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 l 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.

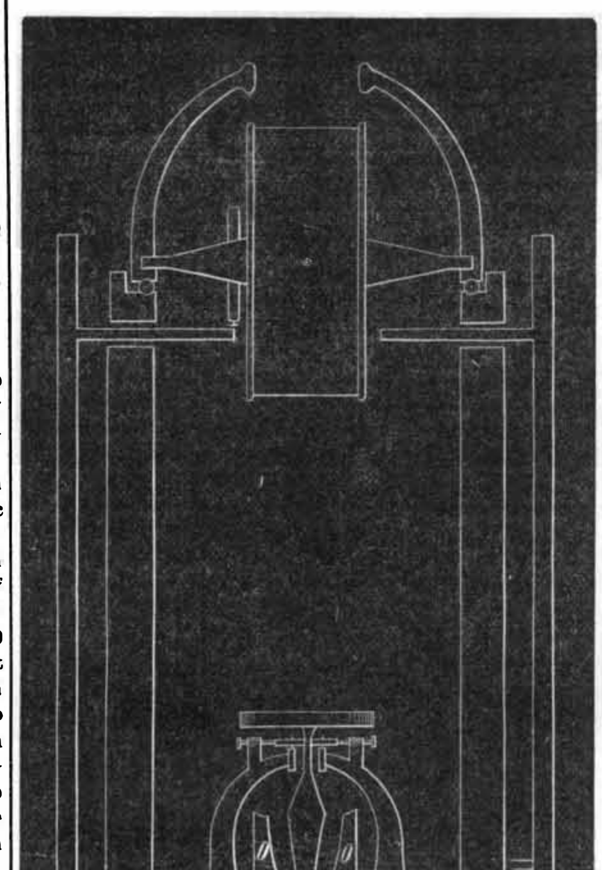
S.

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 $\frac{1}{40}$.