

of European members but none yet from Indian members, and I hope that some of the latter will join and send in their names. They need not mind how limited their knowledge of astronomy may be.

President.—The next meeting of the Society will be held on a date to be notified hereafter. The meeting is adjourned.

At the conclusion of the proceedings Mr. Tomkins showed on the screen a photograph of the Daylight Comet which had been taken by Professor Lowell and some photographs of solar and planetary spectra, which were greatly admired. A spectroscope which had been set up by Mr. Raman to show the bright line spectrum of sodium was also exhibited to several of the members present.

The Construction of a Cheap Telescope.

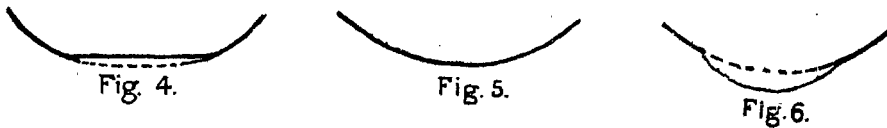
By H. G. TOMKINS, C.I.E., F.R.A.S.

II.

In my last paper I dealt with the grinding of the glass mirror the curve of which had been roughly ground and tested by the sun for focal length. At this stage the glass is of course full of pits caused by the rough emery, and the next process consists in getting rid of these until we have a surface sufficiently fine to take a good polish. It is this process which I shall describe in the present paper. The first steps are very simple, it being merely necessary to use finer and finer grades of emery powder until the flour emery is reached. Care should be used between each stage to thoroughly clean the tub and tools as well as the vessels in which the emery is to be mixed, as a rough grain of emery will badly scratch the mirror and necessitate a return to the coarser grades to get rid of it. It is also a good plan to mix a larger quantity of emery than is required in plenty of water. Stir this up well and let the emery settle. Then syphon off the water and use only the top half-inch of the material for grinding. By this means any rough grains will be left at the bottom of the vessel. The procedure and steps for grinding are the same as already described, and each stage should be carried on until the pits in the glass left by the previous grinding have been completely removed. The curve should also be continually tested with the sun as already explained, and if it is found that the curve is deepening too rapidly, the stroke should be reduced in length. It is very easy to deepen the

curve but difficult to get back again when it has been made too deep. A constant watch should therefore be kept on this, and it will also be found that as the surface of the mirror becomes finer with the fine grinding, the reflected image of the sun on the wall will become sharper and better defined and it will be easier to measure the exact focal length. Care should be taken when working the mirror to rinse the sponge into the enamel pail already mentioned for the purpose so as to collect all the used sludge of the mirror and tool as this will be wanted later on. I would also recommend a fresh sponge or cloth for each grade of emery so as to obviate any risk of a coarser grain remaining in the sponge and getting mixed with a subsequent grade and thus scratching the mirror.

The work can be proceeded with in this way until the grinding with the flour emery has been begun. The mirror will now have a fine surface and should be uniform all over. It sometimes happens, however, that at this stage or a later one the finer grinding does not come in the surface of the mirror equally all over. If it does all is well; but it is possible that an examination of the mirror or tool may show that either the centre is rougher than the edge or *vice versa*. In the former case it is clear that the centre of the mirror is not properly touching the tool; in other words the mirror is too hollow in the centre and in the latter case it is too shallow. Let us examine the curves to see why this is so and what is the remedy. We may get three forms of curves: the spheroid as in Fig. 4, the sphere as in Fig. 5, or the hyperbolic curve as in Fig. 6.



Evidently we have to aim at the sphere, and this it will easily be seen is the only curve the surface of which will touch the tool all over in any position. The spheroid in which the centre is too shallow will touch the tool all over only in one position, that is when the mirror and tool are concentric, but when the stroke is given the edge of the mirror will leave the tool, and the centre will receive excessive grinding. Similarly with the hyperbolic curve the edge will receive excessive grinding.

The former fault is the preferable one and is caused by too short a stroke in the grinding. The remedy therefore when it is found that the edge is rougher than the centre is a slightly longer stroke, but care must be taken not to go too far or the hyperbolic curve will result. Now, not only is this difficult to remedy, but in the fine grinding there is almost certain to be an air lock in the space between the middle of the mirror and the tool which will cause the discs to stick together, and if the disc is large and the lock a bad one, the mirror is very likely to be damaged before they can be got apart. The moment therefore any tendency to stick is felt it is advisable to examine the mirror at once, and it will probably be found that the surface is rougher in the middle than at the edge—a sure sign of the hyperbola. The stroke should now be shortened to about an inch or so and the grinding continued with this until a good touch all over is obtained.

From the above it will be seen that the curve is always under control, and if it is spherical as it should be, the mirror will slide smoothly over the tool without sticking and the surfaces both of the tool and the mirror will be uniform all over. Having now completed the grinding with the flour emery a stage has been reached beyond which it is impossible to obtain a finer surface with the bought emery and we have therefore to adopt other measures. Here the pail of sludge previously mentioned comes to the rescue. This pail, besides a good deal of coarse material, contains the finely-ground washings from the several processes which have already been gone through, and it is only necessary to separate these out to obtain material of any degree of fineness we require. The method is known as washing the emery. Stir the contents of the pail well up and pour half of it into another pail. Now take one of these and fill it up with clean water. Stir well up and then let it stand half a minute and pour off carefully into a third clean pail, being careful not to let the sediment go over into the clean pail. Treat the second pail the same. The sediment from each of these operations can now be thrown away and the fluid poured off can all be put in one pail called P 1. Stir up well and let settle for one minute. Pour off as before into a fresh pail called P 2, taking care that the sediment does not go into the fresh pail. Allow the stuff in P 2 to completely settle and then draw off the water. Transfer what is left to a bowl, stir and let settle for use. If there is too much water in the bowl draw some off. Use only the top of the material as before. Proceed with the grinding until the marks left by the flour emery are all out, and remember to watch the uniformity of the surface as well as the focal length. The pail P 1 should be filled up with water and the washings off the tool and mirror rinsed into it so as

once again to collect the finer sludge left by the grinding. This stage having been completed a fresh lot of material for the next must be washed as before. Stir and settle as before for half minute and then make the second settling for three minutes. This will give a much finer grade. Similarly grade after grade must be made according to the following times, the grinding with each being continued until the marks left by the one before have disappeared :—

1', 3', 6', 20', 30', 60', 90'.

From the 30' grade onwards it will probably be found an advantage to use a little soap in the water with which the mirror is wetted when the material is put on. This makes the grinding smoother and assists in obtaining a fine surface. Some people use saliva and it is certainly simple and effective. The grades above having been gone through, if the directions have been carefully followed the surface of the mirror should now be beautifully fine and uniform to the edge of the mirror and it should be possible to see the irregularities of the pitch at the back through the disc. The sun's reflected disc on the wall should now be very sharp and clear and the focal length about the required distance. The mirror is now ready to be polished, and this I will deal with in my next paper.

A Paper on some References to Meteoric Showers in the Ramayana.

By P. C. BOSE, Esq.

At our last meeting there was an interesting paper on a solar eclipse during the battle of Kurukshetra. The authors found it difficult to reconcile the position of Venus as given in the Mahabharata with what it ought to have been according to modern calculations. Our Ramayana and Mahabharata are only epic poems, and accurate scientific information cannot be expected from them. Poets sometimes twist facts so out of shape in order to extol the prowess of their heroes or gods that it becomes very difficult to distinguish between fancies and facts at this distant age. The events at the birth of Hanuman, the monkey god, as described by Valmiki in the Ramayana will serve to illustrate my meaning very clearly. It is said there that just after the birth of Hanuman his mother leaving him alone in a cave entered the forest in search of food.