

JOURNAL OF THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA,
FOR THE PROMOTION OF THE MECHANIC ARTS.

VOL. CXXII.

JULY, 1886.

No. I.

THE FRANKLIN INSTITUTE is not responsible for the statements and opinions advanced by contributors to the JOURNAL.

OLIVER EVANS AND HIS INVENTIONS.*

BY COLEMAN SELLERS, JR.

[*Abstract of a Lecture delivered at the FRANKLIN INSTITUTE,
November 20, 1885.*]

Of all the early American Mechanics, there is perhaps none who has left a more definite impress upon the industrial progress of our country than Oliver Evans, and there is none whose successes and failures are of more interest to the student of mechanical history. He is widely recognized as the inventor of improvements which completely revolutionized the processes of flour manufacture, and which remain in use to-day substantially as he left them.

* The writer desires to express his indebtedness for illustrations used in this lecture, to President Henry Morton, Stevens Institute of Technology, for lantern slide of the "Stevens Engine"; to Prof. Geo. F. Barker, of the University of Penna. for slides showing types of early locomotives; to Prof. Benjamin Sharp, also of the University, for transparency of Oliver Evans's portrait; and to Robert C. Davis, Esq., for information furnished and engraving loaned.

C. S. Jr.

WHOLE NO. VOL. CXXII.—(THIRD SERIES. VOL. xcii.)

I

But it is not alone as an inventor of flour making machinery that he claims our attention, he is even more widely known for his earnest and successful efforts to introduce the high pressure steam engine, and by his enthusiastic advocacy of steam locomotion. Indeed, he has been styled the "Father of the High-Pressure Steam Engine," and it has been often said that he was the original projector of the locomotive and the inventor of the first practicable steamboat. These broad claims have generally been maintained by American writers and ignored by the English, who give much the same credit to Richard Trevethick, Oliver Evans's contemporary. It is, of course, difficult in any such case to clearly establish general claims to priority in the conception of ideas, but we can at least compare his work with that of other inventors of his time and form some judgment as to their relative merits. With this in view, it will be our task this evening to review briefly the life and labors of Oliver Evans, to acquire, if we can, a just appreciation of the true value of his work and his proper place among those geniuses to whom we owe the mechanical attainments of the present age; to learn, if we may, who and what he was, and what his environment; to learn the meagreness of his opportunities, the restrictions by which he was hampered, that we may the better understand the character and value of his inventions, and the measure of credit to which he was entitled.

Unfortunately, what is recorded of his life can be told in a few words, and is, indeed, little more than a history of his work. He was born near Newport, Del., in 1755, and died in New York City in 1819.

When he was born our country showed scarcely a trace of its present industrial development. The Atlantic seaboard was sparsely settled throughout its length, and a few adventurous pioneers were forming occasional settlements beyond the Alleghanies. Not only were there no railroads and no canals, but there were no tolerable highways of any kind except in the neighborhood of the larger towns. The goods required by the settler on the Ohio or Lake Erie were packed on horseback over the mountains, through Pennsylvania, by Lancaster and Chambersburg, or by the Southern route through Virginia, by Winchester, Hagerstown and Cumberland. It was not until 1789 that the first wagon load was sent over the Southern route to the

shores of the Ohio. These four-horse wagons would haul twenty hundred-weight from Hagerstown to Pittsburgh and back in about a month, and charge \$3 a hundred-weight for hauling. Salt packed over the mountains sold in Pittsburgh for \$8 a bushel as late as 1796, when salt from Western New York was introduced at half that cost.*

When Oliver Evans was born, there was just one steam engine on the American Continent; before he died, steam engines were in common use. During his life, good turnpikes were completed, canals projected and partly built, and steamboat navigation established on the great rivers. These were vast strides; but the crowning achievement, the railroad, which his prophetic eye discerned so clearly, he did not live to see an accomplished fact.

Evans was apprenticed at the age of fourteen to a wheelwright. He was a thoughtful, studious boy, who devoured eagerly the few books to which he had access, even by the light of a fire of shavings, when denied a candle by his parsimonious master. He says that in 1772, when only seventeen years old, he began to contrive some method of propelling land carriages by other means than animal power; and that he thought of a variety of devices, such as using the force of the wind and treadles worked by men; but as they were evidently inadequate, was about to give up the problem as unsolvable for want of a suitable source of power, when he heard that some neighboring blacksmith's boys had stopped up the touch-hole of a gun barrel, put in some water, rammed down a tight wad, and putting the breech into the smith's fire, the gun had discharged itself with a report like that of gun-powder. This immediately suggested to his fertile mind a new source of power, and he labored long to apply it, but without success, until there fell into his hands a book describing the old atmospheric steam engine of Newcomen, and he was at once struck with the fact that steam was only used to produce a vacuum, while to him it seemed clear that the elastic power of the steam if applied directly to moving the piston, would be far more efficient. He soon satisfied himself that he could make steam wagons, but could convince no one else of this possibility. At the age of twenty-two, he had completed a successful machine for making the wire teeth of wool cards, and

* Bishop's *History of American Manufactures*.

then invented, but did not build, a machine for making and sticking the teeth in the leather backs. In 1780, he married the daughter of John Tomlinson, a Delaware farmer, and removed to Queen Anne County, Md., where he opened a store. Here he seems to have remained until 1782, when his two brothers, who were practical millers, persuaded him to join them in building a merchant flour mill in Newcastle County, Del. They started the mill September 5, 1785, and it required the constant attention of three men with "half the time of a boy." Evans was disgusted with the crude and laborious methods then in use and worked out a system of mechanical devices which could replace the labor of the attendants. In the old mill, the wheat or meal was handled at each stage of manufacture, and was carried from one point or one machine to another by manual labor. This he entirely revolutionized, and when he had applied his improvements, he found that the mill which formerly required more attention than three men could give was easily managed by one man; indeed, Evans wrote that once when a committee of millers came to see his new machinery, he took care to be at work in a neighboring hay field; they found the mill open and at work; and walking over it they saw that all the operations of milling were going on without the care of any attendant—cleaning, grinding and bolting all in progress without human intervention. This, Evans thought, would be convincing, but, they returned home and reported the whole contrivance "a set of rattle-traps unworthy the attention of men of common sense."

Having worked out his improved system and demonstrated its practical value, he set about putting it into general use. This he proposed to do by selling "rights" to millers; and he and his brothers canvassed Maryland, Pennsylvania, Delaware and Virginia without success, although they offered the right free to the first miller in any county who would put in the improvements. The greatest obstacle to his success was the obstinacy of the millers of the Brandywine, whose mills were the most celebrated in the country. They declined to put in his machinery on any reasonable terms, although he had shown them what it appears should have been a convincing proof of the value and utility of his improvements.

Oliver Evans was one of those discontented men who are not satisfied to do things in the time-honored, but perhaps clumsy way

in which they have always been done, and constantly sought opportunities to improve existing methods, and I fancy he generally found them. Certainly, the flour mill of the period badly needed mechanical assistance. Thomas Ellicott, who helped Evans in the preparation of his *Millwright and Millers' Guide*, in 1795, wrote that when he first began the business (about 1757): "Mills were at a low ebb in this country; neither burr-stones, nor rolling screens being used; and but few of the best merchant mills had a fan. Many carried the meal on their backs, and bolted it by hand even for merchant work; * * * it was counted extraordinary when they got their bolting to go by water; after fans by hand, and standing screens; then burr-stones, rolling screens, and superfine bolting cloths with a number of other improvements, some of the latest are the elevators, hopper-boys, etc., invented by Oliver Evans, late of Delaware, tho' now of Philadelphia. * * * By them the manufacture of grain into flour is carried on by water, with very little hand labor and much less waste, either in small or large business. And I do believe, that taking a large quantity of wheat together, that we can make two or three pounds more out of a bushel by the new than by the old way, although it be equally well ground; because it is so much more completely bolted, and with less waste. In the old way, the wheat is weighed and carried up one or two pair of stairs, and thrown into garners; the bags often having holes in, it is spilt and trampled under foot; several pounds being frequently lost in receiving a small quantity, and when it is taken from these garners, and carried to the rolling screens, some is again wasted, and as it is ground it is shovelled into tubs, a dust is raised, and some spilt and trampled on; it is then hoisted and spread, and tossed about with shovels, over a large floor, raked and turned to cool, and shovelled up again and put into the bolting hopper; all which occasions great labor, besides being spilt and trampled over the mill, which occasions a considerable waste. Besides these disadvantages, there are others in attending the bolting hoppers; being often let run empty, then filled too hard, so that they choke, which occasions the flour to be very unevenly bolted; sometimes too poor, and at other times too rich, which is a considerable loss; and when the flour is bolted, it is much finer at the head than the tail of the cloths; the fine goes through first, and has to be mixed by hand, with shovels or rakes;

and this labor is often neglected or only half done ; by this means, part of the flour will be condemned for being too poor, and the rest be above the standard quality. The hoisting of the tail flour, mixing it with bran by hand and bolting it over, is attended with so much labor that it is seldom done to perfection."

It thus appears that the improvements in milling, which were originated by Evans, were chiefly in devices for handling the grain and its products during the processes of manufacture without the employment of manual labor. These devices were of various kinds, adapted to the nature of the service they were to perform, and in his publications Evans claimed five different ones, viz.: the *elevator*, for raising vertically ; the *descender*, transferring down an incline ; the *conveyor* and the *drill*, for moving horizontally, and the *hopper-boy*, whose function was to spread and cool the meal and feed it regularly into the bolting hopper. The *elevator*, perhaps the most important of these, was a modification of one of the oldest of machines, the "chain of pots," which had been used for raising water from time immemorial. As modified for raising grain, it was constructed of an endless flat band or strap, carried upon two drums or pulleys, and upon which, at regular intervals, a number of small troughs or buckets were so arranged that in passing under the lower pulley the buckets filled, and in passing over the upper one emptied themselves into a suitable box, from which a spout discharged the contents as required, the apparatus being kept in motion by power applied to the upper pulley. This machine has been vastly increased in size and capacity since Oliver Evans first put it to work in his little New Castle mill, and it is now applied to a multitude of uses that were never contemplated by him ; but the device is essentially the same, and has proved itself to be one of the most useful of his inventions. The *descender* he himself described as "a broad, endless strap, of very thin, pliant leather, canvas, or flannel, etc., revolving over two pulleys, which turn on small pivots, in a case or trough, to prevent waste, one end of which is to be lower than the other. The grain or meal falls from the elevator on the upper strap, and by its gravity and fall sets the machine in motion and discharges the load over the lower pulley. There are two small buckets to bring up what may spill or fall off the strap and lodge in the bottom of the case." Although this machine would work by gravity even when the

descent was small, yet Evans recommended that power should be applied to it where practicable; and when driven in this way it became the prototype of the *belt conveyors* of the present day, which are generally used for the horizontal movement of grain in large quantities. Concave carrying rollers, or other devices, are now employed to compel the belt to form a trough which will hold a greater amount of grain than would stay on a flat belt. Evans also used for the same purpose the *drill*, which was simply an elevator laid horizontally, with wooden cleats, or, as he called them, "rakes," instead of buckets. These rakes scraped the grain along the bottom of the case or box in which they ran. The *conveyor* was simply a quick pitch screw of two or more threads, running in a trough or box into which it fitted closely. This screw, when used for grain, Evans made of a round wooden shaft, around which he nailed two or more sheet iron helices, or spirals, which, when the shaft was rotated, forced the grain along in the trough. When he desired to move flour or meal, he substituted for the sheet metal helix a number of radial arms, arranged spirally around an octagonal shaft.

The *hopper-boy* consisted of a slowly rotating vertical shaft, or spindle, the lower end of which passed through a horizontal beam, upon whose lower surface were arranged a number of inclined boards called "flights," whose function was to spread the meal and to gather it towards the bolting hopper. The horizontal arm also carried a "sweeper," or scraper, which pushed the meal into the hoppers, which were situated in the floor near the base of the vertical post. The meal was allowed to fall from the elevator at the extremity of the arm, which carried on each end an adjustable scraper, whose function was to drive the meal before it, trailing it in a circle, so as to discharge its load by the time it again reached the elevator. This circle of meal was collected by the "flights" and forced into the hoppers as described. The first flight, or that next to the scraper, could be swivelled so as to pile the meal in a ring to allow it more time to cool. As this ring increased in thickness, the arm rose on the spindle to suit. This was rendered easier by the fact that it was counter-weighted over a pulley near the top of the spindle. The arm fitted loosely to the spindle, and was provided with an upper bearing of iron, by means of which it could be levelled, and it was driven by

means of a rope from a cross-beam near the top of the spindle. In order to deflect the grain delivered from an elevator in any particular bin, Evans used a pivoted wooden spout which could be rotated to suit his needs. All of these devices were efficient means of accomplishing the end in view, and were all of such a simple character that they could be readily constructed by the millwright with ordinary tools and materials.

At this time, the U. S. Patent Office had not been organized, and the several States exercised the privilege of granting exclusive rights to the use of inventions within their own boundaries. In 1786, Evans applied to the Legislature of Pennsylvania for a right to use his improvements in machinery for making flour, and also to use his steam wagons on the roads of the State. During this year, he explained his proposed engine to several people, and in particular his plan for propelling boats by paddle-wheels turned by steam engines. The following year, the legislature granted his flour mill patent, but made no allusion to the steam wagon claim; but on May 21st, the Legislature of Maryland granted both rights for fourteen years, on the ground that although it would doubtless do no good, yet it certainly could do no harm. A similar patent was subsequently granted (1789) by New Hampshire. About this time, the Ellicotts, well-known millers on the Patapsco, in Maryland, adopted Evans' improvements with great success, so that in making about 325 barrel of flour daily, they saved annually in wages \$4,875, and increased the percentage of flour obtained from the wheat so as to reduce the cost of flour fifty cents per barrel, which amounted, Evans says, to a total saving of \$32,500 yearly. In 1790, when the U. S. Patent Office was organized, Evans relinquished his State rights, and December 18, 1790, a U. S. patent was granted for his "method of manufacturing flour and meal." This is said to be one of the three patents granted that year. In 1794, he arranged with a Mr. Joseph Stacey Sampson, of Boston, to introduce and patent his steam engine improvements in England, and he furnished him with full drawings and specifications for this purpose. It is said that Mr. Sampson showed these papers to many English engineers, but that he died in England without having done anything to further Evans's interests.

Some time previous to 1790, Evans had removed to Philadelphia, and soon began the preparation of the *Millwright and Miller's*

Guide, which appeared in 1795. This book took three years to prepare, during which time he exhausted his capital, injured his eyes, and became gray. The first edition was of 2,000 copies, was published by subscription, and sold for \$2 each to subscribers. He says that during this time his wife sold tow cloth of her own make to help feed their large family. In 1800, he had a mill about Third and Market Streets, and the next year was selling mill supplies at the southeast corner of Ninth and Market Streets.

Having tried in vain to induce some one to advance him the necessary capital to build an experimental traction engine, he began the work, in 1801, on his own responsibility, being moved thereto, he says, by sense of his obligations to the State of Maryland, which had granted him a patent when all others scouted at his visionary scheme. Before he had completed his engine, he concluded that as it differed from any of those then in use, it might be worth while to make some other application of it. He, therefore, changed his plans and started a small stationary engine, 6-inch cylinder, 18-inch stroke, which he had running in the winter of 1802, on Market Street. He set it to grinding and breaking plaster of Paris, then recently introduced as a fertilizer, and it broke and ground twelve tons in twenty-four hours; or when applied to sawing, with twelve saws, it cut up 100 feet of marble in twelve hours. This little engine and boiler cost him \$3,700, including his own time, which he valued at \$1,000. It took all his capital, and again, he tells us, he was impoverished. The success of this little engine lead to an order for one to drive a steamboat on the Mississippi. The boat was built 80 x 18 feet, at New Orleans, where Evans sent the engine. A freshet, however, left the boat stranded far from the river's edge, and while awaiting another rise to get her off again, the engine was removed and set to sawing lumber. This it did at the rate of 3,000 feet in twelve hours, which sold for \$60 a 1,000, and in this time burned a cord and a-half of fuel. It is worthy of remark that this engine ran for a year without failure of any sort. An incendiary fire, attributed to the hand sawyers, whose business was injured by the engine, destroyed the mill, and the engine lay idle for nearly ten years, when it was again put to work, this time driving a cotton press. The boat and engine involved a loss of \$15,000 to the enterprising owners.

In 1803, Evans started in business as a regular engine builder and he was probably the first in the United States to make a specialty of this work. The Philadelphia Board of Health ordered of Evans, in 1804, a steam dredging machine for cleansing the docks of the city. This machine he called the "*Oruktor Amphibolos*" or Amphibious Digger, and he described the craft and its performances as follows: "It consists of a heavy flat-bottomed boat, 30 feet long, and 12 feet broad, with a chain of buckets to bring up the mud, and hooks to clear away sticks, stones and other obstacles. These buckets are wrought by a small steam engine set in the boat, the cylinder of which is 5 inches diameter and the length of stroke 19 inches. This machine was constructed at my shop, one and one-half miles from the river Schuylkill, where she was launched. She sunk nineteen inches, displacing 551 cubic feet of water, which at 62.5 pounds, the weight of a cubic foot, gives the weight of the boat, 34,437 pounds, which divided by 213, the weight of a barrel of flour, gives the weight of 161 barrels of flour that boat and engine are equal to. Add to this the heavy pieces of timber and wheels used in transporting her, and the number of persons generally in her, will make the whole burden equal to at least 200 barrels of flour. Yet this small engine moved so great a burden with a gentle motion up Market Street and around the Centre Square; and we concluded from the experiment that the engine was able to rise any ascent allowed by law on turnpike roads, which is not more than four degrees. Before launching, July, 1805, this machine was run during several days around Centre Square, and the daily papers of that time contain an advertisement by Evans, in which he invited those interested to visit the square and inspect the *Oruktor Amphibolos*; he also mentioned that twenty-five cents a piece would be collected from those of the spectators who felt disposed to contribute it, and said that one-half of the sum thus realized he proposed to retain himself, and promised to expend it in the prosecution of other useful inventions; the remaining half of this money he proposed to divide among his workmen who, he further said, at their own expense, provided the wheels and axles upon which the scow was mounted, those first made having failed on account of their inability to support the great weight put upon them. Finally the scow was launched at Market Street Wharf, the engine having been connected with the paddle

wheel, she steamed down the Schuylkill and up the Delaware to her dock."

Having satisfied himself that he could build a traction engine, he made September 26, 1804, a statement to the managers of the Philadelphia and Lancaster Turnpike Company, in which he set forth the comparative expense of hauling, by steam and horse-power, and showed conclusively, in his estimation, that by adopting his proposed engines they could nearly treble the net profits they made with the Conestoga wagons. He proposed that this traction engine should carry 100 barrels of flour, travel three miles per hour on a level road, and one mile an hour up and down hills, and it was to make the trip to Columbia in forty-eight hours; while to carry the same load in the usual way took five wagons, with five horses each, seventy-three hours. No attention seems to have been paid this document, and in December of the same year we find him petitioning Congress to extend the term of his flour mill patents. The bill passed safely to a third reading when an unexpected opposition arose which caused its defeat. While anticipating the favorable action of Congress, Evans advertised a new book to be entitled *The Young Engineer's Guide*, upon which he proposed to expend \$3,000 and produce a very exhaustive and valuable work. Completely disheartened by the failure of his bill, and deprived of the additional royalties he felt sure of getting, he was obliged to issue a much smaller book than he had intended, and to omit many of the illustrations which he had promised. This abridged volume, he called *The Abortion of the Young Engineer's Guide*.

Evans expected great things from the extension of his patents, for although his royalties had been very low, yet comparatively few millers adopted his inventions, while the first patents were in force. After their expiration, the millers hastened to avail themselves of the advantages offered by his improvements and when, in 1808, Congress finally passed a bill continuing his patent rights for twenty-two years and protecting him for the interval between the expiration of his first patents and the date of the regrant, Evans felt that better days had at last dawned upon him. He put up prices from \$30 for one pair of four and one-half feet stones to \$300, and from \$200 for five pairs of seven-foot stones to \$3,675; but no great success appears to have attended this move, for

whereas some mill-owners, Thos. Jefferson, for instance, paid the license; most of them refused and were only compelled by process of law, which involved the inventor in a series of expensive and troublesome litigations. It is probable, however, that from this time his circumstances were somewhat more comfortable.

In 1803, Mr. B. H. Latrobe, in his report to the American Philosophical Society, describes five or six engines then at work in the United States, and among others mentions "a small engine erected by Mr. Oliver Evans." This was doubtless his first engine, that which he started the year previous to Mr. Latrobe's report.

In 1807, he established the Mars Works, at the corner of Ninth and Vine Streets, Philadelphia, and announced himself as an iron founder and steam engineer. This business he carried on until his death. In 1810, he associated with him his sons-in-law, James I. Rush, and David P. Muhlenberg, and shortly afterwards they purchased the lot at the corner of Sixteenth and Buttonwood Streets, which is now occupied by a portion of Mr. James Moore's Bush Hill Iron Works.

In 1812, he mentions ten of his engines as being then in use, and four years later he claims fifty. In 1817, he received an order for an engine and boilers for the Fairmount Water Works. This engine had a 20-inch cylinder, 5-foot stroke and was started in December of that year. It was supplied by four cast-iron boilers, 30-inch diameter, 24 feet long, carrying steam at pressures ranging from 194 to 220 pounds per square inch. Its product was 3,072,606 ale gallons, pumped 102 feet high in twenty-four hours, at an expenditure of 1,660 cubic feet of wood. It does not appear to have been an entire success, and the boilers burst on three different occasions.

Evans seized every opportunity to press his claims for the high-pressure engine. He set forth his views at some length in *The Abortion of the Young Engineers Guide*, in 1805, describing his engine and its application to various duties, gave rules for pressure and point of "cut-off," and recommended a cylindrical boiler, 3 feet diameter, with a maximum length of from 20 to 30 feet. In this work, he republished some of his previous papers and also the acrimonious correspondence carried on in the *Repository* between himself and Col. Stevens, of Hoboken, N. J., in which he accused the latter of appropriating his ideas. In this

work, Evans also described his projected volcanic steam engine, in which the products of combustion were to be passed into the water to assist in vaporizing it; and he also set forth a scheme of mechanical refrigeration.

In the *Emporium of the Arts and Sciences*, Vol. 2, published in Carlisle, Pa., 1812, we find quite an extended account of the state of the steam engine at that period, and the feeling against the use of high-pressure steam is well illustrated by an account of the explosion of one of Trevethick's boilers with fatal effect. This fear of the power of high-pressure steam dated from the time of Watt, who thought Richard Trevethick ought to have been hanged for using it, and was a potent factor in the opposition which Evans encountered in his efforts to introduce his engine. In the *Emporium*, he gave an account of his "Columbian Condensing High-Pressure Steam Engine," somewhat modified from that shown in his earlier publications; he also described the progress of his invention and reiterated his offer to make a steam carriage that would "run on good level railways," at the rate of fifteen miles an hour; and repeated his oft-quoted prophecy as to the future of the railroad.*

* "The time will come when people will travel in stages moved by steam engines from one city to another almost as fast as birds fly—fifteen to twenty miles an hour. Passing through the air with such velocity—changing the scenes in such rapid succession—will be the most exhilarating, delightful exercise. A carriage will set out from Washington in the morning, and the passengers will breakfast at Baltimore, dine at Philadelphia, and sup at New York the same day.

"To accomplish this, two sets of railways will be laid so nearly level as not in any place to deviate more than two degrees from a horizontal line, made of wood or iron, on smooth paths of broken stone or gravel, with a rail to guide the carriages so that they may pass each other in different directions and travel by night as well as by day; and the passengers will sleep in these stages as comfortably as they do now in steam stage-boats. A steam engine that will consume from one-quarter to one-half a cord of wood will drive a carriage 180 miles in twelve hours, with twenty or thirty passengers, and will not consume six gallons of water. The carriages will not be overloaded with fuel or water. * * * And it shall come to pass that the memory of those sordid and wicked wretches who oppose such improvements will be execrated by every good man, as they ought to be now.

"Posterity will not be able to discover why the Legislature or Congress did not grant the inventor such protection as might have enabled him to put in operation these great improvements sooner—he having asked neither money nor a monopoly of any existing thing."—*Extract from Address to the People of the United States.*

Evans again appeared in print in 1815, when he published an address to the people of the United States, in which he offered the use of his patented improvements in steam engines for propelling boats or land carriages upon liberal terms to any who would form companies for the purposes of using them. In 1816, he published "An Exposition of Part of the Patent Law by a Native-born Citizen of the United States, to which is added Reflections on the Patent Laws." During his struggle to secure from Congress an extension of his patent rights, Evans issued a pamphlet entitled "Oliver Evans to His Counsel who are Engaged in the Defense of His Patent Rights for the Improvements He has Invented, Containing a Short Account of Two out of Eighty of His Inventions, their Use and Progress in Despite of All Opposition and Difficulty, and Two of his Patents with Explanations."

The "drawings and specifications" of the eighty inventions mentioned in this formidable title were ruthlessly committed to the flames in the presence of his assembled family, while he was suffering under the mortification caused by the defeat of his application to Congress; and there is every reason to believe that he ever afterwards sincerely regretted this foolish act.

In April, 1819, Evans was visiting in New York City, when he received the distressing information that his Philadelphia shop had been destroyed by an incendiary fire. This news appears to have brought on a fatal attack of apoplexy, and he died on the twenty-first of the month. Thus ended in a new and bitter disappointment the life of one whose existence seems to have been one long struggle against the incredulity and prejudice of those whom he sought to benefit. He lacked the capital to carry out his cherished schemes and keenly felt the apathy which prevented the accomplishment of his great purposes.

His life, though full of disappointments, was not without its compensations; the success of his steam engine was itself a triumph and a vindication, and the universal adoption of his mill improvements afforded him more or less remuneration, and increased his business as a millwright and engineer. In regard to these improvements, there can scarcely be two opinions, his own testimony is amply supported by contemporary evidence that is unassailable. His theories of physics, especially of thermo-dynamics were doubtless, many of them faulty enough as might be expected from one whose

scientific knowledge was so scanty, and whose books were so few; but his mechanical ideas were seldom at fault, and his constructions were the best that his opportunities afforded. His application of the ancient chain of pots to lifting solids was a most felicitous conception, and has found its way into many other branches of industry not contemplated by him.

His system of handling grain, modified in detail only, in principle the same as he left it, is now used in all our flour mills, in all of the grain elevators which mark the railroad stations in our great Western wheat country, and the vast granaries of the railroad termini, with their capacity for holding millions of bushels: this system handles every grain of wheat from the time it leaves the wagon of the Western farmer, until it is packed, as flour in some gigantic Minneapolis mill, or stored in the hold of the trans-Atlantic steamer.

With regard to Oliver Evans' connection with the steam engine, this much we can safely say, that he early conceived the idea of using steam of high pressure, that he lost no opportunity to bring his views to the attention of those whom he thought could assist him in the realization of his hopes; that he built a successful steam engine in 1802; drove a heavy wagon by steam in 1805, and propelled a boat by steam-driven paddle-wheels the same year. That the type of engines he designed (small diameter of cylinder and long stroke) continued for many years the distinctive American engine. We see that he helped to overcome, by his personal exertions, the universal fear of high pressure steam, and introduced a type of engines which, by their lightness and cheapness, were fitted for the needs of a new settlement. But that he was the first man to conceive of the idea of using high pressure steam is scarcely probable; that he originated the locomotive is very doubtful. A Frenchman named Cugnot built a model high pressure traction engine in 1769, which ran for a time about the streets of Paris, until it upset, and was, with its inventor, promptly cast into prison. The next year he made a second, which is still in existence in Paris, and failed chiefly because its boiler was too small. In 1784, Murdock made a model high-pressure engine, and Watt in his patent put forth the idea of a steam carriage for common roads. This was two years before Evans applied for his patent in Pennsylvania. In 1800, Trevethick made an engine with beam, cylinder 19 inches

diameter, 5 feet stroke, and, in 1802, he took out his patents. There are certainly many points of similarity between the engines of Trevethick and Evans, but I do not think it is proved that the former copied the drawings of the latter, or even appropriated his ideas. It is much more likely that the two inventors, having the same goal before them, endeavored to arrive at it by the same means, or, as Oliver Evans says of another, "it frequently happens that two persons, reasoning right on a mechanical subject, think alike and invent the same thing without any communication with each other."

We can afford to grant a measure of merit to Evans's contemporaries without injuring his memory. He accomplished enough to establish his reputation upon a firm basis. What he might have done with better facilities and ample capital we can scarcely conjecture. My own opinion is that he underestimated the difficulty of building such a traction engine as he conceived possible, and from the fact that such engines are only now coming into anything like common use in this country, I fear that had he been permitted to carry out his ideas, the result would have fallen far short of his cherished expectations. We cannot but admire the pluck and determination with which he endeavored to develop his inventions, the courage with which he expressed his convictions. In the words of the late Mr. Joseph Harrison, Jr.: "*He, with no misgivings as to the future, and with no dimmed vision, saw with prophetic eyes all that we now see. To him the present picture in all its grandeur and importance, glowed in broad sunlight.*"

And as was said by another: "Wherever the steam mill re-sounds with the hum of industry, whether grinding flour on * * the Schuylkill, or cutting logs in Oregon, there you find a monument to the memory of Oliver Evans."

MAGNESIUM FOR ILLUMINATION.—M. Graetzel has succeeded in producing pure magnesium by an electrolytic method, at a price much below the rates at which it has hitherto been sold. Serious thoughts have thus been awakened of employing it for ordinary lighting purposes. The Bremen factory of aluminium and magnesium, which uses Graetzel's processes, has just organized an exhibition for magnesium lamps with clock-work movements. Two prizes of \$125 and of \$50, will be awarded to the makers of the lamps, which shall be adjudged the best and the most practical.—*Ann. Industr. Cosmos*, Aug. 24, 1885.