

in a recent issue of the American Journal of Science. More than 14,000 stones were picked up. I have had a note regarding this put in our JOURNAL for January.

Mr. Tomkins.—I have only one point to add—it affects the Maharaja who very kindly sent the meteorite. Members may like to know that he has just been elected a Fellow of the Royal Astronomical Society and to send him our congratulations.

Chairman.—I would now ask you to accord your thanks to Dr. Harrison for his paper.

Mr. Tomkins then showed three slides of the Comet C of 1908. The meeting was then adjourned.

The Construction of a Cheap Telescope.

BY

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

PAPER III.

IN my last paper the stage was reached at which the mirror was fine-ground ready for polishing, the surface being even all over from edge to edge and finely ground enough to enable the pitch to be seen in outline through it.

We come now to the polishing, and there are three ways of doing this—namely with pitch, rosin and paper.

In this country I have always found pitch give trouble either by scratching the mirror or else from being too soft and losing shape, and in my own hands it became such a nuisance that I gave it up. It is, however, used by professionals in preference to the other methods and is of course considered to be *the thing*.

Unquestionably the most simple polisher is the one made of paper and I prefer it for small mirrors such as we are now making on account of its cleanliness, ease of handling and simplicity in making. I will describe it first.

Thoroughly wash the glass tool and the tub so as to get rid of every trace of emery. The mirror will of course have been similarly washed and put aside until the polish is ready. Now select a nice even piece of white paper of good texture and smooth surface large enough to cover the tool. Care

should be taken to pick out a good piece free from specks and other blemishes. Hold it up to the light and see there are no thick places in it. With some well mixed arrowroot paste stick this paper on to the face of the tool. See that the paste is not laid on too thickly and is evenly spread. Now with a sharp knife or pair of scissors clip the paper round the edge of the tool. Next with the foot of a wine-glass work the paper well down on the glass rubbing from the centre of the tool outwards towards edge all round. Spend some time over this and do not be satisfied until you have made a thorough job of it. You may spoil a little paper perhaps; but if so, try again. When you have finished this, the paper should be firmly down all over the glass tool. With the point of a knife pick out any hard lumps or specks which appear during the rubbing. The paper should now be nice and even all over with a shiny surface from the rubbing, but no shiny spots. These indicate a lump in the paper to be removed or else a lump of paste underneath. They must on no account be left as they will damage the mirror when the polishing begins.

Next get your jewellers' rouge ready. Put a good quantity into a wide mouthed bottle which should be deep and not too wide. Add some water and make a paste of the rouge and then fill up with water nearly to the top. See that your stirring rod or spoon is quite clean and free from dust. Let the rouge all settle and then draw off most of the water with a syphon. Now tie a pad of soft clean mull-mull or linen on a stick for a brush, and dipping it *only in the top layer of the settled rouge*, smear the paper on the tool all over with rouge and let it dry. Don't forget to cover up the rouge bottle to keep out dust. When the tool is dry rub the rouge well in with the stem of the wine glass, blowing off the excess as you go on. Don't press too hard and pick out the shiny spots as before. It will take an hour or more to complete this part of the work and the rubbing should be done more and more lightly as it goes on until finally you have the tool of an even red tint all over and the surface beautifully soft and smooth. Be very careful to keep dust off the tool. Now with the face of a piece of ordinary glass—a quarter plate negative well cleaned will do—go over the tool once more with a light touch and see if there are any signs of scratching. You will either feel, see, or hear them easily and they must be removed. When you have got the tool to your satisfaction, take the mirror and having dusted it carefully with a clean cloth place it face down on the tool and *with no pressure whatever* polish it with the same strokes as in grinding. When you find that the rouge is getting used up off the paper on the polisher you must put on a new supply and rub it in as before. When

the mirror has had about half an hour's work on the tool, the surface should be showing signs of the polish and it is now time to examine it in order to see how the figure is going. The rule is the same as before described in grinding. If you find the centre more polished than the edge, increase the stroke: if less, diminish the stroke. Go on until the polish is fairly well up all over. This will be in about an hour or perhaps two. The mirror must now be tested by a much more sensitive method than any yet described, and as some small apparatus will have to be made for this, I will describe it in my next paper. In the meantime try the reflection in the sun for length of focus. You will probably be pleased with the neat round image of the sun which your handiwork produces on the wall.

I have used the above for several mirrors of 8 inches diameter with success, but some people get scratches on their mirrors with it, and unless the rubbing is well done there is a liability of this. I will, therefore, describe another form of polisher which is a little more trouble to make but is less liable to scratch and certainly gives a fine polish.

Clean the glass tool as before and round the edge of it fasten a strip of stout paper so that it sticks up about $\frac{1}{4}$ of an inch all round above the face of the tool. The tool and paper will thus form a receptacle into which the rosin can be poured. Now take sufficient rosin to fill this receptacle and some to spare. See that it is clean. Melt the rosin over a primus stove or clear fire and add to it $\frac{1}{3}$ of its weight of turpentine. Well stir and then take out a small quantity in a tea-spoon and cool it in cold water. When cold try it with the edge of the thumb nail. If it is of the right consistency a moderate pressure should just leave an indication of the edge of the nail in the rosin. The rosin should not be sufficiently brittle to chip off or on the other hand sufficiently soft to be pliable. It should be just not hard enough to chip. If it is desired to make it softer, add more turpentine, if to make it harder, add a little more rosin. When it is right, warm up well and strain through two thicknesses of mull-mull or cheese cloth into a clean pan. Then warm up again and strain it once more on to the tool until the rosin is up to the edge of the paper. Care should be taken not to boil the rosin as this will cause air bubbles. Similarly with the pouring, bubbles should be avoided. Now let the rosin on the tool cool until there is no danger of its running off the tool and then remove the paper strip round the edge. The rosin has now to be divided up into squares, and this is best done by pressing it while yet warm with a wooden mould made as in Fig. 7.

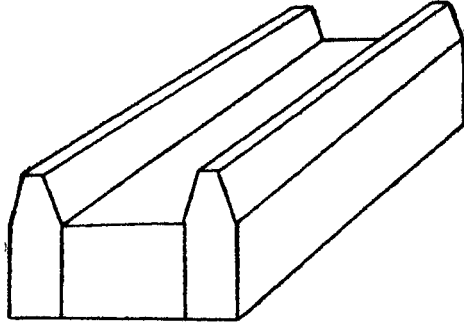


FIG. 7.

If now this mould is pressed down into the rosin it will make two parallel grooves $\frac{1}{8}$ " wide at the bottom and $\frac{1}{4}$ " wide at the top. When ready to press, make a small prick in the centre of the tool with a pin point and having wetted the mould put it on the rosin so that this point shall be about $\frac{1}{4}$ " away from one edge. Now press down; then wet and press again. Next put one edge of the mould into the groove already made and press down a third groove and so on to the edge of the tool. You will then have a series of parallel grooves across the tool. This done put the mould once more across the centre of the tool at right angles to the grooves already made so that the prick is again about $\frac{1}{4}$ " away from the edge of the mould and press. Proceed to the edge as before and you will have the tool divided up into squares of 1" a side and grooves between them $\frac{1}{4}$ " wide at the top and $\frac{1}{8}$ " at the bottom. The pin prick should be at the corner of the centre square about $\frac{1}{8}$ " from each side of it. The grooves after this pressing are not likely to be very regular. They should be therefore now trimmed up with a knife or chisel. This is not at all difficult. The grooves should be made wider towards the edge of the tool than at the centre so that the square in the centre may be 1" a side but those at the edge about $\frac{3}{4}$ ".

Now warm the tool and having wetted the face of the mirror press it down on the tool. Repeat this until the rosin squares touch the mirror evenly all over. The squares will probably have spread out a little during this process. If so, trim them up again and then press once more with the rosin. Now melt some clean bees-wax in a pan and strain it carefully so as to free it from all grit, etc. Then get it well hot, and with a brush made of mull-mull on a stick, as once before described for the rouge, quickly put a thin coat of wax over each square. Make only one stroke for each square or the wax will be thick and uneven. When cool put a plentiful supply of the settled rouge and water on the tool and lay the mirror face down on it with a weight on it to press it down. This

will cold press the wax to shape, and it will easily be seen from the appearance of the squares when the mirror is touching them all over and they are to shape. A supply of rouge and water is then put on the tool and the polishing proceeded with as before.

As will be seen this polisher is more trouble to make than the paper one, but it is very good to polish with. In my next paper I will describe how to test the mirror when the polish has reached the stage described above.

The Erection of an Observatory.

BY

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WHILST in London last year I saw advertised for £35 in the *English Mechanic*—a weekly paper, price 2d., every amateur astronomer should take—a 5" Cooke Equatorial with Declination and Right Ascension Circles, verniers and slow motions but without "Driving Clock." This I at once saw was a bargain. So I wrote to the owner, soon came to terms and purchased the same, first taking the precaution to have it examined and tested optically by a practical astronomer, even though it was a Cooke.

The question of mounting the instrument arose as soon as I returned to India. There are a good many trees outside the College compound, and it was therefore necessary that the telescope should be well elevated to command a good horizon. To have built the observatory directly on the ground would have meant expense beyond my means, so I decided to build on the roof of my bungalow. It is well in this country to be as near as possible to one's hobby. I might have found a higher building than the bungalow but that would have been at a little distance, and further it would have meant that many a night now given to the telescope would have been lost owing to lack of desire on account of sheer weariness of body to go even across the College compound. In this enervating climate one must accommodate oneself to the prevailing conditions, otherwise nothing will be done. Having fixed upon the site, I decided to put up a substantial round brick building and dome with an annexe for a small Transit Instrument and Sidereal Clock.