sists of two gases;@@1 about one-fifth being oxygen, and four-fifths azote. According to the present state of chemical knowledge, the oxygen alone is effective in producing beat ; and the operation of blowing a furnace may be thus analyzed.

“ 1. The air is forced into the furnace in a condensed state, and, immediately expanding, abstracts heat from the surrounding bodies.

“ 2. Being itself of moderate temperature, it would, even without expansion, still require beat to raise it to the temperature of the hot substances to which it is to be applied.

“ 3. On coming into contact with the ignited substances in the furnace, the oxygen unites with them, parting at the βame moment with a large portion of its latent heat, and forming compounds which have less specific beat than their separate constituents. Some of these pass up the chimney in a gaseous state, whilst others remain in the form of melted slags, floating on the surface of the iron, which is fused by the heat thus set at liberty.

“ 4. The effects of the azote are precisely similar to the first and second of those above described ; it seems to form no combinations, and contributes nothing, in any stage, to augment the beat.

“ The plan, therefore, of heating the air before driving it into the furnace, saves obviously the whole of that heat which the fuel must have supplied in raising it from the temperature of the external air up to that of 600° Fahrenheit ; thus rendering the fire more in­tense, and the glassy slags more fusible, and perhaps also more ef­fectually decomposing the iron ore. The same quantity of fuel, ap­plied at once to the furnace, would only prolong the duration of its heat, not augment its intensity.

,, The circumstance of so large a portion of the air@@’ driven into furnaces being not merely useless, but acting really as a cooling, in­stead of a heating, cause, added to so great a waste of mechanical power in condensing it, amounting, in fact, to four-fifths of the whole, clearly shews the defects of the present method, and the want of some better mode of exciting combustion on a large scale.”

The reader will find it interesting to compare this account with the following by Dr. Ure.

“ Wherever a forced stream of air is employed for combustion, the resulting temperature must evidently be impaired by the coldness of the air injected upon the fuel. The beat developed in combus­tion is distributed into three portions ; one is communicated to the remaining fuel, another is communicated to the azote of the atmos­phere, and to the volatile products of combustion, and a third to the iron and fluxes, or other surrounding matter to be afterwards dis­sipated by wider diffusion. This inevitable distribution takes place in such a way, that there is a nearly equal temperature over the whole extent of a fire-place, in which an equal degree of combustion exists.

“ We thus perceive that if the air and the coal be very cold, the portions of heat absorbed by them might be very considerable, and sufficient to prevent the resulting temperature from rising to a proper pitch ; but if they were very hot they would absorb less caloric, and would leave more to elevate the common temperature. Let us sup­pose two furnaces charged with burning fuel, into one of which cold air is blown, and into the other hot air, in the same quantity. ln the same time, nearly equal quantities of fuel will be consumed with a nearly equal production of beat ; but notwithstanding of this, there will not be the same degree of heat in the two furnaces, for the one which receives the hot air will be hotter by all the excess of heat in its air above that of the other, since the former air adds to the heat while the latter abstracts from it. Nor are we to imagine that by injecting a little more cold air into the one furnace, we can raise its temperature to that of the other. With more air indeed we should bum more coals in the same time, and we should produce a greater quantity of beat, but this heat being diffused proportionally among more considerable masses of matter, would not produce a greater tem­perature ; we should have a larger space heated, but not a greater intensity of beat in the same space.

“ Thus, according to the physical principles of the production and distribution of heat, fires fed with hot air should, with the same fuel, rise to a higher pitch of temperature than fires fed with com­mon cold air. This consequence is independent of the masses, being as true for a small stove which burns only an ounce of char­coal in a minute, as for a furnace which burns a hundred weight ; but the excess of temperature produced by hot air cannot be the same in small fires as in great ; because the waste of beat is usually less the more fuel is burned.

“ This principle may be rendered still more evident by a numeri­cal illustration. Let us take, for example, a blast furnace, into which 600 cubic feet of air are blown per minute ; suppose it to contain no ore but merely coal or coke, and that it has been burning long enough to have arrived at the equilibrium of temperature, and let us see what excess of temperature it would have if blown with air of 300° C. (572° F.) instead of being blown with air at 0° C.

"Six hundred cubic feet of air under the mean temperature und pressure, weigh a little more than 45 pounds avoirdupoise ; they con­tain 10∙4 pounds of oxygen, which would burn very nearly 4 pounds of carbon, and disengage 16,000 times as much heat as would raise by one degree cent. the temperature of two pounds of water. These 16,000 portions of heat, produced every minute, will replace 16,000 other portions of heat, dissipated by the sides of the furnace and employed in heating the gases, which escape from its mouth. This must take place in order to establish the assumed equilibrium of caloric.

“ If the 45 pounds of air be heated beforehand up to 300° C., they will contain about the eighth part of the heat of the 16,000 disen­gaged by the combustion, and there will be therefore in the same space one-eighth of heat more, which will be ready to operate upon any bodies within its range, and to heat them one-eighth more. Thus the blast of 300° C. gives a temperature which is nine-eighths of the blast at zero C., or at even the ordinary atmospheric temperature ; and as we may reckon at from 2'200° to 2700° F. (from 1200° to 1000° C.) the temperature of blast furnaces worked in the common way, we perceive that the hot-air blast produces an increase of tem­perature equal to from 270° to 360° F.

Now in order to appreciate the immense effects which this excess of temperature may produce in metallurgic operations, we must con­sider that often only a few degrees more temperature are required to modify the state of a fusible body, or to determine the play of affi­nities dormant at lower degrees of heat. Water is solid at 1° under 32° F. ; it is liquid at 1° above. Every fusible body has a deter­minate melting point, a very few degrees above which it is quite fluid, though it may be pasty below it. the same observation applies to ordinary chemical affinities ; charcoal, for example, which reduces the greater part of metallic oxides, begins to do so only at a deter­minate pitch of temperature, under which it is inoperative, but a few degrees above, it is in general lively and complete. It is unneces­sary, in this article, to enter into any more details to show the in­fluence of a few degrees of heat, more or less, in a furnace, upon chemical operations, or merely upon physical changes of state.

“These consequences might have been deduced long ago, and indus­try might thus have been enriched with a new application of science ; but philosophera have been and still are too much estranged from the study of the useful arts, and content themselves too much with the minutiae of the laboratory or theoretic abstractions. Within the space of seven years, the use of the hot-blast has been so much extend­ed in Great Britain, as to have enabled many proprietors of iron-works to add 50 per cent. to their weekly production of metal, to diminish the weekly expenses of smelting by 50 per cent., and, in many cases, to produce a better sort of cast-iron from indifferent materials."

The following table is from a report of M. Dufresnoy, made to the director-general of mines in France in 1834.

@@@ the accurate proportions are, by measure, oxygen 21, azote 79.

@@@ This mineral is very rich : the average produce of the iron mines of the Glasgow coal basin is 44 per cent. after calcination ; in this state it costs front 8s. 6d. to 9s. per ton. The cost of the mineral will, therefore, be very nearly as stated in the table.

@@@’ A similar reasoning may be applied to lamps. An argand burner, whether used for consuming oil or gas, admits almost an unlimited quantity of air. It would deserve inquiry, whether a smaller quantity might not produce greater light ; and, possibly, a different supply furnish more beat with the same expenditure of fuel.

**Cost price of a ton of pig-iron at the Clyde Iron Works.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Materials used.** | | **∣ln 1829.** | **with cold air.** | **In 1833, with hot air.** | |
|  |  | ton. cwt. | ***L. β.*** | ton. cwt. | ***L. s****.* ***d.*** |
| Coal for fusion, at |  | 6 13 | 1 13 3 | 2 0 | 0 10 0 |
| 5s. per ton. |  |  |  |  |  |
| — for blowing |  | *,* |  |  |  |
| machine, at 1s. 8d. |  | 2 0 | 0 3 6 | 0 11 | 0 0 11 |
| per ton, |  |  |  |  |  |
| — for the beating ap- |  |  |  | 0 8 | 0 0 8 |
| paratus, |  |  |  |  |  |
| Calcined ore, at 12s. |  | 1 15 | 1 1 0 | 1 18 | 1 2 9 |
| per ton,@@3 |  |  |  |  |  |
| Limestone, at 7s |  | 10 | 0 3 6 | ... | 0 3 6 |
| Labour, at 10s.. |  |  | 0 10 0 |  | 0 10 0 |
| General charges, in- |  |  |  |  |  |
| terests of capital, |  | ... | 0 6 0 | ... | 0 6 0 |
| 6s |  |  |  |  |  |
| Total | | | L.3 17 3 |  | L.2 13 10 |