Considering their number, their size, their continuous working for many days together, and their liability to incrustations, such boilers might be expected to explode frequently. [It is not at all singular; it is because they are taken care of.—EDS.]

In some of the locomotive boilers made by Mr. Allan, of the Scottish Central Railway, the fire box is a cylindrical continuation of the barrel of the boiler, and is wholly surrounded by a water space with the exception of an opening, like a man-hole, for the admission of air to the internal grate.

Dr. Ernst Alban at one time worked a steam engine, in London, to a pressure of 1,000 lbs. to the square inch.

Steam boilers constructed of wood were at one time employed to some extent.

Professor Rankine estimated the evaporation of water, per pound of coal, in the boilers of the steamer *Thetis* as 13·78 lbs.

In a discussion on steam boilers at the Institution of Mechanical Engineers, Mr. D. Adamson stated that he knew of many boilers 7 feet in diameter working at 100 lbs. pressure, and one of that size was worked at 150 lbs. [How thick were the plates?—EDS.]

The Giffard injector, when supplied with steam of 25 lbs. per square inch from one boiler, has forced water into another boiler against a pressure of 48 lbs. per square ineh.—*Engineering.*

OUR SPECIAL CORRESPONDENCE.

ORE HILL, SALISBURY, CONN.
July 21, 1866.

The way the famous Salisbury charcoal iron is mined, and the way it is made.

Near the western edge of the town of Salisbury, Conn., about one mile from the New York State line, is the Old Bed of hematite iron ore, from which, when smelted with charcoal, iron is made equal in quality to any produced in the world. This excellence is doubtless owing to the absence of sulphur, phosphorus, and other impurities in the ore, and the advantage of charcoal, as a reducing agent, is its freedom from these impurities, which are generally present in mineral coal. The mine resembles a very extensive railroad excavation, excepting that it is crooked and irregular, and the mass of earth which has been drawn out of it is piled in scattered mounds around it. It is about eighty feet in depth, and the town road passes right through it, though not in the deepest part, following the winding cart paths up which the waste earth is drawn. The deposit above is mica slate, in an advanced stage of decomposition, and the ore occurs in seams or beds dipping to the southeast, at an angle of about fifty degrees. The beds range in thickness from that of a knife blade to twenty or twenty-five feet, and the ore is so brittle that most of it may be dug by the pick, though considerable blasting is required. Three-fourths of the labor is expended in removing the superincumbent mica slate and clay, which are hauled up steep paths in one and two-horse carts, and dumped in irregular piles around the sides of the pit. The large lumps of ore are thrown directly into wagons and hauled away to the furnaces, but the small fragments are passed through a washing machine to free them from the earth with which they are mingled.

The washing machine is a revolving cylinder about 4½ feet in diameter and 6 feet in length, formed of cast-iron staves with wrought-iron hoops. Each alternate stave is perforated with quarter-inch holes for the escape of a portion of the water, and all the staves are armed upon the inner side with broad teeth cast on them, and arranged spirally so as to tumble the ore through the cylinder and out at the end opposite to that at which it enters. Water, raised from the bottom of the pit by a steam pump, flows down a steep trough into the cylinder; and into this trough the small fragments of ore are dumped from the carts. The cylinder receives a slow rotary motion from horse-power—three horses being required for the work. The water, with the waste earth, flows from the cylinder through a long trough, at the lower end of which a workman is constantly employed in shoveling away the deposit.

The mine is owned by an incorporated joint-stock company, with a nominal capital of $40,000, though its actual value is several times this amount, as the annual revenue is in the neighborhood of $30,000. The furnace men pay the proprietors $2 per tun for the ore in the bed; they then pay $2 75 per tun for digging, and from $1 upward for hauling, according to their distance from the mine. The mine has been worked for more than a hundred years. The ore at first was transported in leather bags on horseback to Sheffield, where it was made into wrought iron by the direct process, without passing through the state of cast iron. Mr. Peter P. Everts, the agent of the proprietors, tells me that some of the Salisbury mines make very inferior iron—only this particular bed enjoying the reputation of the very best quality among those who understand the matter. He says also, that this iron—both cast and wrought—shrinks much more in cooling than most qualities, but that the cast iron is less fluid and does not make so sharp castings as some inferior metal.

It is owing to the steepness of the hill sides in this region that charcoal can be used here for smelting iron; the hills, being too steep for cultivation, are given up to the growth of wood, from which the charcoal is made. About a mile from this place is the Phenix Furnace, which is one of the vast and varied possessions of C. T. Maltby, a self-made millionaire, of New Haven. In the neatness and perfection of its arrangements it is a model establishment, and it is supplied with both ore and limestone from a mine and quarry directly by its side. It is 32 feet in hight, 9 feet in diameter at the boshes, and 4 feet at the top, built of stone and lined with fire-brick 9 inches in thickness. The "founder," Mr. Horace Harris, is a Massachusetts man, and he was brought up to the trade by his father.

Long before chemists had learned that carbon will, at the proper temperature, take oxygen from any other element, practical iron workers had discovered that by heating iron ore in contact with coal they were able to obtain metallic iron. Hematite is a combination of oxide of iron ($Fe_2 O_3$) and water, in the proportion of 80 lbs. of oxide of iron to 9 lbs. of water. This combination is a brittle substance, neither malleable nor ductile, nor possessing any of the peculiar properties of metals. The object of smelting is to remove the oxygen and to retain the iron in a pure metallic form. This is effected by heating the ore in contact with some form of carbon, either charcoal, anthracite, or coke. As 1-10,000th part of either phosphorus or sulphur materially impairs the quality of the iron, and as anthracite and coke are rarely, if ever, free from these impurities, the best quality of iron is obtained only by smelting with charcoal.

The process, as practiced at Mr. Maltby's Phenix Furnace, is as follows: The furnace is first filled with charcoal, which is set on fire. Then a charge of ore and limestone is introduced at the top. As the coal is burned out the charges are renewed, from 40 to 45 being introduced in the course of 24 hours. Each charge consists of 25 bushels of coal, 200 lbs. of limestone, and from 1,200 to 1,500 lbs. of ore. The quantity of ore is varied to adjust the temperature, as on this depends the hardness of the iron produced. The ore gives up its oxygen, which combines with the carbon of the coal, forming carbonic acid—a gas that floats away in the atmosphere. At the same time the iron absorbs a small quantity of carbon, becoming, by this process, cast iron, with a melting point far below that of pure iron. The hotter the furnace the smaller is the quantity of carbon absorbed, and the softer is the cast iron produced. The iron is numbered from 1 to 6, according to its hardness, with an intermediate half number between 4 and 5. This intermediate number, 4½, is suitable for car wheels.

The fire is urged by a powerful blast of hot air, the air being heated by the waste heat in the top of the furnace; the waste heat is also used for generating steam for driving the blowers. The blowers are two wooden cylinders, furnished with pistons like those of steam-engine cylinders. These cylinders are each 5 feet in diameter, with 5-feet stroke. They are formed of inch plank sawed out in pieces like fellies, and are lined with veneering, the grain of which is laid longitudinally. The heads are of cast iron, and they are held together by iron bolts extending from one to the other, outside the cylinder. These cylinders are laid horizontally, and to prevent the weight of the piston from wearing them on the lower side, the piston rod is extended through the head and supported by a yoke running in greased ways. These wooden cylinders have been in use 13 years, and are still in good condition, but Mr. Harris thinks iron is much the most suitable material for this use. To prevent the force of the blast from varying with the varying velocity of every stroke, the air is blown into a regulator, which is simply a cylinder like those of the blowers, set upright, and with the upper head loose like a piston, and loaded to the requsite pressure. The pressure of the blast is about 1½ pounds to the square inch; it is measured by a siphon gage placed in plain sight of the engineer.

The air is heated after it leaves the blowers by passing through a series of cast-iron pipes, of siphon form, set in the furnace chimney above the point at which the coal, ore, and lime are introduced. The temperature desired is about 600 deg., and the founder at this furnace employs two tests to measure the temperature. As lead melts at 612deg. this affords a convenient test for that temperature; and a still more convenient is the kindling of a stick of pine wood. Mr. Harris says that he does not suppose, in still air, a stick of pine would take fire at 600 deg., but, in the powerful blast from these tweers, he was taught by his father to regard it as a trustworthy test.

The furnace is kept in constant operation night and day, and once in eight hours it is tapped at the bottom, and the molten metal is drawn out and run into pigs—from 3 to 3½ tuns of iron being obtained at a casting. The present price of the best Salisbury iron is $70 per tun. Mr. Maltby is holding heavy stocks of cast iron—variously stated at from $150,000 to $300,000 worth—and it is said that most of the furnace men in the region are also holding largely in hopes of still higher prices, notwithstanding the inflated condition of the currency.

The lime used in smelting iron is employed as a flux. It combines with the silica of the iron ore, forming a silicate which is fusible at the temperature of the furnace, and which consequently melts and runs out of the way, thus allowing the several globules of molten iron to run together and flow down to the bottom of the furnace. Innumerable other chemical changes go on in the interior of a smelting furnace, among the many impurities of iron ore with the fuel and flux, at the high temperature that obtains, but those stated are the principal and essential ones. G. B.

Casting of a Twenty-inch Cannon.

Another twenty-inch gun was recently cast at the Fort Pitt Iron Works, Pittsburg, Pa., being the third one of that size. This is the first naval gun, however, and is intended for the *Puritan*, consort of the *Dictator*, both ocean monitors. The two previously cast were army guns. They are Rodman guns, that is, cast with a water-cooled core.

The quantity of metal melted at once was enormous; not less than 140,000 pounds, and three furnaces were in use to accomplish it in time, the fires being started at 4.30 A. M. on the morning of pouring. The iron was in the following proportion: 101,000 Juniata, second fusion; 39,000 Juniata pig, from the Bloomfield Furnace; this is stated to be the finest quality of metal, for gun founding, in the country. The furnaces were tapped at 12.10, and the mold was filled in a short time.

The length of the rough casting is 236 inches. The maximum diameter is 65½ inches, and the minimum 48 inches. When finished, the breech of the gun will measure 64 inches in diameter, and the nozzle 35½ inches. The length of the cylinder bore is 147 inches, depth of chamber 10 inches. The thickness of metal outside the bore, at the breech, is 22 inches, and at the nozzle 7 9-10 inches. Diameter of trunnion 18 inches. At 9.20 Sunday morning the water was turned off, at which the temperature was 97 deg. The core barrel was hoisted, when it came out perfectly clean, there being every indication of perfect success in the casting. After the barrel was hoisted out, a very small stream of water was allowed to flow into the bore, when it immediately became steam. This was to be continued until 8 o'clock, when a column of cold air would be forced in, and the cooling process completed in this way.