impossible to make a definitive statement concerning the distance to the source at this time.

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McCrosky, Richard E. Fragmentation of faint meteors.

By the use of a new graphical method of reduction, a large fraction of the 4000 meteors doubly-photographed by the Baker Super-Schmidt cameras of the Harvard Meteor Project can be rapidly reduced for approximate values of velocity, height and radiant. Mean errors are about 5 per cent in velocity and 3 per cent in heights. Results for about 500 meteors are included in this discussion. In general, these meteors represent a homogeneous group in terms of apparent maximum magnitude. Consequently, all meteors of a given velocity group are represented by the same mass. It is to be expected, on the basis of the present meteor theory, that such a group of meteors of the same velocity and mass should appear at the same height. It is found that the beginning heights for meteors with normal light curves can be well represented by the relationship $\rho v^3 = \text{constant}$, where ρ is the atmospheric density and v is the meteor velocity.

Among the meteors studied, a group of low-velocity meteors comprising 15 per cent of the total are peculiar in the sense that they display an abrupt rise of light at the beginning of the trail. A typical meteor of this group will rise from below the plate limit to 1 magnitude above in less than 1/60 sec. The shutter breaks often become invisible at the end of the trajectory (terminal blending). Both of these phenomena can be explained by a sudden increase of the effective surface area of the meteoroid by fragmentation into a number of smaller pieces. The differential deceleration of fragments of different sizes cause the meteoroid to spread along the trail and obscure the shutter breaks.

Meteors of this group do not obey the $\rho v^3 = \text{constant}$ law for beginning points. However, the point at which the burst takes place can be described in terms of a constant value of the dynamic pressure, $\rho v^2 = 2.5 \times 10^4$ dynes cm^{-2} (0.02 atmosphere). Quite likely we have here a measure of the weak crushing strength of meteor-

itic material. Such a value is in qualitative agreement with our present conception of cometary meteoric material as derived from Whipple's comet model and from the densities of meteoroids as determined by Whipple and others.

The height corresponding to the observed value of ρv^3 is greater, at all meteor velocities, than the height corresponding to the observed ρv^2 value. Consequently, if the above hypothesis is correct we should expect to find occasionally a high velocity meteor that first appears normally at the proper value of ρv^3 and then shows a fragmentation after its trajectory has carried it into the range where crushing may take place. In 1949, Jacchia reported 7 examples of high velocity meteors that displayed an abrupt increase in luminosity some time after their appearance. The average value of ρv^2 at the point of discontinuity of the light curve agrees with the value obtained for those low velocity meteors of this study which obey the ρv^2 law.

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McKellar, A., Welsh, H. L. and Stephenson, F. C. The spectrum of solid oxygen a few degrees above absolute zero.

The rather rough agreement in wave length between the two strongest unidentified diffuse interstellar lines ($\lambda\lambda 6284$ and 5780) and absorption bands of high-pressure gaseous, liquid and solid oxygen prompted us to investigate the absorption spectrum of solid oxygen down to the temperature of liquid helium (4.2°K). The spectral region $\lambda 4000$ to $\lambda 6700$ was covered. With absorbing paths of the order of millimeters, bands and diffuse lines were photographed, characteristic of the three modifications of solid oxygen (α -oxygen up to 24°K , β -oxygen between 24° and 43°K , and γ -oxygen from 43°K to the melting point, 55°K). Spectra of the three modifications differed in diffuseness and slightly in wave length, as reported in 1935 by Prikhoto, Ruhemann and Federitenko. The strongest absorption was in a violet-degraded sequence of bands with heads near $\lambda\lambda 6300$, 5780 , 5330 , and 4940 . Several line-like absorptions occurred between $\lambda 4459$ and $\lambda 4806$.

Three of the seven diffuse interstellar lines ($\lambda\lambda 6284$, 5780 , and 4760) occur in regions of absorption by solid oxygen. Our knowledge of the role played by the structure of the modifications

of solid oxygen in the production of the spectrum is not sufficiently complete nor are the wave length coincidences exact enough to warrant identification of the three interstellar lines with solid oxygen, but neither is the possible identification ruled out. Further experimental work on low-temperature solids is advocated; particularly on a material recently discovered by Giguere and thought to be HO_2 .

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Markowitz, Wm. The annual variation in the rotation of the earth, 1951-54.

Variations in the rate of rotation of the earth with periods of a year or less can be determined with the aid of quartz-crystal clocks. Solutions were made for each of the three years from September 1951 to October 1954.

The astronomical observations were made with the photographic zenith tubes at Washington, D. C., and Richmond, Florida, on a total of over 1500 nights. Two resonator clocks of the National Bureau of Standards, R2 and R3, which had uninterrupted runs, were used. These clocks are of remarkably high precision, and separate solutions were made for each clock. The deviation of either clock from the mean was less than 2 milliseconds for the entire three years.

The variation in rotation of the earth was fairly regular from year to year. The earth was about 35 ms fast on October 1 and about 35 ms slow on June 1. Harmonic analysis gives a 1-year term of 30 ms amplitude and a 0.5-year term of 10 ms amplitude. There were also found two new terms of about 1 ms each, which had been predicted. The periods are 13.6 days and 27.6 days, respectively.

Values for these four terms were computed by Y. Mintz and W. Munk from meteorological and tidal considerations. The agreement with those given by observation is so good that we may consider the causes of the annual variation to be known. The 1-year term, apparently, is due principally to meteorological causes. The 0.5-year term is due principally to the solar tide S_{sa} and the other two terms are due to the lunar tides M_f and M_m , respectively. Tides affect the moment of inertia of the earth and, hence, its rate of rotation.

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Markowitz, Wm., Hall, R. G. and Edelson, S. Ephemeris time from photographic positions of the moon.

The program for the photographic determination of the position of the moon was started at the U. S. Naval Observatory in June 1952. The principal aim of the program is the determination of uniform time and uniform frequency. Enough of the plates taken have been reduced to provide preliminary values of Ephemeris Time.

The photographic observation gives the position of the moon at a known Universal Time, which is non-uniform. The Improved Lunar Ephemeris gives the position of the moon as a function of Ephemeris Time, which is uniform. The Improved Lunar Ephemeris is entered with the observed position and the Ephemeris Time is taken out. The difference in the two kinds of time is

$$\Delta T = E.T. - U.T.$$

A value of $\Delta T = 30^s.0$ for 1955.0 was obtained from the plates measured.

Limb corrections have not yet been applied, but two provisional corrections were applied: $+0^s.60$ to the observed latitude of the moon to reduce from the center of figure to the center of gravity, and $+0^s.27 \cos l$ to the tabular longitude, where l is the mean anomaly of the moon.

The position of the center of the moon derived from the west limb averages $1^s.2$ greater in longitude than that from the east limb. Equal weight was given to the mean value of ΔT obtained before and after full moon for each lunation.

If an atomic standard capable of furnishing measurable frequency were constructed it would be possible to test the equivalence of two measures of uniform time, gravitational and atomic.

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Menzel, Donald H., Layzer, David and Krook, Max. The origin and evolution of sunspots.

A star with differential rotation and a permanent magnetic field will in general not be in a steady state. It performs torsional oscillations in which during successive stages of a single cycle azimuthal fields are first built up in one sense, decay, build up in the opposite sense, then decay again. With even moderately small basic poloidal fields, the lines of force may "wind round" many times and thus provide comparatively strong azimuthal fields. Parts of these azimuthal fields