imum separation of only 0.143 ± 0.013 (m.e.) seconds of arc between photocenters. The most southerly observatories to report no occultation were the McDonald Observatory and the Kitt Peak National Observatory. As seen from McDonald the minimum separation would be reduced to 0.125 seconds of arc. This corresponds to a linear diameter of 5800 km for Pluto, or an upper limit, allowing for the mean error to a 90% confidence limit, of 6800 km. If the density of Pluto does not exceed that of the earth, then the corresponding upper limit to the mass of Pluto would be 0.15 earth masses. If, on the other hand, the current value of 0.90 earth masses were adopted for the mass of Pluto, the lower limit for Pluto's mean density would be 33 g/cm^3 .

Microcosmic Model of the Universe. E. R. HARRISON, *Goddard Space Flight Center* (on leave from the Rutherford High Energy Laboratory, Chilton, Didcot, Berkshire, England).—The usual idealizations in cosmology, which are used with the general theory of relativity for deriving the cosmological equations, lead to the idea of a partitioned universe and to the boundary conditions necessary for isolating a small region or cell of space. An isolated cell, infinitesimally small and embedded in flat space, forms the basis of a microscopic model of the universe. An internal observer perceives an expanding unbounded universe and applies the same theoretical concepts commonly used in macrocosmic models. He is also free to work within the framework of special relativity theory, and from the first law of thermodynamics and the equations of hydrodynamics is able to derive the cosmological equations without the aid of general relativity and without making any approximations. The application of the cosmological principle to a universe containing a uniform perfect fluid accounts for the complete equivalence of the microcosmic model with the usual macrocosmic models. In many of its properties the microcosmic model closely resembles Newtonian cosmology; it avoids, however, the ambiguous nature of the gravitational field in a uniform unbounded fluid and is also not limited in its treatment to a pressure-free universe.

Absolute Transition Probabilities of the Solar Ultraviolet CO Bands. JAMES E. HESSER AND KURT DRESSLER, *Princeton University Observatory*.—The long suspected presence of ultraviolet bands of CO in the sun has recently been demonstrated by Goldberg, Parkinson, and Reeves (*Astrophys. J.* **141**, 1293, 1965) from comparison of laboratory shock tube spectra with rocket spectra taken by Tousey (*Quart. J. Roy. Astron. Soc.* **5**, 123, 1964).

We have measured the radiative lifetimes of several electronic-vibration bands of the CO, NO, and NO^+ molecules, including that of the CO $A-X$ (fourth positive) system detected in the solar spectrum, using an rf-modulated electron beam light source, a vacuum monochromator and a phase sensitive detection system built by Lawrence (*J. Quant. Spectry. Radiative Transfer* **5**, 359, 1965). The phase delay of the modulated emission is measured relative to that of simultaneously excited Lyman- α radiation. The wide range of modulation frequencies available enables us to detect and correct for the presence of radiative cascading, although none was observed in the CO $A-X$ measurements. Nor were pressure effects detected in the low-pressure light source ($10\text{--}60 \mu$). In the absence of these systematic errors, lifetimes may be interpreted as radiative ones. The results are tabulated in Tables I and II, where for the second table we

TABLE I. Lifetimes and total transition probabilities.

Band	v'	$\tau_{v'}$	$A_{v'}$
$\text{NO } ^2\Sigma^+ - X ^2\Pi$	1	$8.3(\pm 2) \times 10^{-9} \text{ sec}$	$12.0 \times 10^7 \text{ sec}^{-1}$
$\text{NO}^+ A ^1\Pi - X ^1\Sigma^+$	0	$53(\pm 5)$	1.9
	1	$53(\pm 5)$	1.9
$\text{CO } A ^1\Pi - X ^1\Sigma^+$	0	$12.5(\pm 0.5)$	8.0
	1	$11.0(\pm 0.5)$	9.1
	2	$11.0(\pm 0.5)$	9.1

TABLE II. Absolute oscillator strengths for the CO $A ^1\Pi - X ^1\Sigma^+$ bands $f_{v'v''} (\times 10^{-3})$.

v''	0	1	2	3	4	5	6	7	8	9	$\sum f_{v'v''}$
$v' 0$	9.7	19.7	14.1	12.7	6.4	2.0					64.6
1	19.3	10.0	0.0	6.7	17.5	14.0	5.3	2.1			74.9
2	20.9	1.1	8.8	10.0	0.9	6.6	13.5	8.1	2.7	1.0	73.6

have used measured branching ratios to compute oscillator strengths for individual vibration bands. This work has been supported by NASA grant NsG 414.

Emission Gradients in the Continuum at the Sun's Limb. EIJIRO HIEI (introduced by John W. Firor), *High Altitude Observatory* (on leave of absence from the Tokyo Astronomical Observatory).—The intensity variation at the sun's limb has been studied in order to derive the gradient of the temperature in the low chromosphere. Eclipse observations have previously shown that in the low chromosphere the height gradients of the total intensity of the continuum vary systematically with wavelength; the observed maximum gradient in the red is found to be steeper than in the blue. This wavelength dependence of the gradients has been explained by the temperature increase in the low chromosphere.