THE EQUATORIAL TELESCOPE MOUNTING

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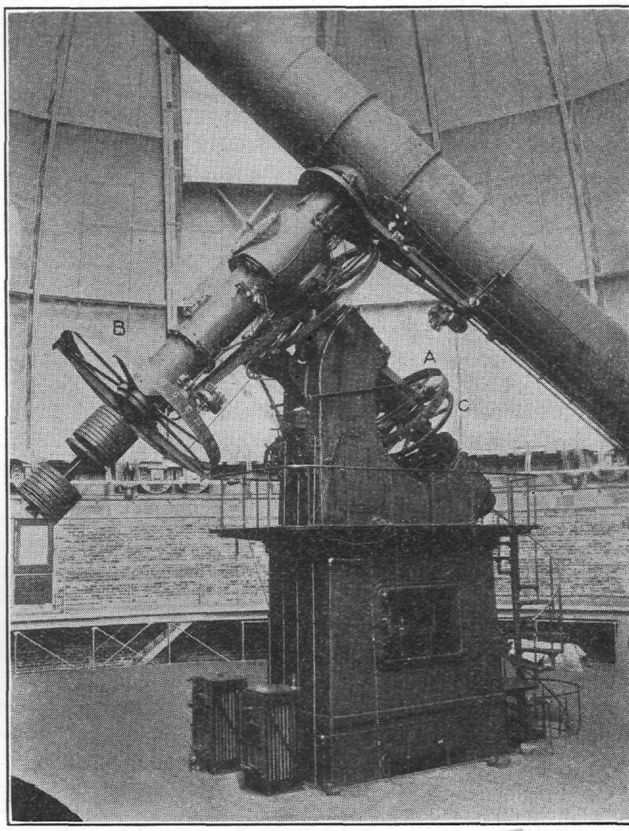
There are several different types of telescope mountings and innumerable variations of these. One type will be discussed here, the equatorial. To understand the reason for using an equatorial mounting, we shall have to refresh our memories on a few astronomical facts. Due to the earth's rotation, the stars appear to pass across the sky in paths parallel to the celestial equator, so that at the earth's equator the stars that rise in the east pass directly overhead and set in the west. Now, if a stick be rotated about an axis parallel to the earth's axis, it will be able to point to these stars any time by simply turning the axis. If at the pole where the above-mentioned stars pass around the horizon once a day, the stick is set up in a similar manner, that is, with its polar axis now perpendicular to the earth's surface, it will still follow the specified stars. At Columbus, these stars rise in the east, and take a path in the southern sky rising about 50 degrees above the southern horizon. If the stick is set up here with its axis parallel to the earth's axis again, it will be found that the stick is inclined 40 degrees with the horizon (the latitude of Columbus), and the stick will follow the stars on the celestial equator as it did before. Substitute a telescope for the stick and allow it to move north and south as well as east and west, and the telescope will be able to follow any star it is pointed at by turning the polar axis only. This is the type of mounting shown in the picture.



—Courtesy of the Yerkes Observatory

This picture shows the mounting of the 40″ Yerkes telescope. The tube is 62′ long and weighs about 6 tons. The telescope is the gift of Mr. Charles T. Yerkes. It was constructed in 1892, the lens being made by Alvan Clark and Sons, Cambridgeport, Mass., the mounting by Warner & Swasey, Cleveland.

The type of telescope and the purpose for which it is to be used often requires a variation from the type illustrated. For example, the Perkins telescope at Delaware, which is a 70″ reflecting type, weighs so much that it has become necessary to support the polar axis at both ends. The Mount Wilson Telescope is a reflecting telescope of 100″ diameter and weighs approximately one hundred tons. Telescopes of such size as these present quite a problem to the engineer.

Large self-adjusting ball bearings are placed in the south pier to support the weight of the instrument illustrated, others being placed at the bearing point of the declination axis. The Yerkes telescope, a 40″ refractor, weighs about twenty tons, and is so nicely balanced that the eye end of the telescope may be moved 1/100th of an inch. Although these telescopes are readily moved by hand they are completely controlled by electric motors, one for right ascension (east and west) located on the pier, another for declination (north and south) on the declination axis itself. These motors are controlled from the pier and there is frequently an extension switch to the observer's seat.

Following the telescope in importance is the "clock" or drive clock which counteracts the rotation of the earth. This piece of machinery has to be powerful enough to drive the telescope and keep it pointed at an object, whether it is a star or a planet. The object must not move relative to the field of vision, because photographs of an hour's exposure are common, and the slightest change would be noticeable. The clock has to perform normally under all conditions. At the Yerkes Observatory temperatures as low as 25 degrees below zero and as high as 90 degrees with varying degrees of humidity have been experienced with no trouble from the clock. The clock is driven by weights because they are the smoothest source of power known. Electricity has been tried but was found unsatisfactory due to certain small variations in the speed of the motor. When the weights unwind they trip a switch in the floor and are wound up again; in the meantime, by means of clutch, a second set of weights have been set in action, thus keeping the clock running smoothly for as long a time as is desired. The clock is connected to the axis by means of either a beveled gear and worm screw or two beveled gears.

The graduated circle at *A* in the illustration is the hour circle for measuring right ascension. On the Perkins telescope there is another circle just below this one which moves independently of the telescope at the speed of the drive clock and therefore reads sidereal (star) time, which is a great help in setting the telescope. The circle at *B* is for measuring declination. These circles are visible from the floor and are sufficiently accurate for

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most observations. However, there are circles of greater accuracy available if they are needed.

The mounting of the telescope has to be absolutely stable to have the instrument render the best service. The Yerkes telescope is a trifle unsteady when it is pointed low, but the Mount Wilson telescope is so rigid that a man may stand on the end of the tube without any effect on the setting of the instrument. To get this stability at Mount Wilson the polar axis was supported at both ends. This made it impossible to view part of the northern sky around the pole, but there is seldom any cause to use such a high-powered telescope in this region.