were not systematic, and indeed promise to throw additional light on cloud structure and temperature. At the antenna spacing used, only the center source of the Sgr A complex was unresolved by the interferometer and it was thus possible to study and compare the absorption in the spectrum of the center source with that of the complex source. Different baseline spacings and orientations (corresponding to resolution planes) should provide a valuable complement to the information obtainable with single antennas.

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Infrared Isothermal Mapping of Certain Crater Areas of the Moon. J. M. SAARI AND R. W. SHORT-HILL, *Aero Space Division, Boeing Airplane Company, Seattle, Washington*.—Detailed isothermal contour maps of relatively small areas of the moon which can be related to the visible surface features should prove valuable in deducing localized properties of the surface. To this end, measurements were made on a variety of crater areas with the 60-inch telescope at the Mount Wilson Observatory. The thermistor detector subtended a field of 8" (~ 10 miles on the moon's surface) when mounted at the Newtonian focus. A scan program was used which consisted of setting the clock near lunar rate and moving the telescope alternately east and west while the moon drifted in declination. The position of the detector on the moon was followed at the finder telescope and a description of its motion was recorded vocally on one channel of a tape recorder while the temperature signal was recorded simultaneously on the other channel.

During totality of the September 5, 1960 eclipse scans were made over the rayed craters Tycho, Copernicus, Aristarchus and Proclus; all except the latter proved to be about 40°C warmer than their surroundings. In addition, several drives across Kepler at the same time showed similar results. All of these areas were scanned during the full moon together with six other areas (Alphonsus, Cleomedes, Dionysius, Menelaus, Posidonius and Theophilus). In general, the infrared energy variations observed in these areas were comparable to those found over the rayed craters during totality, although the temperature differences are less because of the higher temperature. Explanations for the variations will be discussed in terms of geometry and localized variations in surface properties.

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The Abundance of Water Vapor on Mars. CARL SAGAN, *Dept. of Astronomy, University of California*.—To date, all spectroscopic searches for water vapor on Mars have been negative. A resulting rigid

upper limit on the water vapor abundance is 3.5×10^{-2} g cm $^{-2}$. A lower limit to the water-vapor abundance follows from the discrepancy of about 30 K° between the theoretical radiation temperatures and the observed thermocouple temperatures of Mars. The water vapor required in addition to the Martian CO $_2$ to explain this greenhouse effect is determined as a function of the mean infrared surface emissivity, ϵ . If $\epsilon < 0.82$ no water vapor is required; since observations of the polar ice caps indicate water vapor must be present, ϵ must exceed 0.82. The emissivity of Mars in the 3.5- μ surface absorption bands is 0.94. One minus the visual albedo is 0.85. The true infrared emissivity should fall between these values, as is characteristic of many common minerals. The resulting water-vapor abundance is between 2×10^{-2} and 2×10^{-3} g cm $^{-2}$. The H $_2$ O abundance can also be determined from the vapor pressure above the sublimating edge of the polar ice cap, if the temperature of the edge is known. Considering an increase over the theoretical temperature of the edge due to CO $_2$ alone, a water-vapor abundance is derived. A new temperature is derived from the CO $_2$ -H $_2$ O greenhouse effect. Successive approximations converge near 10^{-2} g cm $^{-2}$ for $\epsilon \simeq 0.90$. We conclude the water-vapor abundance is within an order of magnitude of existing spectroscopic tolerances. The corresponding thickness of the polar caps at maximum extent is about 1 mm. With 10^{-2} g cm $^{-2}$ of water vapor on Mars, there are few infrared wavelength intervals of complete transparency; with 10^{-3} g cm $^{-2}$, the 5- to 8- μ interval where characteristic organic bond resonances lie is almost completely transparent. Observations of this interval from high altitudes should give a firm water-vapor abundance determination. These low water-vapor abundances do not argue against life on Mars; obligate halophiles are known which obtain their entire water requirements from the water absorbed on a crystal of salt, and other organisms are known which produce all water requirements metabolically.

On the Origin of the Venus Microwave Emission. CARL SAGAN, *Dept. of Astronomy, University of California*, K. M. SIEGEL, *Radiation Laboratory, University of Michigan*, AND D. E. JONES, *Jet Propulsion Laboratory, Pasadena, California*.—The Venus microwave spectrum is thermal from 21 cm to 3 cm. Below 3 cm the conjunction brightness temperature falls from about 600°K to about 300°K at 8 mm. There are two possible sources of this emission: a Cytherean ionosphere, at an electron temperature of 600°K, which becomes optically thin below 3 cm; and a 600°K surface overlaid with clouds which attenuate only below 3 cm. A uniformly thick ionosphere in which free-free transitions reproduce the observed spectrum has $\int n_e^2 dz \simeq 4 \times 10^{25}$ cm $^{-5}$,