



Making and Using a

By ART YOUNGQUIST

POWERFUL enough to see the craters on the moon, this 7 power, 8° monocular, which is similar to the type used by Moonwatch teams, will enable you to see satellites far beyond the range of your naked eye. A first-surface mirror mounted at 45° to the telescope barrel reflects the object sighted into the telescope so that you can look down into the scope, while in a comfortable sitting position (Fig. 6), instead of straining your neck looking up.

The adjustable stand (Fig. 1) can be placed on

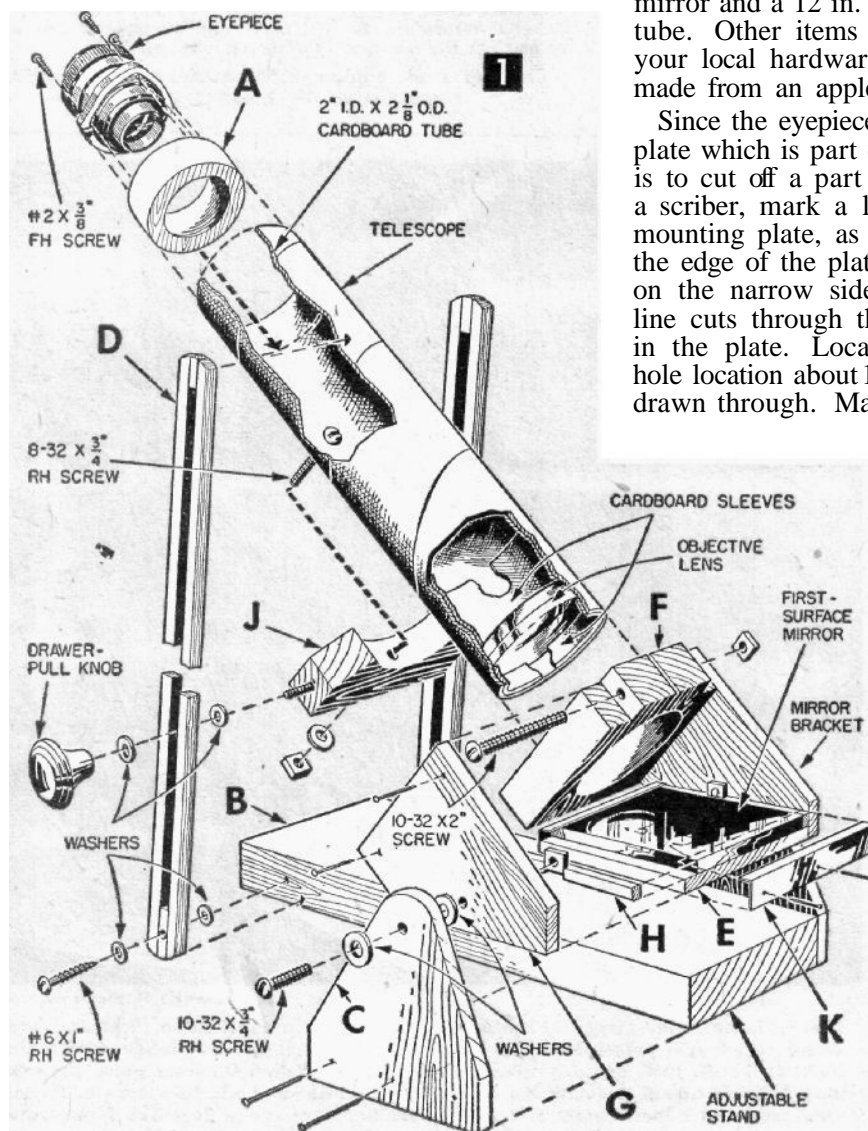
a table or clamped to a camera tripod to steady the telescope; this is necessary when viewing an object at a great distance. A tilting arrangement that can be locked at any angle from 0° horizontal to 20° from vertical enables you to set the telescope at the exact angle called for when using the satellite finder method described later in this article.

Availability of top quality war surplus lenses makes it possible for you to make this telescope for only \$9. The lenses, listed below, may be purchased separately from surplus optical supply houses, or in a kit for \$8.50 from American Lens and Photo Co., (Dept. S&M) 5700 North Northwest Highway, Chicago, Illinois. The lens kit consists of: a 7 x 50 focusing binocular eyepiece, a 51 millimeter achromat objective lens having a 180 millimeter focal length, a 2 x 3 in. first-surface mirror and a 12 in. length of 2 in. I.D. cardboard tube. Other items needed can be purchased at your local hardware store. Wooden parts were made from an apple box.

Since the eyepiece is mounted in an aluminum plate which is part of a binocular, your first step is to cut off a part of this plate (Fig. 3). With a scribe, mark a line on the wide side of the mounting plate, as in Fig. 2, the same distance the edge of the plate is from the eyepiece barrel on the narrow side. You will notice that this line cuts through the center of the drilled hole in the plate. Locate and counterpunch a new hole location about 1/4 in. from the hole you have drawn through. Make the new hole location the

same distance from the eyepiece barrel as the two other holes you will find on the narrow side of the plate. Then curve the two ends of the scratched line outward to provide a lug of additional metal around the hole to be drilled and the existing hole diametrically opposite (Fig. 11). Drill and counterbore the hole the same size as the other two existing holes.

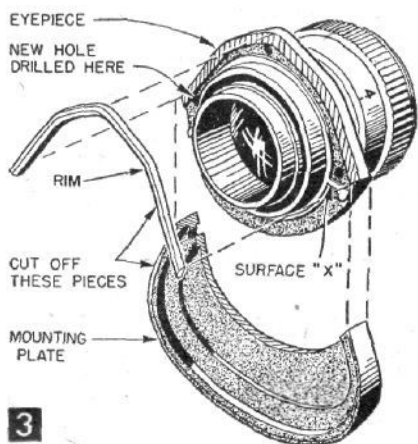
To cut the mounting plate, grip it in a vise as in Fig. 4, and saw along the scribed line with a fine-toothed blade in a coping saw. Then grip the cut edge of the mounting plate in the vise (Fig. 5) and saw off the projecting rim flush



\$9 SATELLITE 'SCOPE

with surface X in Fig. 3. Smooth saw-cut edges with a file.

Making the telescope barrel from the cardboard tube is your next step. Because it is important that the eyepiece and objective lenses be installed parallel to one another, first check the ends of the tube for squareness as in Fig. 7 at two places 90° apart. If neither of the ends is square, cut 1/4 in. off one end for a starting or measuring end. To make a square cut, wrap the tube with a sheet of typing paper lining up the edges of the paper. Then, with a sharp knife or razor blade, score a line around the tube at the edge of the paper (Fig. 9). Continue by cutting the scored line deeper until the tube is severed.



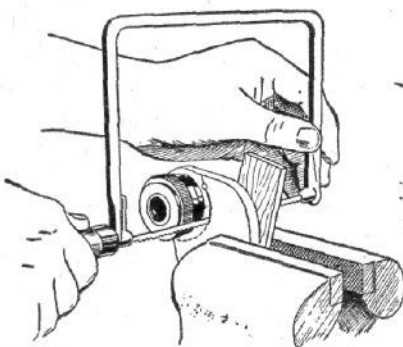
Measure and cut off a 3/8 and 1-1/2 in. ring or sleeve of the tubing first. Then cut the tubing for the telescope barrel 8-3/16 in. long.

The 1-1/2 in. piece of tubing must be glued inside the barrel (Fig. 11), to serve as a locating rim and stop for the objective lens. To fit it inside the barrel, first cut it lengthwise, then overlap the ends and insert into the tube. Cut off the overlapping end as in Fig. 10. Since the distance from the objective to the eyepiece is fairly critical, carefully measure and mark off the 7-13/32 in. distance inside the tube from one end. Mark it in three places equi-distant around the inside of the tube. Coat the outside of the 1-1/2 in. length of tubing with glue, insert it in the barrel tube so that the

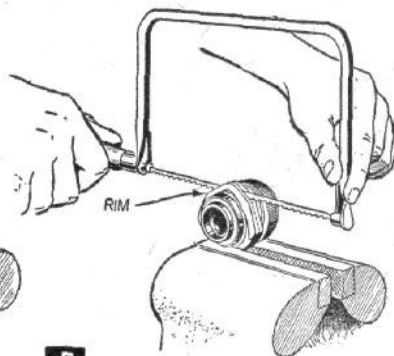
Camera tripod makes a convenient and steady mount for satellite scope. Clamp or bolt telescope to tripod head and adjust to lever position before setting angle of telescope barrel.



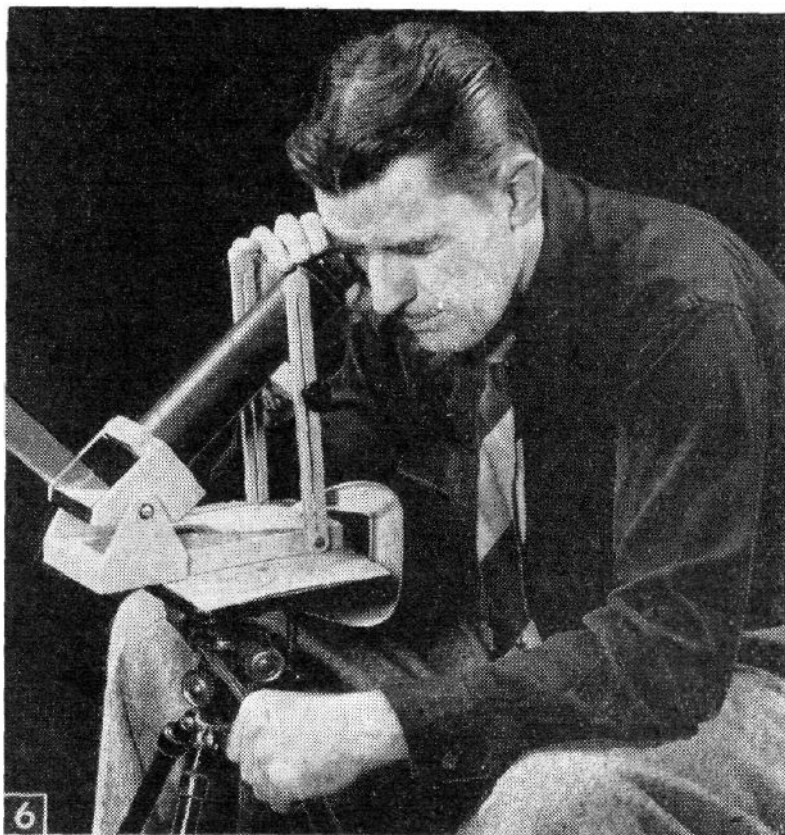
Hold the scribe against the focusing ring for a guide when scribing line.

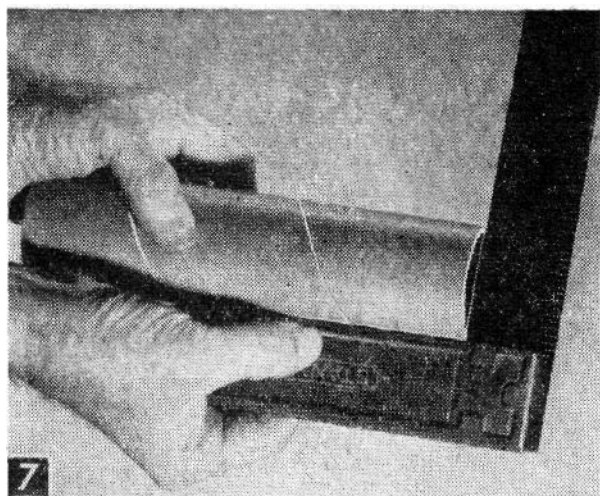


CUTTING OFF PART OF MOUNTING PLATE

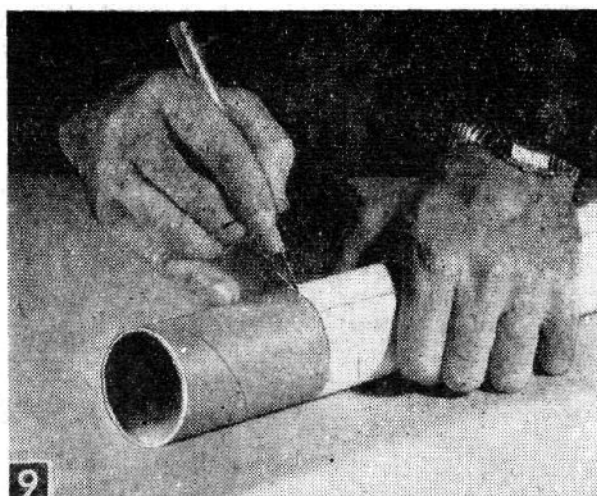


CUTTING OFF RIM





7 Check ends of tube for squareness at two places 90° apart. Accuracy of lens placement depends upon squareness of ends.



9 Wrapping a piece of typing paper around tube and lining up edges at location of cut will serve as a guide for making square-cut end.

near end is exactly on the three marks, and fasten in place.

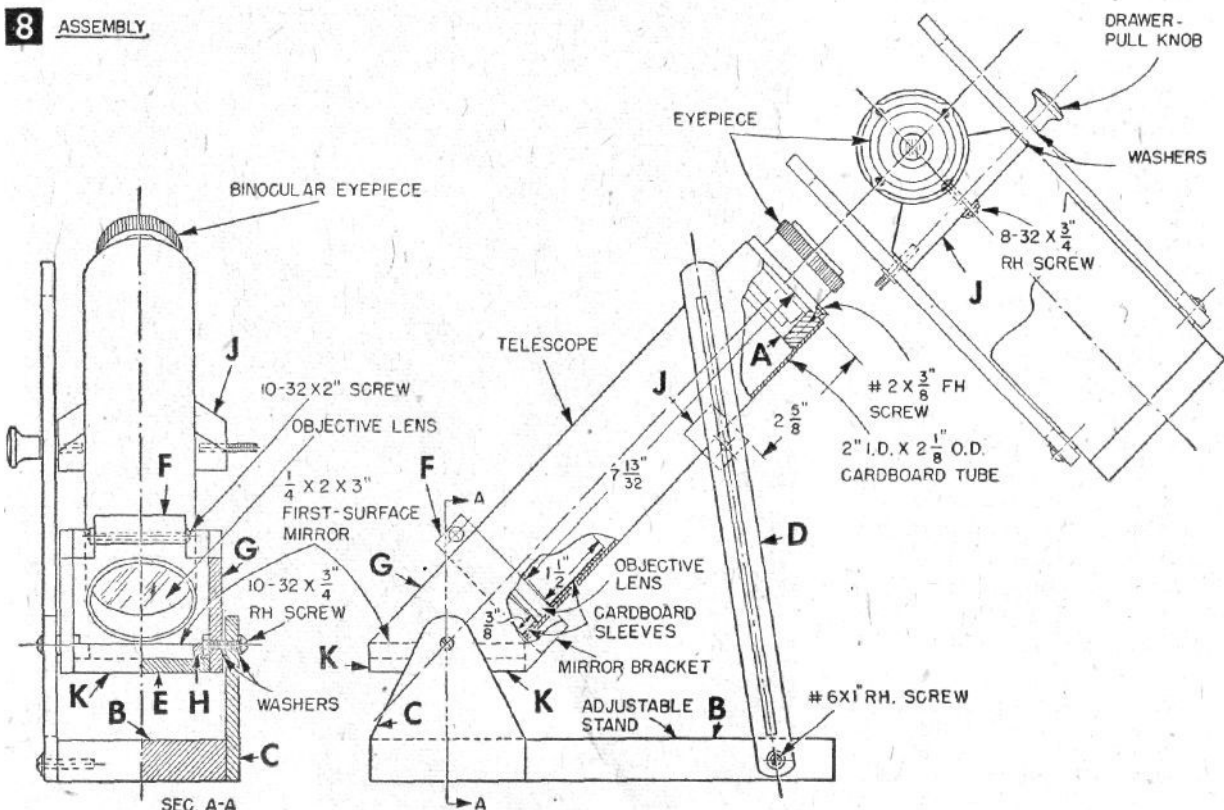
To mount the eyepiece at the other end of the tube, (Fig. 1 and 11) make the wooden ring A in Fig. 8. Use a jigsaw or coping saw and make the outside of the ring slightly oversize. File and sand the outside of the ring until it makes a snug sliding fit with the inside of the barrel tube. Then assemble inside the end of the tube with glue and three 3/8 in. nails or brads. Check to make sure the end of ring is flush with end of tube. After glue dries, coat tube inside and out with shellac thinned 50% with alcohol.

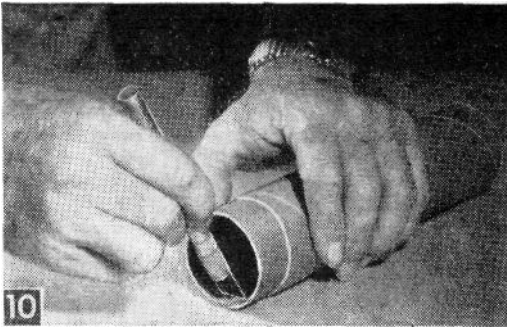
Before installing any of the lenses, make up part J in Fig. 8. The two 8-32 screws were sup-

plied with the plastic drawer pulls purchased in the dime store. Place a drop of household cement in the 1/8 in. drilled holes and drive the screws in, allowing 5/8 in. projecting. Then saw off the screw heads and file the saw cut ends smooth. Fasten part J to the barrel 3 in. from the end having the wooden ring as in Fig. 11 with glue and an 8-32 x 3/4 in. rh screw. Fasten a piece of wire to the head of the 8-32 screw to feed it through the hole in the barrel from the inside.

The objective lens fits very tightly in the barrel tube. It may be necessary to sand the inside 1/2 in. of the tube end to insert the lens. When sanding be careful not to round off the rim of the 1-1/2 in. lens stop you glued inside. Insert the lens to

8 ASSEMBLY

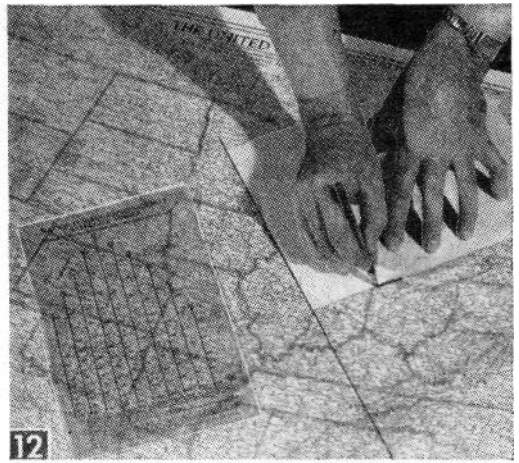




Cutting off overlapped ends of tube sleeve.

make sure it will fit properly, then remove it by stuffing a rag in the other end of the barrel for use as a pad between the lens and a stick needed to force the lens out.

Now, paint the barrel inside and out with a dead flat black paint (the type used for photo darkrooms). Allow to dry at least 24 hours so that all traces of turpentine evaporate. Then, again insert the objective lens in the barrel, making sure it seats tightly against the stop ring. Glue the $\frac{1}{8}$ in. cardboard tube ring inside the



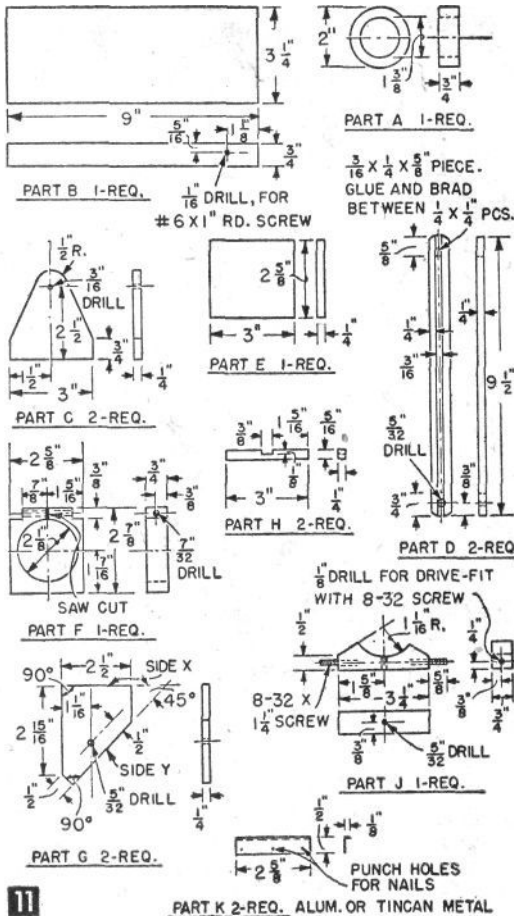
Using a sheet of typing paper to draw a line at right angles to line A. Note transparent plastic findex at left.

barrel in front of the lens. Put the eyepiece into the wooden ring at the other end of the barrel, positioning the screw holes as in Fig. 11 and fasten with three #2 x 3/8 in. *fh* screws.

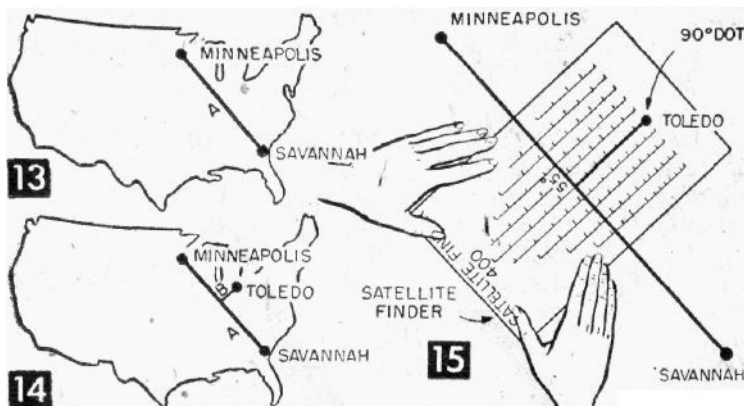
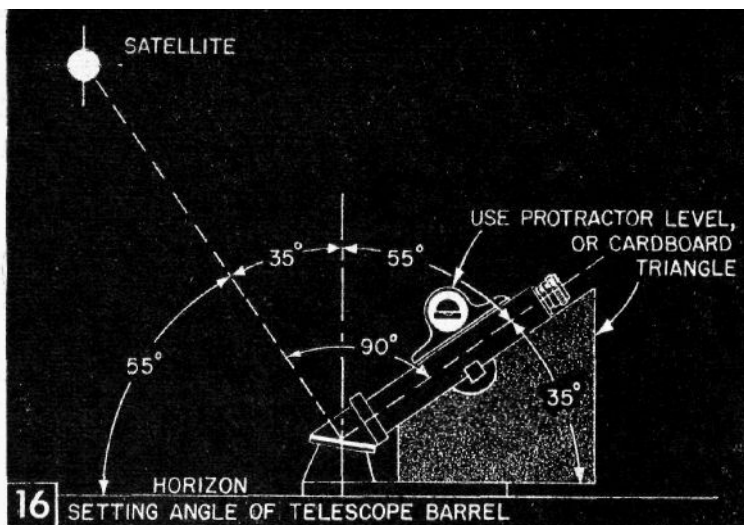
This completes the telescope. It could now be used as is for a hand-held monocular for quickly scanning the skies in search of a satellite whose orbit you are not certain of. You would, however, find it difficult to hold it steady enough to maintain a sharp image of objects hundreds of miles away. For this reason, the telescope was mounted on an adjustable stand. The adjustable feature of the stand will also enable you to set the 'scope at a predetermined angle to cover a certain segment of a known satellite orbit as do members of "Moonwatch" teams.

To hold the mirror at exactly 45°, make one of part F, one of part E and two of part G as in Figs. 8 and 11. When making parts G, fasten two pieces of 1/4 in. stock together with brads and cut, plane or sand both of them at the same time so they will be exactly alike in size and shape. Check side X and Y to make certain they form a 45° angle. Carefully locate and drill the 5/32 in. hole through both pieces at once. The exact location of this hole is important because the center of it must be in line with the top surface of the mirror as in Fig. 11.

When assembling the mirror bracket, fasten parts F and E between the two sides G with glue and secure with a C-clamp. Then immediately check the inside surfaces of parts E and F with a 45° draftsman's triangle or a Combination square. If they are not set at exactly 45°, loosen the clamp and reset them. Then nail the side pieces to parts E and F with 5/8 in. nails. While the glue is drying, make parts H and K, Fig. 11. Parts H serve as spacers on each side of the mirror as in sec. A-A Fig. 8. Make a temporary assembly to see if the spacers securely hold the mirror without side-to-side movement. If too tight, sand down; if too loose, make a new spacer. Then permanently



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fasten the spacers H to the mirror bracket with glue. The grooves in the spacers should straddle the 5/32 in. drilled holes in the sides to provide clearance for the 10-32 screw nuts. Paint the inside of bracket flat black, the outside gray.

When dry, set the mirror in position between the spacers and secure in place by nailing parts K to part E at both ends of the mirror. Now, force the end of the telescope into the hole in part F of the mirror bracket, making the edges of the telescope barrel flush with the inside surface of part F. Secure with a 10-32 x 2 in. *rh* screw at the top of part F.

For the adjustable stand, make parts B, C, and D, as detailed in Fig. 11. Assemble parts C to each side of the mirror bracket with 10-32 x 3/4 in. *rh* screws as in Fig. 1, using washers on each side of parts C. Also fasten the two slotted uprights D to the stand base, using washers on each side of the uprights. Then position the telescope assembly between the uprights, inserting the screws in part J into the slots of the uprights. Use washers on each side of the uprights and secure the telescope to the uprights with the plastic drawer pulls. Finally fasten parts C to the base B with glue and a C-clamp. Raise and lower the telescope to see that it moves freely and without binding. Readjust parts C if needed and then fasten with nails to part B. Give the stand a coat of shellac followed by a coat of gray paint. Remove the telescope barrel and mirror bracket

from the stand before painting and reassemble when paint is dry.

Using The Satellite 'Scope. As a contribution to the International Geophysical Year, the National Geographic Society has made available a very practicable and easy to use satellite finder. The finder was developed by Mr. Millman Chamberlin, of the Society's cartographic staff, in collaboration with astronomers of the Smithsonian Astrophysical Observatory. Although originally developed for use by "Moonwatch" teams throughout the United States, the satellite finder in kit form may be ordered by anyone for \$2. from the National Geographic Society, Washington 6, D. C.

The kit includes a finder, map of the United States and instructions for use. The finder, scaled for use with the Society's latest United States map published September 1956, is printed on transparent plastic (Fig. 12) so that lines drawn on the map to represent the path of a satellite can be clearly seen. For example, suppose a satellite is expected to pass over Minneapolis and Savannah at a height of 400 miles. Draw line A in Fig. 13, connecting these cities. Now, if you live in Toledo, Ohio for instance, draw another line on the map (line B in Fig. 14) from Toledo to line A and at right angles to it. Any square-cut sheet of paper, such as typing paper or even newspaper can be used to draw a line at right angles by placing one edge on line A and lining up the location of the city on the adjacent edge as in Fig. 12. Then place the plastic finder's 400-mile column on line B with the 90° dot at Toledo (Fig. 15). Where the 400-mile column crosses line A, read the angle at which the satellite will appear above the horizon. In this example, it would be 55°.

When setting your satellite 'scope angle, be sure the table or camera tripod you have the 'scope resting on is level both in the north and south, and east and west directions. Because the mirror reflects light into the telescope at 90°, you will have to set it at 90° minus the 55° given on the finder, which is 35° above the horizon. Use a protractor level as in Fig. 16 to set the telescope barrel at the desired angle. If you do not have a protractor level, a triangle drawn with the aid of an inexpensive protractor and cut out from a piece of cardboard could also be used. Place the cardboard triangle under the barrel as in Fig. 16 to set the angle.

Once you have the angle set, all that remains is to aim the telescope in the direction of line B on the map. You can approximate the direction from the map or use a compass for a more accurate setting. Now consult your newspaper for the latest news from the space front!