

ployed for that purpose, and, by means of this process, it will be rendered more extensively useful and valuable. [*Ibid.*]

¶ TRANSLATIONS FROM FOREIGN JOURNALS.

*Extract of a Report upon the employment of Hot Air in smelting Iron with Charcoal. By M. E. GUEYMARD, Engineer in Chief of Mines.**

A successful experiment in the smelting of iron by the aid of the hot air blast, has been made at the furnace of Rioupéroux, (Department of Isere.) In this furnace, the distance from the blowing machine to the tuyere was insufficient for the erection of the apparatus for heating the air which the machine furnishes; they were obliged, therefore, to make the conduit pipe semicircular.

Six kilns, or ovens, were made with one chimney, $54\frac{1}{2}$ feet (French) high, placed against the stack of the furnace. The fuel used in them was anthracite, which was applied to heat a pipe eight inches in diameter, and ten feet long; the part of the tube which traverses the fire was protected by a coating of fire clay, one inch thick, covered by a shield of cast iron, which received the direct action of the fire.

Five months' work have proved the efficacy of this arrangement; the expense of the construction of the apparatus for heating, including a tube for water, amounted to the sum of 5,009 francs, (1,001 dollars.)

Upon the blast pipe, and close to the tuyere of the furnace, is placed an air gauge, and a thermometer. The consumption of fuel by the air oven has been fixed at 150 kilog. (300 lbs.) of anthracite in twenty-four hours.

The experiments were commenced on the 3d of April; the fires were lighted in succession, and, on the 15th of May, five of them being lighted, the temperature of the air was raised to 125° R., (313° Fah.) and even as high as 130° R., (324° Fah.)

Before the introduction of hot air, the furnace was charged each time with 65 kilog. (130 lbs.) of soft charcoal, and with 77 litres ($2\frac{3}{4}$ cubic feet) of ore.

Gradually the hot air was introduced, the temperature being raised more and more. They have been able to use with the same load of charcoal, quantities of ore increasing as 82, 87, 92, 102, and up to 105, litres; a quantity which has not been exceeded. It was observed that, at this maximum charge, the scoria, or slag, was more liquid, and the metal of a better quality, and finer than before.

The consumption of the five fires was 750 kilog. (1500 lb.) of anthracite in twenty-four hours.

When they worked with cold air, the mouth of the tuyere was eighteen lines ($1\frac{1}{2}$ inches) in diameter, and the pressure of the air equalled twenty-four inches of water. Upon the introduction of the hot air, the diameter of the mouth was increased to twenty lines, ($1\frac{2}{3}$

* Translated by request of the Committee on Publications.

inches, and the pressure decreased to twenty inches. The number of charges were forty in twenty-four hours, in the first case; but in the second, they could not exceed thirty-four, or thirty-five. Afterwards, having restored the pressure to twenty-four inches, they were enabled to increase the number of charges to forty.

The economy of fuel by the use of hot air, at the furnace of Rionpérroux, may be estimated by the results of the castings made during the month of June, being about the average of three months' experiments, and about the same with those of the months of July and August.

During the month of June, 57,989 kil. of pig iron were made by the consumption of—

Ore,	110,400 litres.
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Charcoal,	.	.	.	1,104 charges.
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To obtain the same quantity of metal by using the cold air blast, would have required 1,434 charges of the same charcoal.

There was, therefore, a saving of 330 charges, of which the value,
at five francs per charge, = 1,650 francs,

Add eight days' work of the work-

men, at 19.36 francs, = 154.88 dollars.
1804.88 = 360.98

Deduct for the expense of heating the
air,

Attendance of fireman,	45
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21,500 kil. of anthracite,	516
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Interest, 10 per cent., on the cost of the heating apparatus,

$$\frac{41.10}{602.10} = 120.4\%$$
$$1202.78 = 240.56.$$

The benefit resulting from the employment of hot air was, for one month, 1202.78 francs, (\$240.56,) or 20f. 72, (\$4.14,) per 1000 kilog. (20 cwt.) of the casting produced. This is the minimum gain. Since, the general expenses are not given, and refractory mixtures of ores have frequently been used, during the month of June. It must be observed that the saving of 21,450 kilog. (42,900 lbs.) of charcoal, made in the casting, had required a consumption of 21,500 kilog. (43,000 lbs.) nearly an equal weight of anthracite, of which the value is much less than that of charcoal.

The tuyere was burnt through three or four times in twelve hours, an inconvenience which was remedied by surrounding it with water; after which, the working of the furnace became perfectly regular.

The sixth fire having been lighted, the temperature of the air was maintained at 130° R., (324° Fah.) and was sometimes raised above; but no change was found in the working of the furnace, nor could the charge be increased beyond 105 litres (3 $\frac{3}{4}$ cubic feet) of mineral, to 65 kilog. (130 lbs.) of charcoal.

The dimensions of the tuyere mouth, and the pressure of the air, were varied, and the results were always inferior to those already stated; so that the maximum effect produced, with the mixture of ores employed, was with a pressure of twenty-four inches of water,

a diameter of tuyere of twenty lines, the temperature of the blast, 130° R. (324° Fahr.) and 105 litres of ore to 65 kilogs. of charcoal.

A mixture of more refractory ores than the preceding, and which could not be smelted with the cold air blast, was reduced with much facility, but the charge of ore could not exceed 100 litres. It should be remarked, that the temperature of the blast, which appeared to give a maximum effect at temperatures not exceeding 130° R., was much below the temperature of melted lead, (604° Fahr.) to which it had been carried in the experiment made at Vienna in a coke furnace.

Remarks on the foregoing by the French Editor.

1. *M. Guymard* has correctly observed, that unless the air can be heated by the flame which issues from the mouth of the charcoal furnace, those who are not able to procure a cheap combustible for the heating furnace, and continue to work with cold air, must be most unfavourably situated.

Happily, the attempts made in Germany, and the apparatus there contrived, and which has already been imitated in France, have shown that the flame which escapes from the furnace will heat to a proper temperature all the air which is required. It is recommended that at furnaces where charcoal is used, the heat which would otherwise be wasted, shall thus be used instead of the separate apparatus for heating air, thus augmenting the profits of smelting with heated air, by the whole value of the combustible consumed in the fires.

Thus at Rioupéroux, the saving which has been made of 1202.10 fr. will be carried to 1763.78 fr. per month, or to 30 fr. per 1000 kilog. of iron produced in place of 20 fr.

2. The best plan yet presented for heating the air by the flame at the top of the furnace, is the following, which differs a little from that employed at Wasseraufingen, and described by *M. Volz*. The air required for the blast, is passed through twenty small columns or vertical tubes, four feet long by two inches and a half in diameter, which are placed in a space or oven near the mouth.

By this means, the air is more heated and there is less friction, than by passing it through a long tube horizontally, because the air passes slower and has only four feet to traverse.

The diminution of the resistance to be overcome by the blowing machine is considerable and very important, because the water courses are frequently hardly sufficient, during the summer, to furnish the quantity of air necessary for the consumption of the iron furnaces.

3. The temperature of the air thrown into the furnace of Wasseraufingen, has been raised constantly to 165° R. (403° Fahr.) and often to 210° R. (504° Fahr.) with increased effect.

M. Guymard, on the contrary, has observed that the production of iron was not augmented by an elevation of the temperature above 130° R. (324° Fahr.)

At Wasseraalfingen, with the air heated to a temperature varying from 165 to 210° R. (329 to 400° Fahr.) to produce 1000 kilog. (2000 lbs.) of iron, 1130 kilog. (2260 lbs.) of charcoal was consumed, in place of 1730 kilog. (3460 lbs.) burned when the cold air was used. The weekly production has been carried from 527 local quintals to 734 quintals—equal to 357 metrical quintals, (lbs.)

At Rioupérroux, with the air heated to 130° R. (266° Fahr.) they have consumed, for 1000 kilog. (2000 lbs.) of castings, 1270 kilog. (2540 lbs.) of soft charcoal, in place of 1610 kilog. (3220 lbs.) with cold air.

The differences between the results obtained in these furnaces are not considerable. It is remarked that in both the quantities of charcoal consumed in twenty-four hours, is not augmented, but the charge of coal and the daily produce of casting, has, by the employment of the hot air blast, received a considerable increase.

[*Annales des Mines.*

REPORT

To the Board of Directors of Bridges, Public Roads, and Mines, upon the Use of Heated Air in the Iron Works of Scotland and England. By M. DUFRENOY, Engineer of Mines. Paris, 1834.

(Translated for this Journal, by S. V. Merrick.)

Some experiments by Mr. Neilson, Director of the Glasgow gas-works, led him to think that advantage would be gained by previously heating the air to supply the smelting furnace. He communicated his ideas to Mr. Mackintosh, long known for his inventive genius, and they united in undertaking at the Clyde Iron Works, in concert with Mr. Wilson, one of the proprietors of the establishment, a series of experiments to determine this important question.

In the first experiment, the air from the blowing machine was passed through a rectangular trunk of sheet iron, ten feet* long, four feet high, and three feet wide, where it was heated previous to its entrance into the furnace.

Notwithstanding the imperfection of this method, by which the temperature of the air could not be raised above 200° Fahr., it was evident from the experiment that the plan of Mr. Neilson was destined to produce a revolution in the manufacture of iron.

This first apparatus was soon destroyed by the action of the heat, and its renewal being very costly, they substituted a cast iron pipe, having in the middle an enlargement like the bulb of a thermometer.

This second apparatus produced beneficial effects; it lasted much longer, and the temperature of the air was raised by it to 280° Fahr. This increase, though small, produced a visible economy in fuel. Messrs. Neilson, Mackintosh and Wilson then understood the advantages which would result from raising the temperature many hun-

* English.