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.

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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.
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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.

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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

latitude from $b = +40^\circ$ to -40° at longitude 100° , and were taken with the 24-foot radio telescope at the Agassiz Station of Harvard Observatory. From two to four scans per position were obtained on centers 2° apart in galactic latitude near the plane and more widely spaced at higher latitudes.

The observed profiles were analyzed by first reducing the observed antenna temperatures to optical depth on the assumption of a constant kinetic temperature for the hydrogen atoms of 140°K throughout space. The curve of optical depth versus velocity thus obtained was then represented by the sum of a few Gaussian curves. Each Gaussian curve represents the contribution of a localized region in space, and the standard deviation of the curve gives the random velocities at a point in space in the region.

A plot of the central velocities of the contributors against latitude shows the presence of six main features. In order of distance from the sun, they are: the nearby section and the branch of the Orion arm; two features in the Perseus arm which can be separated out at latitudes more than 4° from the plane; the interarm II; and the distant arm. One minor feature present, called the interarm I complex, is located between the Orion and Perseus arms.

The distance to a feature is best determined from the OB aggregates associated with the neutral hydrogen. The aggregates I Lac and II Per determine the distance of the nearby section of the Orion arm, while the distance to the branch of the Orion arm is given by I and II Cam.

The distance of the Perseus arm, considered as a single entity here, depends on the distance to the clusters h and χ Persei, since unpublished observations by G. Munch show that the optical interstellar lines of the cluster stars cover the same velocity range as does the neutral hydrogen. The mean velocity of cluster stars on the other hand is 10 km/sec more positive than the mean hydrogen velocity.

The interarm II hydrogen is tentatively connected with a group of OB stars found by Farnsworth and McCuskey (1955) in LF 5, $l = 97^\circ$, $b = -1^\circ$, at a distance of 4.5 kpc. It seems reasonable to consider the Perseus arm, the interarm II hydrogen and the distant arm as three separate concentrations of hydrogen roughly 2 kpc apart, as are the spiral arms in M 31 and our galaxy. Otherwise large systematic velocities of 25 km/sec must exist, or else the Perseus arm must be about 4 kpc thick.

The table shows the distances to the features and the velocities predicted by the models of galactic rotation of Schmidt (unpublished thesis) and Weaver (1955). The comparison of the predicted velocities and the observed velocities seems to favor Weaver's model, but any conclusion will have to await similar comparisons at many other longitudes.

The analysis also shows that the distribution of the amount of hydrogen in a 1-cm-square column through the feature, decreases fairly uniformly with increasing distance from the plane of the galaxy. The widths between the half-intensity points for the features are: nearby section of the Orion arm, 250 pc; Perseus arm, 220 pc; interarm II, 490 pc; distant arm, 1700 pc.

COMPARISON OF OBSERVED AND COMPUTED VELOCITIES

Feature	Observed V_{LSR} (km/sec)	Distance (kpc)	Galactic Rotation Schmidt (km/sec)	Weaver (km/sec)
Nearby part				
Orion arm	-1	0.40	-7.6	-4.5
Branch				
Orion arm	-12	0.97	-18.0	-13.0
Perseus arm	-50	2.35	-38.8	-50.8
Interarm II	-75	4.5	-62.8	—

Farnsworth, A. H. and McCuskey, S. W. 1955, *Ap. J.* **121**, 643.

Weaver, H. 1955, *A. J.* **60**, 202.

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Mayer, C. H., Sloanaker, R. M. and McCullough, T. P. Radiation from Venus at 3.15 cm wavelength.

Radio radiation from Venus was measured over the period May 2 to June 23, 1956 with the Naval Research Laboratory 50-foot reflector, at 3.15 cm wave length. The radiometer used for the measurements compared the radiation collected by the reflector with the radiation collected by a small horn antenna pointed at the sky. The comparison rate was 30 times a second. On May 2 the antenna power from Venus was near the limit of detectability of the apparatus. As the distance between Venus and the Earth decreased during the observing period, the flux collected by the antenna increased by a factor of about four. The magnitude of the received flux can only be estimated approximately because of measurement uncertainties and because the characteristics of the antenna are not accurately known. The