

he will collect sufficient evidence to occasion quite a change to come over the spirit of his dream. Any merchant steamer on this station is proportionally better manned in the engine department than the "*Powhatan*," and but few of them do more running. But I am digressing. I sat down to write about the "*Lancefield*."

To resume. The cylinders are fitted each with a locomotive slide valve, which cut off the steam at one-third from the termination of the stroke. They were formerly fitted also with slide cut-off valves, but they did not work well, and the engineer has now dispensed with them as a useless appendage, preferring the use of the throttle valve and the consequent loss of steam by wire drawing, when a reduction of speed becomes necessary.

With the maximum speed of 62 revolutions per minute, in smooth water, under steam alone, I am informed she obtains a speed of fifteen knots the hour; but as this only gives the propeller, allowing 6082½ feet to the knot, 12·3 per cent. slip, I fancy she does not make as much as that; but as she is a vessel of excellent model, very fine lines, and considerable length, comparatively with breadth of beam, I think that under favorable circumstances, her bottom and propeller blades being free from barnacles, shells, &c., that very rapidly form on iron vessels running in salt water, 20 per cent. would be a fair allowance for slip, which would give her a maximum speed of 13·7 knots per hour. This speed is obtained by the consumption of 45 tons of coal per diem. The data that I obtained relative to the performances of the boilers, &c., I do not consider sufficient of reliance upon which to base any calculations either of their evaporative powers, or the horses power developed by the engines, more particularly as I am in possession of no indicator diagrams showing the true point of cutting-off with the pressure of steam on the piston for any particular period. K.

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For the Journal of the Franklin Institute.

*Is there Native Iron in Africa?* By ROBERT F. BROWER, M. D., Secretary of the American Iron Association.

Not a little interest has been felt in relation to an alleged discovery of native iron in the interior of Africa. Nearly all our journals have published some general statements that have been made in respect to it, coupled with names of practical analysts; on which account we have waited with some hope that we should have, fully recorded, all the particulars of such an interesting and anomalous discovery. As we have not been satisfied by any explanations, we take the liberty to declare our opinion of the improbability of any such discovery, with the reasons for our conclusions. Inasmuch as we have had similar representations made concerning iron ores found in our own country, it is well that we should clearly understand how pure it is possible for iron to exist in its matrix—the soil or rocks.

Iron has a strong affinity for oxygen, to such an extent that it will decompose water, whether free or in union with soils or rocks. Most min-

erals contain water as a chemical constituent, and iron under the slow but sure operation of attraction will, where there is the least permeability of rocks, decompose it, drawing from it, even though at remote distance, its oxygen. Those elements which have the strongest affinities for each other, will unite when brought together, however long time is required. Whether we find iron in plutonic or secondary rocks, at whatever depth below the surface, it is invariably in the state of an oxide, if not combined with other elements. Such has been the universal experience of mining. Meteoric iron having been formed under different circumstances from any that present to us in or upon the earth, we cannot refer to it as conflicting with our statements.

Iron presents such a variety of interesting phenomena under various treatments, that it is very easy to be misled in theoretical conclusions, if we do not measure accurately the chemical forces at work. A smith may take a piece of the magnetic ore of Lake Champlain or New Jersey, or of the specular ore of Superior or Missouri, and by careful treatment in his smithery fire, will work out a knife blade from one end, while the other retains its original appearance. Again, he may take a piece of these ores, and in a moderate fire, allowing considerable time, will convert it into metallic iron, without altering materially its general outward appearance. That the smith and many others should conclude, therefore, that the ore was pure iron, is not at all strange. He does not know the influences of heat in driving off, or rather drawing off, its oxygen, to unite with a portion of the carbon of the fuel.

Iron under careful or moderate protection by artificial means may be preserved possibly for ages; but as a general rule it is steadily in process of union with oxygen and returns to earth. It is not reasonable, therefore, to expect to find virgin or native iron, unless it has been formed by some recent cause. Meteorolites are presumed to be ejected from volcanoes of our own or some other sphere. The only other conceivable circumstance under which pure iron might be formed in nature, is by the ejection of trap rock through pure iron ore lying contiguous to coal; but the great improbability of any such occurrence is at once evident to a geologist. The idea of such a possibility would not suggest itself, were it not stated that the alleged native iron was associated with zeolite. A crystallization often occurs in working iron ores which resembles zeolite, and possibly has the same composition. There are no facts presented in relation to the alleged native iron, disproving that the specimen was originally magnetic or specular oxide, or the spathic carbonate of iron, and had been converted in a smithery, under a slow fire, by which means, as it may often occur, there was no excess of carbon; on the contrary, crystals of magnetic oxide remained, with quartz and zeolite, a silicate of alumina, and lime or soda.

The following are the compositions of magnetic, specular, and spathic ores, which are the purest states in which iron is formed in the earth.

Magnetic iron ore ( $\text{Fe}_3\text{O}_4$ ) contains in 100 parts

of iron, 72.4 parts by weight,

oxygen, 27.6 do. do.

affording 72.4 per cent. of iron by analysis, or about 65 per cent. in a smithery, or catalan forge fire, when carefully managed.

Specular iron ore ( $\text{Fe}_2 \text{O}_3$ ) contains in 100 parts

of iron, 70 parts by weight,

oxygen, 30 do. do.

affording 70 per cent. of iron by analysis, or about 63 per cent. in a smithery, or catalan forge fire.

Spathic iron ore ( $\text{Fe. O. C. O}_2$ ) contains in 100 parts

of iron, 48.3 parts of iron,

carbon, 10.4 do. do.

oxygen, 41.3 do. do.

affording 48.3 per cent. of iron by analysis, or about 40 per cent. in a smithery, or catalan forge fire.

We should remark in respect to this last ore, that when first mined it is yellow, but in time turns to a dark brown color. This ore when roasted becomes the magnetic oxide of iron, the carbonic acid being driven off or decomposed. When found quite pure, it may be worked as the others, in a smithery, or catalan forge fire. Most probably this is the ore found in Africa, for the Rev. Aaron P. Davis, who sent the specimens to America, writes that "When he (Mr. George L. Seymour, who obtained it from the natives) brought it, it appeared like a craggy rock, of yellowish color on its surface, and with a very small exception, it could not be separated but by heat, and hard pounding with my largest sledge hammer, and a chisel prepared for the purpose." *Heat and hard pounding*, we know not for how long a time, have materially altered the character of the mineral.

When pure iron ore in small quantities is reduced in a smithery fire, it may be worked to any degree of excellence. We have not space to show the relative costs of reduction by various processes, or to set forth the relative value of the products. But it is evident to every one conversant with the nature of iron, that in small quantities, in a charcoal fire, it may be thoroughly worked to a superior quality, as by the natives of Africa, at a heavy cost of labor. A SMALL SPECIMEN OF IRON PREPARED EXPRESSLY FOR ANY CERTAIN PURPOSE, DOES NOT AFFORD A PROPER EVIDENCE OF THE QUALITY WHICH CAN BE MADE FOR THE MARKET, WITHIN THE MARKET VALUE.

We cannot reasonably leave this subject without alluding to what would be the expense of mining native iron, supposing it were found. Even the quotation from Mr. Davis's letter may satisfy our judgment, though there is stronger evidence that it could not be mined at a profit for our market. Native copper when found in masses, costs for mining several times the value of its weight of iron. Copper may be cut with chisels, but who would undertake to cut up solid or even porous masses of iron for its whole value? If there are any who desire the business, they may find in our country pretty extensive masses of iron taken from chilled furnaces, which the furnace masters would gladly have removed from their premises.

Since the above article was written, the writer has received specimens of the iron, and has examined several reports and accounts respecting the reputed discovery. He is fully confirmed in opinion that his views of the iron in question are correct; and that the specimens were "brought

to nature" in a smithery fire, from the spathic ore—the proto-carbonate of iron.

If there is an abundance of this ore, or of the others mentioned, in even a moderate degree of purity, found in Africa, and easy of access, it is far more valuable than a seam or deposit of massive native iron. Copper, in masses, may be cut up, and is then worth about \$500 a ton. Crude irregular masses of iron would be worth not more than 20 to 25 dollars a ton.

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*An Account of some Experiments made with the Submarine Cable of the Mediterranean Electric Telegraph.* By CHARLES WHEATSTONE, F.R.S.\*

The following results were obtained between May 24 and June 8 in last year, with the telegraphic cable manufactured by Messrs. Kuper and Co. of East Greenwich, for the purpose of being laid across the Mediterranean Sea, from Spezia on the coast of Italy, to the island of Corsica. The manufacturers, in conjunction with Mr. Thompson, the engineer of the undertaking, kindly afforded me every facility in carrying on the experiments. The short time that elapsed between the opportunity presenting itself and the shipping of the cable for its destination, prevented me from determining with sufficient accuracy some points of importance, respecting which I was only able to make preliminary experiments, but the following, which I was able to effect with the means at hand, may possess sufficient interest to be made public. They present perhaps nothing theoretically new, but I am not aware that experimental verifications of some of these points have been made before. I assume that the reader is acquainted with the experiments of Dr. Faraday described in the *Philosophical Magazine*, Ser. 4, vol. vii, p. 197.

The cable was 110 miles in length, and contained six copper wires, one-sixteenth of an inch in diameter, each separately insulated in a covering of gutta percha one-tenth of an inch in thickness. The whole was surrounded by twelve thick iron wires twisted spirally around it, forming a complete metallic envelope one-third of an inch in thickness. A section of the cable presented the six wires arranged in a circle of half an inch diameter, and one-fifth of an inch from the internal surface of the iron envelope.

The cable was coiled in a dry well in the yard, and one of its ends was brought into the manufactory. The wires were numbered 1, 2, 3, 4, 5, 6, and the ends in the well were indicated by an accent; the ends 1'2, 2'3, 3'4, 4'5, 5'6 were connected by supplementary wires, so that the electric current might be passed in the same direction through all the six wires joined to a single length, or through any lesser number of them, the connexions being made at pleasure in the experimenting room.

The rheomotor employed was an insulated voltaic battery consisting of twelve troughs, each of twelve elements, which had been several weeks in action.

*First Series.*—The following experiments show that the iron envelope

\* From the Lond., Edin., and Dub. Philos. Mag., July, 1855.