reflects the beam to the side of the tube, where it can be conveniently observed with an eyepiece and directly photographed as before. The instrument arranged thus is called a Newtonian telescope.

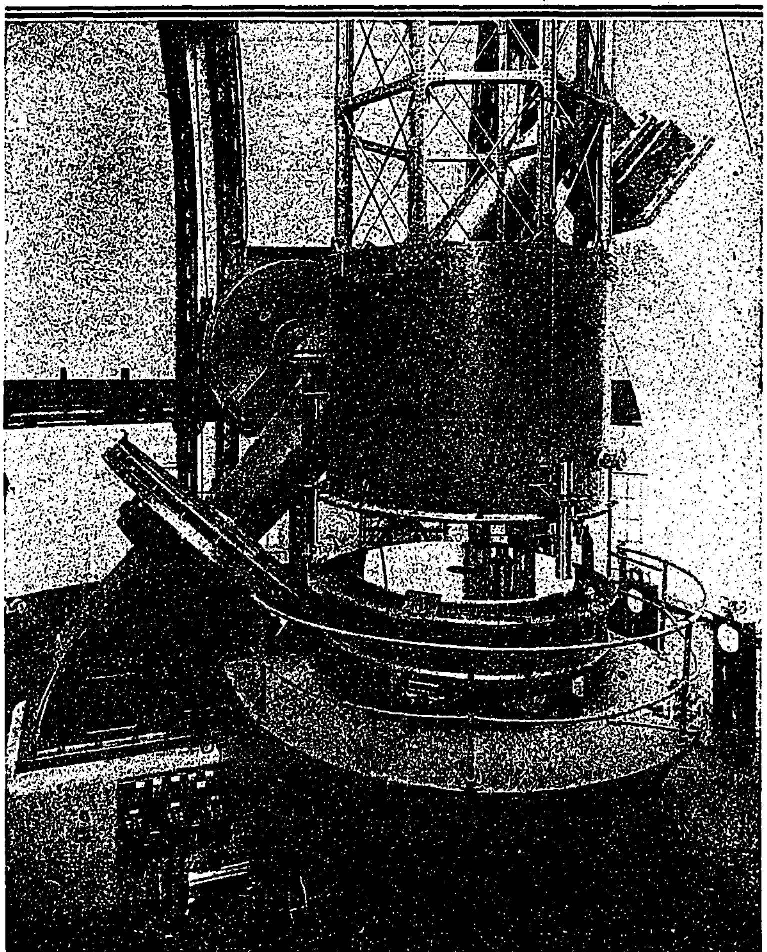
A third method, and the form in which the telescope will mostly be used, is the Cassegrain, in which a convex mirror, 20 inches in diameter, attached to the same circular member, and held about 7 feet down in the tube, reflects the light from the main mirror back again through its central hole and forms the image of the object pointed at about a foot below the mirror cell. Here it can be viewed by an eyepiece or photographed, but will in general be analyzed by the spectroscope, which is seen attached below the mirror cell at the bottom of the tube. The spectrum of the star is formed and photographed by the spectroscope, and from this spectrum can be determined, not only the elements present in the atmosphere of the star and its temperature and pressure, but also the velocity with which it is moving towards or from us, and, as a development of the last year or so, its distance. The spectroscope is probably the most wonderful instrument of research ever devised, as, by the character of the light from any body, no matter how distant, such marvellous knowledge can be obtained, and the telescope will mostly be used with this attachment.

The tube of the telescope weighs 15 tons, and this great weight is necessary in order that it may be sufficiently rigid to maintain the optical parts in their correct relative positions. At the same time, they, and the tube in which they are held, must be so mounted as to enable them to be readily pointed to any desired object in the sky and then to accurately follow its motion across the sky.

This is effected by attaching the tube to a cross shaft, passing horizontally to the right in the photograph, called the declination axis, which is 14 feet long, 16 inches in diameter and weighs over five tons. This axis ends in the weights shown, which balance the telescope on the polar axis, the large, inclined built-up shaft, running diagonally across the photograph and resting in bearings on the two piers. Motors and gearing for moving the declination axis and tube are contained in the large circular housing to the right.

The polar axis, so called because it is adjusted parallel to the earth's axis, is built up of three steel castings bolted together, and is 23 feet long, weighing nearly 10 tons. It carries tube, declination axis, housings and mechanism in ball-bearings on the north and south piers, the total weight of the moving parts being 45 tons, and is also moved by motors for setting the telescope to any desired object. In addition to such comparatively rapid movement, it is driven by a very accurate governor mechanism, called the driving clock, at the rate of one revolution every twenty-four hours on the polar axis. This revolution at the same rate and in an opposite direction and on a parallel axis to the earth, counteracts the effects of the earth's revolution, and enables the telescope to accurately follow the apparent motion of the stars across the sky.

All this mechanism has to move the enormous mass of the telescope with the greatest smoothness and accuracy, and requires the greatest perfection of workmanship. It is a masterpiece of the mechanician's art, and forms a marked advance, not only in size, but in design, quality of workmanship, accuracy and convenience of operation, with, at the same time, relative simplicity of construction, over any previously built. The builders of the mechanical parts of the telescope and of the dome were the Warner & Swasey Co., who have made the mountings for the Yerkes 40-inch, the Lick 36-inch, and



THIS MIRROR WEIGHS 4,340 POUNDS. ITS DIAMETER IS 73 INCHES AND IT IS 12 INCHES THICK AT THE EDGE. THE HOLE NOTICED IN THE CENTRE IS 10 INCHES IN DIAMETER.

(*Concluded on page* 368.)