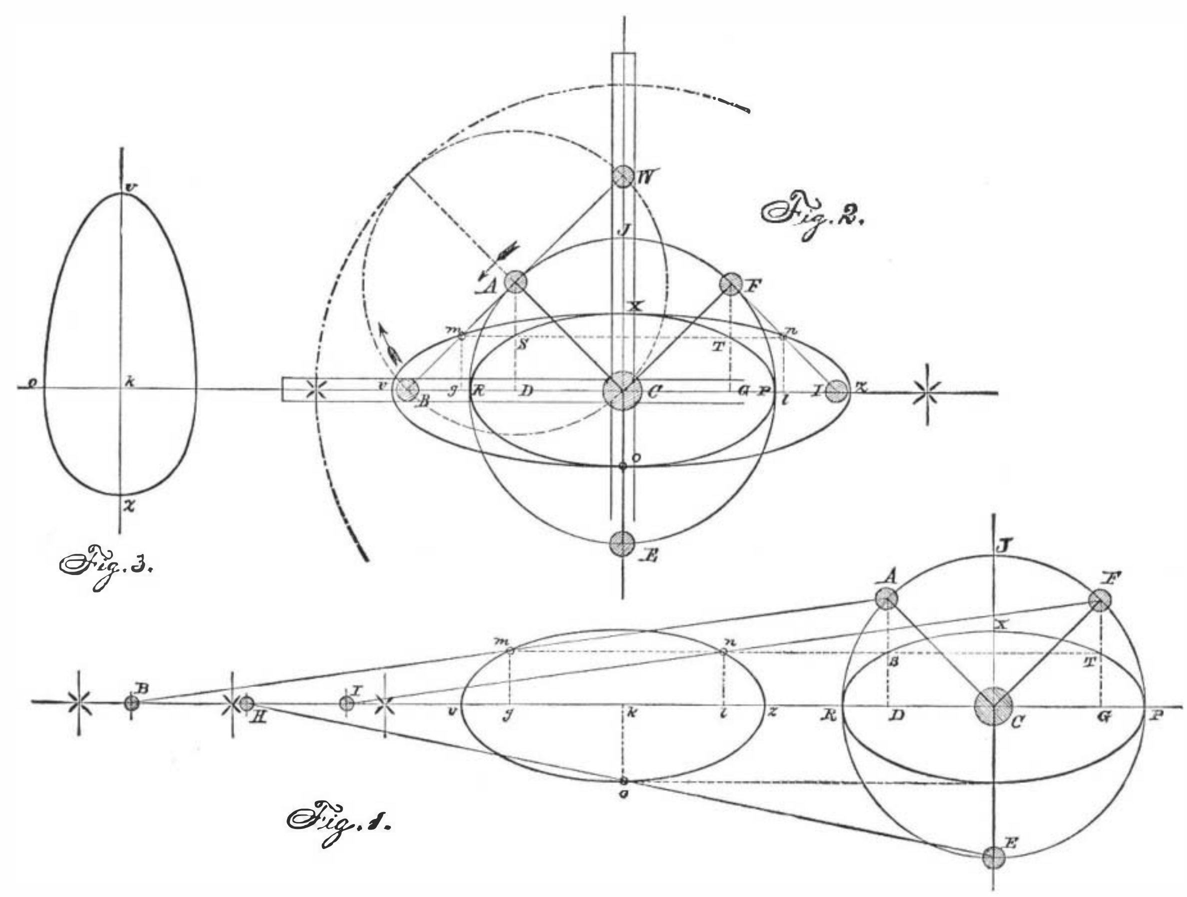
Communications.

The Curve Described by a Point on a Connecting Rod.

To the Editor of the Scientific American:

In your issue of January 20 appears a note from W. H. P., in which he repeats the erroneous statement that the path of a point on the connecting rod, between the crank pin and crosshead centers, is always an ellipse: adding that an instrument constructed on that principle would be a most perfect elliptograph. A trial would convince him of his error, and that would do no harm; but as some one else may be misled into such an experiment, by supposing that W. H. P.'s diagram proves the truth of his assertion, it may be worth while to point out that, on the contrary, it clearly proves its fallacy.

Let the circle in Fig. 1 be the path of the crank pin; if we draw ordinates, AD, JC, FG, and bisect them, the curve, RXP, through the points of bisection, is an ellipse: and the equal ordinates, SD, TG, are equidistant from the minor axis. Now let *o*, the middle point of the connecting rod, EH, be the tracing point; then *ok* will be the greatest ordinate of the described curve, and equal to CX. But it will not be at the middle of *vz*, the length of the curve, nor will equal ordinates be equidistant from it. For instance, *mg*, *nl* are ordinates corresponding and equal to SD, TG. But the triangles, ABD, FIG, having the same hypothenuse and the same altitude, have equal bases; the triangle, HEC, has the greater altitude, CE, while the hypothenuse is the same, therefore its base, HC, is less than B D or I G, and as *g*, *k*, *l* are the middle points of these bases, *gk* is greater than *kl*. The curve in question, then, is *not* an ellipse, nor is it symmetrical with respect to any transverse line; if not "slightly wider" at one end than the other, it is at any rate slightly longer.



The deviation from the elliptical form may not be great under all conditions, but it exists in all cases, with one exception, and is sufficient to preclude the adoption of what is usually understood by the "crank and connecting rod movement" in an elliptograph. The exceptional case I mentioned in a former note; if the length of the connecting rod be equal to that of the crank, and the stroke of the crosshead four times as great, the described curve will be a true ellipse. Such an arrangement would hardly be adopted in a steam engine, but is perfectly practicable in a drawing instrument. The movement is shown in Fig. 2, which is lettered to correspond with Fig. 1. It is also clear that in this case the tracing point being as before at the middle of the connecting rod, the whole length, *vz*, of the described curve will be 1½ times RP; and in order to prove it a true ellipse, it will suffice to show that all the abscissas are increased in the same proportion, the ordinates remaining the same as in RXP. Now, when the crank pin is at A, the crank and connecting rod, AC and AB, form two sides of the isosceles triangle, CAB, whose base, BC, is bisected at D by the ordinate, AD, of the circle: which, itself being bisected at S, gives SD, the ordinate of RXP, to which *mg* is equal. But A B being bisected at *m*, *ms* or its equal, *g*D, is the half of BD or of its equal, DC; that is, C*g* is 1½ times CD: and so of any other position of the crank. It may be added that the movement of AB, the connecting rod in this arrangement, is identical with that of the pencil bar in the common trammel, which will be seen by prolonging BA to meet the vertical center line in W; for in that case the triangle, CAW, being also isosceles, it is clear that, as B moves to and fro on the horizontal line, W will rise and fall in the vertical line: and if these points be compelled to travel in those lines by the slots as shown, the crank may be removed without affecting the result. The mechanical device of the crank, however, gives some advantages; one of which, it may be mentioned, is that, by altering the length of the connecting rod, the instrument may be adjusted to draw curves which are not elliptical, but very decidedly egg-shaped; Fig. 3, for example, would hardly be mistaken for an ellipse by any one.

It may be of interest to some to note that the result attained by either of the devices mentioned, and illustrated in Fig. 2, may also be accomplished in another manner. If the wheel shown in dotted lines, whose center is A in that figure, roll within the annular wheel of twice its own diameter, whose center is C, the points, B and W, will move in the horizontal and vertical lines, and *m* will trace the ellipse.

Stevens Institute, Hoboken, N. J. C. W. MACCORD.

THE average weight of 20,000 men and women, weighed at Boston, Mass., was: Men, 141·5 lbs., women, 124·5 lbs.

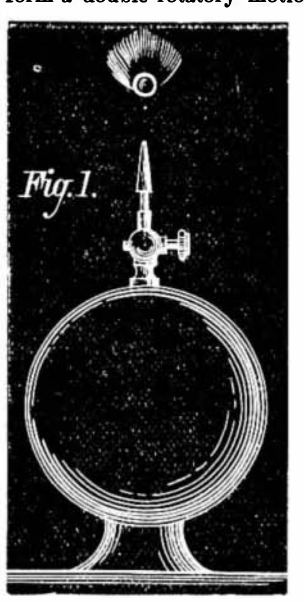
Supporting a Ball on a Blast of Air.

To the Editor of the Scientific American:

In looking up some other matters, I came across an account of some experiments in the direction indicated by the above title, which may possess some interest, and furnish some suggestions in connection with the experiments of the same character exhibited at the Centennial, and which have been discussed in the SCIENTIFIC AMERICAN within the last two months. See page 262, volume XXXV.

In the Glasgow *Mechanic's Magazine* for July 2, 1825, volume LXXX., page 338, in an article entitled "Account of several experiments, performed with a compressed gas apparatus, by John Deuchar, Esqr.," occurs the following:

"*Experiment* 1. When a common brass blowpipe nozzle is put upon the top of the condensing gas-holder, a mahogany ball will be supported upon the column of gas as it is allowed to escape; and when the ball is at the distance of from one inch to one and a half inch above the opening, we may inflame the gas, and still the ball will be supported, and perform a double rotatory motion in the center of the flame (as shown in Fig. 1). Although this experiment be continued for five minutes, yet the wooden ball is not burned, nor even much warmed. In order to mark the motion of the ball, it has a white ring round it.



"There are two causes which operate here in keeping the temperature of the ball below the point of combustion. The first is the hollow nature of flame; it is on the outer surface of the gas alone that the combustion takes place, for there only it has the necessary supply of oxygen to carry on its combustion; the interior, therefore, in which the ball is situated, consists of a mixture of the gas, partially scorched or converted into smoke, united with some that has not been at all changed. And, secondly, the rapid rotatory motion of the ball further prevents the action of the interior uninflamed column of gas, and completely prevents the wood burning.

"*Experiment* 2. Repeat the last experiment, and, at the same time, incline the apparatus to one side, and we have the ball supported on a column of flame obliquely, even at an angle of nearly 45° (as shown in Fig. 2), from the perpendicular. The inflammation of the gas in this instance shows how correct Professor Leslie's ideas were with regard to the nature of the phenomenon which he, I believe, first noticed, of a column of air supporting a hollow brass ball at an angle of 45°; namely, that the ball was enveloped by a sheath of the air; and the inflammation of the gas renders, so far, unnecessary any mathematical demonstration with regard to that point.

"Here is shown, in a very beautiful manner, the inflamed sheath of gas surrounding the ball, by the rapid motion and force of which it is that the ball is enabled to resist the power of gravitation even at the inclination of an angle of 45°; but when we slant the apparatus more to one side, we then find that the attraction of gravitation becomes stronger than the propelling force of the inflamed gas, and we see the ball drop through the burning sheath in which it was previously enveloped.

"In alluding to the very curious observation of Mr. Leslie regarding common air, I cannot help stating that, in the *Chemist*, volume I., page 381, it has, by misrepresentation, been attempted to make it appear that the learned Professor had claimed the merit of discovering that a brass ball could be supported on a column of water. Now, so far as my information goes, Mr. Leslie leaves the far less singular circumstance of a ball being supported on a perpendicular column either of water or air, to be claimed as the discovery of those earlier philosophers, from whose ingenuity the Swiss and German schoolboys (of whom the correspondent in the *Chemist* speaks so highly) had learned their amusing recreation; but the Professor deservedly, I think, is entitled to the merit of first proving that a brass ball could be supported upon a column of water or of air, when that column is inclined even to an angle of 45° from the perpendicular."

In the volume of the *Chemist* referred to, which I chance to have also in my library, I find on page 15 the following:

"HYDRAULICS.—*Curious Experiment.*—The following experiment has recently been exhibited in the northern part of this country by a celebrated professor. A jet of water, by means of a great pressure, was made to spout upwards, and bear aloft, almost as high as the ceiling, a hollow copper ball as large as an egg; and sometimes an egg itself is used. The water was made to spout up in one unbroken jet, about the thickness of a lady's finger. Striking the ball on the under side, it spread out into a thin shell or film, which invested the globular surface on all sides, and afterwards descended in rain or spray. The ball kept playing on the top of the jet, not leaping up and down, but vibrating a little from side to side, and generally it performed at the same time a slow vertical motion on its axis. It is remarkable that it is not necessary for the water to rise in a vertical direction. The experiment succeeded, and the ball was supported equally well, when the jet was inclined ten or fifteen degrees."

And on page 175:

"CURIOUS EXPERIMENT.—We mentioned some months ago an experiment exhibited in Professor Leslie's class room, in which a hollow brass sphere was balanced on the top of a jet of water, and made to play up and down, in a manner very striking and beautiful. We saw the Professor exhibit subsequently an experiment of the same kind with air, but of a more novel and singular description. Two or three atmospheres of common air were condensed into a close copper vessel, of a size which might be conveniently carried in the hand. A stopcock, with a very minute aperture, fixed on the top of the vessel, being opened, the condensed air rushes out in a stream.

If a wooden ball of the size of a schoolboy's marble, or larger, is placed by the hand in this current of air, it is not blown aside or suffered to fall, as we would expect, but continues to leap up and down some inches above the orifice, generally performing at the same time a vertical revolution round its axis. Though the air and water in the two experiments perform the same office, they act in a very different manner. The water, thrown up by pressure, rises in one unbroken filament, of the thickness of a slender rod, to the height of twenty feet or more; but the air being greatly condensed, the moment it escapes from the tube its particles exert a lateral repulsion, and, instead of pouring upwards in a uniform slender stream, it spreads out into the form of an inverted cone, in the axis of which, where the rarefaction is great, the ball plays up and down. So securely is the ball confined by the conical shell of air which invests it, that the vessel may be inclined at an angle of 30 or 40°, or carried about freely in the hand, without the ball falling off. The experiment has, in fact, something of a magical effect; for, when viewed at a distance of three or four yards, so that the whizzing noise of the air is not heard, the ball seems to leap and play, and attach itself to the vessel by some secret and invisible power of its own.—*Scotsman*."

The article alluded to as occurring on page 381 is simply a rather unamiable criticism on something which was *not* asserted concerning Professor Leslie, and is not worth repeating.

Various experiments closely related to the above under the general title of the pneumatic paradox have been frequently discussed and may be found in some text books; but it is curious to see how the supporting of a ball by an oblique blast of air has died out of recollection.

I have encountered in many places a general reference to investigations of Faraday on the above subject, but have found no trace of them as yet among the list of his papers given in the "Catalogue of Scientific Papers" published by the Royal Society, nor have I encountered any publication by Professor Leslie in relation to the matters quoted above.

HENRY MORTON.

Stevens Institute of Technology, Hoboken, N. J.

A Segmental Parabolic Reflector.

To the Editor of the Scientific American:

The descriptions published of the so-called Balestrieri reflector (repeatedly pre-invented by Americans) have reminded me of an instrument which I designed in 1867, when living in Mono county, California, and which has remained on paper because I had no chance then of getting it made, and have ever since been occupied with other affairs. It is a reflector consisting of concentric parabolic rings or segments of copper, coated inside with nickel or silver, which are so curved and arranged that all solar rays falling upon them parallel with their axis are bent to a common focus. In consequence of the latter being behind the reflector and quite near to the same, manipulations which would be very difficult or impossible to perform in front of a concave mirror are rendered perfectly convenient. The reflector may be so mounted as to enable the operator to keep its axis directed towards the sun, and thus to maintain a complete focus for a considerable space of time; and means may also be devised for separating the solar rays by filtration through proper absorbing media. Any good physicist will know, without being furnished with a diagram, how to construct the instrument, which may, indeed, be done in somewhat different ways, it being necessary only to give to the concentric rings or segments (which might best be made by depositing copper upon moulds of wood, covered with plaster and correctly shaped on a lathe) such a curvature and position that the parallel rays, striking them at various angles of incidence, be reflected to the same point. There can be no doubt that, with a large reflector of this kind, it will be possible to produce calorific effects of which we have at present no conception; and the instrument may not only become an important aid to Science, but may also find some useful applications in the arts. By the Balestrieri reflector, which consists of concentric conical rings or segments, the solar rays can naturally not be brought to a focus, but only be collected in an axial line. Its proper purpose is to cast the light of a focal flame in a certain direction into space, and it must answer that purpose quite well. A. PARTZ.

Paris, France.

Plant Vigorous Young Trees.

To the Editor of the Scientific American :

On page 70 of your current volume, you advise farmers and fruit growers to buy small trees rather than large ones. In a general sense you are perhaps correct; but practical pomologists know that to judge rightly of the value of a tree by its rings alone is quite impossible, there being other conditions of growth quite as important, and even more so, than the relative size and height of its trunk and branches. Having a pretty extensive experience in the planting and growth of young fruit trees especially, I have found the roots to be the most important consideration, and the best indication of vigor and quality; and were I compelled to purchase trees without seeing them, roots and all, I should much prefer seeing the roots than the trees proper; and indeed, with such evidence of their quality, I could not be greatly deceived. A tree with a fine mass of fibrous surface roots of a healthy, vigorous color, and thin, small, rather than thick, broken main roots, is sure to grow and thrive with any sort of fair treatment, and in almost any soil; but without such fibrous roots, and having only two or three large mutilated horns or prongs, and a heavy stub for a tap root, which must from necessity have been broken and skinned in removal from the nursery row, the tree were better thrown on the brush heap than given space and trouble in the orchard. In view of the fact that most of our nurserymen work their trees upon seedling root stock and leave them standing in the rows where first planted, it is easy to understand why so large a percentage fails to grow and thrive when removed to our gardens and orchards, and why in some cases, with the utmost care and attention, so many years of doubt and uncertainty must intervene before the fruit appears. In the deep fertile soil of the nursery, they send down long tap roots which, if left undisturbed, grow to the exclusion of anything in the shape of fibrous roots; and when the trees are finally removed for sale, this long tap root must of course be cut or broken off, and it is thus somewhat miraculous if the tree lives at all.

To buy only small trees will not entirely obviate the difficulty, although it is in every way poor policy to purchase or plant very large trees of any kind. But in procuring small trees, it is very important to know various other attending conditions: whether they are small simply from a stunted condition of growth and general lack of constitutional vigor, or because they are young, which of course is the only admissible condition. I have trees of three years which far surpass in vigor and size others of ten. I would certainly prefer even large trees, if vigorous, to small, stunted trees of like age. So it will be seen it is not safe to rely upon small trees altogether. A better rule would be perhaps to buy young trees rather than small, if, indeed, the matter can be narrowed down to one short invariable rule, which I very much doubt. Show me the roots of a tree, and I'll tell you how it looks above ground. Look at the roots first, then the wood and bark; do not care about the size so much, and you need not inquire very particularly about the age after having made the examination indicated. All reliable nurserymen are well acquainted with these facts, and should not mislead their customers in their catalogue classifications. The real, true quality of a fruit tree exists in its degree of vigor and thrift; and it is with reference to this, together with age, that the various grades and prices should be arranged.

Kingston, N. Y. H. HENDRICKS.

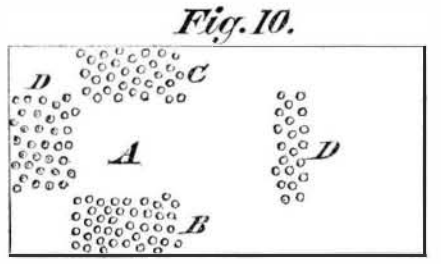
STRAIGHTENING WROUGHT METAL PLATES.

No. II.

As an example, let us take a plate, say 18 inches by 24, as in Fig. 10. The first thing to do is to ascertain where it is out of straight, which is done as follows: If it is a thin plate, say of 19 gauge, we rest one end of it on the block and support the other end in the left hand, as shown in Fig. 11; then with the right hand we exert a sudden pressure in the middle of the plate; and quickly releasing this pressure, we watch where its bending movement takes place. If it occurs most at the outer edges, it proves that the plate is contracted in the middle; while, if the center of the plate moves the most, it demonstrates that it is expanded in the middle. And the same rule applies to any part of the plate. This way of testing may be implicitly relied upon for all plates or sheets thin enough to be sprung by hand pressure.

Another plan, applicable for either thick or thin plates, and used conjointly with the first named, is to stand the plate on edge with the light in front of us, but not overhead, as in Fig. 12; we then cast one eye along the face of the plate upon which the light falls, and any unevenness will be made plainly visible by the shadows upon the surface of the plate. The eye should also be cast along the edges to note any twist or locate any kinks. Perhaps our trial by these tests, employed either singly or in conjunction, demonstrates the plate to have the bulge in it, denoted in Figs. 10 and 11 by the inclosure within the line, A. This bulge is called a loose place; and if the plate is bent or springs back and forth a little, this spot will be found to move the most. The plate is, in fact, edge-bound, as it might aptly be termed; and hence, to straighten it, we do not attempt to batter the bulge down by placing the plate on a large block and hammering away at the convex side; but we place it on a small block and proceed to stretch the plate at and near the edges, and so remove the bulge or loose place without hammering it at all. The method of attack is to first hammer the plate, letting the first series of

Fig. 10.

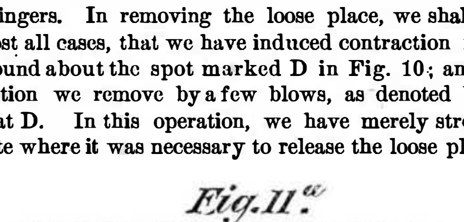


blows be delivered as denoted in Fig. 10 by the marks at B; and we then deliver the blows denoted by the marks at C and at D in the same figure. These blows will, if sufficient of them are delivered, remove the loose place. While giving these blows, the workman takes care to hold the plate so that his blows fall solid and do not "drum:" that is to say, if the spot where the hammer falls does not rest upon the anvil, the effect of the plate is similar to that produced by a drumstick upon a drum, producing no result save to jar the fingers holding the plate. And this jar is frequently sufficiently great to cause severe pain and sometimes injury


Fig. 11.

to the fingers. In removing the loose place, we shall find, in almost all cases, that we have induced contraction in the plate round about the spot marked D in Fig. 10; and this contraction we remove by a few blows, as denoted by the marks at D. In this operation, we have merely stretched the plate where it was necessary to release the loose place.

Fig. 11a.



Let us now suppose that our testing had shown the plate to be twisted. We then carefully note which edge of the plate is the straightest, and which is the one that is bent, and then place our plate upon the anvil, as shown in Fig. 11a, in which that part of the plate on the left hand side of the diagonal line is supposed to be the one that is bent, the bend lying downwards (the edge, A, being the straightest). We then attack the plate, if a thick one with the long cross face hammer, and if a thin one with the twist hammer; and in either case we deliver the blows denoted by the marks, the action of the hammer being to lift the plate in front of it. The blows at and towards the edges are always delivered first, the hammering being carried towards the middle, and being also wider apart as the middle of the plate is approached.

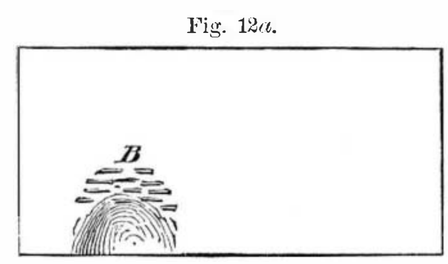
A plate is said to be contracted when the hand bending process shows the edges to move the most; and in this case all that is necessary to remove the contraction is to strike the plate a few blows about the contracted part, as we did to remove the contraction at D in Fig. 10. The blows in this case, however, may fall perpendicularly, and be delivered (for fine work) with a broader faced hammer.

To remove a kink or crooked place at or near the edge of a plate, we proceed as shown in Fig. 12, laying the plate with the convex side of the kink resting upon the anvil (the shaded part, A, representing the kink), and delivering the blows denoted by the marks at B, in Fig. 12a. We next turn the plate upside down, and strike the blows denoted by the marks or dashes at C, Fig. 13; and the kink will be removed.

Fig. 12.

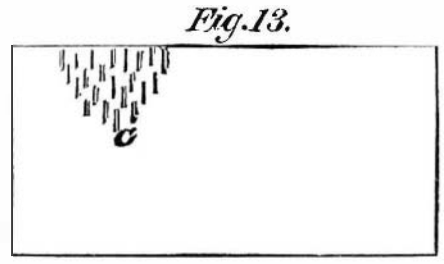
To straighten the plate shown in Fig. 9, we place it upon the anvil, as shown in Fig. 14, striking blows as denoted at A, and placing but a very small portion of the plate over the anvil at first; and as it is straightened, we pass it gradually further over the anvil, taking care that it is not, at any part of the process, placed so far over the anvil as to drum, which will always take place if the part of the plate struck does not bed, under the force of the blow, well upon the anvil.

Fig. 12a.



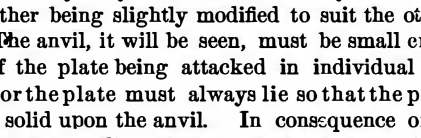
We have now explained all the principles involved in straightening wrought metal plates; and no matter in what shape a plate is bent, it can be straightened by the application of these rules, applied either singly or in combination. As a rule, they require to be used in combination: thus a plate may have a loose place and a kink, or a kink and a twist, and in these cases the operation to remove the one is

Fig. 13.



performed conjointly with that necessary to remove the other, either being slightly modified to suit the other operation. The anvil, it will be seen, must be small enough to permit of the plate being attacked in individual spots or places; for the plate must always lie so that the part being struck is solid upon the anvil. In consequence of this requirement, the holding of the plate becomes an important element; for, with a good helper, the plate may be quickly and readily adjusted, thus saving much time and labor.

Fig. 14.



A rude system of straightening is sometimes performed by the aid of a trip hammer, the finishing process being performed on a large iron block. This plan is crude, however, and is more productive of hammer marks than it is of true work. Very thick plates, those too thick to be readily affected by the blows of a sledge hammer, are made red hot and straightened upon iron blocks larger than the plates. For this operation large wooden mallets with very long handles are sometimes used. J. R.

OVER 13,000 applications for space have already been filed by the authorities of the French Exposition next year; 7,800 are from the city of Paris alone.