the event it was found that the coke or coal that became most deoxidated in burning, revived, under precisely the same circumstances, the least quantity
of

of metallic oxide : and from the experiments hereafter to be detailed, it will not appear rash to infer, that this inverse ratio of carbonation proceeded exclusively from an approximation, however remote, to the state of diamond ; arising chiefly from a new and more dense arrangement of the particles of the coal, in consequence of parting with a portion of oxygen.

These experiments were arranged and conducted in the following order :—About 50 pounds of oxide of iron were prepared, and thoroughly mixed, that there might not exist any variety of quality arising from different preparations. This was kept during the whole series of experiments in the same temperature, that none of the results might be affected by the moisture of the atmosphere. A parcel of hand-made crucibles, all nearly of the same size, prepared from Stourbridge clay, with ground covers, made so as to form a water-tight joint, were set aside for the experiments. These, from time to time, before the introduction of the mixture, were brought to a red heat : when in this state, the mixture was introduced, the cover was slipped on, and the whole was put directly into the assay furnace. This mode had not only the advantage of facility, but, which in these experiments is absolutely indispensable, prevented the carbonaceous matter introduced from being dissipated by the moisture, which is always contained in the clay when crucibles are put into the furnace in a green state.

The proportions of oxide of iron and oxide of carbon, used in the most of these experiments, were oxide of iron 200 grains, of carbon 15 grains.

These were intimately mixed, and put into a square of thin paper containing about five superficial inches of measurement, and productive exactly of half a grain of charcoal : this, and $14\frac{1}{2}$ grains of the substance to be tried, formed the quantity of 15 grains. So that in all these experiments there is nearly 1-29th of carbon of paper united. When the experiments were directed to comparative views betwixt the raw and coked materials, a quantity of the former was used, that would, by accurate experiment, have formed 15 grains of coal, or prepared oxide of carbon. The paper

paper and mixture were with facility introduced into the crucibles respectively, and the immediate introduction of the cover prevented the most minute contact of air, or dissipation of the subject of experiment. The duration of the crucible and degree and management of the heat in the furnace were scrupulously attended to, and many of the experiments were repeated three times.

The first class of experiments was with various woods, from which the following were selected :

Experiment I.

Charcoal prepared from Walnut, composed of

Oxide of carbon	-	96.048
Ashes	- - -	3.952
		<hr/>
		100 parts.

15 grains of this oxide and 200 grains of oxide of iron, were subjected to fusion, after being carefully mixed, and the result was a metallic button which weighed 36 grains, (equal to 18 per cent.) from the oxide of iron.

It was found, upon a calculation of what this wood lost in distilling, that 76 grains of raw wood would have formed 15 grains of the charcoal operated upon. This quantity of wood was therefore rasped down, and, in a similar manner with the former, introduced into the crucible. The result was

A metallic button weighing	-	-	49 grains.
Charcoal of the same wood, revived as above,			36
Increase (equal to $6\frac{1}{2}$ per cent, or $24\frac{1}{2}$ upon			<hr/>
the whole,)	-	-	13

Experiment II.

Charcoal prepared from Elm, composed of

Oxide of carbon	-	96.70
Ashes	- - -	3.30
		<hr/>
		100 parts.

15 grains of oxide from elm and 200 grains of oxide of iron, yielded a metallic button weighing 40 grains (equal to 20 per cent.).

75 grains

75 grains of the same wood, in the state of raspings, found to be equal to 15 grains of prepared coal, being mixed with 200 grains of oxide of iron, they were fused together, and the result was a metallic button weighing 59 grains. (Equal to $29\frac{1}{2}$ per cent. from the oxide of iron.)

With the charcoal, the quantity revived was 40

Increase (equal to $9\frac{1}{2}$ per cent.) - 19

Experiment III.

Charcoal prepared from Holly,

Composed of oxide of carbon 94.152

Ashes - - 5.848

100 parts.

15 grains of this carbon and 200 grains of oxide of iron, yielded by fusion a metallic result that weighed 44 grains. (Equal to 22 per cent.)

71.4 grains of raw holly, being equal to 15 grains of charcoal, and 200 grains of oxide of iron, yielded by fusion

A neat metallic button weighing 45 grains.

Revived as above with charcoal 44

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

Experiment IV.

Charcoal prepared from Scotch Pine,

Composed of oxide of carbon 97.10

Ashes - - 2.90

100 parts.

15 grains of this charcoal and 200 grains of oxide of iron, being fused together, yielded a metallic button of iron weighing 40 grains, or 20 per cent. 88 grains of raspings of this wood (equal to 15 of charcoal,) and 200 grains of oxide of iron, yielded a button of iron that weighed

34 per cent., or - - 68 grains.

Revived as above with charcoal 40

Increase (equal to 14 per cent.) 28

Experiment

Experiment V.

Charcoal prepared from Beech,

Composed of oxide of carbon	95.20
Ashes - - -	4.80

100 parts.

15 grains of charcoal of beech mixed with 200 grains of oxide of iron, yielded by fusion a metallic button of iron weighing 42 grains, (equal to 21 per cent.)

71.5 grains of raspings of this wood, (found equal to 15 grains of carbon,) being mixed with 200 grains of oxide of iron, there resulted from the fusion of this compound a metallic button that weighed (= to $27\frac{1}{4}$ per cent.) 54.5 grains.

Revived as above with charcoal	- - -	42
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Increase (equal to $6\frac{1}{4}$ per cent.)	12.5
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Experiment VI.

Charcoal prepared from the American Maple-Tree,

Composed of oxide of carbon	96.140
Ashes - - -	3.860

100 parts.

15 grains of this charcoal and 200 of oxide of iron gave a metallic button weighing 50 grains, (equal to 25 per cent.) from the oxide of iron.

76 grains of this wood (equal to 15 grains of charcoal,) and 200 grains of oxide of iron, yielded by fusion a button of iron, weighing (equal to $30\frac{1}{2}$ per cent.) 61 grains.

Revived as above with charcoal	- - -	50
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Increased, (equal to $5\frac{1}{2}$ per cent.)	11
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Experiment VII.

Charcoal prepared from Spanish Mahogany,

Composed of oxide of carbon	96.154
Ashes - - -	3.846

100 parts.

15 grains

15 grains of this charcoal with 200 grains of oxide of iron, gave by fusion a metallic button weighing 40 grains, (equal to 20 per cent.) from the oxide of iron.

55.5 grains of mahogany was found equal to 15 grains of charcoal. This, in the state of small raspings, was mixed with 200 grains of oxide of iron. The result by fusion was

A metallic button weighing 43 grains.

Revived as above with ch. coal 40

Increased, (equal to $1\frac{1}{2}$ per cent.) 3

Experiment VIII.

Charcoal prepared from Sallow,

Composed of oxide of carbon 93.865

Ashes - - - 6.135

100 parts.

15 grains of this charcoal mixed with 200 grains of oxide of iron, gave by fusion a metallic button which was found to weigh 43 grains, (equal to $21\frac{1}{2}$ per cent.)

79 grains of sallow, being found equal to 15 grains of charcoal, this, in the state of raspings, was mixed with 200 grains of oxide of iron. The compound was fused, and the result was

A button of iron weighing 60 grains.

Charcoal revived only - 43

Increase, (equal to $8\frac{1}{2}$ per cent.) 17

Experiment IX.

Charcoal prepared from American Black Beech,

Composed of oxide of carbon 95.169

Ashes - - - 4.831

100 parts.

15 grains of this charcoal mixed with 200 grains of oxide of iron, yielded by fusion a metallic result weighing 36 grains, (equal to 18 per cent.)

69 grains of black beech were requisite to form 15 grains of charcoal. These, in the state of raspings, were mixed with
200 grains

200 grains of oxide of iron and fused together, the result was,	A metallic button that weighed	48 grains.
	Revived with charcoal	36
		—
	Increase (equal to 6 per cent.)	12
		—

[To be continued.]

XLI. *Some Circumstances relative to Merino Sheep, chiefly collected from the Spanish Shepherds, who attended those of the Flock of Paular, lately presented to His Majesty by the Government of Spain; with Particulars respecting that great National Acquisition; and also respecting the Sheep of the Flock of Negrete, imported from Spain by His Majesty in the Year 1791*.* By Sir JOSEPH BANKS.

Soho Square, Feb. 18, 1809.

SIR JOHN,

AT a time like the present, when Spanish wools, though at a price unheard-of in the annals of traffic, still continue to find a market; thus clearly proving, that their value in the estimation of the consumer is far above any price that has been hitherto offered for them by the manufacturer; and when we must all agree, that the interruption of our trade with Spain may still continue for some time longer, I trust that a paper written with a view to facilitate the production of this valuable article in the United Kingdom, and to communicate some information relative to the important present of Merino sheep lately received by our most gracious Sovereign from the government of Spain, will be interesting to you, sir. I beg the favour of you, in case you shall approve it, to do me the honour of placing it at the disposal of the very useful institution over which you preside with so much advantage to the agricultural interests of this country.

I have the honour to be, sir,

Your obedient and faithful humble servant,

JOSEPH BANKS.

Sir John Sinclair, Bart. President
of the Board of Agriculture.

* From Communications to the Board of Agriculture.