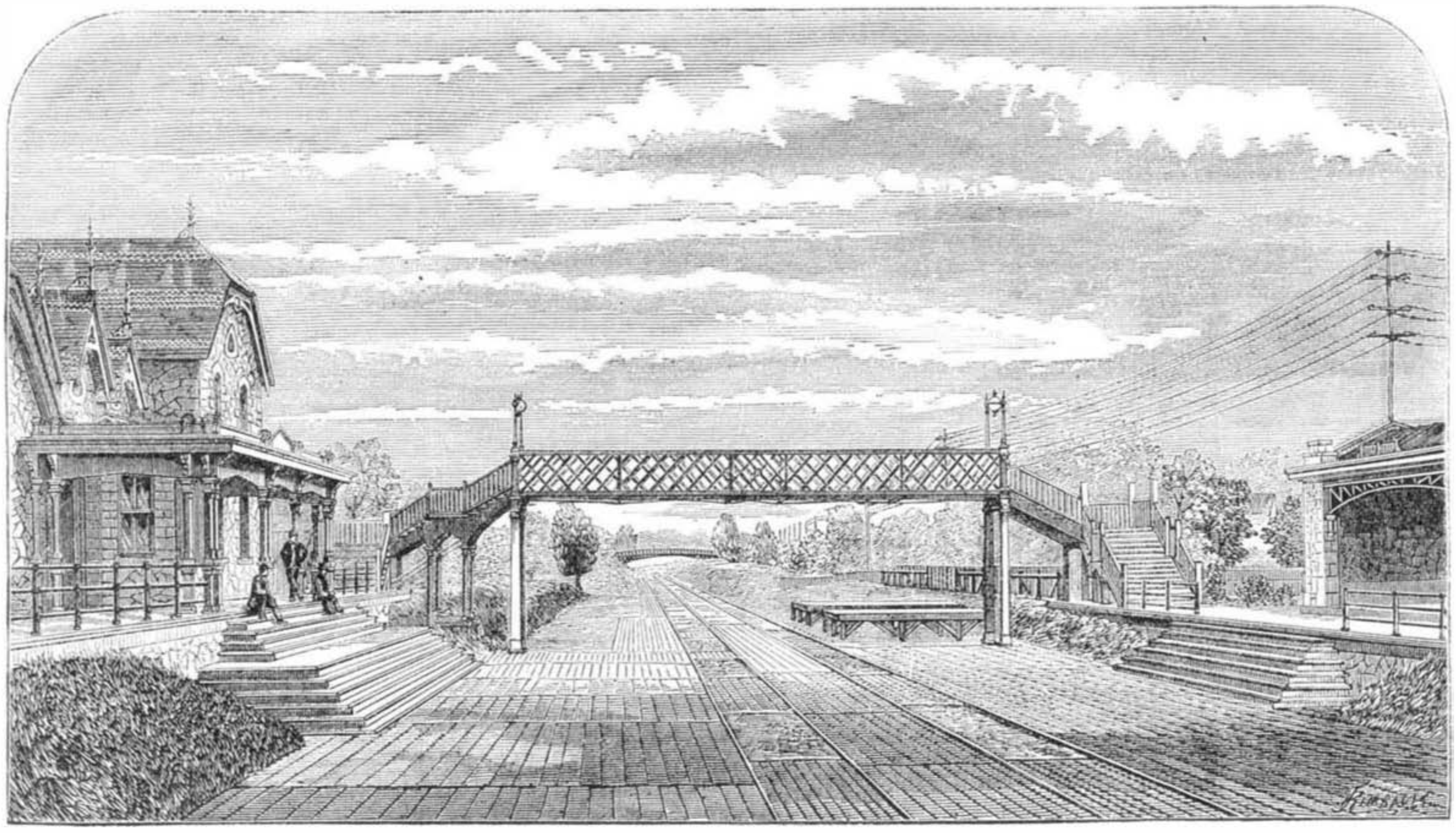
AMERICAN RAILROAD STATIONS.

Since the civil war, progress in the United States has been rapid and vigorous in all directions, but in no department has this been more marked than in railroads. The main lines or arteries throughout the country are becoming every day more substantial; and their permanent way, stations, warehouses, shops, etc., are rapidly assuming the solid appearance that we see on English and Continental roads. No road stands higher in this respect than the Pennsylvania Railroad; in fact, it has always maintained a prëeminent reputation in matters of this kind, with its iron bridges, its solid ballasted track, steel rails, and fine shops.

We publish an engraving herewith, taken from *Engineering*, of a passenger station erected recently on this line, at Bryn Mawr, eight miles from Philadelphia, a portion of the country thronged with summer residences and country seats of wealthy Philadelphians. It is only a sample of a number of others on the road, and shows what this road is doing for the comfort of its patrons.

This station consists of a main passenger building and agent's dwelling combined, on the south side of the road, and a passenger shelter on the north side, an iron foot bridge connecting both sides, to prevent the necessity of passengers crossing on the tracks. The buildings are constructed of a handsome native gneiss rock, with dark pointing, and Connecticut brown stone dressings. The interior is finished up with hard woods, black walnut and ash, throughout, and presents a very handsome appearance. The main waiting room covers an area of 24 feet by 37 feet, and has an open timbered roof. The building is lighted by gas made on the premises. The engineers and architects were Messrs. Joseph M. Wilson and Henry Pettit.



RAILROAD DEPOT AT BRYN MAWR, PA

THE WEAK POINTS IN IRON CASTINGS.

Iron poured into a mold, on changing from a liquid to a solid state, becomes a mass of crystals. These crystals are more or less irregular, but the form toward which they tend, and which they would assume if circumstances did not prevent, is that of a regular octahedron. This is an eight sided figure, and may be imagined to be formed out of two pyramids having their bases together. In Fig. 1 is a group of crystals from a pig of iron, among which you see one that has, by the aid of favorable circumstances, succeded in gaining the natural form. In a perfect crystal of iron, all the lines joining the opposite angles are of equal lengths and at right angles to each other. These lines are called the axes of the crystal. The crystals assemble or group themselves in certain lines, in the direction in which the least pressure is exerted. When we define the direction of these lines as in the direction of least pressure, we deal with pressure due to the mass itself, and heat leaves a mass of iron according to the same law; and, therefore, the lines of assemblage will be in the direction in which heat leaves the body. This direction is always perpendicular to the cooling surface. We can now state the law upon which we shall base all of our reasoning on this part of our subject. In the case of any casting, upon the metal changing from a liquid to a solid state, the crystals arrange themselves in lines perpendicular to the cooling surfaces; or these lines lie in the same direction in which the heat went out of the iron. If the heat leaves all surfaces of a casting, then each surface will have the lines in which the crystals assemble, and which lie near to it, perpendicular to itself.

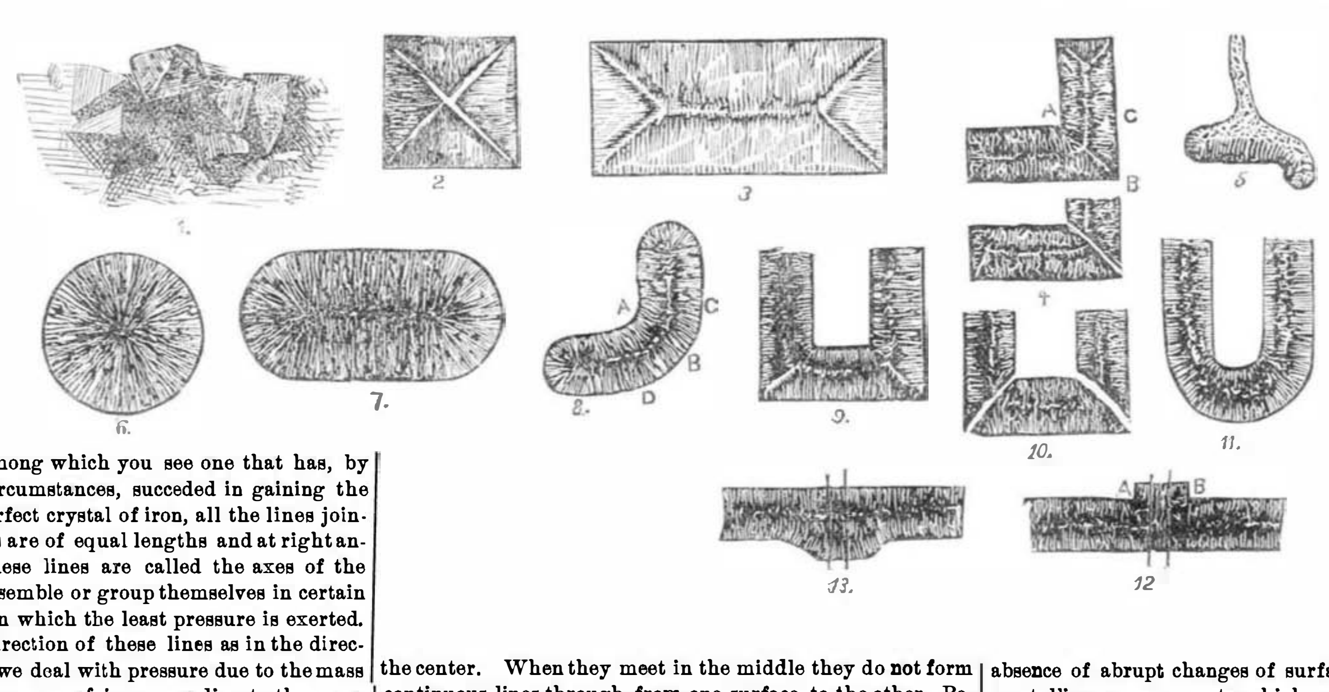
We may then briefly state the law thus: The lines about which the crystals assemble are perpendicular to the surfaces of the casting.

Fig. 2 shows a view of the end of a casting. This shows the assemblage lines, though the individual crystals are too small to be visible. In this figure you see the lines perpendicular to the bounding surfaces; but what I wish to call your attention to especially is the behavior of these lines at the corners of the castings. When two surfaces, as in this example, lie at an angle to each other, the systems of perpendiculars must meet in a plane diagonal to those surfaces. Some of the lines of each group run by into the lines of the opposite group, so that in the diagonal plane the lines interlock, breaking up the natural order, and making very poor connection. We shall find in every such case that the diagonal is the weakest part, and that the casting will bear less strain there than through a part where the lines lie parallel to each other. In the figure which we are considering, each corner has its weak line, meeting at the center of the casting.

In Fig. 3 we have a drawing of a flat bar, and in it we see the same diagonal lines of weakness. The pairs of diagonals, joining the corners nearest to each other, are joined by a long line parallel to the two long surfaces. This line is also a line of weakness, as the lines in which the crystals assemble, in the systems belonging to each surface, begin at the surface, and as the casting cools elongate toward the center. When they meet in the middle they do not form continuous lines through from one surface to the other. Before leaving this class of surfaces, I wish to refer to Fig. 4, also a drawing of a casting. In this way we observe the same phenomena as before, at all of the angles except at the angle, A. Here the metal lying mostly outside of this angle, the lines which we have been considering are perpendicular to the surfaces forming this angle, A, and extend beyond the angle until they interlock, as before, and, together with the diagonal from the corner, B, form a weak line, the entire distance from A to B. Now, though there is much more metal between A and B than between A and C, yet the casting will always break through A B, rather than through A C, the break taking the longer course.

Castings may be made which will not show this peculiar appearance, and may not have it in any marked degree; but if such castings are exposed to heat, the crystals will change position and assemble in lines perpendicular to the surfaces through which the heat entered the casting. The greater the heat the more marked will be this peculiar structure, and the law, as before stated, applies equally in this case, all the crystals finally assembling in lines perpendicular to the bounding surfaces which were heated.

This can be illustrated in the following manner: Take two pieces of zinc which have been rolled into sheets, and heat one of them just below the melting point. To make what I am going to say illustrate the point in question, it must be remarked that rolling any metal into a sheet elongates each crystal in a direction perpendicular to the pressure exerted in rolling—that is, lengthwise of the sheet; and if metal is drawn into wire the crystals are lengthened in the same way. If you bend the piece of zinc that has not been heated, you will find that it is tough, and can be bent many times without breaking, the crystals running lengthwise. Take the other piece of zinc that has been exposed to heat. In it the crystals have turned round, and have formed themselves in lines perpendicular to the surface through which heat entered; and you will find that it breaks when it is bent. The peculiar crystaline structure to which we have referred is varied somewhat by the quality of the metal used, but it depends more directly upon the amount of heat either passing out of or into a casting, or upon the rapidity with which the operation is performed.



We see from the foregoing remarks that the strength of a casting is greatly impaired by the lines of weakness caused by angles, especially re-entrant angles.

Now, let us look for a means of remedy. Referring again to Fig. 2, and then to Fig. 6, or comparing Figs. 3 and 7, we see that by making the angles into curves, the lines in which the crystals form themselves are all nearly parallel to each other, and the absence of abrupt changes of surface also avoids changes in crystalline arrangement, which will materially affect the strength of the casting. Compare Fig. 4 with Fig. 8, and you see that there is the same amount of metal through A B, in Fig. 8, as there is through A C, and yet the strength at the two places is nearly the same. And, of course, their change of form produces a corresponding derangement of crystaline structure, but the defect, which in Fig. 4 was concentrated in the line A B, is in Fig. 8 spread out between the points C and D, so that no single point is much weaker than a similar point beyond C or D.

During the erection of one of the tubes of which the Britannia bridge is composed, a hydraulic press was used, the cylinder of which had a bottom formed as shown in Fig. 9. When pressure was applied the bottom went out, breaking where we would be led to expect it would, through from the inner to the outer angle, as we have shown in Fig. 10. though metal was in excess at that part. A new cylinder was cast, having a semi-spherical bottom, a section of which you see in Fig. 11; and although it was not as thick in the part where the first cylinder broke, yet it sustained a much greater strain without giving way.

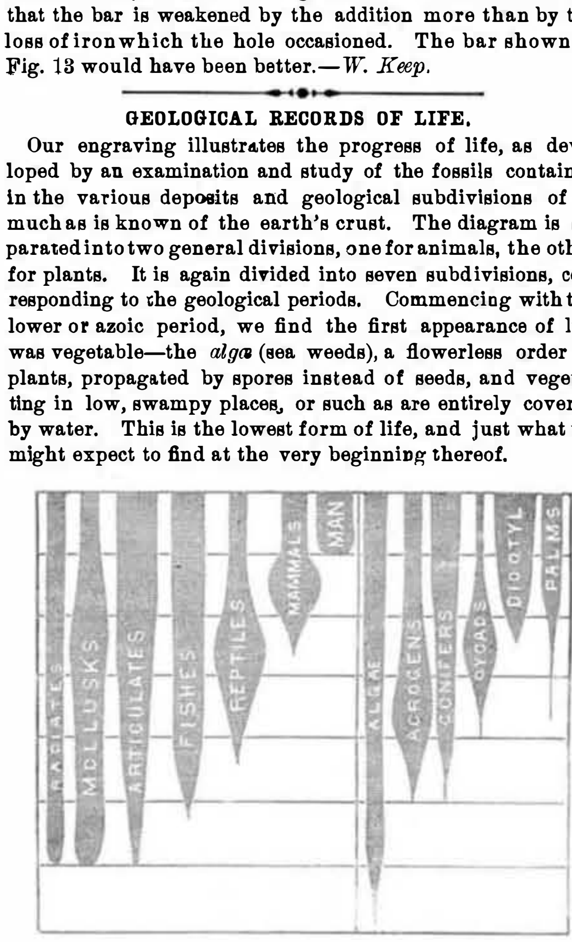
In making patterns for whatever kind of castings, the greatest care should be taken to avoid all angles, of whatever size or shape, for, as has been said already, every change of form brings its corresponding lines of weakness. If curves are necessary, the larger they are the better.

Many of the catastrophes which result from the falling of bridges, or of buildings, might be avoided if this matter had received proper consideration.

For example, it is required to cast a bar with a hole through it. To make up for the iron lost by the hole, the pattern maker adds a square piece to the top of the pattern, as is shown in Fig. 12. When strain is put upon the bar, it breaks through one of the angles at A or B, and it is found that the bar is weakened by the addition more than by the loss of iron which the hole occasioned. The bar shown in Fig. 13 would have been better.—*W. Keep.*

GEOLOGICAL RECORDS OF LIFE.

Our engraving illustrates the progress of life, as developed by an examination and study of the fossils contained in the various deposits and geological subdivisions of so much as is known of the earth's crust. The diagram is separated into two general divisions, one for animals, the other for plants. It is again divided into seven subdivisions, corresponding to the geological periods. Commencing with the lower or azoic period, we find the first appearance of life was vegetable—the *algæ* (sea weeds), a flowerless order of plants, propagated by spores instead of seeds, and vegetating in low, swampy places, or such as are entirely covered by water. This is the lowest form of life, and just what we might expect to find at the very beginning thereof.



GEOLOGICAL RECORDS OF LIFE.

As soon as we leave the azoic period, we come into the lowest order of animal life, which consists of radiates, mollusks, and articulates (crustaceans and worms). Each of these have continued in slightly varying quantities through all geological periods to the present time. The width of the shadings represents their increase or decrease through the several periods.

Fishes next commenced their existence, and have slowly increased in number up to the present time.

Next follow reptiles, and after them mammals, with very important variations in quantities until we reach the age of man, the last and crowning act of creation.

In the vegetable world, as we have already said, we first find the *algæ* or sea weeds—flowerless plants; next come the *acrogens*, a second class of flowerless plants, embracing the coal plants, the wonderful abundance of which, during the carboniferous age, is strikingly manifest from our diagram. The *conifers* also began to appear about this time, and, as will be seen, have steadily increased to the present time. In subsequent succession came the *cycads*, the *dicotyls*, and lastly, the palms—the most magnificent of vegetable creations.

The remains of all these animal and vegetable creations are found as fossils, and always in the order of superposition as here given. They present most interesting and instructive study.

What Constitutes a Mercantile Delivery?

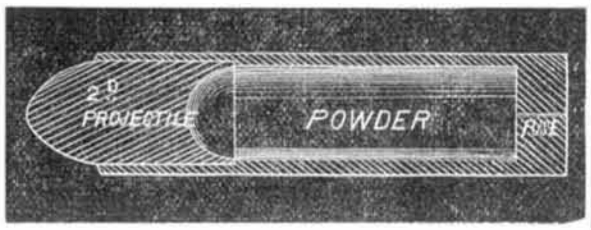
The Superior Court at Boston, Mass., has ruled on the question whether a wagon built to order and remaining in the maker's store room, the buyer having failed to pay for it and refused to allow its sale, was at the buyer's or maker's risk, it having been burned. The court decided that "the article having been specially selected for the defendant, set apart for him and marked with his name, and all with his knowledge, and nothing remaining to be done except that he should pay the agreed price, no further act was needed to vest the title in him, subject to plaintiff's lien for the price, and it remained in the plaintiff's (the maker's) possession at the defendant's (the buyer's) risk at the time of the fire."

Correspondence.

The Sczaroch an American Invention.

To the Editor of the Scientific American:

In your issue of August 1 you describe a recent Russian invention called the sczaroch. I herewith send you a drawing of a projectile which I invented last January, and which I showed to a number of influential men here. I made drawings (which I still possess), and it would be easy to prove the truth of what I say. The enclosed sketch needs no explanation after reading your article of August 1. But I have thought of a use for the projectile, not named in your article.



It cases where it would be of advantage to send a shell a long distance, this could be accomplished by making the outer projectile of rolled iron, so that the second explosion would not burst it. The inner shell would, I think, travel as far as the outer would have done, *plus* the additional distance given by the powder contained in the outer shell. Of course, great accuracy of aim could not be effected.

If I understand the sczaroch, my invention is substantially the same.

Minneapolis, Minn. C. RIDGWAY SNYDER.

V-Threaded Taps.

To the Editor of the Scientific American:

Your surmise that "Max Adeler's" account of his pyrotechnic experiment with Pitman's chickens "emanated from this side of the water" is quite correct. But the *Danbury News* man is guiltless of any part in it. Max is a Philadelphian, and can point a moral with fun, and disclose the ludicrous side of human imperfections. He has had his turn, too, with the plumbers, and tells a story thereof, which, though quite different from that on page 176 of your current volume, is equally moving. This, with much beside to provoke quiet laughter, may be found in his "Out of the Hurly-Burly, or Life in an Odd Corner." From chickens, morals, etc., to taps is a somewhat violent change of base; but it is the very one I must make.

If my experience of nearly thirty years in a machine shop has taught me anything, it is that a tap (I speak only at this time of those having a V thread) should have clearance in all parts of its thread. The curve of any thread between two adjacent grooves should be an involute, not a circle. Simply filing away the tops of the threads is only a little better than nothing. After the thread is finished, grooves cut, and burrs carefully cleaned from the cutting edges, *blue* the tap over a clean fire and let it cool. Now take a good Stubs' taper saw file, lay it nicely between the threads, and file the clearance. The color will show the work of the file, and should be left untouched for a small distance back from the cutting edge, say, in an inch tap, one thirty-second of an inch. A machine tap, never requiring to be turned backward, may be cleared entirely across the section, so that its cut will be like that of a reamer in principle, but with less clearance. A hand tap, which requires to be turned backward, should be filed straight across the section, leaving both the cutting and following ends of each thread up to the original diameter; and the grooves should be shaped something like those in the lower figure on page 187, current volume. This will most effectually prevent any trouble from the cut tings wedging in backing out. A fair mechanic will very readily acquire the knack of filing up taps as above with ease and rapidity. A little experience will also teach him how much clearance is best. Too much causes the tap to work with some irregularity unless very carefully handled, so that it is better to commence with but little. Of course, in establishments where the manufacture of taps is a business, devices can readily be attached to an engine lathe, by which the thread cutting tool shall receive such movement as will give the clearance as required, without subsequent filing.

Whitworth has made taps in this way for at least twenty five years. A number of establishments in this country are also using similar machinery for tap-cutting with every satisfaction. And a good many smaller concerns are regularly filing all their taps as described above; each, perhaps, with some trifling difference in detail. CALLIPERS.

Philadelphia, Pa.

Grindstone Spindles.

To the Editor of the Scientific American:

For every mechanic who has neither steam nor water power, it is of some importance to have a good method of turning his grindstone by foot power, so that it will not take more than one person to sharpen a tool.

Common grindstone spindles, for this purpose, with a crank at one end, are open to the great objection that the stone will never keep round, because every person is inclined, more or less, to follow the motion of his foot with his hand, which causes the pressure on the stone to be unequal. The harder pressure is always applied to the very same part of the stone, and will soon make it uneven, so that it is impossible to grind a tool true. To avoid this, put in place of the crank a small cog wheel to the spindle, say with twelve cogs; have another short spindle, with a crank and a cog wheel of thirteen cogs, to work into the former. The stone will make about 0·07 of a revolution more than the crank, and the harder pressure of the tool on the stone will change to another place at every turn; and the stone will keep perfectly round if it is a good one. This is a very simple contrivance, but it will be new to many of your readers.

W. KAPP.

Small Printing Press Engine.

To the Editor of the Scientific American:

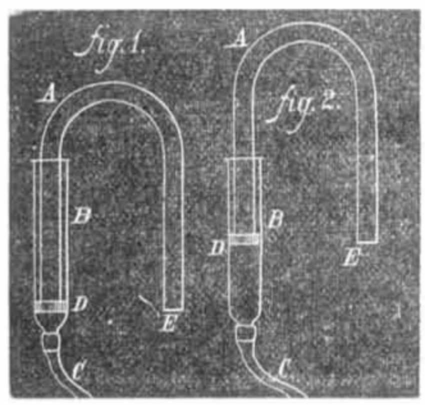
Some weeks since, I noticed an article in the SCIENTIFIC AMERICAN, requesting a statement of the performances of small engines. A few years ago, I built a small engine, which I set up in the *Herald* office in this place. The dimensions of the engine were as follows: cylinder 2 x 4 inches, steam ports $\frac{3}{16}$ x 1 inch, and exhaust $\frac{1}{4}$ x 1 inch. Outside lap of valve was $\frac{1}{16}$ of an inch; no inside lap. Throw of valve was $\frac{1}{2}$ inch. The engine also had a link, the slot of which was 2 inches long. The main rod was 8 inches from center to center. The pin in the crosshead was $\frac{3}{8}$ of an inch in diameter, and the bearing of the main rod on crank was $\frac{3}{4}$ of an inch in diameter. The entire length of the bed plate was 2 inches. The shell of the boiler was $\frac{1}{4}$ of an inch thick, and the heads, $\frac{3}{8}$. The boiler was 3 feet long by 1 foot in diameter, with nine $1\frac{1}{4}$ inch flues. Half of the boiler and the flues made up the heating surface. The grate was 1 foot square. The flame went under the boiler, and returned through the flues to the stack. The pulley on the engine shaft was 6 inches in diameter, over which a belt ran to a 16 inch pulley on a fly wheel of 700 pounds. This wheel was belted to a line of $1\frac{1}{4}$ inch shafting, from which a large Potter newspaper press was run. The pulleys were of equal diameter from the fly wheel to the press. With 75 pounds of steam, the engine, making 300 revolutions per minute, ran the Potter press, printing 1,000 sheets per hour, also a medium sized press printing 1,200 sheets per hour. A small armful of wood and four buckets full of water was sufficient to run off the edition of 1,200 copies in a little over an hour. The water was pumped cold from a tank by a half stroke pump directly into the boiler. The exhaust steam was turned into the stack. Has the performance of this engine been beaten by any similar small engine? The edition was formerly worked off by four men, turning the large wheel by cranks, in four hours. FRANK C. SMITH.

Delaware, O.

A Siphon for Drawing Liquids.

To the Editor of the Scientific American:

I wish to bring to the notice of your readers a siphon, which I believe to be new. I have been using it for two or



three months, and I find it very convenient for drawing acids and solutions. It is composed of the glass tubes, A and B, B being about twice the diameter of A, and drawn down small at one end, to which is attached a rubber tube, C. The tube, A, is packed at D. By immersing E in a liquid, taking the rubber tube, C, between the thumb and forefinger, and drawing it down as far as possible, it will create sufficient vacuum to cause the liquid to pass the bend and flow out, which it will continue to do until the rubber is released. J.W.S.

Magnetic Experiments.

To the Editor of the Scientific American:

On reading the account of the magnetic experiments of Mr. H. P. Henry, on page 100 of your current volume, it occurred to me that an interesting and instructive variation would be to substitute mercury for water. Let the magnet be cemented to the bottom of a glass vessel, to keep it from floating, and then drop iron filings on the surface of the mercury. It seems to me that the laws that govern the movements of the currents would be more correctly exhibited than in the usual experiments on glass and paper, where the friction must necessarily interfere with freedom of movement. The experiment could be still further varied by first sprinkling iron filings on the mercury, and then causing the magnet to approach from above, first with its plane parallel to the surface, then at right angles, etc.

Will you please request Mr. Henry or some one else who has the time and facilities to make the experiments suggested, and publish the results in your paper?

Albany, N. Y. A. F. ONDERDONK.

A RECENT report on the Great Butler Oil District, covering the entire production of the country south and west of Pittsburgh, gives at present 596 producing wells and 81 wells now drilling. There are 1,076 engineers employed. The working capital invested is $1,859,000. The daily production of oil in this district is 15,548 barrels, which indicates a large decrease within the past month.