weekly the sum of £3.500 in wages to the mechanics and others engaged on these works. The following items, from the account of materials issued from the stores at Crewe, for the twelve months ending May, 1863, will convey some idea of the magnitude of the operations:—Finished brass, 67 tuns; rough brass, 234 tuns; brass tubes, 331 tuns; sheet, bar, and other copper, 244 tuns; iron rails, 13,849 tuns; steel rails, 2,206 tuns; sheet iron, 1.986 tuns; bar iron, 1,272 tuns; oak timber, 85,241 feet; various timber, 1,220,-607 feet. The shops connected with the locomotive department cover a space of 26,336 square yards; and the rail works, including the yard, occupy 13,302 square yards. The extensive consumption of water at the works and the neighboring station is met by the conveyance, from Whitmore, a distance of eleven miles, of the produce of a well sunk in the red sandstone. This water is remarkable for purity, containing only about five grains per gallon of foreign substances, and no organic matter, which renders it specially applicable to engineering purposes. The total consumption amounts to between 600,000 and 700,000 gallons per day. In the neighborhood of the main works is an establishment for the manufacture of the peculiar yellow grease whose appearance is familiar to all railway travelers, the whole requirement of the London and Northwestern Railway Company in this article being furnished by the Crewe Works.—*Ryland's Trade Circular.*

## Correspondence

### Sandpaper Finish.

Messrs. Editors:—I could not repress a smile as I read in my Scientific of September 30 the description of E. J. W. of his "solder chuck." The sticking point, viz., how to remove the soft solder from the disk of sheet metal, he passes over rough-shod and in the most unworkmanlike manner. What would a good workman think of doing a fine job and "finishing" with sand paper? His "solder chuck" would undoubtedly hold true, but he must devise some better way than the use of sandpaper for finishing. He cannot do it in the lathe, for he has no means of holding it.

I have heard English mechanics "slur" American work, styling it "deep scratches and high polish." It is certainly humiliating to an American to hear one who is admitted to the columns of our great scientific journal advise the use of sandpaper as a finisher. M. L. B.

Kane Co., Ill., Oct. 1.

[If our correspondent will try the effect of 0-sandpaper covered with chalk on any metal that has been well finished previously, we think he will not be disappointed with the result. English mechanics have good reason to complain of some American work on account of the "Buffalo finish," as it is sometimes called; but we noticed, on examining the *Great Eastern* engines that, for some cause or other, great patches of scale or hammer marks had been left in the principal finished parts, which certainly did not improve their appearance.—Eds.

### Melting Wrought Iron.

Messrs Editors:—In the Scientific American of October 7th, you state, in reply to your correspondent, A. P. W., of Wisconsin, "That when the carbon is all burned out of cast iron by the Bessemer process, the metal is brought to a state of pure wrought iron in a molten condition."

I have been a close observer of the manufacture of wrought iron in this place, for a number of years, and have never yet seen "wrought iron in a molten condition," and do not think it possible for it to exist in that shape. I have been informed by practical manufacturers of wrought iron, that when cast iron has been sufficiently decarbonized to become wrought iron, it ceases to be a fluid, and then, by adding sufficient carbon to make it fluid, it becomes cast steel. I am aware that in the Bessemer process of making steel they burn out of the cast iron as much of the carbon it contains as possible, and, by adding a percentage of molten cast iron containing a proper amount of carbon, the mass in the converter becomes molten cast steel, and, as such, is poured into ingots. But that the mass obtained by decarbonizing cast iron in the open converter of Bessemer, is wrought iron in a molten state, I cannot yet understand; for if so, why not dispense altogether with the present style of puddling furnaces and manufacture wrought iron by the pneumatic process? It would be cheaper, require less labor, and be quicker done than puddling—the present way of obtaining wrought from cast iron. If wrought iron could exist in a molten condition, could not molds be filled with it, and in that way produce wrought iron machinery without the labor of forging?

I once tried to melt wrought iron in the following manner:—I filled a black-lead crucible with small pieces of wrought iron, and, making the lid on it as near air-tight as possible, I subjected it to an intense heat for several hours; I then made a small hole in the lid for the purpose of pouring out the molten iron, when a stream of flame burned intensely from it for a few moments, and then ceased. I removed the lid and found my crucible filled with cinder.

I was told by a scientific gentleman that the oxygen of the air, which the hole permitted to enter, combined with the iron, burning it up, leaving nothing but the oxide; if that is so, then wrought iron cannot exist in a molten condition to be of any practical use, as contact with the air would immediately destroy it. J. E. F.

Johnstown, Pa., Oct. 9, 1865.

[We have seen a rod of wrought iron, under the action of a powerful galvanic battery, grow first red at the end and then white, and finally fall in liquid drops apparently as fluid as water. The melting point of pure iron is stated by Booth and other authorities at 2,850° Fah., but as in the case of many other substances, the melting can be effected only when the metal is sheltered from the atmosphere, for even at a red heat the affinity of iron for oxygen is so great that the two substances instantly combine when brought in contact, forming oxide of iron. There is no pyrometer that will measure temperatures so high as 2,850°, and the real fusing point of pure iron must be regarded as undetermined; some authorities estimate it as high as 6,000° or 7,000°.—Eds.

## THE HOOSAC TUNNEL.

The progress on this work appears to be somewhat delayed, it does not drag its slow length along at all, and public attention has lately been directed to the causes. Mr. F. W. Bird writes a long article to the Boston *Advertiser*, wherein he foots up a long array of errors, etc., against those having the work in charge. We make such extracts from this paper as our space will allow:—

"The materials near the surface of the ground, and for a short distance in the shallowest part of the open excavation, are common earth and hard pan. These gradually change into a substance that is neither earth nor rock, in any common acceptation of those terms. The most appropriate name I heard it called by was 'demoralized rock.' In its normal condition it is tough and hard, like rock, but when exposed to the combined influences of air and water, it runs away like quicksand; or, if pent up, it becomes 'porridge.' It abounds in seams, or crevices, from which issue numerous springs and little streams of water. The one hundred and ten feet of heading accomplished at the west end required a stout framework, or lining of heavy timbers and planks, to be set up as fast as the excavation was made, in order to resist the pressure and weight of the surrounding material. At first the progress here was fair. This favorable state of things continued for a few days, when the quantity of water began to increase, 'demoralizing' the rock, and converting it into an unmanageable fluid, which could neither be drained, nor shoveled, nor pumped. Pouring down from the top, rushing in from the sides, boiling up from the bottom, in a few days it had let daylight through the forty feet of roofing. Owing to the peculiarity of this material before referred to, it will stand vertically at almost any height so long as it is dry; whereas, as soon as the water touches it, it is disintegrated or worse, if possible, than the worst quicksand.

"The nature of the difficulty may be inferred from the fact that this bad material was struck in December last, nine months ago, and since then the whole progress made, with indefatigable labor by as many men as could work in the cramped quarters, inclusive of the advance of three or four feet a day at first, has been one hundred and twenty-five feet! The managers are at their wits' ends. Indeed, despondency broods over the whole western side, relieved only by the forlorn hope that 'something will turn up' in the shape of a feasible contrivance for confining the slippery material. It is, as one of the workmen said, 'Be jabers, ye might as well try to shovel a cart load of live eels!'

"As a last resource, it was decided to continue the open cutting on a level passing above the top of the tunnel, until the point directly above the largest spring was passed. A stout timber frame work, some twenty feet long (similar in construction to the cribs used in deep-water foundations for masonry,) having the sides and forward end planked, but open at the bottom, was then placed over the spring and forced down into the fluid mass until it came to the bottom line of the tunnel. A plank flooring was next added to the crib, and a timber roof is now being constructed to make the finish of this portion of the 'heading' correspond with the part which was really made by horizontal excavations.

"Having groped along thus far in the solution of the ugly problem, the next question seems to be how to remove the plank and timbers from the forward end of the crib, and yet stay the rush of 'porridge' from all directions into the opening. When the crib was put in, the planks at the forward end were hard up against the rock. Since then it has been found by boring through this planking, that the rock has become 'demoralized,' and that there are three or four feet of 'porridge' between the planks and the face of the rock. How to get that 'porridge' out nobody knows; and how, in case they can dip out the 'porridge' already formed, they can extend the crib forward, and make tight joints on the sides, top and bottom, against the rock that is yet hard, is a still more difficult problem; and this accomplished, there remains the incalculably greater difficulty of keeping the face of the rock open for work without the rush of 'porridge,' which all experience has hitherto shown will instantly form upon the exposure of the surface of the rock to air and water. Engineering resources may, and perhaps will, prove a match for the emergency; but common men, and some uncommon men, too, look upon these difficulties as insuperable. The prevailing opinion is that our State treasury is bottomless, and, therefore, that, somehow or other, in some time or other, if money enough is forthcoming, science, skill, and perseverance will triumph.

"It will at once be asked, How far does this material extend? About half a mile from the west face is the West Shaft. This shaft was sunk by Mr. Haupt, and he excavated some forty or fifty feet of tunnel in each direction. When the heading had advanced two hundred and eighty feet westerly, the workmen struck a material similar to that at the west face, accompanied, as there, with water. Finding the water increasing very nearly to the full capacity of the pump, and finding also the same tendency to 'porridge,' and confident that the water would speedily become greater than their means of pumping, and thus stop the work on the eastern face of the shaft, it was decided, as a matter of expediency, to discontinue the work on the west face in the shaft. Between this point and the west end of the tunnel, (that is, where the crib is), the distance is twenty-three hundred feet! Artesian borings have been made at different points on the way, all showing the same material. These facts give the data of the problem. They have been nine months advancing one hundred and twenty-five feet under a bank some forty to sixty feet high; and they have got along so far only by removing substantially the whole mass, and making an open cut. How long, at this rate, will it take to advance 2,300 feet, especially if they have to make an open cut running rapidly from sixty up to three hundred feet? And what will it cost, either to tunnel that material, or to make an open cut, with slopes that will stand?"

PNEUMATIC DRILLS.

"But whenever exception is taken to the slowness of the progress, we are told, 'Oh, wait till we get the penumatic drills at work! then you'll see the chips fly!' Well, we have waited quite patiently. Nearly two years ago the money was sent abroad to purchase drills of the kind used at the Mont Cenis Tun-

nel; but though the money went, the drills did not come, and, it is understood, will not. One reason given for their not coming is, that the French engineers, or the Italian engineers, or some 'cussed furriner,' would not sell a drill to a Yankee; another is, that the drills would not work in the Mont Cenis rock; the third is, that though they might work in that rock, they would not in the Hoosac rock. The 'dem'd total' is, that the Mont Cenis drill calculation has gone to the tomb of the other 'great expectations,' which illustrate the history of the Hoosac Tunnel.

"In their first report the Commissioners handle the matter of machine drills, or boring machines, very gingerly. Haupt had failed, and they seemed to fear to rush hastily in where his genius had been foiled. But between that time and last December they had acquired confidence. In their last report, December 20, 1864, they say: 'Drilling machines will not be likely to be in operation at this place (the east end) before next midsummer.' That is cautious and safe. Of the central shaft, they say: 'We hope by the latter part of winter to get some automatic drills at work in the shaft, etc.' Of the west shaft they say: 'Machine drills are not likely to be used here before next spring, and perhaps not till early summer.' Well, 'the latter part of winter,' 'the next spring,' 'early summer,' 'midsummer,'—all have gone; and nothing appears of the automatic drills but the *disjecta membra* of all the contrivances hitherto tried. 'These are our failures,' Beau Brummell's valet used to say; but he could point to the one cravat-tie which was a success. The truth is, no intelligent man puts the slighest confidence in the successful working of any borer or drill in the rock of the Hoosac Mountain, unless operated by hand. In a strictly homogeneous rock machine drills or borers might work—even then, as the Commissioners admit, saving only time, but not money—but in a rock like the Hoosac, where the drills, working generally in a comparatively soft material, are liable at any moment to strike nodules, or veins of quartz, and where a part of the hole will be in the slate and the rest in the quartz, no machine-drill or borer has yet been found to stand. What science and perseverance may achieve no man can say; to-day the path to success has not been found. I shall not be charged with partiality to Haupt; but it cannot be denied that the big hole bored by Haupt & Co., at the eastern face, shows a greater result and promised more success if it had been followed up with adequate means, than every thing Mr. Brooks has accomplished with the treasury of the Commonwealth subjected to his draft."

WHAT IS TO BE DONE.

"A year ago the State could have wound up the concern and got out with a loss of about $600,000. The advances with interest to July, 1864, had amounted to about $1,000,000. We had on hand nearly 3,000 tuns of railroad iron, which was worth last year $110 per tun. This might have been sold for $330,000. There was other saleable property on hand belonging to the State which would have brought enough to reduce the deficit to $600,000. Even upon the assumption that the State was surely to complete the tunnel, it would have been the best policy to sell this iron at the enormous price of last year, and hereafter buy other iron at less than half that price, in season to finish the road before the tunnel could be opened.

"Mr. Brooks was urged to do this by gentlemen whose judgment is as good as that of any men in the State. But no; it must be kept, and for no earthly business reason except that the Fitchburg Railroad Company and the Vermont and Massachusetts Railroad Company had offered to pay, for rent of the road for six years after it shall be finished, $129,000—an average of $21,500 per year, for the use of a road which could not be put in proper running order for a million of dollars (including, of course, the cost of the iron); while at the end of six years the road would be thrown back upon the State, to lie dead till the tunnel is finished, or to be run with a traffic which would not half pay running expenses.

"What is to be done? To-day we can get out by pocketing a loss, say, of $1,800,000. Every day's work only increases the sum, which will be a total loss in the end. One of two things the State will do—either abandon the enterprise, sell off, and close up a bad job, or else find some responsible parties who will agree to take the whole thing off her hands and complete it. If it cannot be got rid of on better terms, a gift of a million or two of money with it to any parties that will relieve the State of the disreputable business would be better than for the State to continue the work."

## RECENT AMERICAN PATENTS.

The following are some of the most important improvements for which Letters Patent were issued from the United States Patent Office last week; the claims may be found in the official list:—

*Knitting Machine.*—This invention relates more particularly to that class of knitting machines represented in the Letters Patent granted to the inventor Sept. 15, 1863, having two rows of needles; and also to machines having straight frames and only one row of needles. One part of the invention relates to the construction of the cams for operating the needles and to the manner of operating such cams. Another part relates to the manner of regulating the length of the loops; another relates to the manner of supporting the sliding carriage; another relates to the manner of constructing the jacks; another relates to the manner of driving the sliding carriage; another relates to the construction and operation of the yarn guide or carrier and to means for doing it; another relates to a novel construction of latch openers; another relates to the means for connecting suitable weights to the work. I. W. Lamb, of Rochester, N. Y., is the inventor.

*Distilling Apparatus.*—This invention relates to an apparatus which is to be used for distilling alcohol and other liquids, but which is particularly intended for refining petroleum, and which is so constructed that the process of distillation can be continued without interruption, and the oils of different specific gravity or density can be separated while the process of distillation is carried on. Furthermore, the apparatus is so constructed that the naphtha and lamp oil, or the light constituents of the petroleum, are evaporated by the heat of the vapors of the heavy oil, and only the heavy constituents have to be distilled by direct heat. By this arrangement a great saving of fuel is effected. A. Kreusler, of New Lebanon, N. Y., is the inventor.

*Rifling Barrels of Fire-arms.*—This invention relates to rifle grooves, the transverse section of which is not rectangular but getting gradually smaller toward the outside—their form being dependent upon the kind and size of the fire-arms. The depth of these grooves decreases for a certain distance, and, together with the depth, the width decreases, so that the advantages of the wedge-shaped grooves are obtained, and where the depth does not alter, the width remains unchanged. The production of these grooves is much simpler and more correct than that of the wedge-shaped grooves, because the cutters used for cutting the same have to move only in a radial direction in the proper proportion in order to produce the desired result. In the same manner the operation of polishing the improved grooves, which is difficult with wedge-shaped grooves, is easily accomplished and can be effected simply by radially expanding polishing jaws. As previously remarked, the depth and length of these grooves gradually decrease from the chamber up to a certain point, and then they continue to the muzzle without diminution. A. Trauth, of Chemnitz, Saxony, is the inventor.

*Paddle Wheel.*—The object of this invention is to obtain a paddle wheel by which the lift and plunge now occasioned by the entrance and emerging of the floats of the ordinary wheels into and out of the water, will be avoided, and a great saving of power effected, as well as an avoidance of the jars and concussions attending the operation of the ordinary paddle wheels. William Choate, of Newburyport, Mass., is the inventor.

*Exploding and Opening Oil and Other Wells.*—This invention has for its object to open the veins and seams of oil and other deep wells by exploding powder or other substances therein. It is also applicable to clearing away paraffine and other obstructing matters from the sides of such wells and from the seams in the rock. It consists in constructing it of such material as to enable the operator to withdraw it, after the explosion, without difficulty, and also in so constructing it that it shall be exploded by its own weight after it has nearly reached the point to be acted on. A. T. Ballantine, of Morristown, N. J., is the inventor.

*Steam Valve.*—This invention relates to the valves of steam engines. Its character makes it especially suitable for use in propellers, but it is applicable to all kinds of steam engines. The valve is a rotating slide valve counterbalanced or supported at its center of rotation, and is fitted with a graduated cut-off, which is so constructed and applied that the steam is cut off by the motion of the main valve itself. The cut-off may, however, be applied so as to work also independently of the motion of the main valve. Ethan Rogers, of No. 127 Warren street, New York, is the inventor, who has assigned one half of it to Wm. P. Williams.

*Gas Burner.*—The object of this invention is to produce a gas burner by which, with a comparatively small expenditure of gas, a good light is obtained. The invention consists in a gas burner forming a hearth or grate below and a chimney above. The grate in the lower inside parts of the burner, consists of a perforated bottom surmounted by a system of wire work, which equalizes the pressure of the gas and regulates the quantity which is permitted to reach the flame. The chimney consists of an inclosure rising somewhat above and surrounding the jets of gas emanating from the burner in such a manner that the draught of the atmospheric air to the flame is increased, and, at the same time, the heat of the flame is concentrated, and by this combined action the carbon is readily raised to a bright white heat and a brilliant flame is obtained with a comparatively small expenditure of fuel. Dr. V. Dubourg, of Frankfort-on-the-Main, Germany, is the inventor.

*Improved Suspender.*—The object of this invention is to improve the suspenders by which pantaloons are held upon the person of the wearer, the particular features of the improvement being as follows:—To combine with the suspenders the quality and office of a shoulder brace; to simplify the construction of the suspenders; to make them in such a manner that each side of a pair of pantaloons is suspended independently of the other; and, lastly, attaching the several straps of which the suspender is composed, to their buckles or links, in such a way as that they will pull squarely thereon, and so preserve the evenness of the straps. B. J. Greely, of No. 540 Broadway, New York, is the inventor.

### Enormous Stock Business.

According to the returns made to the Internal Revenue offices, of this city, it appears that the stock and gold brokers return their aggregate sales for one year at the enormous sum of six thousand and seventy-three millions seven hundred and eight thousand eight hundred and eighteen dollars. Quite a number of the firms have only made returns for one, two, three and five months. If the list included a full statement of all the houses for the entire year the amount of sales would exceed three times our national debt. Computing the tax on the basis fixed for the transactions in stocks we find that the brokers contributed to the revenue of the Government three million thirty-six thousand eight hundred and fifty-four dollars. One firm sold stocks and gold to the amount of $169,232,939. These figures appear incredible, but they are no doubt substantially correct, as brokers do not like to be overtaxed.

PROF. W. A. MILLER recently stated before the British Association that an extensive branch of industry was now springing up in the improved methods of voltaic deposition of the metals. Weil had, by the use of an alkaline solution of tartrate of copper, contrived to coat iron and steel with a tough closely adherent sheathing of copper, by simply suspending the articles to be coated by means of a wire of zinc in a metallic bath. No battery was required. Lead and tin might in a similar manner be deposited on copper, iron, or steel, if the oxide of tin or of lead was dissolved in a bath of strong solution of caustic soda.

A NEW MACHINE.—From the *Commercial Bulletin* we learn that there are at the fair in Boston "two bars, exhibited, one with a $4\frac{1}{8}$-inch hole punched in a bar, $1\frac{1}{4}$ inches in diameter." We deem this a praiseworthy style of thing.