The Tribune and the Scientific American on Locomotion.

The *Tribune* of the 14th inst. contains an article in reply to ours in No. 48; it commences as follows:—"A recent article of ours on locomotion, has provoked the criticism of the Scientific American. We said that but for the resistance of the air, with the engineering requisite for the circumstances, a speed of a hundred miles an hour might be attained on a railroad economically—we did not say how safely." The article of the *Tribune* which we criticised, stated very plainly that but for the resistance of the atmosphere, railroad trains might run *very* economically, at the rate of *several* hundred miles per hour. This, we thought, required correction, as many persons not acquainted with the subject might be led to form the opinion that the resistance of the air was the principal obstacle to our railroad trains adopting higher speeds. At the present time the speed of express trains on the New York and Erie Railroad is thirty-five miles per hour, and on the New York Central forty miles and if this were increased to fifty miles, the resistance of the atmosphere—as we presented the question—would only be 12 1-2 lbs. on the square foot of frontage—a mere trifle in the running of trains at such a speed. If this were the only obstacle to our railroad trains increasing their speed to 100 miles per hour, it would not give the engineers or superintendents a second thought.

We have always endeavored not to make a dubious statement in discussion for the mere purpose of making a good case. The amount of resistance, 12 1-2 lbs. on the square foot, on trains running at the rate of 50 miles per hour, is the amount of pressure exerted by the wind on a stationary body, and recorded by numerous experiments, and we presented this amount, so that no person could say we under-stated it. But Dubuat has observed, that both in the case of air and water, the resistance to a body moving through them with a certain velocity is less than the resistance of the air or water moving with the same velocity against the body at rest; according to Emerson, the mathematician, the resistance is but one half. It has also been found that the resistance of the air to a body, if it is a cube like a railway train, is as 0014 to 0017 of a plate embracing the same area of frontage. The resistance of the atmosphere, therefore, to railroad trains moving at the rate of 100 miles per hour, may, upon good authority, be set down as low as 25 lbs. on the square foot of frontage—it cannot at least, by any possibility, be more than 50 lbs. But for the sake of all that is sensible in discussing improvements in science and art, let no one talk any more about the difficulties of atmospheric resistance to railroad trains running at the rate of two hundred or one hundred miles per hour, as long as our fastest trains are running only at the rate of forty.—When they attain to 50, 60, or 100 miles per hour it will be time enough to talk of atmospheric resistance.

The *Railroad Advocate*, of the 18th, returns to another interloping charge. We did not suppose there was a single paper in our country, that could so stupidly understand the subject and misrepresent it. It now admits all we contended for, but insinuates to the contrary. It states there is a resistance arising from friction, and a resistance from concussions, "the principal one up to a speed of 100 miles per hour." This latter, it asserts, merely increases directly as the velocity, while the atmospheric resistance is as the square of the speed. This is not correct, the resistance of concussions increases as the square of the speed also.

The *Tribune* of the 18th contains a second and very unfair reply to our remarks. It expresses sorrow at us "manifesting so strong a disposition to ignore the question whether atmospheric resistance increases in the duplicate ratio of the velocity." Now we have done no such thing. We simply proved a negative to atmospheric resistance being the cause of preventing railroads running very *economically* at high speeds. We have done more than comply with the legitimate rules of discussion in what we have said. The *Tribune* has not yet proved a positive; but as it has asked for more information on the subject, we will give it.

D. K. Clarke, the very best authority on railroad engineering, says, respecting railroad resistances: "they are divisible into two parts—the *constant* and the *variable* resistance, of which the latter varies as the square of the speed, starting from nothing, when the train is just in motion. The *constant* resistance is due to the internal friction of wheels, axles, and machinery; the *variable* resistance is due to the atmosphere, to lateral oscillation, and concussion, to vertical oscillations, and concussion between the wheels and rails."

"All these *varying* resistances ought to vary, we believe, as the square of the speed, as we find in fact *they* do, *and not as the speed simply*."

These were the conclusions at which he arrived after a number of personal experiments made upon railway trains to test the resistances, with proper apparatus, and also by an examination of D. Gooch's tables of experiments. No matter, then, what speed may be adopted on our railroads, all the variable resistances increase as the square of the velocity, and at present speeds, the atmospheric resistance is by far the smallest. This has been found to be the case in the working of all our railroads. We have been the constant advocate of improvements in our railway system, and have frequently pointed to the great source of expense in working them, viz., defective permanent way, embracing numerous curves, inclines, bad tracks, &c. For this we have received the thanks of many engineers at various times, and we shall never be diverted from advocating sensible improvements in railroad engineering by absurd and ignorant declamations about *air* resistance.

The *Tribune* asks us some questions respecting Ithiel Richardson's method of sending packages through a vacuum tube. It still entertains very wrong theoretical ideas respecting it. It says, "when you have got rid of atmospheric resistance it is obvious that any constant force which is more than able to move a load, will, on a level, cause it to move with an accelerated velocity like that of a falling body."—This cannot be a correct comparison, as the accelerated velocity of falling bodies is caused by the attraction of gravitation, the force of which increases according to the square as two bodies approach one another. A railroad train upon a level, or a parcel in a tube, with the atmospheric resistance removed could not be moved by a constant force to acquire an accelerated velocity, because they would have to overcome constant and variable resistance at every point along their whole course.—The expression of the *Tribune*, "any constant force which is more than able to move a load," is very obscure. We presented no arguments against Mr. Richardson's plan of sending messages and packages through a vacuum tube; we would really like to see it tried.

The *Tribune* will find some useful information on this subject on page 298, Vol. 8, Scientific American.

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On the Manfacture of Steel.

The following is the substance of a paper read a short time since by Charles Sanderson, Esq., before the Royal Society of Arts, London, and published in the London *Mechanics Magazine* and the *Mining Journal*.

The kinds of steel which are manufactured are natural steel, called raw steel, or German steel; Paal steel, produced in Styria, by a peculier method; cemented or converted steel; cast-steel, obtained by melting cemented steel; puddled steel, obtained by puddling pig iron in a peculiar way.

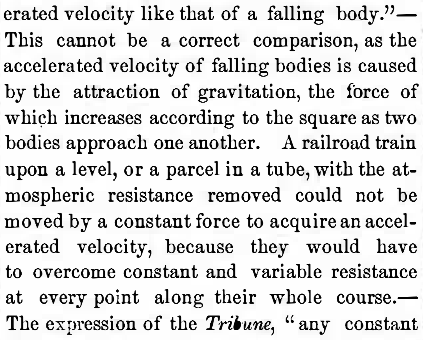


Fig. 1

Natural or German steel is so called because it is produced direct from pig iron, the result of the fusion of the spathouse iron ores alone, or in a small degree mixed with the brown oxyd; these ores produce a highly crystalline metal called *spiegel eisen*, that is, looking-glass iron, on account of the very large crystals the metal presents. This crude iron contains about four per cent. of carbon, and four to five per cent. of manganese. Karsten, Hassenfratz, Marcher, and Reamur, all advocate the use of gray pig iron for the production of steel; indeed they state distinctly that first quality steel cannot be produced without it; that the object is to clear away all foreign matter by working it in the furnace, to retain the carbon, and to combine it with the iron. This theory is incorrect, although supported by such high authorities. Gray iron contains the maximum quantity of carbon, and consequently remains for a longer time in a state of fluidity than iron containing less carbon; the metal is then mixed up, not only with the foreign matter it may contain, but also with that with which it may become mixed in the furnace in which it is worked. This prolonged working, which is necessary to bring highly carbonized iron into a malleable state, increases the tendency to produce silicates of iron, which entering into composition with the steel during its production, renders it red short. Again, by this lengthened process, the metal becomes very tender and open in its grain; the molecules of silicate of iron which are produced will not unite with the true metallic part; and also, whenever the molecular construction of iron or steel is destroyed by excessive heat, it becomes unmalleable. Both these are the causes of red shortness, and also of the want of strength when cold. In Austria, however, they have improved upon the general continental process, their pig iron is often highly carbonized, but they tap the metal from the blast furnace into a round hole, and throwing a little water on the surface, they thus chill a small cake about half an inch, this is taken from the surface, and the same operation is performed until the whole is formed into cakes; these cakes are then piled edgewise in a furnace, are covered with charcoal, and heated for 48 hours; by this process the carbon is very much discharged. By using these cakes in the refining, the steel is sooner made, and is of better quality. Pig iron can only be freed from its impurities whilst in a fluid state. It should be purified in that state to obtain a purer metal for the production of steel. The metal itself being to some extent decarbonised, is sooner brought into "nature," as it is termed; that is, it sooner becomes steel. The process being shorter, and the metal itself being purer, there is less opportunity for the formation of deleterious compounds, which becoming incorporated with the steel, seriously injure its quality. Of course steel manufactured from crude iron, either purified or not, of any defined quality, will inherit such quality, be it good or bad. Art can in some degree remove these noxious qualities from the crude iron.

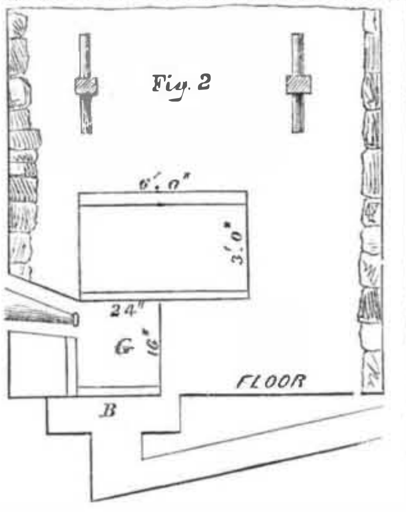
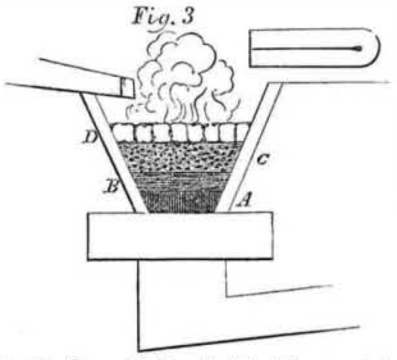


Fig. 3



The furnaces in which raw or natural steel is manufactured are nearly the same, as far as regards their general construction, in all countries where such steel is produced; yet each country, or even district, has the fire in which the metal is worked differenly constructed.—We find, therefore, the German, the Styrian, the Carinthian, and many other methods, all producing steel from pig iron, yet pursuing different modes of operation. In Seigen they use the white carbonized manganesian metal, while in Austria a gray or mottled pig iron is used.

The furnace is built in the same form as a common charcoal refinery.

Fig. 1 shows a ground-plan of the furnace; fig. 2 an elevation; and fig. 3 the form of the fire itself and the position of the metal within it. The fire, D, is 24 inches long and 24 inches wide; A A A are metal plates surrounding the furnace.

Fig. 2 shows the elevation, usually built of stone, and braced with iron bars. The fire, G, is 16 inches deep and 24 inches wide. Before the tuyere, at B, a space is left under the fire, to allow the damp to escape, and thus keep the bottom dry and hot.

In fig. 1 there are two tuyeres, but only one tuyere-iron which receives both the blast nozzles, which are so laid and directed that the currents of air cross each other, as shown by the dotted lines; the blast is kept as regular as possible, so that the fire may be of one uniform heat, whatever intensity may be required.

Fig. 3 shows the fire itself, with the metal, charcoal, and blast. A is a bottom of charcoal rammed down very close and hard. B is another bottom, but not so closely beaten down; this bed of charcoal protects the under one, and serves also to give out carbon to the loop of steel during its production. C is a thin stratum of metal, which is kept in the fire to surround the loop. D shows the loop itself in progress.

When the fire is hot, the first operation is to melt down a portion of pig iron, say 50 to 70 pounds, according as the pig contains more or less carbon; the charcoal is then pushed back from the upper part of the fire, and the blast, which is then reduced, is allowed to play upon the surface of the metal, adding from time to time some hammer slack, or rich cinder, the result of the previous loop. All these operations tend to decarbonize the metal to a certain extent; the mass begins to thicken, and at length becomes solid. The workman then draws together the charcoal and melts down another portion of metal upon the cake. This operation renders the face of the cake again fluid, but the operation of decarbonization being repeated in the second charge, it also thickens, incorporates itself with the previous cake, and the whole become hard; metal is again added, until the loop is completed. During these successive operations the loop is never raised before the blast as it is in making iron, but it is drawn from the fire and hammered into a large bloom, which is cut into several peices, the ends being kept separated from the middle or more solid parts, which are the best.

This operation, apparently so simple in itself, requires both skill and care. The workman has to judge, as the operation proceeds, of the amount of carbon which he has retained from the pig iron; if too much, the result is very raw, crude, untreatable steel; if too little, he obtains only a steelified iron. He has also to keep the cinder at a proper degree of fluidity, which is modified from time to time by the addition of quartz, old slags, &c. It is usual to keep from two to three inches of cinder on the face of the metal, to protect it from the direct action of the blast. The fire itself is formed of iron plates, and the two charcoal bottoms rise to within nine inches of the tuyere, which is laid flatter than when iron is being made. The position of the tuyere causes the fire to work more slowly, but it insures a better result.

The quantity of blast required is about 180 cubic feet per minute, at a pressure of 17 inches water gauge. Good workmen make 7 cwt. of steel in 17 hours. The waste of the pig iron is from 20 to 25 per cent., and the quantity of charcoal consumed is 240 bushels per tun. The inclination of the tuyere is 12 to 15 degrees.—The flame of the fire is the best guide for the workman. During its working it should be a red blueish color. When it becomes white the fire is working too hot.

This concludes first part of Mr. Sanderson's very useful paper on natural steel. The second part embraces a distinct manufacture of steel, and is entirely separate from this.