THE MANUFACTURE OF IRON--THE RADCLIFFE PROCESS.

Attempts have been repeatedly made to economize in time, fuel, labor, and material, in the manufacture of iron, by welding several puddled balls into a homogeneous mass under the steam hammer; but never with good results. The difficulty lay apparently in securing a good weld between the surfaces, exposed as they were to the oxidation of the atmosphere. But, if we can credit *The Engineer*, Mr. Radcliffe, of the Consett Iron Works near Durham, England, has, for a year, been manufacturing, by this process, direct from the puddled ball, into bar, rail, or sheet.

In the usual process a charge of about four or five cwt. is used, and each puddled ball, when made, is taken separately to the hammer or squeezer to expel the cinder, and the rough bloom is then passed through rolls producing puddled bars. These are allowed to cool down until wanted for the next process. This consists in cutting a given weight of puddled bars into lengths of from 18 to 36 inches, and making them into a pile, which is placed in a heating furnace and raised to the proper heat, when it is rolled into a bar. This process is repeated—sometimes twice—to produce a superior article.

Now, each of these processes absorb fuel, labor, and time, and necessitate waste—waste in oxidation in the heating, as well as waste in the clippings of rough ends. The loss by oxidation cannot be less than five or six per cent, and the other waste as much, and probably more, at each re-heating. To the cost of the amount of the coal used in converting the pig iron—which is about four times the weight of the iron itself—must be added, at each re-heating, ten cwt. to each ton of iron. These costs do not comprise the extra labor, time, and wear and tear of machinery. If all these are saved by the Radcliffe process, it certainly deserves attention from iron manufacturers, as it does away with all cutting, piling, and re-heating. We copy from *The Engineer* the description of the process:

The details of the process, as carried out at Consett, may thus be described: Six, eight, or any required number of puddling furnaces are each charged with four cwt. of pig iron. The fettling consists partly of pulverized hematite ore from Ulverstone, partly of a very rich cinder obtained from the first pile heating furnaces in the rail mill, or from two furnaces specially employed in making cinder from small scrap. The iron is brought to nature as soon as possible, and the blooms are taken out while the iron is yet very young—as soon, indeed, as the balls will hold together.

The moment the iron is ready in a sufficient number of furnaces, the process of manufacture begins. A puddler takes a ball weighing about 80 lbs. to an eight-tun double-acting steam hammer. It is placed on the anvil and struck, first lightly and then, as the mass becomes consolidated, with more force. The cinder is expelled with considerable violence, and we have, at the end of twenty seconds, a flat cake of iron on the anvil perfectly quiescent. At this moment a second puddled ball is placed on the first. This receives, first a light, and then a couple of heavy blows. The hammer is raised for a few seconds, and then a curious action takes place. The first and second blows apparently expelled most of the cinder, and the mass, seemingly, tolerably solid, lies quietly on the anvil, but in a moment its surface rises like a cake of dough in a baker's oven. The surface seems to boil; little jets of flame sometimes start from the mass, and cinder pours in a torrent from every pore, flowing over the lump of iron, and running down all round. To what this peculiar action is due we cannot say. That this, in a sense, spontaneous evolution of cinder is a fact we can testify from close personal observation. A few blows from the steam hammer again consolidate the heaving mass. Another ball is placed on it; a few blows; a short pause. The rising of the mass and the flow of torrents of cinder follow as quickly as thought—and so the process is continued till eight balls are united. Then steam is brought to bear on the upper side of the hammer piston. The mass of iron is turned and re-turned, while the whole shop resounds with the sound of the hammer delivering blows with the speed of lightning on every portion of the red-hot mass, which finally assumes the form of a homogeneous slab some 3 feet long, 13 or 14 inches wide, and 8 or 9 inches thick. This slab is then taken up by a little steam crane at the side of the hammer, and, while hanging in the air, weighed. It is then run off to a heating furnace, preparatory to being rolled into a finished plate. The heating furnace is of the ordinary kind, and is only used to restore the heat lost by the outer surface of the mass. From the furnace it is taken to the roll mill, passed through the breaking-down grain rolls, and subsequently between a pair of chilled rolls in the same train, and finally it lies on the floor of the shop, a plate with whose appearance the most hypercritical can find no fault.

Mr. Radcliffe courts inquiry, and we were afforded the fullest possible opportunities for examining into the process known by his name. We witnessed the formation of many plates, and the following particulars of the manufacture of one, selected almost hap-hazard from our note-book, will show nearly at a glance of what the process is capable: At half-past three P.M. the first of eight puddled balls was brought from the furnace and placed on the anvil. In four minutes and a half this and seven other balls were welded into a slab weighing 644 lbs. At twenty-six minutes to four o'clock this pile was placed in the heating furnace; at nineteen minutes to four o'clock it was taken out and brought to the rolls; at fourteen minutes to four o'clock it lay on the floor of the mill ready for shearing. Thus, precisely, sixteen minutes were occupied in producing the plate from the puddled ball. The weight of the plate before shearing was 574 lbs. It was then sheared to the finished size, 20 feet by 3 feet; thickness, 3-16th of an inch, nearly; weight sheared, 448 lbs. Is it necessary to point out here how much is gained in time, coal, iron, labor, and, finally, in money, by the Radcliffe process, as compared with old systems of manufacture? We think that they will be apparent at a glance to every ironmaster. What we have said in the beginning of this article should suffice to make them clear to others.

The question that here obtrudes itself is, what is the quality of the finished plate, bar, or rail? Unless the answer is satisfactory, the Radcliffe process—ingenious, cheap, and rapid as it is—is comparatively valueless. At Consett we examined some scores of specimens of sheets tested in every possible way. Plates 7-8 inch thick, bent cold to an angle of 90 deg. Thinner plates, bent upon themselves, coiled into a helix, split and bent backwards and forwards, dished up into troughs, twisted and tortured in every imaginable fashion, punched close to the edge—as close as holes would go—yet no symptom of crack or flaw. We have no hesitation in classing the specimens we examined with the very best ship-plates in the market; and yet these plates are produced at a price which has enabled Mr. Radcliffe to take very heavy orders from Dutch shipbuilders, beating Belgium out of the market, and yet leaving a fair profit.

MANUFACTURE OF PRESSED AND CUT GLASS WARE.

Having described, in former articles, the composition and modes of manufacturing bottles and window glass, our readers will understand the methods employed for pressed glass ware by a very brief description. The pressed glassware is made by pressing glass into molds of iron, and the articles thus formed aproximate in beauty and regularity of form to those of cut glass, described further on. The operation requires less skill in manipulation than glass-blowing, but is, nevertheless, interesting.

It will be best understood by describing the manufacture of some special article—say a fruit dish, the bowl of which is saucer-shaped, and its foot formed like the bell of a trumpet. Such an article would be made in two parts, the bowl and the foot being pressed in separate molds, and afterward joined together. A boy takes upon the end of an iron rod or "punty," a quantity of glass from the melting pot, and holds it over the open mold. The weight of the molten glass causes it to depend in the form of a large pear-shaped drop. The principal workman, who has charge of the mold, cuts off this drop with a pair of shears, as soon as, in his judgment, enough has depended to exactly fill the mold. As soon as the glass has fallen into the mold, it is closed with a lever which forces the glass into every part of the matrix. The molds are made in two parts corresponding to the convex and concave sides of the piece. So accurate is the judgment of the skilled operators in this process that they rarely fail to properly apportion the glass to the capacity of the closed mold. The glass is removed from the mold as soon as it cools enough to become rigid, and is carried by an assistant to the annealing oven, if complete; or, if, as in the particular case of the fruit dish, it requires to be joined to another portion, it is cemented to its fellow by a small portion of plastic glass, and then placed in the annealing oven. Varieties of form and pattern may be attained by this method which are impossible in the blowing process, and the larger portion of goblets, salt-cellars, and other glass table ware, in common use, is made in this manner.

The finer and most costly articles of glass ware are finished by a process called cutting, which is, however, really a grinding process, performed by means of iron, sandstone, or copper disks, of various sizes and forms, according to the nature of the work to be performed. The disks are fixed, by proper chucks, to lathes, and are supplied with sand for rough grinding, and emery for finer work. A stone wheel is also used to efface the sand marks, and wood disks are used for polishing, supplied, at first, with a mixture of pumice and rotten stone, and finally with "putty powder," a preparation of tin and lead. Flint glass is the best for this purpose, as its superior hardness enables it to take a finer polish. Great skill and artistic taste is shown by the artisans, in this department, and cut-glass wares command a higher price than any others.

Plate glass constitutes a large and important branch of the glass manufacture, and may form the subject of a future article. The numberless uses to which glass is now applied, render all information, respecting its manufacture, of value, and although the manufacture of plate glass has not yet been successfully introduced into the United States, the extent of the demand here would seem to justify further attempts at home production.

THE NORTHERN PACIFIC RAILROAD.

A joint resolution has passed both Houses of Congress relieving the Northern Pacific Railroad Company of the prohibition against mortgaging the road. This resolution was adopted in consequence of a proposition by the company to build the road without further Government aid, in consideration of the authority thus given to them.

The *Superior Gazette* says an assurance has been given on the part of the company that the road will be commenced early in the spring and pushed with a vigor worthy of so great an enterprise.

Now that the thing begins to look like work, we lay before our readers some facts showing the advantages this route possesses over that of the Union Pacific. The eastern terminus of this road is at Superior, situated at the western extremity of Lake Superior, and its western terminus is to be at the southern extremity of Puget Sound. Its length is 1,725 miles, of which the journal above quoted says:

"Not over 250 miles will have an elevation exceeding 3,000 feet above the sea, while of the Union and Central route, 1,100 miles are more than 4,000 feet above the sea, and more than 500 miles of it have an elevation of 7,500 feet above the ocean. Every 300 feet of ascent lowers the mercury one degree. The elevation of the valley of the Yellow Stone is scarcely above 2,000, while upon the same meridian the Union road reaches an elevation of 6,000 feet, and at the summit reaches 8,424, while the Northern route only attains 5,330—a difference of nearly 3,100 feet. Beside this, the fall of snow at the same elevation on the two routes is one-half less on the Northern than on the other, owing to the extreme dryness of the atmosphere.

"While a large portion of the lands granted to the Northern road is susceptible of a high state of cultivation, and of sustaining a dense population, not one acre in one hundred of the Union grant is susceptible of keeping alive more than one sage hen to the square mile.

"The Northern road will cross and drain from the north of it the country to which the United States must look for all time to come for its supply of wheat. The country which the hardy emigrant from the north of Europe will occupy in almost countless numbers, when this road is opened. On this route he will find his 'home' climate, and as they are the better class of immigrants will add millions to the wealth of the country through which the route passes. By the time the road reaches the mountains, at least two or three hundred thousand of population would be drawn to its line; while on the Union, except at two or three isolated spots, hardly as many hundreds have an abiding place. The arable portion of the great central plain of the American continent extends twelve hundred miles to the north and northwest of the head of Lake Superior; while it does not reach over half that distance to the west of Chicago. The distance from the former to Lake Winnipeg is less than from Chicago to the Missouri river

"The Northern route for six months in the year will not have a land carriage to exceed 1,750 miles, and from this point to the seaboard during the season of navigation, freights can be transported for one-third what railroads charge."

The latter advantage will also enable the company to do through business for a considerable portion of the year before the road is completed, by laying sections connecting the navigable waters which, for a large portion of the route, lie almost parallel to its general course.

Although this route lies so much farther north than the Union Pacific, its lower mean elevation compensates for the higher latitude in its climatic effects, and we regard it as established that there is less danger of snow obstruction than on the Union Pacific line. We have always regarded this route with favor, and are glad to see such good prospects for its speedy construction. When it is remembered that vessels coming from China make the North American coast near the straits of San Juan De Fuca, the entrance to Puget Sound, it will be seen that this road is destined to become, on its completion a formidable rival to the Union Pacific for the China trade. So far are we, however, from thinking either will ultimately suffer from competition, that we believe ere another half century shall have passed, the increase of population on the Pacific coast will necessitate the construction of a third trunk line connecting the great West with the Atlantic.

Mercury and Sulphur.

A few interesting facts, in which mercury plays a remarkable part are worth mention. Certain Dutch chemists discovered that plants cannot live in an atmosphere which contains vapor of mercury. Boussingault, of Paris, found that this noxious effect could be neutralized by introducing sulphur into the atmosphere; and further, that sulphur, when exposed to vapor of mercury, takes on a coat which resembles iron, and does not easily rub off, or soil the fingers. This coat is sulphuret of mercury. Here, therefore, is a suggestion which may be turned to account by enterprising artists. Let them melt sulphur, and cast it into statuettes, friezes, moldings, flowers, and so forth, expose them to vapor of mercury, and they will obtain a number of ar icles, all wearing a metallic appearance, which may be found useful for ornamental purposes. The French chemist, taking a wide view of the subject, asks whether sulphur, which is at times found in the atmosphere, may not play an important part in neutralizing the effects of noisome vapors, or the deleterious miasm which rises from marshes and the banks of rivers in hot countries. And may we not ask, whether it will ever be found possible to stay the progress of an epidemic by flooding the atmosphere with fumes of sulphur?

The Hydroscope.

An instrument called the Hydroscope has recently been invented in England, and is intended to be used for the purpose of measuring the distance of an object from a coast battery, situated at least one hundred feet above the sea level. The construction of this instrument is described as being exceedingly simple, and the apparatus, it is asserted, can be used with great ease. The hydroscope consists of a piece of ordinary gas pipe, about six feet long, to the extremities of which upright tubes are attached. The whole is filled nearly full of water, and in each upright tube is inserted a tin float, carrying a crosspiece, and weighted so that when the long tube is in a horizontal position the cross bars are on an exact level.

An upright tangent scale, graduated for yards of distance, is attached to the sight end of the tube, which moves on its center in both a horizontal and a perpendicular direction. The instrument is placed in any part of the battery which commands an open view, and the observer revolves the tube until it is in a line with the object, and then raises the tangent scale until he can just see the object in a line with the two cross bars. The range is then read off in the tangent scale, and the gun is placed in the direction thus ascertained.

WELL-DIRECTED LIBERALITY.—Mr. Peter Cooper, the founder of the Cooper Union in this city, has furnished the Trustees with the sum of $20,000, to be applied to purchasing a complete s t of mechanical models, illustrating every conceivable form in which power can be applied to machinery. The models will be procured in Darmstadt, in Germany, and will be about 2,000 in number.

PROPOSALS have been published in Berlin for the formation of a company to lay down a new telegraph line between Europe and America, to be called the International People's Cable. One part of the arrangement is, that the subscribers are to receive bonds which will be accepted in payment for the transmission of messages when the line is in working order.