POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

[Reported expressly for the Scientific American.]

On Thursday evening, the 19th inst., the usual weekly meeting of the Polytechnic Association was held at its room in the Cooper Institute, this city. The chairman, Professor C. Mason, read the following report on—

ZINC.

In a remote age, the metals known to man had reached the sacred number *seven*—gold, silver, copper, mercury, tin, lead and iron equaled the seven days of creation, the seven stars, the seven colors of the rainbow, the seven sounds of music, the seven sons of Job, and the seven wise men of Greece. To have searched for more would have been presumption in a philosopher and impiety in a priest.

But nature thrust upon the notice of lead-miners an eighth substance, which had a faint metallic luster, and was fusible at a low point, but was extremely brittle and intractable, and the miners rejected it as "blind lead." Nature, however, regardless of popular opinion, pressed this same material on the attention of metallurgists, in combination with carbon and with silica, until the alchymists resolved to examine it. They put the ore into the crucible, and at the end of the roasting they found nothing left but a blackened sand; the shining particles had escaped. If it was a metal, it was volatile and invisible at its escape. They then tried to fix it by combining some other substance with it. In these experiments they tried copper. The result was a bright yellow metal, harder and heavier than copper, which they at first mistook for gold, but were finally content to call "brass." Sixty pounds of copper, treated with the *strance* ore, gave them 100 lbs. of brass. They had discovered a new metal, and set vigorously at work to separate it from impurities and alloys; finally they succeeded in confining its volatility and producing metallic zinc, which the first ship of the East India Company brought from China at about 24 cents a pound. Still it was a brittle, intractable metal, fit only to make brass. But the uses of brass increased rapidly, and the desire to cheapen that useful metal led to the invention (in Europe) of the retort process of obtaining zinc metal. This was followed, in 1806, by the discovery of vast deposits of zinc ores in Belgium and in Silesia. The product of these mines soon glutted the markets of the world, and brought down the price from 24 to 4 cents a pound. Ingenious men undertook to find out new uses for this cheap metal. Their attempts were rewarded by three inventions, which are to be noticed in the order of their occurrences.

A man of Glasgow undertook to handle metallic zinc at every temperature. At 130° of Fahrenheit he found it malleable and ductile, and up to 300° it behaved in the same laudable manner; this capacity for good conduct continued in the rolled metal until it was again heated above 300°, when it again became intractable and crusty. Immediately sheet zinc began to take the place of sheet iron, sheet tin and sheet lead; and being insoluble in water and but slightly subject to oxydation, it rose rapidly in favor with the public, and new uses are now constantly arising.

Meanwhile an ingenious Frenchman conceived the idea of converting zinc metal into an oxyd and using it, in oil, as a paint, in place of the oxyd of lead, which was known to be poisonous to the painters and to the inmates of recently-painted houses. He first obtained a coarse paint of a dull blue color; but after 30 years of experiments, Leclaire, in 1849, produced the "zinc-white," which immediately commanded such notice and commendation and public patronage as the French nation and government bestow only on great public benefactors. This invention opened a market for all the zinc products at a better price.

During this period zinc ores had come into notice at various points in our country, from Stirling Hill, in Sussex county, N. J., throughout the Saucon valley, extending south-west through Pennsylvania, Virginia and Tennessee; but especially at Stirling Hill, N. J., and near Bethlehem, Pa. The Hon. Samuel Fowler, senator in Congress, aware of the mineral treasures in Sussex county, had purchased from the heirs of Lord Stirling thousands of acres of land at and around Stirling Hill. Without knowing what was passing in France, Mr. Fowler began, more than 30 years ago, some rude but partially successful experiments to separate the zinc of Stirling Hill from the Franklinite with which it was combined, and to convert the zinc into paint. His paint resembled the first produced in Paris. He applied it to the weather-boards of a coarse building, and, 20 years after, it was found an effectual protection to the boards.

In 1834, Mr. Hassler made, from the ore of Stirling Hill, the zinc for the brass weights and measures ordered by Congress for the several States; but the cost for separating the zinc showed that the metal could not compete with the foreign article. While the owners of the mine were perplexed at this result, one of their number suggested to Mr. Gray an experiment which he made the same day. At his office, in Nassau-street, he had a heap of red oxyd of zinc. Breaking up a parcel of the ore, he threw it on the top of an anthracite coal fire in a cylinder stove. When the zinc began to flow from the ore, he held over it a clean fire-shovel. On withdrawing the shovel, he found it coated with a snowy-looking substance, which he brushed off, carried it to a paint-shop, prepared it in oil, and with a clean brush spread it on a shingle, where it dried in a short time, and left a coat of smooth, hard white paint. This humble experiment was soon wrought out by Sam. Wetherell into that ingenious machine called the "bag process," for making white oxyds of zinc directly from the ore. The "bag process" has yielded 7,000 tuns of zinc-white in the past year. Zinc-white and zinc ores are now regular articles of export; the mining at Stirling Hill and at Bethlehem can produce more zinc than is produced in any other part of the world, at prices which must find a market, and drive the poisonous white-lead out of use in all civilized countries.

DISCUSSION.

Mr. Curtiss understood that S. T. Jones, of England, first commenced making white oxyd of zinc, instead of Mr. Wetherell, as reported by the committee. It was called the "bag process" by crushing the ore to powder placed in a stove with a short pipe, and as the vapor ascended it was blown into bags by fans and resembled snow. It is the purest oxyd in this state.

Professor Mason would, at some future time, convince Mr. Curtiss that the report was correct.

Mr. Seely presented an analysis of oxyd of zinc, made by Professor Jackson, of Philadelphia, namely, oxyd of zinc 98.82, manganese 0.88, manganese per oxyd of iron 0.33. The ore of zinc was in a carbonate or sulphuret state. The carbonate is roasted, replacing oxygen for carbonic acid; and the sulphuret is converted into sulphate of the oxyd. The metal is produced by distilling in an earthen retort, at red heat, volatilizing and the carbonic oxyd escapes. The white oxyd of zinc, sometimes called "philosopher's wool," is the vapor exposed to the atmosphere according to the French process. The ores of New Jersey are the red oxyd of carbonate. Silica is more prominent than carbonate.

Mr. Chamberlain mentioned a metal like the carbonate of zinc, formed in crystal, found in the lead and iron ores of England.

Professor Mason said that zinc and other metals were mined to a greater extent in England in the time of William Pitt, by the taxes imposed, than had been since. Zinc-white is obtained here for ⅓ less than in England. Zinc fell to four cents per pound when the mines of Silesia and Belgium were commenced to be worked.

Dr. Stevens hoped that the ancient history of zinc would be investigated. The geological and minerological formations of this country were on a grander and more developed scale than in the Old World. Zinc is found in the three geological eras of the United States—the metamorphic silurian, the lower silurian, and the carboniferous. From the richness and abundance of metal in the South, it is supposed the silurian sea was very deep; for metals are not ejected from the earth, but precipitated or deposited on it to the thickness of a knife-blade or several hundred feet deep. On the lower silurian strata of magnesian limestone was found the lead and zinc at the Galena mines of Illinois, which shows, from the immense deposits, that the sea was deep, or probably an eddy whose area is unknown in the Arctic regions. In South America it is interspersed with silver. In the cretaceous rocks along the sea-board States and in the Gulf of Mexico little zinc is found.

Professor Mason was informed that, not only in Sterling, N. J., and Bethlehem, Pa., but also in Tennessee, zinc was discovered. In the latter State it had not been mined, although every facility was offered; coal being half the New York price and freightage easy.

Mr. Tillman considered that, in regard to the discussion of zinc, it had not yet been investigated satisfactorily in New Jersey.

Professor Mason would proceed by asking how metals aggregated?

Mr. Seely said that if three salts were put into hot water they would crystallize at different periods, and each precipitate in order; so in the deposits of metal.

Mr. Hendricks accounted for it by electro-metallurgy.

Dr. Stevens said the copper of Lake Superior was an instance of infiltration, and that definite calculation could not be made, owing to the chemical change excited by heat in the earth.

Professor Mason stated that the subject of zinc, in connection with Franklinite and aluminum, would be continued next week.

MISCELLANEOUS BUSINESS.

Mr. J. Montgomery presented a new iron street-pavement, pressed on each side alike into serpentine parallel ridges, 1½ inches and ¾ inch apart, which were to be filled with crushed stone, and "cambered" from curb to curb.

Mr. Worthy explained his interest table on two cylinders in a box 3×2 inches, to calculate from $1 to $10,000, and from one to five years.

Mr. Wykoff explained a plan for precipitating infinitessimal particles of gold that floated off in the water, by pouring mercury into the water at the boiling point for three-quarters of an hour, and thereby saving from $15 to $20 per tun, at the cost of $1. [This is the process described by us on page 41 of the present volume of the SCIENTIFIC AMERICAN.—EDS.

OUR SPECIAL CORRESPONDENCE.

RAILWAY MISNOMERS—NECESSITY FOR REFORM—PRACTICAL ENGINEERING—"CORN COB" CONTRACTORS.

ST. LOUIS, MO., Jan. 7, 1860.

The Ohio and Mississippi Railway, being the most direct means of communication between Cincinnati and St. Louis, carries the major part of the travel between those two cities, and also a large share of the passenger trade going westward of the latter. A word about the naming of railways. We have not been by any means happy in this respect. The plain simple method, and the most precise, is to designate the line by its two terminal (and, in some cases, its central) points. Thus, the name "Ohio and Mississippi Railway" conveys no very distinct idea of its locality and direction; there might be many lines connecting those two rivers besides the one in question, but if it was called the "Cincinnati, Vincennes and St. Louis Railway," that title would denote it at once. So of most other lines in this country. We have "Centrals," "Air-lines," "Directs," "Greats," &c., without stint; but very few, comparatively, are named as they should be. While on this topic, it may well be questioned if the term "railroad" is as appropriate as that of "railway;" I think not. People are very apt to omit the prefix, "rail," to the first word, calling it simply "road;" this results in an indistinctness of meaning, it not being of itself clear whether a common road or a railroad is meant. But when "railway" is used, the prefix is never left out. This may appear a small matter, but where it gives no additional trouble, it is as well to be correct; besides, there is more in nomenclature than many suppose. [We may here remark that, though a world-renowned author asks, "What's in a name?" and then adds, "A rose by any other name would smell as sweet," the question of the general admissibility of the principle involved in that assertion is open to serious controversy, especially on a subject of *raillery*. Our greatest American lexicographer says, in effect, that it would be a useful distinction to always apply the word 'railroad" to the ground or road on which a line of rails is laid down, and only use "railway" when it is desired to indicate the iron rails themselves.—EDS.]

The directors of the Ohio and Mississippi Railway profess to furnish sleeping cars, but on the occasion when I passed over it, not only was there no such accommodations, but there were no sleeping seats, nothing but the ordinary day seats. The track was rough—so rough that a certain freight train, which was a few hours ahead of us, refused to stay on it any longer, and be subjected to its unmerciful bumpings; so it jumped right off without much ceremony, and piled itself up, car on car, in the most approved "railway accident" fashion. The officials found it impossible to clear away the wreck in time to allow of the passage of the express train; so another train was brought from the West, and stood in readiness to receive us. We bade adieu to the Cincinnati train, walked past the wreck, and took the other cars. This change of cars (not put down on the way-bill) did not occupy much time, and was regarded by the passengers generally as rather a pleasant "break-in" on the tedium of the journey; for my part, I don't admire tramping long distances through snow-drifts at midnight. Near the crossing of the Illinois Central Railway, we encountered another rebellious freight train, that had likewise left the rails for the prairie; they managed to pull these cars sufficiently out of the way to admit of the passing of the express, so we had no second change of cars. To have *only* two run-offs in one trip is not so bad —even for the West. By-the-by, since the officials of the above line seem to have deputed the tending of the stoves to the nearest good-natured passenger, I hope that they will in future have the wood cut short enough to fit the stoves, and also have it split up finer. This suggestion is given gratuitously, and I shall not charge for my long services as "fireman" on the occasion referred to, although they were quite laborious.

The farther I got towards the West, the more imperfect seemed the railways; this was to be expected. The North Missouri Railway (running from St. Louis to intersect the Hannibal and St. Joseph Railway, at Hudson) is an exception, though, of course, it would bear no comparison with such lines as the Pennsylvauia Central, Philadelphia and Reading, and some lines in your State; still, for such an unsettled country, it is quite passable. Single tracks, of course; gage, 5 feet 6 inches; rails, T-form, about 58 lbs. per yard; wrought iron chair of 13 lbs.; no ballast; 3,000 sills or cross-ties (of about 8 to 9 feet long) per mile, with a more liberal use of spike fastenings than one would expect; the foregoing forms about the inventory of the track. Many of the cuttings have been taken out with perpendicular sides, which are said to stand better than the ordinary slopes of 1 to 1. The clay which forms the sides of these excavations washes very readily; this is the case with the whole district of country through which this line passes. As soon as the prairie sod is removed, then look out for gullies wherever there is running water! Where the side slopes are of this nature, it may be good policy (if it is not intended to soil them) to take out the cuttings perpendicularly; but I believe that railway companies would find it to their interest to give the cuttings flatter slopes than usual, say never steeper than 1½ horizontal to 1 perpendicular, and then carefully soil them, both cuttings and embankments, with the tough prairie sod, which seems admirably adapted for this purpose. A little attention to top or surface draining, in connection with this system of soiling slopes, would cut off one of those various *leaks* (and, by no means, a small one) by which so many of our railway companies are kept in a dangerous and sinking condition, namely, the sloughing-down of the slopes and the filling-up of the bottom side drains, thus necessitating the constant employment of ditching and gravel trains, everlastingly at work cleaning out side drains, taking out slips, widening out embankments, &c. If the evil stopped here, though bad enough, it might be said, "it only costs money; it does not endanger life, as deficiencies in the rolling stock do." But it is not so; this bad condition of the side drains at once affects the track, especially on unballasted lines; and to the defective tracks are to be attributed fully one-half of the fearful accidents that annually disgrace our railway community.

Those conversant with engineering matters in the eastern part of this continent, where railways have been long established, know full well what a mammoth millstone is formed around the necks of companies by the everlasting repairs of tracks, bridges, tunnels, &c. These repairs are mainly necessary in consequence of the bad work at first put up by the contractors. I will not prolong this subject, but it is a fact, nevertheless, that most lines have to be practically re-constructed in a (comparatively) very short time after they are in running order. Yet, with all the sad experience of eastern people in this respect, here, out West, they are not only following in the same financially ruinous course, but are actually going beyond anything ever attempted in reckless construction. I would not advocate the English system of spending millions on ornamental terminal buildings, stations, ornamenting bridges, tunnels, &c.; everything of that sort would be out of place in a new country. I do say, however, that nothing that is requisite to ensure the strength of the railway proper should be omitted. Let the outside constructions be built up leisurely, according as the means of the companies and the increase of trade require them; but, in the name of humanity, let the line itself be properly constructed at first. It may be said that this method of constructing railways would retard their introduction, especially into new districts. Well, let it do so; better for the country to grow more gradually and steadily than to rush forward with the mad, feverish haste it sometimes does, then be seized with a panic, and take years to recover itself. If a man runs too fast in a race over rough ground and falls, he will drop farther behind than if he had taken more time and not tumbled down; so of nations.

Science is at a decided discount here; and, to judge by appearances, Practice (her twin sister) does not receive the cultivation they pretend to give her. How absurd to attempt to exalt one at the expense of the other! They should go hand in hand—one collecting the facts, and the other eliminating the laws which govern them. A western man, who, in his time, had been a merchant, a surveyor, an engineer, a land agent, a railway president and a professional politician (on more sides than one, by way of variety), once remarked to me, concerning a mutual acquaintance who was an engineer, "A good theoretical man, sir, but requires millions to carry out his plans; he might do well in England, with an unlimited supply of money, but he is not calculated for our western country; not practical, sir, not practical! We want men that can build railroads of *corn cobs*, if necessary!" Now, the individual in question has been practically engaged in railway construction for, at least, 14 or 15 years, but probably it will require even a longer time than that to purge him of the preparatory "education" he was unfortunate enough to receive. The same advocate of "corn cob" engineering also said of the West Point engineers, "They are too slow for us; may do well enough elsewhere, but not here." As he said this, visions of Fort Monroe and the Capital Extension rose before me, and I was silent. I had been accustomed to regard the West Point engineers as the "flower" of the profession, even though they *are* military men; for if a man can construct a fortification, he can also build a railway culvert. [We refer our correspondent to the antagonistic opinion so nobly expressed by Hon. W. T. Avery, of Tennessee, during the last session of Congress, and published by us on page 122, Vol. I. (new series), SCIENTIFIC AMERICAN, under the head of "Give to Mechanics what belongs to them."—EDS.]

Do not imagine that the "corn cob" contractor was a fool; far from it! He was emphatically a smart, active man; and I am persuaded he would make money and grow rich where Sir Isaac Newton would starve. As a specimen of the "corn cob" style of construction which he advocated, I will mention a stone arch that I lately saw, from beneath which it was feared (and with right good reason, too) to remove the centering. On speaking of it to one of the builders, he said: "Oh, those centers are of good pine; they will last a long time yet; we will leave them till they rot down; I will have them painted to preserve them as long as possible." It would probably astonish some of our New York and Pennsylvania civil engineers to be told (as I was) that 8 feet was the best width to make railway embankments (which would probably ravel down to 6 before the track was placed on them); that anything over that was money wasted, at least unless the banks were 20 or 30 feet high; and that the ends of the sills should stick out at each side—into space illimitable, I suppose. On my dissenting from these views, I was told that "long experience has shown this width to be the best out *here*." Query: are earth, air, wood and iron different "here" from elsewhere? How a horse and cart could be readily turned, and the latter "dumped," on such a bank, is a mystery to me; but the gentleman (an extensive contractor) assured me "there is no difficulty in the matter." It may throw same light on the subject, however, when it is stated that this gentleman *is paid so much per mile* for constructing the line, and *he supplies the engineering corps to look after it*. Possibly, if he was paid by the cubic yard, his ideas of the value of 8-feet banks might be modified. But I must now "switch off" for the present.

E. M. RICHARDS.

COMPRESSION OF STEAM IN CYLINDERS.

MESSRS. EDITORS:—It is not an uncommon notion among engineers that the compression of steam in the cylinder of a steam engine is a disadvantage, and that as such, it is to be obviated as much as possible. It will not be difficult to show, in a few words, the fallacy of this idea; and that, so far from being a loss, it may in certain cases be an absolute gain. Let us take, for example, a cylinder of ordinary dimensions, say 15 inches by 36, making 50 revolutions at 75 lbs. of steam, cut off at 1-6 of the stroke; the ports being 10 inches by 1 inch. The steam in this case would be expanded 6 times, multiplying its mechanical efiect 2.79 times, and giving 52 horse-powers as the effective force of the engine. In the present example, supposing the steam is admitted by the ordinary D valve, with a cut-off valve on the back, there is a large amount of space contained in the port between the valve and cylinder—about 180 cubic inches; the piston also does not go close to the cylinder end. If it is half an inch off, this will give 88 additional; making a total of 268 cubic inches of useless space to be filled at each stroke, either from the exhaust steam or from the boiler. To fill this from the exhaust, it would be necessary for the escape steam to be shut off when the piston was 7½ inches from the end of the cylinder, in order that the steam may be compressed to 75 lbs. at the end of the stroke. This will deduct 8 horse-powers from the total force of the engine. The piston now makes its return stroke, the steam being admitted during its first 6 inches, and giving out its 52 horse-powers; the compressed steam in the port also expands, giving out as much power as was required to compress it, viz., 8 horse-powers; thus having the power of the engine 52 horse-powers, with an expenditure of 1,000 cubic inches of steam at each stroke.

Now what is gained, supposing there is no compression? In the first place, we gain the 8 horse-powers which were lost in the former case by compression; but we also lose 268 cubic inches of steam from the boiler to fill the port and vacancy at the end of the cylinder. This steam will give out its 8 horse-powers during expansion, making a total of 60 horse-powers, with an expenditure of 268 additional, or a total of 1,328 cubic inches of steam. In other words, without compression, we have gained 1-6th more power with an expenditure of ⅓ more steam; making the advantage decidedly on the side of compressing the steam. The result will be the same whether the steam be admitted by a single valve at the center or separate valves at each end of the cylinder: only in the latter case the difference between compression and non-compression will not be so great, on account of the smaller quantity of steam contained in the port.

But this is not all the advantage. Whatever momentum there may be in the piston and rod at the end of the stroke, over and above what is given out to the engine, has to be counteracted by the returning crank; giving a shock consequently to the crank-shaft, brasses, &c. An evidence of this may be obtained by trying a locomotive engine with the wheels raised off the ground. Let the reversing handle be in full gear, and sufficient steam admitted to make the wheels revolve moderately fast, say 100 per minute; now, without altering the starting handle, move the reversing handle so as to cut off shorter, and the wheels will move round faster. What is the cause of this? Less steam is used, it is exhausted earlier, and there is greater compression; all tending to *lessen* the power. It cannot be that the slight difference in the back pressure would produce the effect; but it must be attributable to the advantage gained by the extra compression.

What, then, are the requisites to the most economical working of a steam engine? The steam should be admitted at or a little before the termination of the stroke; a rapid cut-off (so as to have no wire-drawing), variable with the amount of work to be done; compression at the end of the cylinder, so as to bring up the pressure to what it is in the boiler; and the exhaust to open a little before the end of the stroke. The exact point to begin compression may be found by having the exhaust valve variable by hand. Then, while the engine is working with its accustomed speed and load, regulate the exhaust valve until the point is found at which the engines moves fastest and easiest, and then fix it. The cut-off valves invented for the admission of steam to the cylinder are innumerable; some of them being perfect in their action, and only varying in the expense of construction or durability of the parts; but the variation of the *exhaust* valve has not yet received its proper share of attention; and, until such is the case, the steam engine cannot be said to be perfected.

E. B.

Philadelphia Jan. 26, 1860.

ANOTHER FORTUNATE INVENTOR.

MESSRS. EDITORS:—My patent came to hand this day, accompanied by your letter, &c. From the reading of the document I feel induced to bless you, as it is a much better patent than I expected. I have already contracted and sold the right of territory for over $1,000, and yet the papers are not quite ten days old! Truly I am in luck this time, and I shall always remember you with sincere thanks. I shall have another application to send you soon. As soon as the snow is gone I shall procure an ambrotype of my machine at work, and send it to you, that you may further assist me by giving a display in your invaluable SCIENTIFIC AMERICAN.

J. L.

Lockport, Ill., Jan. 18, 1860.