level of which corresponds with that of the water in the receiving tank. Surplus steam, air, and gases are forced out through a check valve in the top of the upper cylinder by the momentum or hammer of the water, obviating the necessity of air pumps, siphons, or similar contrivances, and making a very cheap and direct-acting device for raising water. For draining mines, wrecking purposes, pumping for railroads, elevating water for supplying cities, towns, and villages, and for producing a water power by creating a head, this machine is believed to be applicable and efficient. Forty-five barrels of water can be raised twenty-five feet high per minute with this machine and a ten-horse power boiler carrying twenty-five pounds of steam.

Patented Oct. 27, 1868, by A. J. Reynolds, who may be addressed at the Detroit Locomotive Works, Detroit, Mich., or Reynolds & Newell, 17 Maiden Lane, New York city.

THE BEST MODES OF TESTING THE POWER AND ECONOMY OF STEAM ENGINES.

BY CHARLES E. EMERY, LATE OF THE U. S NAVY AND U. S. STEAM EXPANSION EXPERIMENTS.

Read before the Polytechnic branch of the American Institute, Oct. 22, 1868.

(*Continued from page 342.*)

The anthracite, as a rule, contains much more refuse than the other varieties. The English coals probably average 10 per cent of waste; the West Pennsylvania and Ohio coals have only 5 per cent, and the maximum of our bituminous coals rarely exceeds 13 per cent. On the contrary, the refuse from anthracite rarely falls as low as 10 per cent and often reaches to 24 per cent, so that, on the average, its waste is double that of the bituminous varieties. It will therefore be interesting for us to examine the results produced by the combustible portions of the different kinds of coal The part consumed is called the "combustible," and is found by deducting from the weight of the coal the weight of the ashes, clinkers, soot, etc., which can be collected after the trial. Referring again to the Navy Experiments, we find that the mean evaporative efficiency of thirteen varieties of American anthracite combustible was equal to the evaporation of 10·69 pounds of water, from a temperature of 212°, and, for the three varieties of bituminous combustible, the corresponding effect was 10·84 pounds. The results are practically identical. By throwing out of the comparison some of the varieties of anthracite, which justly have a poor reputation in the market, the preponderance would be upon the other side. If, then, we take it for granted that the average foreign and American and bituminous coals are substantially equal in value, the value of the combustible of the foreign coal will equal that of American bituminous and American anthracite, and we may assume that the combustible of the coal, burned in any case, is a tolerably accurate comparative measure of the economy of a steam engine. All these restrictive qualifications are necessary, for, if selected coal of the best quality, be used in a trial, the results will be above the average in any case. We wish simply to indicate that the greatest difference in the results given by different coals is due to the difference in the quantity of non-combustible matter, so that, if this be thrown out, the weight of the combustible remaining gives the nearest approach possible, without absolute trial, to the comparative heat-producing powers of different specimens. The best standard to show the comparative economy of the steam engine, other than that of the steam used, is therefore "The number of pounds of combustible used per horse power per hour."

We cannot fairly, however, compare the combustible per horse power per hour, used in experiments here, with other experiments when only the coal was noted. This necessitates us to correct the amount of coal used by a common standard, founded on the combustible. Good bituminous coals, here and in England, leave about 10 per cent refuse; hence, to make our experiments compare with those abroad, as well as for convenience, we suggest that in every case, the coal burned in determining the economy of a steam engine be reduced to a common standard of 10 per cent refuse. Let us see the effect of this. The true comparative test for engines is the amount of heat they receive; we have shown that the heat-producing power of the coal is proportioned to the weight of the combustible; hence, if the weight of the coal be also proportioned to that of the combustible, it also expresses the relative economy. The coal is so proportioned when it leaves the same percentage of refuse, so by our plan of correcting the weight of the coal by its combustible, so as to give 10 per cent refuse in each case, the weight of the coal is a true comparative test of the relative economy of the engine. For instance, 100 pounds of coal leaving 20 per cent refuse will evaporate no more water that 88·9 pounds leaving 10 per cent refuse, for both contain only 80 pounds of combustible. If to the combustible we add one ninth of its weight, the quantity added is one tenth, or 10 per cent of the sum, which represents the weight of the coal, corrected to the uniform standard of 10 per cent refuse. Suppose a horse power in a certain foreign steamship costs 2·8 pounds of bituminous coal per hour, and in an American vessel it costs 3 pounds of coal, using anthracite, are we to say our engines are inferior? Let us see. We first deduct the refuse from the anthracite—for instance, 20 per cent, which leaves 2·4 pounds of combustible. This, then, is nine tenths of the weight of coal having ten per cent of refuse; so multiply 2·4 by $\frac{10}{9}$, gives 2·67 pounds as the true cost of the power in the American engine, to compare with 2·8 pounds used by the foreigner, when both are compared by the same standard.

We have been thus explicit because the fuel is so generally used in the comparison of the performance of steam engines. The coal bills of course show the absolute cost of the power in any particular case, no matter what quality of coal was used; but, under such circumstances, the weight of coal consumed, even when corrected as above pointed out, is, as must be seen, but an imperfect comparative measure. To make comparisons sufficiently correct to answer the demands of science, we must measure the steam used in each case—in other words, compare engines by the Number of Pounds of Steam used per Horse Power per Hour.

The calculations are usually made from the pressure shown at the termination of the stroke; the assumption being that the engine uses, at every stroke, one full cylinder of steam at that pressure. In other cases, however, the initial pressure, and the portion of the cylinder filled at the point of cut off, are used in the calculation. These methods of determination pre-suppose that dry or saturated steam enters the cylinder, which may be true, and that the steam continues in this state, through at least part of the stroke, without condensation, which is never the case. Steam is necessarily condensed to set free the heat transmuted into the work done; and the temperature of the metal of the cylinder is a mean of the temperature to which it is subjected, and therefore forms a condenser with respect to the initial steam. The consequence is, that there is always more steam taken from the boiler than is shown by the indicator; the discrepancy increasing with the degree of expansion and amount of external refrigeration. Clarke, in his work on the locomotive, points out great differences between the amount of steam calculated from the initial and terminal pressures shown by the indicator; and yet uses the first in all his calculations. Later experiments, where the steam has been actually measured, show that in small engines twenty to thirty per cent of the steam is unaccounted for by the indicator at full stroke; and as high as sixty to eighty per cent when the steam is expanded considerably. Large engines show a small discrepancy at full stroke, which rises to thirty, and often fifty per cent, with shorter admissions. The best examples of the English double cylinder pumping engines use thirty-three per cent more steam than is shown by the indicator or the cylinders. This method of determination is therefore absolutely worthless for our purpose, as it furnishes no basis for reliable comparative tests. To these discrepancies must be attributed the losses which are known to arise in the steam engine. They have been ascertained, in practice, by indicating the engine and measuring the water pumped into the boiler, and evaporated there, to furnish steam. In other cases, the exhaust steam of the engine has, by surface condensation, been reduced to water, and its quantity determined by measuring or weighing it. The weight of feed water, or, what is the same thing, of steam used in any case, to produce a given power, may, by either of these plans, be ascertained with scrupulous accuracy; and if the coal be weighed at the same time, the evaporative efficiency of the boiler can also be determined, and the excellence of both engine and boiler be detected and credited aright.

In addition to the standards above given, expressing the economy of the engine, others of special application are used, which give the cost in terms of that which costs money everyday; namely, the coal, and the result in that which returns the money. For instance, the miller speaks of the number of pounds of coal it requires to grind a barrel of flour—a thing, by the way, which may depend as much upon the condition of the mill as of the steam machinery. Locomotives are rated by the number of pounds of coal or coke burned per tun, per mile. So, also, what is known as the "duty" of a pumping engine, is the number of foot pounds of work derived from the consumption of a certain quantity of coal.

Having discussed the various measures and means that may be employed for our purpose, we desire next to select such as will be useful in particular cases, and show their practical application, which leads us to

THE METHOD OF CONDUCTING EXPERIMENTS.—I. TESTING BOILERS.

The power of an engine can never exceed that of the boiler which furnishes it with steam; hence, it is eminently proper that we should first select measures to ascertain, in a given instance, whether the steam is economically generated. As has been said, the heat producing power, or evaporating efficiency of a boiler, is measured by the number of pounds of water evaporated per pound of coal from a given temperature, say 212° Fah. We have therefore to weigh the water evaporated, and the coal producing the evaporation—a very simple thing apparently, but one about which there is much misapprehension, resulting in statements grossly erroneous and ridiculous. The water may be measured in a tank or barrel, the contents of which have been ascertained by careful measurement, or by weighing water into it of a given temperature. When experimenting, the water in the tank should be pumped out dry if possible, or at least to a given mark; the pump then stopped, the tank re-filled to the proper hight (the easiest way is to overflow it), when the supply can be shut off and the operation repeated. The supply pipe should be arranged so that the water can be seen entering the tank, and leakage detected while the pump is working. The better way is to have a hose to throw in and out of the measuring tank. Before making even experiment, it should be ascertained if the boiler foams or raises water; if so, it must be remedied before proceeding farther. All leaks about the tank, pump, and boiler, should be stopped; and all extra pipes leading water in or out of the boiler be disconnected, or frequently examined. The steam generator may be worked off in the engine, blown off through the safety valve, or otherwise disposed of, so long as no water is lifted with it. The latter is less liable to happen when the evaporation takes place under considerable pressure. The greatest care is necessary in commencing and ending experiments. There are two methods of doing this. The first is to measure the temperature and hight of the water in the boiler, and, immediately upon starting the fire, to keep an account of the fuel consumed, until the close of the experiment; then to weigh the coal and ashes hauled out of the furnace. This involves a calculation to ascertain the heating effect of the fuel used in generating steam. It is of little value for the purpose of comparison, for the shell of the boiler and its surroundings (often a heavy mass of brick work) has also to be heated; and of this no estimate can be formed. The better plan is to get every thing in average working condition before starting the experiment. The steam should have the proper pressure, the fire be clean, and of a certain thickness, judging by marks on the sides of the furnace, the ash pit clean, and the water at a certain known hight. The experiment may then proceed, weighing all the coal afterward used, and measuring the water pumped into the boiler, till near the desired time to stop, when the fire should be thoroughly cleaned and filled up with coal to the same marks as at the beginning; and should be maintained at that point, with the steam at the starting pressure, till after pumping in the last tank of water, when, as soon as the water level reaches the same hight as at starting, the experiment may be terminated. The ashes in the pit should then be weighed, as well as those previously collected. The fire should be equally bright, and the steam pressure the same at the beginning and end of the experiment, so that the water level will be disturbed in like manner. At stopping or starting a certain feed should be kept on; or the water should be pumped too high, and time noted when, by evaporation, the level falls to the mark. No experiment should be less than eight hours in length; and a trial of forty-eight to seventy-two hours' duration can better be depended upon. During the experiment a log should be kept, upon which should be recorded the time, the weight of the coal and ashes, the number of tanks of feed water, and the temperature of each. The temperature of the escaping products of combustion, and of the fire room, may also be noted; as well as any evident remarks about the kind of coal, and the circumstances of the trial. After the experiment, the following calculations are necessary: First, in an evident manner, ascertain the total amount of coal and ashes, subtract one from the other, which gives the total weight of the combustible. Then find the average temperature of the feed water, and the average pressure of steam. Then calculate the weight of the whole quantity of water evaporated, making allowance for its temperature.

(To be continued.)

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

Steam Engine Indicator.

MESSRS. EDITORS:—I have read with surprise the criticisms on the indicator as a means of ascertaining the power exerted by steam engines, contained in the paper by Mr. Emery, published in your last two numbers. The writer says that its indications have been shown to be of a most unreliable and deceitful character, even in those respects in which they had heretofore been considered practically perfect; and that although the Richards Indicator is undoubtedly a great improvement upon the old style, still the best of these instruments give, at fifty revolutions of an engine per minute, when cutting off at an early point of the stroke, diagrams which have been demonstrated to be erroneous by from ten to twenty-five per cent. He describes an experiment by which he states that any one may prove the existence of these errors, and then attempts to show that they are unavoidable.

The connection leaves it to be inferred that this startling discovery has been made in the course of the experiments on steam expansion, which have for several years been carried on by the Navy Department. This show of authority, together with the candor and evident sincerity of the writer, is likely to carry some weight; and the charge might, if permitted to pass unchallenged, be regarded by many as confessed.

Now, nothing can be more certain than that the defects here attributed to the indicator have no existence. The action of this instrument has been investigated too thoroughly, by too many able engineers, and under too many varied conditions, to permit confidence in it to be shaken by any statements inconsistent with the general experience. I cordially unite in recommending experiments of the character suggested by Mr. Emery to be generally made; and whenever these are properly conducted, it will be found that all the diagrams taken from an engine when exerting the same power, however they may differ in their outlines, instead of presenting the discrepancies stated, will contain the same area exactly.

Mr. Emery accounts for these imagined errors by supposing that the inertia of the moving parts of the instrument compels the indications to be tardy. Let it be assumed that such tardiness of action exists, in a degree sufficient to account for the least amount of error stated; namely, ten per cent at fifty revolutions of the engine per minute. Then, if the speed of the engine is increased, this error also must increase in the same ratio in which the power required to overcome the inertia of the moving parts increases; or as the square of the speed, and at four hundred revolutions of the engine per minute will amount to six hundred and forty per cent, and we find ourselves far beyond the limit of speed at which the indicator can give any diagram at all. But I have taken diagrams with the Richards indicator at four hundred revolutions and over per minute, which were demonstrably perfect, although the entire figure was completed in less than the one seventh part of a second. I have also taken diagrams from locomotive cylinders at two hundred and sixty revolutions per minute, in which the admission line was carried by the momentum of the moving parts, much above the point which would mark the pressure of the steam; and the reaction of the spring was so instantaneous that the pencil descended on the same line. To those who are familiar with the action of this instrument at high speeds, the idea of its being tardy appears quite absurd; and they will unite in assuring our critic that he must look elsewhere for the causes of the discrepancies which he imagines he has discovered.

Thanking you for your courtesy in permitting me to trespass so much on your valuable space, I am yours,

New York, Nov. 20, 1868. CHARLES T. PORTER.

Testing the Power of Steam Engines.

MESSRS. EDITORS:—I notice in No. 21, page 322, the following from the pen of "C. E. Emery, late of the U. S. Navy and U. S. Steam Expansion Experiments:"

"The measurement of the power in the steam cylinder by the indicator is defective, also, because it takes no account of the friction of the engine."

Will Mr. Emery please state what we shall call the result we get by the indicator when we throw off all resistance and run the engine by itself alone? ENGINEER.

Curiosities of Vision.

MESSRS. EDITORS.—In a recent number of your paper I notice an article on a subject which has often occupied my thoughts, that is, the difference in the real appreciation of the magnitude of the same objects by different persons. We know that the vision of all persons is affected by their idea of the distance of the object viewed in relation to its magnitnde, and that correct ideas of magnitude gathered simply from vision are impossible.

The painter when he represents an object, a landscape, or an architectural structure, always places somewhere in the field of view, some well known object, with the proper size of which, all are acquainted, and which object is really the scale by which the dimension of the picture is to be estimated. But even in real objects there is great liability of mistake. It is said that to a stranger not accustomed to the sight, a large man standing in the door of St. Paul's, London, looks like a boy, and that it is necessary for a person to become familiar with the great cathedrals of Europe, and time and again compare them with well known things that have been handled before they can fully appreciate their majestic proportions.

But the question has occurred to me: Is there not a real difference in the appreciation of two persons in relation to the magnitude of the same object even when it can be handled; and is not this the real reason why one person will go into extacies at a view of Niagara, or of Barnum's fat woman, while another will only, like the tailor, see "a glorious place to sponge a coat," or a lump of disgusting humanity? From what I have seen, read, and experienced, I believe that such a difference does exist, and that it is the main spring of what has been called taste by some, in relation to an appreciation of the sublime.

We may read a description of Niagara written by one of these large viewers and our mental vision, may be enlarged by his or her descriptive figures till our ideas may come up almost to the glowing picture painted, and the "Tremendous Current" of our school-boy days be really worth more than the money it would cost to go and see it, but alas for the disenchantment, if perchance we do get to see the original especially after roaming the broad prairies and crossing the wide rivers of the West.

Under such circumstances I must confess my first thought was when I looked on the "insatiable abyss:" Is that all? and I passed on my way, not waiting for it to "grow" on me. But I believe I am not totally devoid of the faculty (or whatever else the phrenologists call it) of sublimity. I can look at the moon on a cloudless night, and by an exercise of will, or imagination, or of reason or arithmetic, I know not which, I can make it appear to my "mind's eye" as large as it should appear if some twenty thousand miles distant. The same experiment is successful with many other objects which can be excluded from other objects in the field of vision.

I recollect that one time when out hunting in a snowy winter on the prairie I saw across a shallow valley, at as I supposed a half mile distance, a "tremendous varmint," smelling around on the sun-lit snow. After screwing up my courage for a few moments, I cautiously advanced, and after a few rods walk, succeeded in slaying one of these little mephitic quadrupeds, which so strongly excited the disgust of old Carver when he traveled here a hundred years ago, and which some call skunk. I would have bet at least on a black wolf or anything larger if we had such, until I had taken a few steps toward him. At another time I got a view of one of the most tremendous structures for a few moments ever seen or made by man. A steamboat had landed against a small island in the Mississippi, covered with low trees, upon the other side of which I happened to be. Beyond, on the other side of the river was a clean prairie horizon which could just be seen above the trees. I saw nothing of the boat but her two chimneys, and at first sight, and indeed until reason had time to prove the contrary, they seemed to me to be two immense towers, at least a thousand feet high, resting on the distant landscape. By imagination, I suppose, I repeated this effect several times, until I really began to feel quite "sublime." Capt. Parry tells us how he used to see on the great snow wastes of the North great cairns of stones, which with a few minutes walk he could pick up in his hand, and I have often seen on a prairie ridge, when traveling, an immense mansion, which in a short drive turned out to be the the 16×20 "box" of a new settler. That there is but a few steps in such cases from the sublime to the ridiculous, I have found out by experience, and that the faculties or the "tastes" of different men depend very much upon a difference in natural or perhaps acquired appreciation in sight as well as in other senses I am fully persuaded. C. BOYNTON.

Lyons, Iowa.

Meteorites--New Theory Propounded.

MESSRS. EDITORS:—Perhaps it may interest your scientific readers to know that this morning (Nov. 14th), especially after 3 o'clock, meteorites fell here and around this vicinity in great numbers—superseding anything of the kind ever heretofore seen, as many of the early-risers say. One fell after 4 o'clock, on the Gloucester ferry-slip, and exploded with a loud report resembling that of a pistol. Several were seen falling, leaving long and luminous trains behind them; and one was observed moving with great velocity in a northwestern direction, and leaving behind it a very long luminous tail. Another blazed forth in the southern heavens, and threw so clear and vivid a light around it that the whole scenery was lighted up for the time being, as it would have been by a flash of vivid lightning.

Two years ago I wrote to a certain scientific editor that the true cause of our annual or November meteoric showers was the fact that, at that period of the year, the earth actually *crosses the sun's path*; that is, the earth is direct behind the sun, and passes over his orbit on the 14th day of November of every year.

For some cause or other the editor referred to did not give my article publicity. I therefore, for the sake of astronomic science, appeal to the SCIENTIFIC AMERICAN. I think it capable of demonstration that not only does the earth actually cross the sun's path on the morning of the 14th Novembar every year without exception, but that the sun is actually moving around the heavens in westward orbital motion, and that he is positively leaving a meteoric train behind him, which stretches out many degrees beyond the earth's orbit.

These are facts of astronomical science, which ought to be carried to the ears or eyes of every scientific man, and which I hope the worthy editors of the SCIENTIFIC AMERICAN will aid me in bringing publicly before the world.

JOHN HEPBURN, SEN.

Gloucester, N. J.

Manufacture of White Lead---New Processes.

For the Scientific American.

The adulteration of white lead with sulphate of baryta has become so common that it is one of the regular steps in its preparation in all factories. The pure white lead of the most finely ground quality is called "Silver White;" when mixed with equal parts finely ground sulphate of baryta it is called, on the European continent, "Venice White." When adulterated with double its weight of sulphate of baryta it is known as "Hamburg White;" and even three parts of the baryta and more to one of lead are frequently used. This adulteration is not entirely a deterioration, and many of these adulterated qualities are preferred for certain purposes to the pure article.

There exists another kind of white lead, called "Kremner White," which owes its pure white color to the original purity of the lead employed (which is free from silver and iron), and the carefulness in the method of manufacture, clearing it from all powdered metallic lead or sulphuret, which, especially the last, even in the smallest quantities, injure many other qualities of white lead.

The method described on page 298 is usually called the Dutch process, and being very injurious to the workmen has in certain localities been superseded by the so-called French process, of which Thenard first established the principle. It consists in making a solution of a soluble salt of lead, and by passing carbonic acid gas through it the lead is precipitated as a carbonate. This process may be executed on a very small as well as on a large scale, and requires the following steps: First, a saturated solution of acetate of lead (lead sugar) is made, either by dissolving this salt in water, or by heating metallic lead with pure vinegar; this solution is boiled with oxide of lead (litharge) till it cannot dissolve any more of it; one part of pure strong wood vinegar (pyroligneous acid) will dissolve a little less than one part of litharge (oxide of lead) and form a neutral acetate, when dissolving twice that quantity of litharge in it (correctly 60 parts of acetic acid to 112 of litharge, one atom of each) we obtain a so-called subacetate, a basic solution, which colors litmus paper blue, and when dissolving three times the amount of litharge the solution is saturated, and the excess of lead above the neutral solution will be readily precipitated as carbonate of lead by passing carbonic acid gas through the solution, till the solution becomes neutral again, or even acid.

This carbonic acid gas may be obtained by the action of sulphuric acid and water on chalk or marble, as is done in the preparation of the so-called soda water, or it may be obtained from the combustion of charcoal, but in this case it must be purified, chiefly from sulphur vapors, as these color lead black, and consequently make the precipitate very dirty looking. The best way is to pass the gas resulting from combustion first through a separate solution of lead, before passing it into the receptacle from which the white lead is to be precipitated. As soon as this precipitation is completed the liquid is left to settle, the supernatant neutral acetate of lead solution is decanted off, and boiled with another dose of litharge; thus a limited amount of acetate could be used for an indefinite period, if there were not unavoidable losses during the process, which have to be supplied from time to time with fresh acetic acid. It is clear that during this method of operation, the white lead being obtained from the first in a wet condition, the workmen are not exposed to the poisonous dust, as is the case in the old process described on page 298.

Several modifications of this French process have been proposed; for instance, Button and Dyer make a solution of litharge in nitric acid, and precipitate with carbonic acid obtained from the combustion of coke. Richardson uses sulphuric acid to precipitate the solution of acetate of lead, and thus forms not a carbonate but a sulphate of lead; and Leigh precipitates a carbonate from a solution of the chloride of the metal by means of carbonate of ammonia, which is only a more expensive way of operating without compensating benefit. Pattinson has a similar method, but precipitates the white lead by means of a solution of carbonate of magnesia in carbonic acid water, which solution he obtains from the mineral hydrate of magnesia, or from magnesia limestone; the solution he uses contains chloride of lead, and he treats the precipitate with caustic potash or soda, and he asserts that in this way his white lead becomes equal to the best known.

A method was recently patented in England and the United States to simply use an impure ore of lead of such a kind as is soluble in acetic acid, boil it with the acid, decant and filter the solution till clear, and then precipitate with carbonic acid. A common lead ore of this class is a mineral carbonate of lead of a reddish brown or gray color, it is abundantly found in England, but when introducing this method in the United States a great drawback was found to consist in the fact that not such a lead ore had been found here. Fortunately railroad cuttings in Missouri quite recently brought to light large deposits of this mineral, which are now being used for the manufacture of lead, white lead, and other lead compounds.

Dr. Vander Weyde, of New York, recently patented an apparatus by which the wood vinegar necessary for the solution of this ore, could be distilled from the wood at the mine, and the residue of the distillation, the charcoal, while hot in the still, was converted into carbonic acid gas, by simply blowing a current of air through the still, as soon as the volatile products were driven off by the distillation; this carbonic acid gas, after passing through cooling and washing tubs, is used for the precipitation of the carbonate of lead, the whole process thus being accomplished in one apparatus and one operation.

By this process of using the lead ore, the labor of reduction to the metallic state is entirely saved, a labor required when following either the old or so-called Dutch method, or when using the lead sugar, or when dissolving in acetic acid the litharge which is manufactured from the metallic lead.

Generally the white lead obtained after the French method by precipitation, has not the body, or else does not cover so well as that prepared after the old Dutch method; the cause is revealed by the microscope; the precipitated white lead consists of little semi-translucent crystals—the Dutch white lead—out of opaque white grains, but later improvements in the French method have overcome that difficulty to a great degree; they consist in preventing the formation of these small crystals by the use of nitric, sulphuric, and hydrochloric acids, and thus form a compound which consists not only chiefly of a carbonate, but also of a sulphate and chloride, which last two, by themselves, are inferior to the carbonate, but when combined in the formation of the precipitate, appear to improve the pure carbonate in a manner not yet precisely explained.

Chemical analysis has proved that the pure white lead manufactured after the Dutch process, is a compound of two atoms of carbonate of lead and one atom of hydrated oxide of lead, therefore is it probable that when the carbonate of lead obtained by precipitation after the French process was boiled with a sufficient quantity of a pure solution of subacetate of lead, it would take from this solution some hydrated oxide of lead, and become also a compound of carbonate and hydrated oxide of lead, and be as opaque, and dense of body as the Kremner white. A hint worth trying.

Of course the white lead manufactured after the French method is also adulterated with sulphate of baryta in different proportions, and this will be the case till a method is found of making pure white lead directly from the ore, and as cheap as the baryta, in which case the adulteration would not pay any more and come to an end. V.

The Defects of Railway Tracks.

Standing by the side of the line when the engine is slowly passing, says the *American Railway Times*, and watching the effect of the wheels, it will soon be detected why the annual repair and reconstruction expenses are so large. As each driving wheel passes over the cross-tie, the tie is driven down in the ballast just in proportion as the bearing surface is deficient to sustain the load. Now where the cross-ties are irregular in size, the resisting power to depression varies, the smaller tie sinking deepest, the blow from the driving wheel being aided by the fall so that the effects are aggravated in proportion. This result leaves the track a succession of short and irregular waves of the chop-sea variety, and not the condition for smooth running, or favorable to the "life" of any portion of the track or rolling stock. No amount of tamping up can prevent the formation of these depressions in the track where the cross-ties are irregular in size, and consequently there is an unequal amount of bearing surface. How many of the track-men, or in fact, how many of the managers ever give any heed to this matter or suppose it of any importance? Not many we fear. on many lines can be seen, lying side by side, cross-ties of every size and shape, some large and long, some small and long, short and small, some crooked. Frequently can be seen one tie extending from one to two feet outside of one rail longer than it does outside of the other, and frequently it is found that no attention is paid to the distance between the ties, and no effort is made to equalize the amount of bearing surface on the ballast per running foot or yard of track. This practice, or mal-practice, is very common, and there can be nothing more wasteful or improvident, nothing more unphilosophical. Vast amounts of money are expended to secure a smooth and even road-bed, for that is the theory of all railway construction, and then the practice is to so arrange the super-structure that the evenness and smoothness are at once destroyed, and the trains instead of having that easy gliding motion so favorable to economy of operation and safety, go thumping and pounding over the line, causing a useless waste of power, destroying the road-bed, and every part of the superstructure, and destroying every part of the rolling stock as well. Railway managers, most of them at least, can see this state of things on their own lines, any day they may take the trouble to examine them; and knowing as they do, for so they say in their reports, that the smooth track is favorable to economy of operation, they yet permit their road-masters and track-men to violate, in a hundred different ways, every principle of common sense and good railway practice that goes to secure this smoothness and evenness of track. The deficiency in this matter we believe is greater now than it was a dozen years since, but it is certainly safe to say that no improvement has been made during the time except in isolated cases. It is common enough to berate the rail manufacturers for failure to produce a serviceable article, but the cause of the early destruction of rails is, we fear, not always the quality of the make, it is in some degree due to the treatment they receive in the track. With the increased weight upon driving wheels and more frequent trains, and the condition of the tracks, with all the disturbing and destructive elements in them to which we have alluded, it is not a matter of wonder that iron rails wear out at an early day, and it is simply absurd to expect any other result. We do not hesitate to say, that unless the railway managers reform the character of the superstructure, arranging its details so as to secure that amount of evenness and smoothness which is practicable even under the present insufficient system, our sympathies will be with the rail makers, and not with the railway managers. In the different details of the superstructure, such as chairs, wood and iron splices, and other joint fastenings, there are some methods which are better than others, but we shall not attempt to sit in judgement upon them at present, and perhaps it is needless that anyone should do so; but one thing the railway manager must be certain of, and that is, that the best results of any system of rail fastening cannot be secured until the rails have equal, continuous, and permanent bearing, so that they may be kept truly in plane and line, and not liable to become disarranged by every passing train. The bearing surface of cross-ties is little enough on all the lines, but what there is should be evenly distributed under the rails. If the road-masters or managers think undue stress is laid upon this matter, they are simply very much mistaken.

Rapid Railroad Building.

The two departments of the great trans-continental railroad seem to grow fully as rapidly as the Ohio pumpkin vine, which the farmer advised the traveler to bestride as being a better means of travel than his jaded nag. As regards the eastern branch, we know that although to-day the newspapers state its working terminus at so many hundred miles west of Omaha, before we can comprehend the fact the report comes that it has added fifty or a hundred miles to its length. It seems to be the same on the other side, if we may credit the San Francisco *Bulletin*, which says:

"A few days since a merchant came down to the city from the eastern side of the Sierra Nevada. Having bought an extensive assortment of goods he gave directions that they should be shipped to the end of the Central Pacific Railroad, wherever that should be, expecting to have a considerable job of teaming to fill up the gap between the working end of the road and his place of business. His directions were obeyed to the letter. But, to his astonishment, on returning he found that the goods ordered had been carried about fifteen miles beyond his residence.

"The Continental Railroad is now 'on its travels.' It is not safe to limit its progress. There are probably twenty thousand days of work performed on every secular day. If a merchant sends goods to the end of the road, they will bring bring up somewhere this side of Salt Lake city, possibly in some ambitious little town that he never heard of before his departure. Miles of road are created, and even towns, in a single day. The dot on the map showing the working terminus of the road at the beginning of the week, must be moved forward at the end of the week to a point representing from eighteen to twenty miles of progress. Only a few months will elapse before a general direction to send goods to the end of the road will insure their bringing up either at Omaha or New York. It might be a safer plan just now for the interior merchant to drive a stake before leaving home, and order his goods not to be sent beyond the stake, lest he should have to chase them into the wilderness."

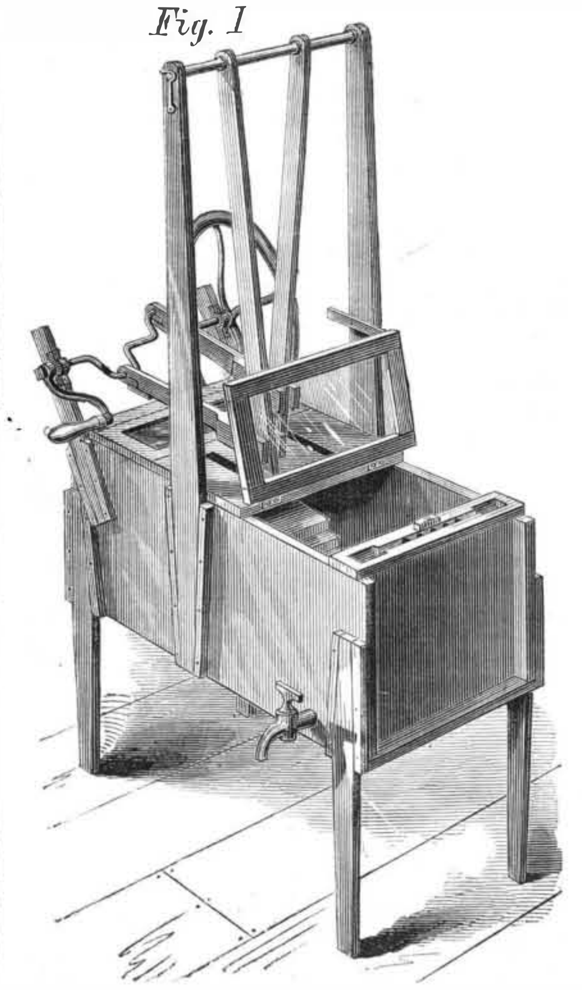
Mead's Monument of Lincoln.

A monument to the memory of Abraham Lincoln is to be erected at Springfield, Ill., at an expense of $200,000, of which sum $135,000 are already secured. Thirty-two designs were offered to the committee, and the decision was given in favor of the one made by Larkin G. Mead, of Vermont, and whose studio is at Florence, where, by patient industry and a refined genius, he has achieved a deserved fame. We had the pleasure of seeing the artist's drawing in perspective, and were favorably impressed by it. The whole hight is to be one hundred feet, and with the exception of its bronze figures, the monument will be of New England granite. Mr. Mead is making immediate arrangements for all preliminary work upon the monument, and will leave for Italy in about two months, to begin his models for the figures necessary. He thinks it will be about four years before the entire monument will be completed. His contract provides that the foundation must be completed during the summer and autumn of next year, 1869; the entire granite work is to be finished by Jan. 1, 1873. The artist will be allowed four years after that date for the completion of the sculpture.

SELFRIDGE'S PATENT WASHING MACHINE.

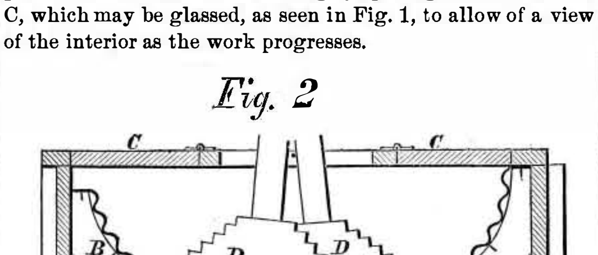
Inventions for lessening the household labor of women do not seem to meet with so great a success as those improvements on machines of which men have the sole charge. The sewing machine is an exception, but it is notable that the

Fig. 1



fact thus stated is evident. Whether the genius of women does not affect mechanics, or that the apparent complication of the devices contrived for women's convenience frightens them from a thorough trial of them may be an open question; but it is certain that the simpler the form and the easier the manipulation of a machine intended for the use of the gentler sex, the better chance it has for success. Apparently acting on this belief, the inventor of the machine of which the accompanying engravings are representations, has contrived a washing machine that is compact, portable, easily cleaned and worked, and very simple. Its form and general appearance is seen in Fig. 1, and the internal construction is seen in the section, Fig. 2. The tank, A, holds a washboard, B, which is in two parts, semi-elliptical and corrugated. These parts can be removed for cleaning by opening the hinged lids, C, which may be glassed, as seen in Fig. 1, to allow of a view of the interior as the work progresses.

Fig. 2



Two plunger or rubbers, D, having corrugated inclined sides, are suspended by pendulum arms to an elevated shaft held in uprights at the center of the machine, the arms being operated by means of hooked connecting bars, driven by cranks set isochronously on a shaft at one end of the machine turned by a handle. As one plunger moves forward the other is returning and a continuous rubbing of the clothes is assured. A faucet is inserted at or near one end of the tank for drawing off the dirty water. All the parts are so arranged that they may be separated for convenience in storing or removing. The recommendations from those who have used it are numerous and very favorable.

Patented through the Scientific American Patent Agency Nov. 5, 1867, by G. C. Selfridge, whom address for additional particulars at Saratoga Springs, N. Y. State rights for sale.

SHARPENING SAWS.—A correspondent informs us that, in answer to an advertisement, he paid fifty cents for the accompanying information: "After filing your saw, lay it on a level board and pass over the side of the teeth with a whetstone until all the wire edge is off the teeth. This will make your saw cut true and smooth, and remain sharp longer. Your saw must be set true with a sawset."

CULTIVATION OF WASTE LANDS ON RAILWAY LINES.

Nothing is more noticeable to the observant traveler on our railroads than the contrast between the land inclosed by the fences confining the road, and that on either side belonging to adjoining farms. Where the latter are cultivated, yielding crops of grass, grain, or vegetables, the former are either gravelly cuttings, scored by rain floods, plats of level denuded of their soil to be used for fillings on the line, or stretches of arable soil, left to grow up to weeds and wildness, detrimental to the adjoining properties and useless to anybody. Occasionally a patch of cabbages or potatoes, in the vicinity of a station or the dwelling of a switch tender, shows what industry can do in utilizing these waste spots. Such oases in the desert of the railroad line prove that "what has been done may be done." There can be no reason why the unimproved lands on the lines might not, in many instances, be cultivated, with a three-fold object, not the least of which would be the gratification of the eye accorded to the passengers. Another would be the additional income afforded to shareholders of the road, or the additional comforts to their employés. Still another advantage would be preservation of the embankments and cuttings from the effects of heavy rains or local floods or freshets, which, in one case, wash away the material of the road, rendering the ties insecure, and in the other deposit upon the track an excess of ballast.

Where an embankment or causeway has been carried across a low-lying "meadow," to equalize the level of the line, the perpetual moisture, aided by numerous trickling rills and running streams, gradually undermine the embankment and cause tumbles or slides, endangering the safety of passing trains and the permanency of the roadway. In such cases these embankments may be preserved by planting the slopes, however steep, with the osier. Wherever there is sufficient moisture, this species of the willow will grow. The kinds most adapted to our northern climate are the *Salix Viminalis* and the *Salix Forbyana*, both very valuable for basket making and other textile fabrics of wood. But beside this value as a material for manufacture, the long tendrils of the main root pierce the soil, on which they are subsisting, horizontally, binding the material of the embankment or dike into a solid mass; while the stocks, or the growing osier, present a barrier to the action of temporary floods and heavy rains. A notable instance of the value of this plant may be seen in the condition of the extensive dikes built in Hartford, Conn., by the late Col. Colt, where hundreds of acres of splendid arable soil has been preserved from annual overflow, and lands, before almost useless, have been turned into fertile fields or covered with villages, the inhabitants of which are supported by the great pistol factory, the manufactory of willow ware—the material for which is drawn annually and wholly from the products of the sides of the dike—and one or more sawing and planing mills.

There can be no valid reason why such embankments on the lines of our railroads may not be similarly utilized. After planting the osiers—which is done simply by slips—no other care is necessary. In the fall the shoots may be cut by a pruning knife, and can be sold as basket stuff, while the roots and stock remain to defend the embankment and furnish another crop the coming year.

But there are also slopes caused by cuttings, in localties where their bases—not like embankments—do not reach perpetual moisture. Few of them are of such an angle that grasses and grains may not be grown upon them. At least they will support the masses which will tend to preserve the integrity of the slope, and, in time, prevent its wearing away except when destroyed by a violent rain storm. Grass and grain seed scattered over these slopes, however gravelly and denuded of true soil they may appear to be, will take root and bear, and clots of grass sod, and of moss, will readily adapt themselves to their new conditions, so that even if *they* should not flourish, they will form a holding place for more useful plants.

On the level of the lines, frequently, large areas are fenced in, which belong to the railroad, that have been used either as deposits from which earth has been drawn to make embankments, or from which the trees have been cut for ties for the road, stringers or braces for bridges, or culverts or for other purposes. Although in many of these places the soil has been removed so that the clean gravel is exposed, in many others the surface is undisturbed except by the removal of the superincumbent growth of trees and brushwood, leaving the soil in tolerable condition for the plow or the spade. These spots might be cultivated by adjacent proprietors, or by the section men when the localities are removed any considerable distance from a village or farm house. The aggregate yield of useful or marketable commodities on a line of say twenty miles would amount to something of value either to the cultivator or owner, whoever the latter may be, and the appearance as well as the value of the road be greatly advantaged The subject is worth attention.

These matters are better managed in the old countries. There the station houses frequently are flanked on either side by beds of vegetables and parterres of flowers, protected by fences from the public way and the railway lines. Each one of these little stopping places are pleasant homes, attached to which are beautiful gardens bearing evidences of thrift and patient industry, forming pleasant views for the passengers of passing trains. What can prevent a similar condition on our railway lines?

IT is proposed to illuminate the great cross upon the Pittsburgh Cathedral with gas lights, to be ignited by electricity.

HARD steel and dry grindstones reduce the temper of the one and injure the usefulness of the other.