in the dark hemisphere. If the ionosphere is 100 km thick, the mean electron density is $n_e \simeq 2 \times 10^9 \text{ cm}^{-3}$, a factor of 10^3 greater than in the terrestrial ionosphere. The ionospheric model gives a strong phase effect at 8 mm, and a negligible phase effect at 3 cm, in good agreement with observations at Lebedev Physical Institute and NRAO, but not at NRL. The required n_e in the illuminated hemisphere is 10^{10} cm^{-3} . Somewhat marginal Millstone radar data suggest a plasma frequency near 400 Mc; therefore also for the dark side $n_e \simeq 10^9 \text{ cm}^{-3}$. However, electron densities of this order are very difficult to explain. If solar electromagnetic radiation is the source of ionization, recombination coefficients of the order 10^{-14} to $10^{-16} \text{ cm}^3 \text{ sec}^{-1}$ are required. Radiative recombination coefficients are characteristically $\sim 10^{-12} \text{ cm}^3 \text{ sec}^{-1}$ and dissociative recombination coefficients $\sim 10^{-8} \text{ cm}^3 \text{ sec}^{-1}$. There would seem to be no way of quenching radiative recombination and allowing lower rate processes, e.g., three-body collisions, to dominate. Solar corpuscular radiation can be the source of ionization only if the Cytherean magnetic field strength is below 0.03 gauss. Both the mean density of Venus and the observations of a decline in terrestrial magnetic activity during Cytherean inferior conjunction argue for fields ~ 1 gauss. The low surface temperatures required for the ionospheric model are inconsistent with the greenhouse effect implied by the observed abundances of CO_2 and H_2O . A definitive experiment to decide between ionospheric and surface origin—a scan of the Cytherean disk near 1 cm—is planned for the 1962 Venus probe.

The Ages of the Open Cluster NGC 188 and the Globular Clusters M3, M5, and M13 Compared with the Hubble Time. ALLAN R. SANDAGE, *Mount Wilson and Palomar Observatories, Pasadena, California*.—Observational data show that the main-sequence termination point occurs in the color-magnitude diagram at $M_{\text{Bol}} = +3.8$ for NGC 188, at $M_{\text{Bol}} = +4.15$ for M3 and M5 (Arp's data), and at $M_{\text{Bol}} = +3.85$ for M13. These values are obtained by fitting the main sequence of the clusters to that of the Hyades, after appropriate blanketing corrections are applied to the observed colors. Such corrections are indicated by the observed ultraviolet excess in the globular cluster stars, presumably caused by the weak Fraunhofer lines due to low metal abundance. The data for all four clusters also show the change in the slope of the main sequence from the breakoff point to 4 mag. fainter caused by the initial evolution from the age-zero main sequence. Even though the observed main-sequence breakoff point for the high metal content cluster NGC 188 occurs at the same M_v as for the low metal content cluster M13, Hoyle's evolutionary tracks (*Monthly Notices Roy. Astron. Soc.* 119, 124, 1959) show that the globular cluster

stars take longer to evolve to a given configuration. Using Hoyle's models, the ages of the clusters are computed to be 16×10^9 years for NGC 188, 22×10^9 years for M13, and 26×10^9 years for M3 and M5. These ages are long compared with the time available since the beginning of the expansion of galaxies according to model universes. In a universe with $\Lambda = 0$ and the deceleration parameter $q_0 = +1$ (as determined by the redshift and apparent magnitude measurements of Minkowski and Baum), the time since the beginning of the expansion is given by $t_0 = 0.57 H^{-1} = 7.4 \times 10^9$ years if $H = 75 \text{ km/sec } 10^6 \text{ pc}$. The only cosmological models which can "save the time scale" are the steady state universe or a generalized Eddington-Lemaître model with $\Lambda > 0$. However, both types of models require $q_0 = -1$ instead of the observed value of $q_0 = +1 \pm \frac{1}{2}$ (Baum, unpublished). All available data are therefore inconsistent. Changes in (1) the stellar evolutionary time scale, (2) the value of the Hubble constant, (3) the observational redshift-magnitude data, or (4) cosmological theory seem to be required at this point.

Hypersensitization Gains in the Near Infrared.

NICHOLAS SANDULEAK, *Warner and Swasey Observatory, East Cleveland, Ohio*.—The hypersensitization of the Kodak 1-N emulsion by water, triethanolamine, and ammonia treatment was studied as part of a project aimed at increasing the effectiveness of objective prism detection of faint, cool stars.

Straightforward intercomparisons were made of optical densities for hypersensitized and for untreated spectroscopic plates which had been given identical exposures and development under controlled dark-room conditions. A tube-sensitometer was used to impress, in the course of a single exposure, a series of extended images of graduated density upon each plate. The optical density of each image was measured with a photoelectric densitometer and these data were used to construct characteristic curves. The displacement of the hypersensitized characteristic curve from that shown by the untreated emulsion, at a common density of 0.6, was taken as a measure of the gain in sensitivity.

The gain in sensitivity achieved by each of the methods was found to depend on the recipe used for the hypersensitizing solution, the age of the emulsion when treated, and the exposure itself.

Pre-exposure treatment of fresh plates with water, triethanolamine, and ammonia solutions was found to produce an average increase in speed of 2.1, 3.3, and 4.0 times, respectively. The results apply for objective prism photography in the spectral range 6800Å to 8800Å. They are valid for exposure times of the order of 30 minutes and therefore for typical astronomical applications.