N. J. Central Railroad. The furnaces have a capacity for over 10 tuns a day, and are prepared to admit enlargement to twice that size.

Fig. 2 is a general section of the zinc works, showing the operation. A is the furnace ash-pit below; B is the flue or tweer for air blast; C is a flue between two furnaces.

The ore ground fine and mixed with its bulk or more of fine anthracite coal, is charged in A. It is first dampened by sprinkling with water. The fire and blast is then applied, and the process commences. The flue between the two furnaces serves to assist draft and also for passage of the vaporized metal. The furnaces of the Bartlett Company do not differ from any of the others, except being larger. Their ore, too, is different.

D is a chamber with partitions alternating from top or bottom, for checking passage of vapor and for settling any ash or coal which may be drawn over. Nearly pure oxide of lead sometimes collects in this chamber at the Bartlett Works.

E—Large iron pipes for cooling the vapor and gases.

F—Exhaust fan. This fan draws the vapor from the furnaces and forces it forward to the bags.

G—Large brick chamber for cooling and distributing the oxide.

H—Pipe to bag room.

h—Pipes in bag room.

The course of the oxide and gases is shown throughout by the arrows. The process is simple. Man throws in the material, and nature does the work with two of her great elements—fire and air. At one time the oxide was made to pass through a water spray, but this was abandoned at the Bartlett Works for some reason.

Fig. 3 is a view of the bag room, in which the oxide vapor is condensed, with its great tall rows of ghost-like flannel bags.

H *h*—Iron induction pipes, as seen in Fig. 2.

J—Balloons of flannel.

K—Flannel bags in which the oxide is collected or sublimated.

L—Bags for receiving the oxide shaken from bags above.

This room is constantly filled with more or less carbonic acid from the coal, and hence has very free ventilation. The bags alone in this room cost over $20,000, and it has size enough to condense 20 tuns of oxide per day. The engine which furnishes power is an excellent one from the Washington Iron Works, and the whole establishment, built two years ago, is excellently managed by Col. Charles Stebbins, General Director, and. Dr. Johnson, Superintendent and Chemist.

Fig. 4.

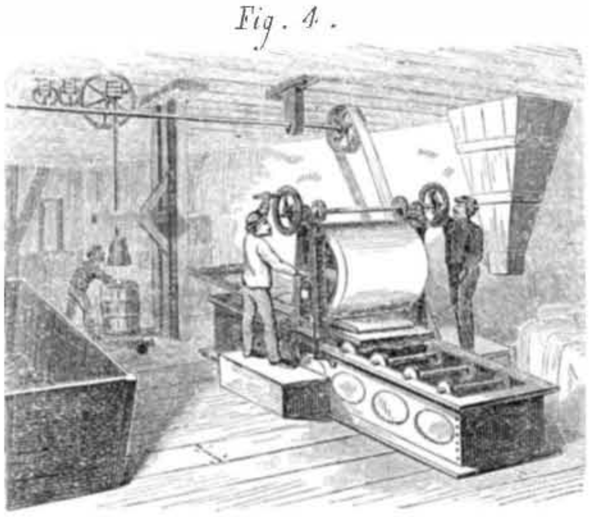

Fig. 4 is the packing room. The oxide is placed in bags and rolled in the machine shown—thence packed in barrels.

The invention of the American machinery marks an era in the history of the zinc trade of the world. The article produced is not so white as the French, yet the Lehigh Company have produced nearly as good a product from the carbonates and silicates of Pennsylvania.

The New Jersey Zinc Company was the first started in this country. They commenced operations in 1848. Their history is one of struggles and failures, but perseverance triumphed. They commenced with the retort process, and it is said made oxide which cost them $1 a pound. In 1850, disheartened, the stockholders were thinking of abandoning the enterprise, when the present style of furnace was erected by Mr. N. Bartlett,and the bag condensers invented by S. F. Jones. A new impetus was given to the business, and the trouble then was not to make the oxide, but to dispose of it after made. Two barrels of the first made were sent to the World's Fair of 1851. Now there are nine zinc companies at work in the United States, and the New Jersey alone produce about 5,000 tuns a year, of which nearly two-fifths is exported to Europe. Their profits have been immense, and the stock has sold, since the flush times of the war, as high as 200 per cent above par. The Lehigh Company was started in 1854.

The New Jersey Company use an ore of zinc and iron and manganese, called Franklinite, of which they control a large deposit. The carbonates and silicates of zinc are used by the Lehigh Company, but they are scarce of ore. This ore abounds in Virginia and Tennessee, and in the latter State works have been erected to use it, but as bituminous coal will not answer for the furnaces, they are at disadvantage in distance from anthracite.

The fire process by which these pigments are produced is very similar. The ores yield variously, that of the Bartlett Company nearly twice as much as the others. The product collected farthest from the furnace is the whitest. That falling in the cooling chambers is usually worked over.

It is only within two years past that it has been found practicable to use the most abundant ore of zinc, the sulphuret, called in mining parlance "black-jack." The use of this ore was made the subject of a patent, granted the Bartlett Lead and Zinc Company in October, 1868. A peculiar pigment was thereby produced, to the structure of which we have alluded. The properties of the pigment made by this company may be due in a great measure to the ore used, which is *sui generis*, as the ordinary "black-jack," while producing a pigment containing lead, certainly does not have it in near equal proportions, or the same chemical form.

This pigment probably deserves more than a passing notice. It is made from an argentiferous galena ore containing zinc, found in North Carolina. It contains about $15 of gold and silver to the tun of ore. Until lately the ore was "buddled" and concentrated; for ten tuns of raw ore one of concentration was obtained. This yielded from $150 to $225 in gold, silver, and lead. The rest of the 10 tuns was roasted in a peculiarly constructed furnace to get rid of sulphur, and then brought to Bergen Point, N. J., opposite New York, and oxidized. The owners found that their process of concentration did not get near all the lead or silver, and doubting whether it would not be better to improve their pigment by using the fresh ore merely roasted, without concentration, tried the experiment with such success that now they have abandoned the concentration, and produce a pigment containing over 40 per cent of lead, and weighing 500 pounds to the barrel—flour barrel size—same as would hold about 200 pounds of ordinary oxide of zinc, or 600 pounds of white lead. It has been rather a matter of dispute in what form this lead is contained. That it is an entirely new form all admit. Our theory is this: The roasted ore as received from the mine contains a certain percentage of basic sulphates, these are set free by the fire-heat; the lead is also oxidized and goes over as a peroxide, the zinc in its usual form; the sulphur of the sulphates is set free as sulphurous acid, this unites with peroxide of lead and forms a new character of sulphate, not being enough sulphurous acid to take up all the lead, the remainder, assuming its acid character, unites with the zinc as a *plumbate of the oxide*. Our theory is one derived from practical observation of the pigment from its first production.

This pigment was introduced to the public about two years ago by Messrs. C. T. Raynolds & Co., the oldest and one of largest paint houses in America, and though a new article, hence meeting with much opposition, while at the same time its singular nature was not understood, it has met with great favor and is firmly making its way into general use. And we are informed that Messrs. C. T. Raynolds & Co. sold in 1869 over 1500 tuns. It is claimed for it that it has more body and greater durability than white lead, and will not peel off as does zinc oxide. Its peculiarities are that when mixed with oil or spirits of turpentine it does not settle as other paints; that a building painted with it bleaches whiter instead of turning yellow; that when mixed and exposed to the air it thickens, and it has a peculiar gloss unknown in any other pigment. At least some of these peculiarities may be due to the fact that a large part of its oxygen is in the form of ozone.

The works of the company, of which we give a bird's-eye view, have now a capacity for production of over 10 tuns of pigment per day. The mines in North Carolina have been repeatedly pronounced inexhaustible by the most competent scientific and practical authorities. We occupy this much space with this pigment because we think, as with the first production of zinc oxide, that its introduction marks an era in the paint manufacture of this country.

It is singular that while the ore from their mines contains an average of over 30 per cent of sulphur, the company have never utilized it for the manufacture of acid, which would add greatly to their profits. In England such an ore would be worth $12 to $15 per tun for the sulphur alone.

As a paint, zinc oxide is generally used for inside work. For nice work of this kind French zinc ground in poppy oil alone, or in poppy oil and thinned with white Damar varnish is used; this last is classed by the trade as China Gloss, Enamel Finish, etc. American zinc is chiefly in use as an adulterant of white leads, and the production of a class of pigments called cheap "leads," which are mere mixtures of sulphate of baryta, zinc, and more or less—sometimes no—white lead. The Bartlett Lead is an inseparable mixture of some form of lead and the anhydrous oxide of zinc. It contains from 30 to 40 per cent of the former, is finer than any pigment known, and has peculiar properties possessed by no other pigment. It has now been before the public for about two years, and barring the disadvantages incident to any new article, has met with almost universal favor, and is increasing in popularity. It is a singular product and emphatically a new discovery in science and the manufactures.

The capital employed in this business in this country is over $12,000,000, and the annual product about 15,000 tuns. The Works of the Vielle Montaigne Company are very large, and are chiefly located in Belgium. The production of metal zinc is, however, a great part of their business. About 450 tuns were imported in 1869. The American article ranges in price from 6 to 8 cents per pound; the French sells at about 9½, gold. The duty is 1½ cents per pound.

STEAM ON COMMON ROADS.

[From the Engineer].

What is the true reason that we nowhere see the steam engine used to any great extent for common road traffic? There is probably no problem in the whole range of practical mechanics, and there is certainly no other problem in steam engineering which has taxed ingenuity so long, so much, and yet with such comparatively slight results. Almost innumerable inventors, dating from Cugnot, have been trying their hands at it for more than a century. It is true that their work has not been without some fruition. Steam traction engines now carry themselves and their plowing tackle in farm operations; they are used for drawing heavy loads for short distances on special bits of road; but that is nearly all. Road engines have never yet found general application in England; and, after many different trials at various times, they have almost completely failed in France, in Germany, and America. The multiplicity of the proposals and attempts in this direction is remarkable. We have Savery, and later Dr. Robinson, ten years before Cugnot's trial, proposing the thing. Then Oliver Evans; in 1784 Watt patented the application of his engine to the purpose; William Symington tried it; and afterwards Murdoch. Oliver Evans actually propelled an engine of some size. The most ingenious at tempts were made by Trevithick; and, after him, by Gurney, Gordon, Ogle, Dr. Church, and Dietz in France. The curious, and perhaps significant, point about the history of these attempts is that the principal ones were renewed with an interval of a generation between each. Thus, after the first schemes in 1759-69, we find Trevithick working in 1802-4; Gordon, Church, and many more in 1832-6; and, lastly, Boydell, Aveling, and others, from 1855-65. We now have another ingenious plan, but, in spite of all that we have lately heard from Edinburgh about Mr. Thompson's road steamers, we are not inclined—while we wish him every success—yet to make an exception in his favor. In the first place, they have not worked long enough; and, in the second, we do not know the proportion that the excellent roads in and about Edinburgh have contributed to his success. In fact, isolated cases of the partial success of steam power on common roads can generally be traced to the good state of the roads in the given locality.

Trevithick, the greatest genius among traction engine inventors, seems at first to have even believed that "railroads are useful for speed and for the sake of safety, but not otherwise; every purpose would be answered by steam on common roads which can be applied to every purpose a horse can effect." In this there is, of course, an evident fallacy. The only reason that greater speed is obtainable on a pair of rails, with a locomotive and its train, than if the locomotive and train were put on a road without rails, is that the rail offers a hard, smooth, unyielding surface, and that the ordinary road offers a soft, rough, and yielding surface. If we took an ordinary train of a locomotive and carriages, turned the flanges off the tires, and placed them on an iron road, made with one smooth level surface—one long metallic table, in fact—we could evidently get the same speed on such a road —which we may suppose perfectly straight and sufficiently wide to get over the difficulty of our want of flanges—as on an ordinary line of railway. As soon, therefore, as a locomotive and train were got to run on rails, it might have been seen clearly that the locomotive steam engine did not want improving, but that, in order to put steam power on roads, it was the roads that wanted improving. In fact, only a year or so after his patent for 1802, Trevithick came to the conclusion that steam carriages could not be placed on common roads before common roads were radically improved and rendered able to bear heavy loads without giving way and increasing the draft to an impracticable amount. Some of the more able later inventors of traction engines saw this, more or less clearly, and attempted to make the engine carry its own railway, though we are not aware that even Boydell's traction engine and endless railway are now anywhere in practical use. After making the most successful road traction engine of any, we now see Messrs. Aveling and Porter taking the lead in the production of steam road rollers.

Briefly, the whole future of the application of steam to common roads clearly lies in the improvement, not of the engine, but of the road. In the same way as rails must be laid down before running the locomotive, so must common roads be rendered able to bear heavy weights, and have given them a hard, level surface, one approaching as nearly as possible that of the rail table. The nearer this condition of hardness is approached, the more extended will be the use of steam on common roads.

These premises being granted, the solution of the old problem of applying steam to common roads is simply to be found in the general use of the steam road roller. The steam roller must precede the steam traction engine. Experience shows that this process of road-making and maintenance gives us a hard level surface, not liable to sink and take ruts under the wheels, and affording more than sufficient adhesion for propulsion with smooth wheels. The possibility of applying steam in this way would give us what might be termed a universal tram-road, rendering available for steam power our 200,000 miles of macadamized roads. Much in this sense was a passage in a late public speech of such an experienced engineer as Sir Joseph Whitworth, in which he pointed to the improvement of common roads rather than an extension of tramways. The roads are there, and their improvement by the process, instead of involving an outlay of capital, actually greatly reduces the cost of their maintenance. In our especial case the employment of an engine on common roads, able to move about with facility, also means the application of steam to the conveyance of stone from the various deposits along the road; to breaking it up and taking it to the required spots before rolling it down. Of extraordinary value would these applications of steam be in countries with such dear labor as that of America.

THE *Coach Maker's International Journal* suggests that if some inventive person could get up some better simpler and neater arrangement for finishing the side lights in leather carriage tops, a good chance to "make stamps" would result to the inventor.