through the retort, as soon as it is charged with ore. On the top of the fuel, which extends in the first place well up the shaft, the ore is fed in, mixed with limestone, both previously calcined by roasting in the open air, to drive off moisture and organic matter. The ore consists of iron in combination with oxygen, and this oxide (the same thing as "rust") is also mixed with various proportions of earthy matter which is chiefly silicic acid. To disengage this earthy matter from the ore, and to prevent the ore when melted forming with the silicic acid a silicate of iron (glass) and thus being lost, limestone is mixed with it, and the first effect of the hot gases passing upward is to decompose this as in a lime kiln, yielding lime. The lime, and the silicic acid or earthy matter mingled with the oxide of iron, now begin to act upon each other and form a crude silicate or glass, which will soon be easily melted and is then called slag. It is probable that at about the same time the carbonic oxide (carbon imperfectly oxidized, having only half the oxygen it will take) finds the iron oxide sufficiently heated and freed to deliver up its oxygen, which the carbon seizes, becoming carbonic acid, and leaving the iron free from oxygen and ready to melt as soon as it has settled a little further down into the intense heat. Here the slag or impure silicate melts, and a little later and lower the freed iron also melts, and at the same time probably combines with a portion of carbon from the fuel and thus subjects itself to what we have called its new master, becoming a carbide as it was before an oxide of iron. The carbide of iron (which we will call iron for shortness, and because we used to think it so) falls by its gravity to the bottom or hearth, the slag swims on its surface, and the chemical work is done. The workmen open a door just at the level of the surface of the iron, and haul off the slag from it, after which a small hole at the bottom of the hearth is opened, and the iron runs out into molds.

This operation has occupied from 24 to 48 hours, according to the height of the retort, and meanwhile alternate charges of fuel and minerals are fed in in at the top until the whole retort is filled and kept full by continued charging as fast as the contents descend and make room.

Entering (mentally) with the blast at the bottom of the retort, let us trace the operations of the fuel and air ascending the shaft, as we have traced the descending materials, ore and limestone.

For many ores such a degree of heat is required —and for most it is advantageous— that the air blast must be heated before it enters. The blast has lately been brought to a temperature as high as 1,100°, and a great advantage in the heat from a given fuel is obtained by feeding it with hot air —Mr. Crossley thinks four fold, up to the point where the blast shall be as hot as the fire itself. The first operation is probably the formation of carbonic acid by the union of two parts oxygen with one of carbon, and this evolves heat enough at this point to enable another portion of the carbon to recover an equivalent of oxygen from the carbonic acid, reducing the latter to carbonic oxide, which ascends until it meets the iron oxide and regains from it one equivalent of oxygen, becoming again carbonic acid and leaving the iron free, as we have before seen. In the improved modern furnaces, the carbonic acid, escaping carbonic oxide, free carbon or smoke, and other gases, are caught at the top of the shaft in contrivances for the purpose and taken off in pipes to reservoirs, whence they are fed into independent furnaces and burned with other fuel and air blast, to heat the blast for the smelting furnace and raise steam for the engines.

Aluminium in Dentistry.

Dr. J. B. Bean announces in the *Dental Cosmos* that he has succeeded in discovering a process for fine casting in aluminium, which will enable the profession to make plates for artificial dentures preferable in all respects to those of any other material, from gold to vulcanite. In strength and rigidity he affirms that the aluminium plate, when properly cast with very slight and suitable alloy, is far superior to gold and platinum of the same condition and thickness, while its extreme lightness is one of the most desirable of qualities. In cleanliness nothing can be better: it has no more taste than porcelain, its brilliancy is much more lasting than that of silver, plates worn for weeks without cleaning exhibit no change, and sulphur and sulphuretted hydrogen, which attack silver and gold, have no effect whatever on aluminium. Its lightness is the great difficulty in casting it in fine molds, and a peculiar process had to be originated, which the inventor generously declines to patent, although he thinks the apparatus used should be covered by a patent, as an article of manufacture. Eminent dentists are said to have pronounced it "the great desideratum attained."

The Past and Future of the Steam Engine.

What have we done in steam engine improvement since the time of Watt? Absolutely nothing, except in the employment of such better workmanship and materials as have resulted from the extension of manufacture and efflux of time. We use more malleable iron in the working parts; the nicety of our workmanship is greater; and the superior strength of our boilers and the diminished prejudices of the public enable us to employ a somewhat higher pressure of steam. But expansion, steam-jackets, surface-condensation were all used by Watt, and are only considered innovations by some persons because they were first abandoned and then resumed. Super-heating was at one time expected to do a great deal for us; but, after all, it is found that an amount of super-heating, such as was obtained in the old flue-boilers with the root of the chimney passing through the steam-chest, is most advisable. In smoke-burning we have done no better than Watt did, and after more than half a century of effort we are forced to come to the humiliating conclusion that in the steam engine we have made no tangible improvement at all. High-pressure steam was as well known in the time of Watt as it is now; but at that time the prejudices against it were greater than they are now, and the manufacture of boilers was in a ruder state. But up to the present time the use of high-pressure steam worked very expansively, though known to be productive of economy of fuel, has been little adopted in steam vessels, where such economy is most important; the prejudices against its use being still such as to hinder its