vanishes and the twilight sky masks the earthshine. Photographs of the earth-lit moon at 2° elongation were obtained on 12 November 1966. This was accomplished with an externally occulted Lyot white-light coronagraph of small size. Two of these instruments were flown side by side in a solar pointing control mounted on an Aerobee-150 rocket, launched from the White Sands Missile Range at 1638 UT and reaching a 175 km peak altitude. The photographs resemble closely those of the full moon. Contrasts are approximately the same, leading to the conclusion that there was no appreciable quantity of cis-lunar dust, which would have manifested itself by strong forward scattering of sunlight. An irregular glint was present on the limb of the moon nearest the sun, and was apparently caused by grazing reflection from the smooth area of Mare Marginis. This glint may be considered a vestige of the new moon crescent.

On the Optical Environment of the Apollo Spacecraft. N. S. KOVAR, *University of Houston*, R. P. KOVAR, *Rice University*, AND G. P. BONNER, *Manned Spacecraft Center, Houston*.—The problem of a permanent debris caused atmosphere or "corona" surrounding a manned spacecraft has been discussed by Ney and Huch (*Science* **153**, 297, 1966) and Newkirk (preprint, August 1966) among others. Appreciable contamination of the optical environment by a manned spacecraft such as Apollo is of serious concern for the observation of faint-light astronomical sources; e.g., zodiacal light, gegenschein, and the solar corona.

The question of the extent and seriousness of the debris caused atmosphere is re-investigated utilizing more recent estimates of the mass loss or contamination rates for the Apollo spacecraft. The results and their import on astronomical investigations are discussed.

Lastly, a simple experiment using a triple disk externally occulting coronagraph is suggested as a means of obtaining data on this spacecraft corona.

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On the Sodium D Lines in Comet 1962c. R. P. KOVAR, *Rice University*, AND N. S. KOVAR, *University of Houston*.—The report of the sodium D line ratio being greater than 2 in the spectrum of Comet Seki-Lines (1962c) (Warner, B., *Observatory* **83**, 223, 1963) seems unable to be explained by the usual atomic mechanisms. In this paper we propose a possible mechanism for the production of this anomalous D-line ratio in terms of optically pumped sodium atoms in the coma of comet 1962c.

It is well known that a weak magnetic field will

result in the splitting of the energy levels of the sodium atom. If these atoms are then illuminated by circularly polarized light of either right- or left-hand polarization, the atoms are preferentially pumped through the $\Delta m_J = +1$ or -1 transitions.

By considering an optically thin, collisionless coma we show that D-line ratios greater than 2 are possible to achieve. The exact value of this ratio will depend on the relative strength of solar D_2 to D_1 and on the relative strength of the right- and left-hand circularly polarized solar light seen by the comet. The applicability of this proposed mechanism to comet 1962c is discussed.

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A Search for an M31 Halo. J. D. KRAUS AND R. S. DIXON, *Ohio State University Radio Observatory*.—A search for a halo around M31 has been made with the Ohio State University 260-ft radio telescope at 610 and 1415 MHz using highly stable liquid-nitrogen-refrigerated parametric amplifiers and the average of many repetitive scans. A sensitivity of 0.01°K was attained at both frequencies.

A feature is found with spurs to the east, north, and west of M31. The existence of a spur to the south is uncertain. This result is similar to that reported earlier (Kraus, *Nature* **202**, 1202, 1964). However, the spurs to the east and west are more symmetrical and much longer than reported earlier and they appear to extend for a number of degrees. The three spurs have a common point of origin located near the major axis of M31 about $35'$ northeast of the nucleus. Profiles and contour maps are presented and interpretations are discussed.

Rotating Stars, Solar Systems, and Black Dwarfs.

SHIV S. KUMAR, *Leander McCormick Observatory*.—It was first pointed out by Struve that main-sequence stars of spectral type later than F5 rotate more slowly than those of earlier type. Based on this observation, Struve, Huang and others have suggested that all single late-type dwarfs possess solar systems similar to our own. The object of this paper is to point out that this may not be true for all late-type dwarfs. It is quite likely that a large fraction of the late-type dwarfs are accompanied by black-dwarf companions in elliptical orbits. Within a distance of 16 light years from the sun, six main-sequence stars (61 Cygni, Lalande 21185, Ci 2354, Barnard's star, BD+20°2465, BD+5°1668) are known to possess black-dwarf companions with masses in the range $0.002-0.02 M_\odot$. These companions are moving in orbits with eccentricity as high as 0.8. Preliminary studies of the stability of an earthlike object in a system such as Barnard's