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 Pennsylvania 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.