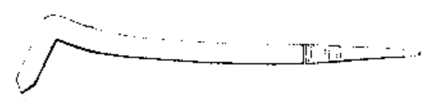
PRACTICAL MECHANISM.

NUMBER VIII.

BY JOSHUA ROSE.

VISE WORK—TOOLS FOR SCRAPING SURFACES.

Surfaces requiring to be very true may be got up with the scraper, the best form of which is that shown in the following illustration, the point, *a*, being the cutting edge. It is



ess liable to jar and more readily sharpened than any other. For use on wrought iron, the cutting edge should be kept moistened, or it will tear the metal instead of cutting it cleanly. All surfaces intended to be scraped should first be filed as true as possible with a smooth file, care being exercised to use a file that is evenly curved in its length and slightly rounding in its breadth. After the surface has been scraped once or twice, a well worn, dead smooth file may be passed over it, which will rub down the highest spots of the scraper marks and greatly assist the operation of scraping. Scraping should be executed in small squares, the marks of one square being at a right angle to the marks of the next; then, after the surface plate has been applied, repeat the operation of scraping in squares, but let the marks cross those of the previous scraping. The face of the surface must be wiped off very clean before the surface plate is applied, or the surfaces of both the plate and the work will become scratched. The face of the plate may be moistened by the application of a barely perceptible coat of Venetian red, mixed with lubricating oil, rubbed on by the palm of the hand, to operate as marking to denote the high spots. In applying the surface plate, move it both ways on the work, and reverse it endwise occasionally. If the work is light, it may be taken from the vise and laid upon the plate; but much pressure need not be placed upon the work, or it will spring to suit the surface of the plate, and thus appear to be true when it is not so. Small surfaces should be rubbed on the outer parts of the surface of the plate, by which means the wear on the surface plate will be kept more equal.

FITTING CONNECTING RODS.

The planing work on a connecting rod being complete, the first thing for the fitter to do is to mark off the key ways, the bolt holes (if there are any), the holes for the set screws, the oil holes, etc., so as to have the drilling completed before the straps or rod ends are filed up, because drills leave a burr where they come through the metal, and because the clamps, which hold the work while it is being drilled, are apt to leave marks upon it. The holes should then be tapped, when the rod will be ready for the file. The faces of the rod whereon the straps fit should then be surfaced with a surface plate, and made quite square with the broad faces of the rod, parallel crosswise with each other, and a little taper with each other in the length. The strap should be made narrower between its jaws than the width of the rod end, so as to require to spring open when placed upon the rod end if the brasses are not in their places. The inside faces of the jaws of the strap must be made quite square with the side faces, so that, when the strap is placed upon the rod end, the latter faces of the strap will not spring out true with the broad faces of the rod end. The rod end must have a light coating of marking rubbed over it, and the strap moved back and forth on it, so that the rod end serves as a gage and surfacing block to the strap.

If, when the strap is on its place, its side faces are uneven with the side faces of the rod end, as shown in Fig. G (which is a sectional view of a strap and rod end, *a* being the rod end, and B B the jaws of the strap), either one or both of the inside side faces of the strap require filing in the direction denoted by the dotted lines, because it is only in consequence of the inside faces not being square with the outside faces that this twist occurs. The key ways in the strap and rod end should be filed out together, that is, while the strap is on its place and secured by being clamped or bolted. If the strap is one held to the rod by a gib and key, the width, from the end of the rod to the crown of the strap when it is placed in position to cut or file out the key way, should be that of the extreme width of the brasses when the joint of the brasses is close, less the amount of taper there is on the key. The key way should then be filed out parallel, both in its width and breadth, and surfaced with a surface plate, the breadth being equal to that of the gib and key together when the head of the key is even with the head of the gib; then when the key way is finished and the strap is placed in its intended position on the end of the rod, the strap will have moved back from off the rod end for a distance equal to the amount of the taper on the key, so that there will be the requisite amount of draw on the key way of the strap on the one side and on the key way of the rod on the other side, while the key will at the same time come through the strap to its required distance. The faces of the rod end, whereon the jaws of the strap fit, having been made (as directed) a little taper, and the strap allowed (as described) a little spring, the rod end will enter the strap somewhat easily, and tighten as it passes up the strap, so that, when quite up, the strap will fit a little tighter than it is intended, when finished, to do. When the strap is fitted and keyed to the rod, a light cut should be taken off the faces of the rod and strap while they are together, the bolts of a bolt rod being sufficient to hold the strap for that purpose; but in the case of a gib and key, a piece of wood should be placed between the rod end and the crown of the strap, that is, in the space intended to be filled by the brasses, and the wood keyed up so as to lock the strap on the rod while the faces of the rod and strap are planed. This being complete, the strap is ready to receive the brasses. The bottom of back brass must be made to a tight fit, so as to spring the strap open sufficiently to make it fit the the rod end as easily as required; thus both the brass and the strap will be closely fitted. The top brass must be fitted to the strap while the bottom brass is in its place in the strap, and must be made to fit the strap without being so tight as to spring it open. The corners of both brasses where they fit the corners of the strap should be eased away with the edge of a half round file, so that they will not destroy the corners of the strap (when the brasses are being driven in and out to fit), which would make the strap appear to be a bad fit on the rod.

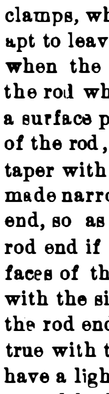


Fig. G.

While fitting the top brass, it is necessary to try the strap on the rod end (the brasses being in their places) at intervals, so as not to take any more off the top brass than is necessary to let the strap fit the rod end. As a guide, when fitting the brasses to the strap, the callipers may be set to the width of the rod end where the strap fits, and applied to the strap when the brasses are driven in to fit. The gib and key must, when placed together edgeways, be quite parallel in their total breadth, so that they will fit properly against each other and against the key way in the rod end and the strap. When setting the gage for the size to which the brasses are to be planed, place the strap on the rod end to get the correct size, for the strap is narrower (between its jaws) when it is off than when it is on the rod, because of the spring. In bedding the back brass to the strap, let it bear the hardest, if anything, upon the crown, for if the bevels of the brass should keep the crown from bedding, the strap would spring away from the rod end, in spite of the gib (or the bolts, if there are any), when the key is driven home, as illustrated in Fig. 35.

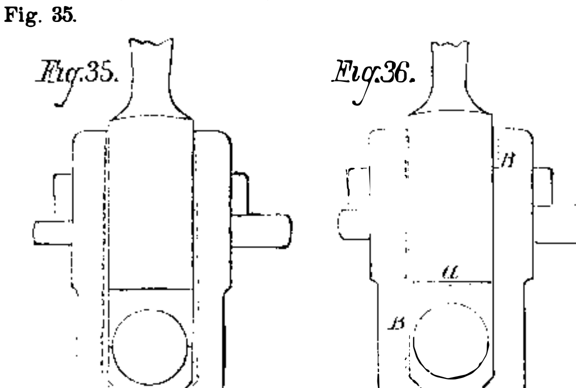


Fig. 35. Fig. 36.

If the back brass does not bed down upon the crown, *a*, of the strap, the latter will spring away from the block end of the rod and from the brasses on the sides, and will assume the shape denoted by the dotted lines. Should the top brass not bed properly against the rod end, the trap will spring as described in Fig. 36.

Fig. 37.

The dotted line, *a*, is the back of the brass, supposed to bed improperly against the rod end, as shown; the dotted lines, B B, denote the manner in which the strap would, in consequence, spring away from the rod end when the key was driven home. If the brasses fail to fit properly against the rod end or strap, in the direction of the breadth of the strap, it will spring out of line, as described in Fig. 37, which is a sectional view of a connecting rod end. C is the strap, D is the rod end, and B B are the brasses, the top one of which, if it did not fit square against the rod end (but on one side only), as represented by the line *a*, would spring the strap out of true with the rod end, in the direction of the dotted lines. The strap is, by reason of its shape, very susceptible to spring; and unless the brasses, or even the gib and key, are quite square and fit well, it is certain to spring out of true. The brasses should be a fit on the journal when they are "brass and brass," that is, the joint of the two brasses close together, so as to take the pressure of the key, which thus locks the strap and brasses to the rod end, and prevents them from moving, or working, as it is called, when the rod is in action; especially is this necessary in straps having a gib and key to hold them to their places, because, if the joint of the brasses is not close, the key cannot be driven home tightly, and hence there is nothing to lock the strap firmly to its place. If, however, the strap is held to its place by bolts, it is not so imperative to keep the joint of the brasses close together, although it is far preferable to do so, especially in the case of fast-running engines, not only on account of the assistance lent by the key to hold the strap firmly, but also because it holds the brasses firmly, and the key cannot bind the brasses too tightly to the journal, even though the key be driven tightly home, so as to assist the set screw in preventing it from slacking back.

The brasses should be left a little too tight in the strap before boring, because they invariably shrink or go in a little sideways from being bored, as do all brasses, large or small, even if bored before any other work has been done on them. For driving the brasses in and out of the strap to fit them, use a piece of hard wood to strike on so as not to stretch the skin of the brass and alter its form, as will be explained in future remarks on pening.

The brasses should be of equal thickness from the face forming the joint to the back of the brass, so that the joint will be in the center of the bore of the brasses. The respective faces forming the joint should be quite square with both the faces and sides of the brass, so that they will not spring the strap when they are keyed up, and so that, when the brasses are let together in consequence of the bore having worn, the faces may be kept square, and thus be known to fit properly together without having to put them together in the rod and on the journal to try them, which would entail a good deal of unnecessary labor.

To get the length of a connecting rod, place the piston in the center of its stroke, and the distance from the center of the crosshead pin to the center of the crank shaft is the length of the rod from center to center of the brasses. Another method is to place the piston at one end of its stroke and the crank on its dead center corresponding to the same end of the stroke, and the distance from the center of the crosshead pin to the center of the crank pin is the length of the rod.

To ascertain when the crank of a horizontal engine is upon its exact dead center, strike upon the end face of the crank axle or engine shaft a circle true with the shaft, and of the same diameter as the crank pin; then place a spirit level so that one end rests on the crank pin and the other end is even with the outline of the circle; and when the spirit level stands true, the crank will be upon its dead center.

The length of a connecting rod cannot be taken if the crank is placed in the position known as full power, because the position in which the piston would then be cannot practically be definitely ascertained; for the angle at which the connecting rod stands causes the piston to have moved more or less than half the length of the stroke when the crank has moved from a dead center to full power, according to which end of the cylinder the piston moved from. If it was the end nearest to the crank, the piston moved less, if the other end, it moved more, than half of its stroke; so that in either case the piston stands nearer the crank than is the center of the length of the cylinder when the crank is in the position referred to. This variation of piston movement to crank movement is greater in the case of short connecting rods than with long ones.

To fit a connecting rod to an engine, first rub some marking on the crank pin, and put the crank pin end of the rod on its place, with the brasses in and keyed properly up. The other end of the rod, being free, can be placed so as to touch against the crosshead pin, when the eye will detect if it will go into its place without any spring sideways; if it will do so, the rod may be taken off the crank pin, and the brasses, if necessary, fitted to the pin sufficiently to allow each to bear on the crown. But if the rod end will not fall into the crosshead journal without being sprung sideways, then move it clear of the crosshead, placing a side pressure on it in the direction in which it wants to go to come fair with the crosshead journal, and move it back and forth under such side pressure, which process will cause the crank pin to mark where the connecting rod brasses want filing and scraping to bring the rod true. The rod must then be taken off, and the brasses eased where the marking and the knowledge of which way the rod wants to go determine, the rod being placed on the crank pin as before, and the whole operation repeated until the rod "leads" true with the crosshead journal. The crosshead end of the rod must be fitted in like manner to the crosshead journal until the crank pin end of the rod leads true to the crank pin journal. The rod must then be put on its place, with both journals keyed up, and, if it can easily be accomplished, the engine moved backwards and forwards, the brasses being then taken out and bedded, when the rod will be fitted complete. A connecting rod which has both straps held by gibs and keys gets shorter from center to center of the bore of the brasses as it wears, and that to half of the amount of the wear. This is, however, generally rectified by lining up the brasses—that is, placing pieces of metal behind them (they may be fastened to the brasses if it is desirable)—which pieces are made of the required thickness to replace the amount of the wear of the brasses.

A connecting rod whose crosshead end has a strap with a gib and key, or, what is better, two gibs and a key, to hold it, the crank pin end having its strap held by bolts, and the key between the bolts and the brass, would maintain its original length, providing the wear on the crosshead brasses was as great as is the wear on the crank pin brasses; but since that on the latter is the greatest, the rod wears longer to half the amount of the difference of the wear between the crosshead and crank pin journals. If both the straps of a rod are held by bolts, the key of one end being between the brasses and the main body of the rod, and the key of the other end between the brasses and the crown of the strap, it would maintain its original length if the wear on both ends was equal; but this not being so, it wears longer, as above stated. When marking off the end of the rod (that is, the circle on the brasses to set them by for boring), or when trammeling a rod to try its length, stand it on its edge; because if it rests on its broad face the rod will deflect, and appear to be shorter than it is; this is especially liable to occur in coupling or side rods, which are generally longer and slighter in body than connecting rods.

The oil hole of a strap for either a connecting or side rod should be in the exact center of the space intended to be filled by the brasses. It will thus be central with the joint of the brasses, and from center to center of the oil holes, and will, therefore, represent the proper length of the rod

When, therefore, the brasses of a rod end whose strap is held by a gib and key, have worn so that the key is let down the brasses must be lined up to bring the key back to its original position, the back brass being lined up so that its joint face comes even to the center of theoil hole, and the other brass being lined up sufficiently to bring the key back to its original position; then the rod is sure to be its proper length. But if the strap is held by the bolts (in which case it does not move when the brasses are let together and the key further through), lining the back brass up to the center of the oil hole at once ensures the rod being of its correct length, without any reference as to what thickness of liner is put on the other brass, or how far the key may come through. In either case it will be observed that the center of the oil hole, when placed as described, forms a gage to keep the rod its proper length. To ascertain what thickness of liner is required for the brass back, place it in its place in the strap, and scribe a line (on the inside of the strap) even with the joint face of the brass; then mark a line across the strap so that the line will intersect the center of the oil hole, and the distance between the two lines will be the requisite thickness of liner.

To find the thickness of liner necessary to the other brass, put the strap in its place with both brasses in, and the back one lined up; then key the brasses up, and scribe a line on the key at its narrowest end, even with the face of the strap; then the difference between the width of the key (on the taper face) at the line (which is the distance it does come through), and the width of the key at or near the narrow end (that is to say, the distance it ought to come through) is the thickness of liner required.

Correspondence.

Car Ventilation.

To the Editor of the Scientific American:

If the public generally knew how soon the air in a railroad car is spoiled and vitiated, there would probably be more zeal in searching for a remedy of the evil; but comparatively few know it, and only those who make the subject a particular study.

Pure air, so called, contains 4 parts of carbonic acid gas in 10,000; and a large passenger car contains about 4,100 cubic feet of floating atmospheric air. If pure, it should not contain more than 1·66 cubic feet of carbonic acid gas. A man exhales 18 cubic inches of carbonic acid gas in a minute. If we suppose that there are 50 passengers in a car, they would exhale 900 cubic inches in a minute, or 5·21 cubic feet in 10 minutes, which is at the rate of 12·55 parts in 10,000; so that in 20 minutes the air is vitiated at the ratio of 25·10 parts in 10,000. Twenty-five passengers would need 40 minutes to come to the same result. This is from the impurities from sound lungs. Take into consideration the breath from diseased lungs, and uncleanness of person and clothes, and the case will be still more desperate. For this there is only one remedy: The air must be continually renewed. The question only is, how?

What is called natural ventilation is the flow of air caused by difference of temperature and weight. Where the temperature is equal, or nearly so, in and outside, there is little or no motion of the air. The displacement will increase with the difference in temperature. Suppose the external temperature to be 32°, and the internal 62°, a difference of 30°: the hight of a car from floor to ceiling 8·5 feet, and the opening for the discharge of air 2·25 square feet, or 1·5 feet square in all. We would then have: Difference of temperature, 30° × 0·002036 (coefficient of expansion) × 8·5(hight of car) = 0·51918 inches difference in hight of the pressing column. The amount of air displaced in a second is ascertained by the formula for falling bodies, which, in our case, would give

$$\frac{2\sqrt{0{\cdot}51918 \times 15{\cdot}6}}{4} \times 2{\cdot}25 = 2{\cdot}54 \text{ cubic feet.}$$

The amount really displaced is ¼ the theoretical result. In a minute, 152 cubic feet are driven out; and as the car contains 4,100 cubic feet, it will be $\frac{4100}{152}$ = 27 minutes before the air in the car can be renewed, when the atmosphere is at freezing point outside and moderately warm within, keeping, in all, 2·25 square feet continually open; but with a difference of temperature of only 15°, it would require 54 minutes to renew the amount of air which is vitiated in 10 to 20 minutes. It very doubtful, however, if ever, in the most approved passenger cars, so large an area is always kept open. In winter would soon reduce the temperature to below the comfortable point, and most of the passengers would protest, preferring even a bad atmosphere to a chilling draft. In summer, r fear of suffocation, all windows must be kept open; and, course, dust, smoke, and cinders cannot be kept out. Air y be forced in by funnel-shaped tubes provided the wind ws in the right direction), but with it dust and smoke ll come in.

We see that natural ventilation will not fully answer the pose; and all the neat and ingeniously arranged so-called tilators, in the frieze and skylight, are more ornamental n useful. There seems to be no other way to solve the stion but the application of mechanical means, such as or blowers driven by some power, to exhaust the foul supply the fresh air. The exhaustion should be near top in summer, and at the bottom during winter. If the er be given, this can easily be done; and any plan for ibution, warming, or cooling can be combined with it.

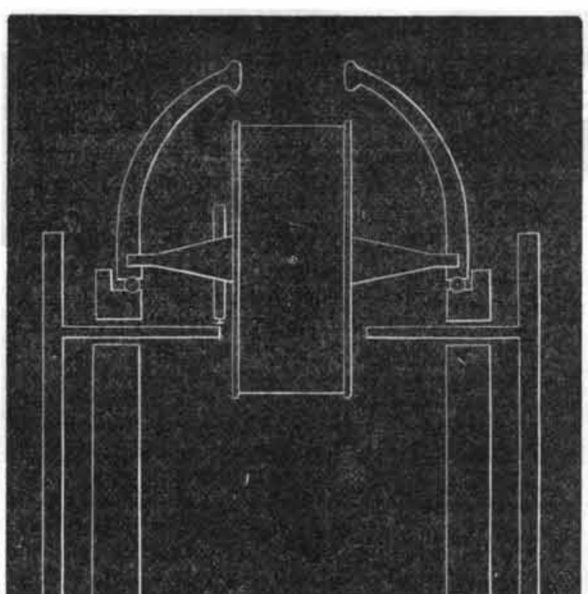
S.

Constructing Mammoth Telescopes.

e Editor of the Scientific American:

sing in your widely circulated paper that a project is tained in America of constructing a gigantic astronomical telescope, and as various methods have been proposed for carrying out that undertaking, I send you an account of a mercurial reflecting telescope (invented by me and exhibited before the New Zealand Institute), published in the "Transactions" of that Institute, Vol. V., p. 119: whereby advantage is taken of the parabolic figure assumed by liquids rotating in the plane of the horizon; so that objects at the zenith and a few degrees distant therefrom can be magnified by eyepieces in the ordinary manner. A zone of the heavens, a certain number of degrees in breadth, can thus be examined, the sweep of the telescope in right ascension being made by the earth's rotation. For viewing objects not near the zenith, a large plane reflector of silvered glass is used, which first receives the rays from the object, and then reflects them vertically downwards on to the mercurial speculum, which speculum then collects the rays and reflects them convergently upwards through an aperture formed in the plane reflector. In the publication (which I inclose) the theory is fully explained, together with a contrivance for causing the plane mirror to be always at the proper inclination, whenever the finder is directed to the object.

In the accompanying figure, showing the vertical section



of the telescope and observatory, the speculum cup containing the mercury is attached to the top of a long, hollow, conical axis, and a thin, hollow metal float is attached to the bottom of the axis. This float revolves in a vessel of liquid, and this liquid is rotated by conducting it tangentially into the vessel at its circumference, at the parts, O O, while its outlet is close to the bottom of the axis; a spiral motion is thus imparted to the liquid. The size of the float is so adjusted that it displaces nearly as much of the liquid as corresponds to the weight of the speculum. There is then but little weight upon the pivot supporting the axis, which is inserted in solid masonry.

Three curved pillars of stone, two of which are seen in the figure, form supports for three levers for leveling the speculum. These levers have a slow motion, communicated to them by screws fixed near the long end of the levers; and when properly adjusted, the short ends of these levers have contact with, but exert no pressure on, the axis. By this arrangement, the axis is secure from any vibration arising from the gyratory motion of the liquid round the float. Then, if this liquid is supplied from an elevated vessel kept full to overflowing, and if the inlets, O O, and the outlet be kept of a constant size, as gravity is a constant and friction at all parts of the axis nearly annihilated, therefore its periodic revolution is a constant too.

This arrangement contains within itself a centrifugal pendulum for regulating its velocity, and that without adding any other apparatus to the parts already described; for let the vessel containing the float be supplied with a slight excess of the liquid, it is then always full up to its edge, and, when rotating, its surface is rendered concave. If, then, from any circumstance, the revolution becomes accelerated, the liquid becomes still more concave, and consequently exerts less buoyant power upon the float; this leads to extra friction on the bottom pivot, which tends to retard the velocity.

A cylindrical wall of masonry surrounds the speculum, forming at the same time the tube of the telescope and also the observatory. The top of this wall supports a rotating dome with suitable openings, and attached to and rotating with this dome is a large plane mirror of glass silvered on its anterior surface and optically tested in every part, while constructed by a novel method.

The axis on which this mirror moves vertically is supported in a similar manner to the axis of a transit circle, and similar vertical graduated circles can be attached thereto; and if the dome is made to revolve on a graduated horizontal circle, we shall have a symmetrical arrangement for an altitude and azimuth instrument on a large scale. Exterior to the wall supporting the plane mirror, and entirely unconnected therewith, is another circular wall, and it is this outer wall that supports the floors, through apertures in the interior wall somewhat larger than the supports; so that any movement of the observer will not vibrate the telescope. The steps up the observatory are in the space between the walls and are attached to the outer wall only.

The symmetry of the horizontal speculum precludes any danger either of deflection by its weight or of irregular expansion arising from increase of temperature; for it possesses the same shape and weight in whatever position it is turned; it is, in fact, self-compensating.

The speculum admits of being beveled with extreme precision by an optical contrivance which can also be applied to test the figure of the plane mirror in all its parts, while being constructed HENRY SKEY.

Dunedin Observatory, Otago New Zealand.

Hardening and Tempering Tools.

To the Editor of the Scientific American:

In reply to the last two communications of Mr. Hawkins upon the above subject, I have to say:

1. An experience of twenty years of workshop practice, here and in Europe, under the most favorable conditions, has proved conclusively to me that, by tempering taps, reamers, etc., in a tube "moderately heated," by performing the operation "slowly," and by tempering them to a "brown color," I could obtain a better tool than by the sand bath, or than by any other method of tempering at present practiced in our workshops. What difference there would be in the temper (the color being the same) if more rapidity, or some other changed conditions of tempering, were employed, I have no need to discuss.

2. My given methods for taps, dies, reamers, etc., determine both the elements of time and access of the air; for I say that the tube must be "heated," by which the workman understands "heated to a red." I then say that "care should be taken not to make the tube too hot, for the more slowly a tool is lowered, the more even the temper will be." I think that, if these instructions are followed, there is not much option as to time, since the tempering cannot be hastened, and can only be delayed by intentionally holding it out from the tube; by the term "slowly," I mean as slowly as it can well be performed without purposed delay. If the tube is merely "heated," the operator cannot go wrong.

3. In the tube process given by me, there is a current of air continually passing the steel being tempered, and it receives at the same time its heat equally all around. No other prevailing shop practice gives so free access to the air, and such evenness of heat at the same time. In the case of dies, my plan, as given by me, surrounds all but one face with air, and turns them over and over, that all parts may have equal access to both the air and the heat. Here again my conditions regulate themselves for the given purposes.

4 As to the oxide question, my reason for declining to discuss it was that I thought it liable to divert attention to matters not germane to workshop practice; and J. T. N., in disputing or questioning with Mr. Hawkins whether the colors produced in tempering are films of oxide, or of carbonization (as claimed by Nobili, who gives an excellent reason for his conclusions), proves the correctness of my premises. I have no objection to a discussion of this interesting but disputed question; it is of importance, I grant, but I can go on using my "color thermometer," be it caused by oxidation or carbonization.

5. It may be that the benefits I have found from the methods I give arise from the very fact that they permit of the proper access of the air, and entail, of themselves, a sufficiently defined limit of time to insure results, correct in themselves and at all times equal; and thus they are merely proofs of Mr. Hawkins' elements of time and exposure. I am inclined to think this to be the case, because the departures from the sand bath process (the most generally approved method), recommended by me, give, as Mr Hawkins advises, free access to the air, and determine of themselves the time by specifying that, in tempering, the hardened steel be subjected to the rays of heated (that is, red hot) iron; for iron "red hot" gives some idea of a certain temperature, while heated sand, not being made red hot, may be made of a wide range of degrees of heat with nothing to denote it, and may, as I have before stated, be hotter in one part than in another in consequence of the unevenness of the fire or of the depth of the sand.

6. I have never tried tempering under conditions which would give a more free access to the air, nor do I know of any method by which more free access to the air and, at the same time, more even heating of the hardened steel can be secured than by the methods I have given: but if Mr. Hawkins can suggest any, I shall be happy to test the same and to report thereon. JOSHUA ROSE.

New York city.

MR. SAMUEL WEBBER, of Manchester, N. H., requests us to state that the power ordinarily required to card one pound of cotton is $\frac{1}{200}$ of a horse power, and not $\frac{1}{20}$, as printed in our article on his book entitled "Facts on Power," on page 48 of our current volume. Similarly, the best results in carding cotton should be $\frac{1}{400}$ of a horse power instead of $\frac{1}{40}$.