delphia and surrounding country, it will afford a fine view. The foundation of the tower is Conshohocken stone, laid in cement and dressed with granite. On the bed plate are fastened ten columns, each seven feet high, and supporting a huge iron ring eight feet in diameter inside and weighing a tun and a half. To this ring the main central shaft is riveted. The top of the tower will be reached by an annular car encircling the shaft and moved upward from the base on the outside of the latter. The car will be made of iron and glass, and be hoisted by a 40 horse power engine. Outside the shaft there will be a truss work of wrought iron. The space at the top of the tower will be capable of accommodating 125 persons. About the base of the structure, an ornamental building is to be erected and used for reception rooms, offices, etc.

A separate building is to be erected for the exhibition of the contributions from the Executive Department of the United States government. The main structure will cover 100,000 square feet, in addition to which will be erected a side building containg 20,000 square feet for a field hospital, the whole covering an area of nearly three acres. The different departments will have especial sections allowed to them. The State Department will exhibit old letters and curious documents from its archives. The Interior Department will show the operation of the Patent Office, and the mode of taking the census, and will probably explain how the Indians are (not) taken care of. The War Department will contribute old and new war munitions, etc., also the United States Cadet Corps, who will encamp for a month or two in Fairmount Park. The Quartermaster's Bureau will furnish specimens of army equipments for transportation, hospital service, etc., and the Subsistence Bureau, specimens of rations and modes of cooking. The Navy Department will contribute the Constitution, or rather a reproduction of the once famous old Ironsides, as the now thoroughly rebuilt vessel does not contain a vestige of the original craft except some wood about the keelson and one of the topsail sheet bits: together with models of various other articles incident to marine warfare. A field hospital after the most approved plan of construction will be erected. Probably one of the most interesting collections contributed by the government will be that of the Smithsonian Institute.

Professor Baird, in connection with this department, will give an exhibition of the propagation of fish of many kinds. An arrangement has been made by which a stream of running water will be introduced, and the method will be shown of hatching the fish from the egg, and statistics will be furnished stating the increase of the fish of the United States by this means, and other facts which may be thought of interest in this connection. Proper means will be taken by the Smithsonian Institute to represent the leading features of the Indian races. Their habitations, manners, and customs will be represented by delegations from the different tribes. They will also exhibit a large collection of specimens of prehistoric remains, comprising stone, iron and copper implements and pottery, dug from the mound hills, the relics of the mound builders, who are supposed to have occupied this continent before the Indians. A complete collection of all the minerals of the United States, prepared under the superintendence of Professor Blake, will not be among the least of these valuable collections. In addition to all these and many others, there will be a zoölogical collection, the material for which is now being collected from all sections of the country.

Ground has been broken for laying the foundation of the English buildings. There will be two separate structures, each two stories high. The larger one, 90x60 feet, will be used for offices of the Canadian and other colonial exhibitors. The other, 60x20 feet, will be used as residences for attendants required in connection with the British display. The buildings are to be constructed of brick and timber. The architecture will be in the old English style, and the roof will be tiled.

The Japanese commissioners are also preparing to erect buildings after their own style of architecture, and structures will shortly be commenced for Sweden and Morocco.

The questions as regards duty on contributed goods from foreign countries, and also relative to the same being liable to seizure for possible debts of the Centennial commission, have been definitely settled. The Secretary of the Treasury has decided that New York, Boston, Portland, Burlington, Suspension Bridge, Detroit, Port Huron, Chicago, Baltimore, Philadelphia, Norfolk, New Orleans, and San Francisco constitute ports of entry at which goods intended for the exposition will be admitted free of duty. All articles properly marked be will forwarded without examination from the port of arrival to Philadelphia, there to be delivered to the collector of that port. Articles entered at the exhibition may at any time be withdrawn for sale on payment of the duties. The Attorney General of the United States and the Attorney General of Pennsylvania have both given the opinion that goods deposited and placed on exhibition are free from seizure, and are not liable for the debts of the person or corporation thus receiving them.

From the advanced state of the buildings, if from no other indication, the reader may conclude that the time for preparing goods is growing very brief. Several foreign nations have already refused to receive further applications, while the present intention is to close the door to further applications in the American department on September 1 next, since there are already on file requests for considerably more floor room than the area set apart. There is a sifting process to take place, however, by which probably a large number of useless and discreditable entries will be thrown out, so that opportunity may then be given for a few eleventh hour applicants to get their goods in. Those proposing to exhibit should lose no time in filing their applications at once.

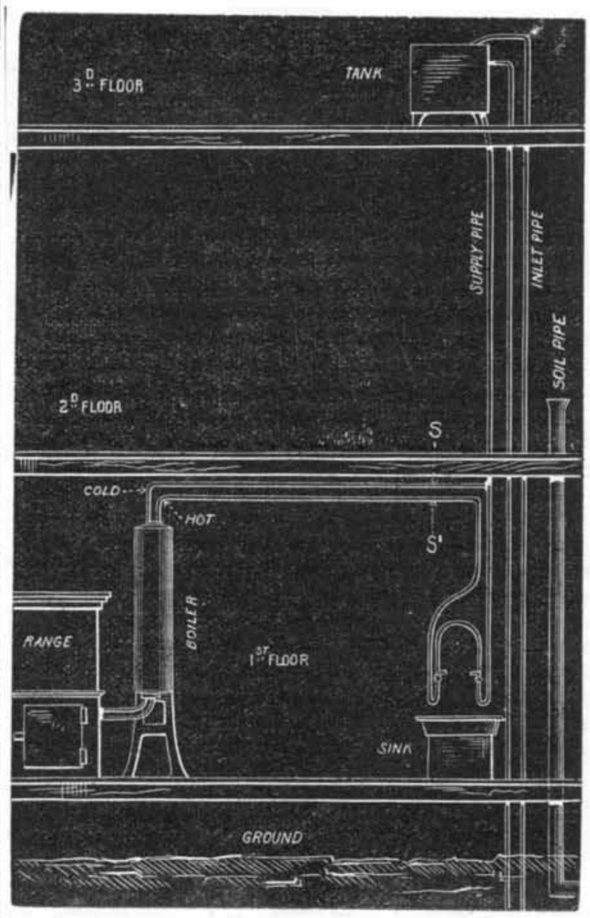
Correspondence.

Remarkable Electric Phenomenon.

To the Editor of the Scientific American:

An electric phenomenon has recently been observed, which I am unable to account for, and I would be grateful if you will help me to an understanding of it.

A house, built of limestone, stands upon a solid bed of the same material. Water is brought to it from a spring on the side of a neighboring hill, across an intervening valley, and poured into a tank on the third floor. An overflow pipe leads from the tank to the barn. The pipe that supplies the kitchen leads from near the bottom of the tank, and is connected to the range and boiler in the usual manner, as shown in the accompanying engraving. All the pipes are in contact with the wall, and are quite near each other. The hot and cold



water pipes are connected at the boiler, and also between the cocks; but of course the pipe is plugged at this point with solder, as usual. During every thunderstorm of any magnitude, frequent and violent electrical discharges are noticed passing from one pipe to the other, at the points marked S S'. The pipes are all iron, except at the connections to boiler and cocks, where lead is used. I would ascribe the excitement to thermal difference in the pipes, but they are so intimately connected that I cannot see how it is possible. Your opinion would be thankfully received.

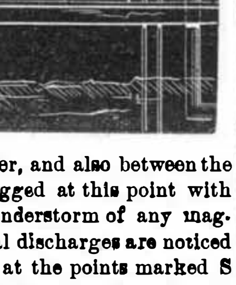
THOMAS P. CONARD.

30th and Chestnut streets, Philadelphia, Pa.

Messrs, Munn & Co.:

In reference to the very interesting observation of Mr. Conard, on which you have asked my opinion, I would say that it is a striking illustration of a well known principle of electricity, to which I have before had occasion to refer in your pages. There was at one time a very general impression that, if two routes of different facility were offered to an electric discharge, it would flow entirely by the better one. This, though (I think) still to be found stated in some text books, is entirely untrue. On the contrary, the fact is that, if two or a hundred routes, differing in facility or conducting power, or, to use a technical expression, "of unequal resistances," are offered to the passage of an electric current or discharge, it will divide itself between them all, in direct proportion to their facility or conducting power.

Among other illustrations of this, I find in Ferguson's "Electricity," 1866, page 63, the following: "A Leyden jar being charged, we have a wire bent, as shown in the engraving, and armed with balls at the ends. One end of this being held against the outside of the jar and the other brought within striking distance of the knob, a spark will pass at E, where the two parts of the wire should be, say, one eighth of an inch apart.



"This evidently is because, while the wire is a far better conductor than the air, yet some of the discharge will even pass through the worst conductor; and the wire being long and the air path short, the difference is not so great but that the fraction passing through the air is an appreciable quantity."

The general principle above stated is one which lies at the foundation of the whole subject of electrical measurements, in which such wonderful results have been reached of late years. Those of our readers who may wish for fuller information on this last subject, we would refer to the article by the present writer on "Electricity," in Johnson's "Encyclopedia," or to Sabine's or Culley's works on the electric telegraph.

After what we have said above, it is hardly necessary to make any personal application to the case before us. No doubt Mr. Conard's tank is near his lightning rod, or in some other way is plentifully supplied with electricity during a thunderstorm. This finds its way to the earth by countless routes, by the walls of the house to a very slight degree, by the various pipes in proportion to their conducting power; and, in the particular case noticed, it finds the hot water pipe so far a desirable road to the copper boiler, and thence to the ground, that part of the current which enters the cold water pipe takes that route. I think it likely that there are some joints on the cold water pipe, between the spark plate, S, and the boiler, cemented with red lead, which is an excellent insulator, or other like body. This would not, however, be essential.

Assuming a difference in the tension of the pipes, S and S', through a difference of their ground connections, induction would exaggerate the same, and aid in this production of the spark; but while this and other actions may no doubt conspire to the effect, the first cause which we have described is, we believe, the main one. HENRY MORTON.

Stevens Institute of Technology, Hoboken, N. J.

Exit from Public Buildings and Railway Cars.

To the Editor of the Scientific American:

As one of our common humanity, I was pleased to see the attention of the public called to the much needed improvement in the means of effecting an escape from churches and public buildings, in case of fire, accident, or sudden emergency, referring as instances to the Holyoke French church disaster, and the accident at a New York church of a few weeks ago; in fact, almost every paper brings an account of some such horrifying occurrence, with the sacrifice of a greater or less number of human lives.

This brings to mind the frequency of accidents and loss of life in railway cars from a similar cause, as instanced in the Roanoke disaster on the Great Western Railway of Canada of last year; in which, during the burning of a car, the passengers, in their frenzy and haste to escape, jammed the door shut, and could not get it reopened, and several were burned to death, some saving themselves by jumping out of the windows.

These accidents will not become less frequent until some important changes are made to prevent them. As your correspondent of July 3 remarks: "Provision can be made, and it should be compelled to be." There has been in force for some years, in the Dominion of Canada, a law compelling the doors of all churches and public buildings to be opened outwards; and so great was the necessity felt for this that the enactment of the statute was accepted as a great boon, and at once universally complied with.

The same feeling is prevalent, requiring statutory enactment compelling the opening outwards of railway car doors, evinced by the fact that, at each of the two last sessions of the Dominion Legislature, a bill was brought forward with this object in view.

As a late resident of the Old Bay State, I am surprised to learn that you are so far behind in such an important matter; and for the welfare of those who are wont to congregate in our churches, and gather in public assemblies, and the ever constant stream of railway travelers, let us hope that those who have assumed the responsibility with the positions they have accepted, as our lawgivers and legislators, will, at the earliest possible moment, do away with these wholesale man traps.

The facts of the case certainly and practically suggest the remedy: Open the doors of all public buildings and railway cars outwards. This is really what must be accomplished, and the wonder will be that it was not done long since.

W. T. SMITHERS, D.D.

Formerly Rector of Christ Church, Boston, Mass.

Lindsay, Ont.

The Iron Horse.

To the Editor of the Scientific American:

Most of your correspondents, when writing on the application of steam to street cars, seem to take it for granted that the power used must be either horse or locomotive, with no alternative. If by locomotive they mean cylinders connected to the car wheels, or to the wheels of a separate vehicle or machine, I must dissent, and agree with you that the horse is to draw these cars awhile longer; for there are some very important things about drawing a street car that locomotives cannot do practically. For instance, a large truck broke down on a track, and the several cars passing each minute were promptly drawn off the track and around the obstruction on the ordinary Belgian pavement, preventing a serious blockade; and this is not uncommon. However effective locomotives may be on a clear track with good rails, they are worth little off it, and on most street railways they would be off too often.

We think the case demands, not a locomotive, but literally an iron horse, that can, like any horse, be readily attached to and detached from the front of any car, with which it can be drawn off from or on to the track at pleasure, and need not be stopped by ice or mud. The first machine would undoubtedly cost the $3,000 estimated by Mr. Woodward (page 52, current volume); but if any of the great lines ordered machinery enough to draw all their cars, they could probably be furnished for $1,500 each. Of course, no company will do this until some one actually brings out the said iron horse, and fully demonstrates his trotting capabilities; for corporations (unlike the Hon. Mortgage Bond) are not so famous for taking "chances," however "big" they may appear.

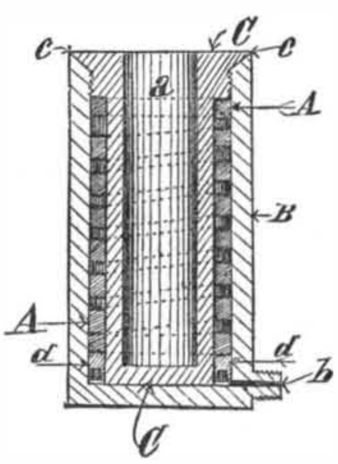
There is a growing demand for a machine of this kind, and many are looking to see whence it will come—a question for our inventors to answer F. H. RICHARDS.

New Britain, Conn.

Cold Air Motor No. 2.

To the Editor of the Scientific American:

As cold air motor stock is at a high premium, and capital is going for it blind, a good opening is presented for an enterprising man, and I do not propose to allow Mr. Keely to have an undisputed monopoly of the motor business. I would, therefore, exhibit, for the consideration of those interested, a motor that will accomplish all that is claimed for the Keely marvel in a more simple manner, dispensing with the receiver, standpipe, and pipes, cocks, etc., in the interior of the chamber of the generator of the new element of power. The engraving shows a sectional elevation of the device; it



consists of a cylindrical vessel made of brass, having its side and bottom walls made very heavy, for a purpose that will hereafter appear. Said vessel is in reality made up of two cylindrical vessels, A B, A secured within B, concentric to the same, and of such relative diameter as to allow a space of proper width to intervene between them. In said annular cavity, a ring, *d d*, is fitted to move under pressure; it is provided with a leathern cup packing, attached to its lower end. Above this ring, which acts as a piston head, a powerful spiral spring, *a*, is placed; the line of junction between the inner and outer cylinders is made on the edge, *c c*, and if the work is well done it cannot be observed. A strong pipe is connected to the nipple, *b*; said pipe is provided with a suitable stopcock, and to its free end a powerful air pump is attached. The proper amount of air to obtain 2,000 or 3,000 lbs. to the square inch is pumped in; the receiving inlet must necessarily be very small. When the requisite pressure is on the generator, the stopcock is turned, the air pump disconnected, and an indicating gage attached in its place.

This little operation should be conducted privately before you exhibit the generator to the uninitiated. The cap or cover is now secured in place upon the top of the generator; it should have a stopcock to which is attached about a yard of small gum hose. When exhibited, the operator blows into the hose for a few seconds; the hose is then secured to a hydrant nozzle, and a couple of quarts of water introduced into the chamber, *a*. This should be well shaken up to expedite the generation of the cold air vapor. If the stopcock in the pipe that the gage is fastened to be now opened, said gage will instantly show a pressure of 2,000 or 3,000 lbs. per square inch. If this device is made of sufficient dimensions (say, 40 inches high and 20 inches outer diameter), an ample quantity of cold air vapor at said pressure can be produced to run a small engine for several minutes, possibly half an hour, and the pressure would be nearly uniform until the vapor is exhausted. Be sure to quit before that event takes place; then take off the top or cover, and show the experts present that there is no humbug about it.

I must candidly state in advance, for the benefit of capitalists desiring to invest in my motor, that there is a possibility of Mr. Keely's invention being substantially the same in construction, and this would bring on an interference in the Patent Office. WM. P. PATTON.

Harrisburg, Pa.

Fire Escapes Wanted.

To the Editor of the Scientific American:

The communication in your issue of July 3 induces me to propose the following preventive of such horrid human holocausts as the late one at Holyoke. Let all churches and public buildings be made with double door frames, the outer one set fast in the wall and the inner one hinged to it, to open outwards; the doors to be hung in this as usual. When the building is occupied, the inner frame can be slightly fastened, so that the least rush will open it. When the building is unoccupied, it can be made fast. Let every State require, by law, public buildings to be thus made.

Kankakee, Ill. S. N. MANNING.

[For the Scientific American.]

Cotton Mathematics.

Deduction of a formula for the production of any number of yarn, per spindle, per hour, in decimals of a pound, at any spindle speed.

Let S R = revolutions of spindles per minute.

N = number of yarn in question.

M = multiplier of square root of number, to determine the twists per inch of yarn; then

$\sqrt{N} \times M$ = number of twists per inch, and

$\frac{SR}{\sqrt{N} \times M}$ = number of inches twisted per minute, and

$\frac{60\,SR}{\sqrt{N} \times M}$ = number of inches twisted per hour.

The hank measures 30,240 inches.

In a pound of any number of yarn, indicated by N, there are N hanks; hence 30,240 × N = number of inches yarn in question per lb.

$$30240\,N : 1\text{ lb.} :: \frac{60\,SR}{\sqrt{N} \times M} : \frac{60\,SR}{30240\,N \times \sqrt{N} \times M} =$$

$\frac{SR}{504N \times \sqrt{N} \times M}$ = decimal of 1 lb. per spindle per hour of N Yarn. In England, the values of M for different descriptions of yarn are as below:

For hosiery yarn, M = 2·5

For doubling, M = 2·75.

For weft, M = 3·25.

For common mule twist, M = 3·75.

For extra mule twist, M = 4.

For super extra mule twist, M = > 4.

Applying the formula, in illustration, to No. 14 yarn, we have as $\sqrt{14} = 3{\cdot}741$, with S R = 6,000, and M = 4.

$\frac{6000}{504 \times 14 \times 3{\cdot}741 \times 4}$ = 0·0568 lbs. No. 14 yarn per spindle per hour; and for 10 hours efficient work, 0 568 lbs. With M = 6, instead of 4, the production in 10 hours will be 0·378 lb. per spindle. The difference is 0·568 —0·378 = 0·19 lb. per spindle, showing a loss daily from 10,000 spindles of 1,900 lbs. yarn No. 14, from excessive twist.

It must be remembered that, in the low numbers, the English spinners use a staple both shorter and weaker than American uplands, requiring more twist than the American. Yet M often in America is made 5, 5½, and sometimes 6.

By comparing, with the practical result in any mill, the theoretical result, ascertained by the infallible formula, the spinner will be at once advised, whether or not his frames are operated to their maximum capacity.

FORWARDS.

Steam Hay-Making.

It is reasonably certain that only a portion of the annual grass crop becomes converted into hay, and that the aggregate loss due to the spoiling of parts of the harvest by rainfalls amounts to very large sums. There is no process of curing hay so cheap as that of exposure, provided the season continues uniformly dry; but as such is rarely the case, there is clearly an economical advantage to be looked for in efficient machinery which does the work expeditiously and in all times and weathers.

A novel invention for this purpose has recently been exhibited at the Royal Agricultural Society's exposition in England. It is the device of Mr. William A. Gibbs' and its operation, according to the description published in the London *Times*, points to a high degree of efficiency. The apparatus is of the following form:

A portable stove constructed of plate iron is surmounted by a fan, which is driven by a belt from a three-horse power portable steam engine; the fan draws all the heated air and gases from the coke fire, together with a volume of warmed air, which passes through a chamber surrounding the inner chamber of the stove, and blows the hot current, at a temperature of 400° Fah. or more, into the dryer. This resembles in general shape a straw elevator, consisting of a sheet iron trough 6 feet in breadth, 20 feet long if mounted on wheels as a portable carriage, or 40 feet or 50 feet long if a fixture. The trough is raised at one end at a low angle, so that hay fed in at the upper end furthest from the stove shall slowly travel to the lower end of the stove—this being assisted by a slow reciprocating motion given to the bottom of the trough. A ridge of triangular section running along the middle of the trough divides it into two almost semi-circular channels, so that the hay passes down in two streams; the hot air issues through two slit apertures, one on each side of the base of the middle ridge, and for the entire length of the machine; and the hay is kept continually stirred and lightened up over the hot blast by a number of small iron stirrers, cleverly contrived to imitate the action of forks worked by hand.

"We saw," says the *Times*, "partly made but wet hay passed through the machine and converted at once into a thoroughly dry condition for the stack; we saw spoilt and musty hay dried into hay of fair apparent quality and pleasant fragrance; and we saw freshly cut grass, saturated with rain from a very heavy thunder shower which poured down at the time, dried into hay of first-class color, and possessing the rich malt odor peculiar to well made hay. With a single twenty-foot machine, the operation is too slow to employ fully one man feeding off a cart and another man removing the product; but with two such machines side by side, or with one fixed machine, of forty or fifty feet length, probably one set of carters and stackers could be kept going. From the experiments made under our supervision, it appears that, while fresh and wet grass loses seventy to seventy-five per cent of its original weight in being made into hay, the quantity of moisture in excess in partially made hay, or hay caught by a heavy rain, may be from ten to twenty per cent. To expel this water from partially made hay requires a consumption of coke in the stove and of coal for the engine not exceeding a cost of 30 cents per tun of hay dried. Preserving freshly cut grass may cost in fuel six or seven times more. With outlay for labor and for wear and tear of apparatus, the total expense, according to Mr. Gibbs' calculations, does not exceed $1.80 or $2.00 per tun, which is, indeed, a very moderate disbursement for saving a loss of perhaps pounds per tun. To make freshly cut grass into the finest hay at one stroke costs about $10 per tun of the dried hay.

Now, it is possible that in a wet season it may pay thus to preserve grass entirely by artificial heat; but Mr. Gibbs recommends the general use of the apparatus for completing the process of hay-making after the grass has been withered by some exposure, and has lost, say, more than half its original moisture. At this stage it will cost little to clear the field and get the hay safely into stack in the best possible condition, instead of leaving it to the chance of being rained on, involving a great additional expense in the ordinary labor of making, with liability to very great loss in "nose" and color. Another feature is that a small proportion of the artificially dried hay, if mixed with damaged stuff, improves the whole bulk in a manner which could hardly be believed without trial; and another is that a farmer having a drying machine at command is not afraid to open out his hay in dubious weather, and thus no fine hours whatever are wasted in waiting."

In some parts of the United States, where sunshine is lacking or wet weather prevails, an apparatus of this kind might be very useful. It could be employed also for fruit-drying and other purposes.

Needed Improvements.

The *Sewing Machine Journal*, published in the interest of the great business indicated by its title, points out the want of the following devices:

1. A ruffler which can be set to gather to a given fulness.
2. A simple embroiderer.
3. An adjustable scroll binder which will not stretch the binding.
4. A practical adjustable hemmer, from the smallest size to an inch wide.
5. A rotary shuttle sewing machine, which will not twist or untwist the thread, and which will sew with great rapidity.
6. A practical tuck folder.
7. A sewing machine which will have, in its working parts, the different attachments which can be thrown in gear with some working part of the machine when the attachment is required.
8. Motive power.
9. A good needle threader.
10. A glass oil bottle which can be sold cheaply, and used to oil the machine instead of the oil can. It must be made so that the oil can be forced out.

Two Inventions Wanted.

We call the attention of inventors and manufacturers to two advertisements in the present issue, in which the advertiser asks for, first, a process by which ten or fifteen copies of freshly written documents can be made rapidly and distinctly on durable paper in ink which will not fade; and second, for a strong, thin, tissue or similar paper which can be used in manifolding with carbon sheets.

It is not difficult to produce several copies of a document by means of devices and materials now in the market; but as a rule, such duplications are blurred and indistinct even when considerable care and skill are employed in producing them. For legal documents, for example, such copies are of little value, and in general, in cases where accuracy and legibility are of importance, press copies are not favored. Again, copying paper in manifold copy books is, as a rule, flimsy and poor stuff, and certainly not the material to which one would wish to commit valuable correspondence were anything better attainable. Messrs. Crane and Co., of Dalton, Mass., make a great variety of special papers for bank notes, bonds, etc., up to a heavy article for machine belting; and we have no doubt that they can make the article required by the advertisements. At all events, the requirements mentioned in the advertisements referred to are well worth the careful consideration of manufacturers generally, as we believe there exists a large demand for the article.

Isaac M. Singer.

Mr. Isaac M. Singer, the well known sewing machine inventor and manufacturer, recently died in England. Mr. Singer was born in Oswego, N. Y, in the year 1811, and in early life worked at the machinist's trade. On the appearance of the sewing machine, he at once turned his attention in that direction, devising an ingenious machine for himself, and subsequently adding improvement after improvement until the now celebrated machine which bears his name was perfected. Mr. Singer obtained a very large number of patents on his various devices, it being his policy to seek such protection as soon as he had demonstrated to himself that any new addition to, or modification of, his machine was essential to its working. His labor and enterprise did not go long unrewarded; and although one of the pioneers in an invention regarding which, as is common with all new ideas, people were at first skeptical, at a comparatively early period in the history of the sewing machine he succeeded in securing the necessary capital wherewith to establish a manufactory.

From that time forward, the fortunate inventor rapidly grew wealthy. The corporation subsequently formed, in which he held a large interest, became one of that powerful combination which practically controlled the entire sewing machine trade of the country, and at the time of his death his private fortune is said to aggregate several millions.

ONE and two thirds lbs. of coal per horse power, per hour, is the consumption of fuel shown by the steamship Plover, a new boat built at Sunderland, England. She has compound engines indicating 562 horse power.