means of $H\gamma$ and $H\delta$ line-intensity measurements. The calibration between line intensity and absolute magnitude was obtained from the B stars in the star clusters NGC 2362, M 36, and the h and χ clusters in Perseus. The period-luminosity relation is in excellent agreement with previous determinations.

*Physics Department,
Brigham Young University,
Provo, Utah.*

Markowitz, Wm. and Hall, R. G. A program for testing the equivalence of the gravitational and atomic time scales.

Uniform time scales may be defined in terms of gravitational and atomic forces. Whether such time scales are equivalent or whether they diverge in the course of time must be tested experimentally. The procedure is to obtain the frequency of an atomic standard in terms of a unit of gravitational time at successive epochs and note whether the frequency is changing secularly. Continuous operation of the atomic standard is not required.

The second was redefined as a constant unit of time by the I.A.U. at Dublin in September 1955. It is identical with the second of Ephemeris time (ET) which is obtained in practice from observations of the moon.

In June 1955 L. Essen and J. V. L. Parry (1955) placed in operation at the National Physical Laboratory, Teddington, England, a cesium beam atomic standard capable of giving measurable frequency. This achievement made it possible to begin the comparison of the gravitational and atomic time scales. A joint program is now under way to determine the frequency of the cesium beam in terms of the second as determined with the dual-rate moon position camera at the U. S. Naval Observatory at Washington.

High precision quartz-crystal clocks of the Essen-ring type serve as intermediary frequency standards. The same time signals from WWV and GBR are monitored regularly at both places. These relate the frequency of Q-13 at Teddington to that of E-43 and E-56 at Washington. Corrections to the signals do not enter in the comparison of frequencies.

Q-13 is easily compared, about once a week, to the cesium standard. The comparison of E-43 and E-56 to the second is more complex, as observations of the moon extending over several years are used. The frequencies of E-43 and E-56 are first related to the average running of the earth, as determined by the photographic zenith

tubes, in terms of UT2, which is nearly uniform Universal Time. The photographic observations of the moon give ET minus UT2. The derivative enables one to convert a frequency in terms of UT2 to a frequency in terms of ET.

It is expected that the first determination of the frequency of the cesium beam in terms of the second will be published near the end of 1956. A much more accurate value should be available as a result of the International Geophysical Year program, 1957-1958, when 20 moon-position cameras will be in operation.

A change of the order of one part in 10^9 per year in the gravitational and atomic time scales relative to each other may be detected, if it exists, by about 1970.

1. Essen, L. and Parry, J. V. L. 1955, *Nature* **176**, 280.
*U. S. Naval Observatory,
Washington 25, D. C.*

Mathis, J. S. The abundance ratio of helium to hydrogen in the Orion Nebula.

To derive the abundance ratio of helium to hydrogen in the Orion Nebula, the strengths of the HeI lines $\lambda\lambda 4027, 4471$, and 5876 were measured relative to the neighboring Balmer lines at two positions in the nebula close to the Trapezium stars. In order to relate the line intensities to the relative numbers of atoms, the theory of statistical equilibrium for the triplet levels of helium in a dilute radiation field was developed. The depopulation of the 2^3S level of helium was found to take place by transitions to the ground state via two-photon emissions and superelastic collisions. The population of all triplet levels was thus determined only by the effective temperature T_e .

The effective value of T_e as determined by the ratio of the $[OIII]$ lines $\lambda\lambda 363$ and $N_1 + N_2$ was $10,000^\circ K$; the value of the electron density indicated by the ratio of the $[OII]$ lines $\lambda\lambda 3726$ and 3729 was 3800 cm^{-3} .

The abundance ratio finally determined is $He/H = 0.13$ by number, or $He/(H + He) = 0.35$ by mass. The various line ratios used gave values within twenty per cent of this average.

*California Institute of Technology,
Pasadena, Calif.*

Matthews, Thomas A. Observations of neutral hydrogen in the 21-cm line at various latitudes near galactic longitude 100° .

The observations of the 21-cm line of neutral hydrogen discussed here cover a range in galactic