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**Contents:**

(Illustrated articles are marked with an asterisk.)



The SCIENTIFIC AMERICAN has always given prominent consideration to letters from its correspondents, and its columns are open to contributions from practical men upon all matters relating to the arts and sciences. Mechanics not accustomed to write for the papers are inclined to shrink from a task which they deem themselves unfit to perform. This ought not to be. All communications intended for our paper are carefully revised before publication, therefore mechanics need not fear to write to us on any subject that may interest them. We will see to it that their contributions are well prepared for the paper before publication. Send in the documents.

### IMPROVEMENTS IN THE MANUFACTURE OF BOILERS.

The English and continental mechanics have directed considerable attention latterly to the improvement of boilers, in their material and method of manufacture. Cast steel has been tried as a material for boilers, particularly those of locomotives, with considerable success. Sixteen locomotives with boilers of cast steel were manufactured during the half year ending 1865 at the works of the Austrian Staatsbahn Railway Company: of these seven were for their own lines, and the rest were delivered for the use of the Ferdinand Northern Railway. All the tests applied to these boilers have given thoroughly satisfactory results, and no fault has yet been found with them. The Ferdinand Northern Railway also ordered last year nine goods-train locomotives with cast-steel boilers, from the engine works of Sigl, in Vienna. It was specified in the order that the engines were to be lightly but very strongly built, and were to be made suitable for burning small coal, the use of which necessitates the employment of boilers having a large heating surface and furnace. Besides these new locomotives, six old ones were reconstructed on the same principles and with cast-steel plates, in the works of the Northern Railway. Eighteen more locomotives for passenger and goods trains are also to be similarly reconstructed during this year at the same works.

Welded boilers are now made quite extensively in England. The Midland Railway Company build all their boilers on this plan. The plates are rolled with thickened edges, the ordinary thickness of seven sixteenths of an inch being preserved in the body of the plate and the edges being thickened to five eighths of an inch, the taper being gradual and extending from the edge back to about four inches. The longitudinal seams of each cylinder of the boiler iron is a lap weld, and the edges of the cylinders are squared up in a lathe, making flush joints, which are covered with welded hoops double riveted. Machinery not essentially different from that in ordinary use is employed to bend the plate, and the welding is accomplished by means of a crane and a curved anvil face, the convexity of which corresponds to the diameter of the barrel. A welding heat is taken on a portion of the seam, the edges of the plate being scarfed down, and the weld is perfected by repeated heatings of successive portions of the joint.

Corrosion of locomotive boilers is a prolific source of deterioration and also of explosions, and this corrosion is generally confined to particular localities, being found around the smoke-box end of the boiler and along the edge of the inside lap of the riveted longitudinal joints. This is to be attributed undoubtedly to expansion and contraction at the longitudinal seams, by which the joints are alternately opened and closed, continually cracking and removing the scale and exposing the iron to further corrosion. It is apparent that if these longitudinal joints could be dispensed with and the substance of the boiler barrel be of a uniform thickness and homogeneousness, the unequal expansion and contraction would be prevented. Such, in fact, has been the result on the Midland Railway, so far as the trials have extended. Experiments as to the strength, also, of the welded joints show that the plate is as strong at the weld as at any other part.

### FRICTION WHEELS FOR DRIVING MACHINERY.

To the use of gears there are several objections. They are noisy, have considerable friction, and the cogs are liable to break. Therefore connections are preferably made by pulleys and belts, unless it is absolutely necessary that the connection between the parts and the ratios of motion should be arbitrarily exact. In changing the direction of motion "half-twist" belts or "turned" belts have been largely used; the first when the driver and driven occupy relatively vertical positions, and the latter when they occupy positions on the same horizontal plane. Bevel gears and crown wheels and pinions —the latter nearly obsolete—have also been used; but a recent device which works admirably is the friction wheel. These wheels may be called bevel gear blanks. They are cast in the form of bevel gears, lacking the cogs, and the face of one is turned and polished while that of the other is recessed to receive a smoothly fitted disk of oak-tanned sole leather, which is soaked and pressed to form. The surfaces of these two wheels are brought in contact, when mutual action is the result. One wheel runs in bearings which are suspended on pivots, so that it can, by a lever or any other suitable device, be brought in contact with or receded from the other wheel.

But not always does the mechanic who uses this device understand its proper construction. Not long ago we saw in a large manufactory two of these bevel friction wheels working, the leather covering of one of which had been renewed several times, and our advice was asked. On examination we found that the driver was the solid wheel and the driven the leather covered. The work required was rather too much for the area of the faces of the wheels, and while the driver continued to revolve the driven frequently stopped. Both run at a high velocity, and the result was that the iron-faced driver revolved under pressure against one spot of the stationary driven, cutting recesses across the face of the leather and destroying its perfect circularity. The remedy was simple. The driver should be the leather covered, and not the driven. Then, if the driver continued to revolve while the driven was stationary, the wear of the leather would be uniform, while it could make but little if any impression upon the polished iron. These matters should receive attention from mechanics. Such mistakes are not in any degree creditable.

### THE HANDWRITING ON THE WALL.

Uneasy lies the head that wears a crown, and British commercial, manufacturing and maritime supremacy costs its adorers much needful sleep, as well as great annual subsidies from the national wealth. It is a sort of nightmare that gives them periodical gasping fits. Their navy, their coal mines, and now their iron exports, have caused successive spasms within a year or two. Belgium and France are looming up as rivals in iron so formidable as to cause certain well informed English writers to declare that "we are now face to face with the greatest obstruction British industry has ever been checked by. . . . Belgium and France have thrust us out of foreign markets to an extent which the trade will hardly credit." In the Russian market "the Belgian and the Frenchman hold the principal position, and are in a fair way of obtaining an absolute monopoly." Against this alarm a Birmingham paper takes ground by showing from trade returns that the annual export of British iron had more than doubled in fifteen years, and had increased at the rate of one half to three quarters of a million dollars per annum for three years, ending with 1865, when it amounted to $59,784,200. It shows that the export of iron to Russia in ten months of 1866 amounted to 65,211 tuns, being 8,526 tuns more than the average of the last six years; while it asserts that in 1864 France sent no iron to Russia, and Belgium but 3,844 tuns. But in the absence of any statistics of the recent vast growth of the foreign trade in which Britain has gained at the rate of but one per cent. per annum for three years past, or of the progress of her rivals since two years ago, it does not seem that the Birmingham organ has made out a very clear case against alarmists whose responsibility and competency to treat the subject it fully admits.

The truth seems to us to be, that the day when a single imperial city or a little island could sway the destinies of the world and draw all nations around her as dependent and subservient satellites, pertained to the infancy of man, and has forever gone by. Man has come into the rights of his majority, the rights of knowledge and power, in this western republic, and that full age is near at hand for the peoples of Europe. The world is to be a mighty commonwealth, and every sceptre must be broken, whether military, intellectual, manufacturing, or commercial. The drift our cousins are struggling against is irresistible. Britain must resign her extraneous possessions and pretensions, and content herself to subside gradually to the position of a peer, not a prince, among the nations. A fair share of the world for you, neighbor, and welcome; but no more lion's share, in the future.

A NEW FUEL.—At some of the towns on the Western lakes the sturgeons that get too stale for market are sold on the wharves to the steamboat stokers, who thrust them into their furnaces, and add greatly to the fierceness of the fire. Twenty of these large fish are said to be equal to a cord of wood in raising steam.

### AMBITIOUS APPRENTICES.

Nothing relating to the management of apprentices is more vexatious to the master mechanic or foreman than the ambition some of them exhibit to be advanced to a higher quality of work than their experience and judgment will warrant. It is eminently proper that the apprentice should have a degree of pride in his occupation and an ambition to become a superior workman, but this is very different from a discontent and dissatisfaction with his proper position. The foreman should be a judge of the attainments of his apprentices as well as of the qualifications of his journeymen, and it is as much his interest to forward the apprentice as it is to the apprentice himself, as fast as it is safe to do so.

Even in the roughest and least delicate manipulations the mechanic's apprentice may learn something. In the work of operating a simple machine which may be almost entirely self-acting dexterity is acquired which can be readily turned to other objects as the novice advances. Experience in the use of the simplest hand tools is acquired only by practice. No amount of oral instruction can ever inform the apprentice as to the proper use of the common cold chisel and hammer. If, for instance, he is employed in dressing castings he must use great care not to mutilate the casting or break the chisel. The experience thus gained is of great value in his after progress. So with every other manipulation upon either wood, the metals, or other materials. Patient plodding, with the exercise of judgment and observation, will in time make the finished workman, and not attempts at fine work without the experience necessary to complete the job in a creditable manner.

### GLASS FROM NATIVE ORE.

On the 27th of February, 1866, a patent was issued through the SCIENTIFIC AMERICAN Agency to Richard Washburn, of Monsey, N. Y., for the manufacture of glass from the native ore. This ore, which is really pure glass, or silicate of iron, in a crystallized and hence opaque condition, exists in abundance in many parts of the world, as in the columnar basaltic rock of the Palisades of the Hudson, of St. Helena, and of the famous "Giant's Causeway." But all efforts to utilize it for the manufacture of glass had proved singularly unsuccessful until the invention we have referred to. Messrs. Chance, Son & Co., the celebrated manufacturers of Birmingham, who export great quantities of plate glass to this country, are reported to have expended not less than a quarter of a million dollars, some years ago, for this purpose. It is gratifying to be able to add this important source of wealth to the list of those opened to mankind by American inventive genius, and to record the fact that the Newburgh (N. Y.) Glass Manufacturing Company, organized to work the ore of that vicinity under this patent, are already successfully turning out quantities of glassware with the two peculiarities of unequalled toughness and unapproachable cheapness. The artificial glass hitherto produced, requiring some thirty per cent. of soda or other oxides as a base, consuming much fuel, and losing much dross, evidently could never be cheapened sufficiently for many of the uses for which it is very desirable. The simplicity of this manufacture direct from the native article, the abundance and accessibility of the material, and the extraordinary tenacity of the product—common quart bottles of the Newburgh manufacture may be freely used in driving nails into solid timber without risk to their contents —must eventually extend existing applications of glass in a beneficent degree, and bring it into many uses from which it has hitherto been excluded. The native glass in this region, and in fact generally, being the silicate of iron, has a dark color, and it is yet to be seen how far it can be whitened by modification of the base and admixture of other bases, so as to become available for the finer purposes. That common window-glass may be produced at a great reduction of cost, seems not to admit of doubt, and this alone involves great improvement in the structure of houses, in common horticulture, and in many other respects which will occur to the reader.

We have thought it of interest to numerous readers who may not have turned their attention to the chemistry of glass, to take this opportunity for giving a popular sketch of its character. And first:

WHAT IS GLASS?—Most persons probably take for granted that glass is a simple mineral substance found in the earth, and would be surprised to learn that it is a *salt* formed by the chemical union of at least two and often three or four compound substances, and thus composed of from three to five very different and interesting ingredients. In fact, taking all the varieties of glass in actual use, it may be said to contain a dozen or more ingredients. Now, the popular notion of a salt is derived in part from the usual appearance of that class of substances in crystals, or small angular grains. Glass does not appear in that form, for the same reason that hot maple syrup, or any other melted sugar, "waxes" or candies when poured upon ice, as many of our readers may remember treating it in younger days in the maple orchards of New England. The reason is that, being cooled suddenly from the boiling point, the atoms are not allowed time to segregate and settle themselves into individual crystals, according to their natural disposition, but are overtaken by solidity as they are, in a single unitary mass. Suffer molten glass or any other salt to cool slowly enough, and its atoms will group themselves in multiplied units instead of one, forming a semi-opaque and crumbling mass: a striking instance and illustration in the lowest sphere, of that union of the kind and the individual which pervades the universe, from grains up to worlds and from cell-life up to that of immortal spirits. Another part of the popular notion of a salt is derived from the ready solubility of most salts, and their consequent pungent effect upon the