extragalactic or probably extragalactic. A complete catalogue of sources will be published in the near future. Between 50 and 60 additional sources are available using the NRAO 300-ft instrument and it is expected measurements will be made on these additional sources during the latter half of 1964.

Water in the Atmospheres of Planets. MURK BOTTEMA, WILLIAM T. PLUMMER, AND JOHN STRONG, *The Johns Hopkins University*.—On 21 February, at an altitude of 87 000 ft, in daytime, we observed the spectrum of the planet Venus, using a spectrometer with 2 cm^{-1} resolving power. We scanned 21 exit slits back and forth through the water band centered at $1.13\text{ }\mu$. At one position of the scan the 21 slits matched 21 absorption positions in this water band. If water vapor is present in the path of the radiation, the photocell response has a minimum at this point. A depression of $10.5 \pm 0.5\%$ was observed, relative to the signal measured with the slits displaced. This modulation corresponds to that produced by $9.8 \times 10^{-3}\text{ g/cm}^2$ of water vapor penetrated during calibration on the ground. When solar radiation was scattered by a local diffusing screen, so that the radiation measured had passed only through the earth's atmosphere, a depression corresponding to only about $1/20$ as much absorption was observed. Thus the 10.5% modulation was substantially all produced by water vapor in the atmosphere of Venus. This is confirmed by our observation of a shift of $0.49 \pm 0.05\text{ }\text{\AA}$ of the matching position, as measured against a mercury line at $1.1287\text{ }\mu$. The expected Doppler shift, calculated from the relative velocity of Venus, was $0.495\text{ }\text{\AA}$ on that date.

Some details of the instrumentation and calibration of equipment that afforded these results are discussed.

Our next efforts—to determine the nature of the clouds around Venus, and to determine water in the atmosphere of Mars by our method (using multiple exit slits in the $1.13\text{ }\mu$ band of water vapor)—are also discussed.

Infrared Interferometric Spectroscopy of Stars and Planets from $1.9\text{ }\mu$ to $4.0\text{ }\mu$. PETER B. BOYCE AND WILLIAM M. SINTON, *Lowell Observatory*.—The infrared birefringent interferometer described in the paper by Sinton and Boyce has been used on the 69-in. telescope of the Ohio Wesleyan and Ohio State Universities at Lowell Observatory and on the 200-in. telescope of the Mount Wilson and Palomar Observatories during the past two years. Over 250 interferograms have been obtained of more than 40 stars and the four bright planets. The majority

of spectra extend from $1.9\text{ }\mu$ to $2.5\text{ }\mu$. Cooling the lead sulfide detectors with liquid nitrogen extends the range to $4.0\text{ }\mu$ but with reduced sensitivity. The maximum resolution is 20 cm^{-1} . The interferograms have been processed on an IBM 7094 computer. It takes about 15 sec to compute both the unapodized and linearly apodized spectra from one interferogram.

The computed spectrum of α Ceti clearly shows the depression due to stellar water vapor lines of high rotational excitation. Six other stars, U Orionis, R Leonis, T Cephei, R Cassiopeiae, χ Cygni, and HD 207076, show strong water absorption. One of the most prominent stellar features is the group of CO bands beginning at $2.293\text{ }\mu$. The strength of this group shows a variation with spectral class, first appearing at K5 III and increasing in strength toward later classes. The spectrum of μ Cephei (M2 Ia) shows stronger CO bands than β Peg (M2 III) and also shows stellar water vapor absorption which does not appear with this strength until M6 in the giants. The spectra of seven carbon stars show much smaller CO bands than would be expected for their spectral class.

With an integration time of 2 sec per point, which corresponds to 20 min per interferogram, the limit for the interferometer on the 69-in. telescope is at Johnson infrared magnitude $K \approx 0$ for dry ice cooling. Thus, more than 100 stars are bright enough to give reasonably good spectra with the present instrument. It is felt that interference spectroscopy has proved to be a valuable and practical technique for recording infrared spectra.

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Transfer Efficiency and Storage Capacity of Electronographic Image Tubes. JAMES B. BRECKINRIDGE, GERALD E. KRON, AND IRAKLY I. PAPIASHVILI, *Lick Observatory*.—When the highly efficient Ilford nuclear track emulsions are used in electronographic image tubes, as many as five or six submicroscopic grains will be formed per incident electron at 30 kV accelerating potential. A microscopic examination of a plate indicates, however, that the groups of grains formed by each electron fuse into single picture units. These picture units vary widely in size, but the ones that contribute appreciably to the picture are of the order of $1\text{ }\mu$ in size, and can be seen easily with the aid of an optical microscope. Counts made of these picture units indicate that even for the most efficient of the emulsions, Ilford G5, the conversion efficiency is only 50% for 30 kV electrons; i.e., two electrons are required to form only one appreciable picture unit. We believe that statistically the efficiency of an