

V. *On the Hot Air Blast.* By Mr. J. B. NEILSON, Cor.Mem.Inst.C.E.
*Communicated in a Letter to the late President, THOMAS TELFORD, Esq.**

I FEEL much pleasure in being able to comply with your request in mentioning to you what I conceive to be the nature of the advantages likely to be derived by the Iron Trade, and the country generally, from my invention of the Hot Blast, and at the same time, I shall very willingly state the circumstances, agreeably to your request, which, in the first instance, led me to direct my attention to the improvement of the process of iron-making.

About seven years ago, an iron-maker, well known in this neighbourhood, asked me if I thought it possible to purify the air blown into blast furnaces, in a manner similar to that in which carburetted hydrogen gas is purified; and from this gentleman's conversation, I perceived that he imagined the presence of sulphur in the air to be the cause of blast furnaces working irregularly, and making bad iron in the summer months. Subsequently to this conversation, which had in some measure directed my thoughts to the subject of blast furnaces, I received information that one of the Muirkirk iron furnaces, situated at a considerable distance from the engine, did not work so well as the others; which led me to conjecture that the friction of the air, in passing along the pipe, prevented an equal volume of the air getting to the distant furnace, as to the one which was situated close by the engine. I at once came to the conclusion that by heating the air at the distant furnace, I should increase its volume in the ratio of the known law, that air and gases expand as $448 + \text{temperature}$.

Example.—If 1000 cubic feet, say at 50° of Fahrenheit, were pressed by the engine in a given time, and heated to 600° of Fahrenheit, it would then be increased in volume to 2104.4, and so on for every thousand feet that would be blown into the furnace. In prosecuting the experiments which this idea suggested, circumstances however became apparent to me, which induced the belief on my part, that heating the air introduced for supporting combustion into

* Although the application of heated air has been extended, and the subject treated more at large since this paper was written, the detail of the discovery from Mr. Neilson to the late President, cannot fail to be interesting. In a future volume, the Council trust to be able to add a further communication from that gentleman on the subject.

air furnaces, materially increased its efficiency in this respect; and with the view of putting my suspicions on this point to the test, I instituted the following experiments.

To the nozzle of a pair of common smith's bellows, I attached a cast iron vessel heated from beneath, in the manner of a retort for generating gas, and to this vessel, the blow-pipe by which the forge or furnace was blown, was also attached. The air from the bellows having thus to pass through the heated vessel above mentioned, was consequently heated to a high temperature before it entered the forge fire, and the result produced, in increasing the intensity of the heat in the furnace, was far beyond my expectation, and so evident as to make apparent to me the fallacy of the generally received opinion, that the coldness of the air of the atmosphere in the winter months, was the cause of the best iron being then produced.

In overthrowing the old theory, I had however established new principles and facts in the process of iron-making, and by the advice and assistance of Charles M'Intosh, Esq., of Crossbasket, I applied for and obtained a patent, as the reward of my discovery and improvements.

Experiments on the large scale to reduce iron ore in a founder's cupola, were forthwith commenced at the Clyde Iron Works, belonging to Colin Dunlop, Esq., which experiments were completely successful, and in consequence, the invention was immediately adopted at the Calder Iron Works, the property of William Dixon, Esq.; where the blast being made to pass through two retorts placed on each side of one of the large furnaces, before entering the furnace, effected an instantaneous change, both in the quantity and quality of iron produced, and a considerable saving of fuel.

The whole of the furnaces at Calder and Clyde Iron Works were in consequence immediately filled up on the principle of the Hot Blast, and its use at these works continues to be attended with the utmost success; it has also been adopted at Wilsontown and Gartshirrie Iron Works in Scotland, and at several works in England and France, in which latter country I have also obtained a patent.

The air as at first raised to 250° of Fahrenheit, produced a saving of three-sevenths in every ton of pig-iron made, and the heating apparatus having since been enlarged, so as to increase the temperature of the blast to 600° Fahrenheit and upwards, a proportional saving of fuel is effected; and an immense additional saving is also acquired by the use of raw coal instead of coke, which may

now be adopted. By thus increasing the heat of the blast, the whole waste incurred in burning the coal into coke is avoided in the process of iron-making.

By the use of this invention, with three-sevenths of the fuel which he formerly employed in the cold air process, the iron-maker is now enabled to make one-third more iron of a superior quality.

Were the Hot Blast generally adopted, the saving to the country in the article of coal, would be immense. In Britain, about 700,000 tons of iron are made annually, of which 50,000 tons only are produced in Scotland; on these 50,000 tons, my invention would save in the process of manufacture, 200,000 tons of coal annually. In England, the saving would be in proportion to the strength and quality of the coal, and cannot be computed at less than 1,520,000 tons annually; and taking the price of coals at the low rate of four shillings per ton, a yearly saving of £296,000 sterling would be effected.

Nor are the advantages of this invention solely confined to iron-making: by its use the founder can cast into roods an equal quantity of iron, in much less time, and with a saving of nearly half the fuel employed in the cold air process; and the blacksmith can produce in the same time one-third more work, with much less fuel than he formerly required.

In all the processes of metallurgical science, it will be of the utmost importance in reducing the ores to a metallic state.