

*Astronomy of Position.*—Although the determination of the positions and motions of the stars is less spectacular than some other aspects of astronomical observation, such determinations nevertheless constitute the foundation on which the science of astronomy is based. All studies of the periods, distances and masses of members of the solar system depend on astronomical measurements of position and studies of the structure of the galaxy and the character of external galaxies are also closely bound up with measurements of the precise positions of stars. Work at Ottawa on stellar positions is carried out with a meridian circle telescope which was first put into operation in 1907. A "transit" instrument of this type is mounted on fixed pivots in such a way as to observe stars as they cross the meridian, or north-south circle in the sky. The actual quantities observed are the time of crossing the meridian and the declination or angular distance of the star above the equator.

Since its erection the Ottawa meridian circle telescope has been used to derive the positions of approximately 10,000 stars as well as to make many observations of members of the solar system. These observations are published not only as Canadian catalogues but are also incorporated in star lists used throughout the world for air and marine navigation, for surveying and for the determination of accurate time. The original Ottawa meridian circle telescope is still in operation, but plans are now under way to replace it with a new instrument of reflecting type and larger light-gathering power which is expected to reach stars of much fainter magnitude.

For time determinations at Ottawa, the meridian circle was used at first but was later replaced by a smaller reversible transit instrument. Though such observations were sufficiently accurate for the great majority of uses to which time is put, the need was felt for greater precision and in 1952 an entirely new type of instrument known as a photographic zenith telescope was put into operation for time observations. This instrument consists of a refracting telescope mounted in a vertical position with a mercury basin located about seven feet below the lens. The mercury surface reflects the light back on itself where it comes to a focus just below the telescope lens. Observations are made photographically and the accuracy obtained is very much greater than with previous instruments. This telescope has the advantage that it operates automatically and photographs are taken of successive stars as they cross the meridian at the zenith without the necessity of an observer being constantly present. Another feature of this instrument is the possibility of making very precise measurements of latitude. A constant check is kept of the latitude of Ottawa which is found to vary in a semi-regular manner with a period of about 14 months.

An important part of the Time Service is its clocks which are required to time astronomical observations and to interpolate between periods of observation. Until 1939 pendulum clocks were used, housed in vacuum cases and kept in constant temperature vaults to maintain accurate rates. The best pendulum clocks leave a great deal to be desired in accuracy however and, following 1939, quartz crystal clocks were gradually substituted. The vibrations of a suitably mounted and thermally controlled quartz crystal are very much more reliable than those of a pendulum and the Observatory now maintains a battery of five crystal clocks including one ring crystal of the type developed by the British Post Office. The best of these clocks show performances superior by a factor of 10 to the pendulum equipment and the average of several is sufficiently good to take full advantage of the increased accuracy of the photographic zenith telescope.

Another feature of the Time Service is distribution of seconds time signals by wire and radio throughout the country. Government buildings, commercial firms, telephone and telegraph companies and the two major railway systems are served by direct wire from the Observatory. The general public is served by the 1:00 p.m. signal on the CBC and the needs of aerial and marine navigators, surveyors and persons living in remote parts of the country are served by shortwave broadcasts of time signals. These broadcasts are in the frequencies 3,330, 7,335 and 14,670 kilocycles and include a voice announcement of the time every minute during the twenty-four hours of the day.