Rotationally Forced Ejection in Stellar Evolution. D. NELSON LIMBER, *The University of Chicago*.—The problem considered is that of the hydrodynamics of circumstellar envelopes formed through rotationally forced ejection. Under reasonable simplifying assumptions, the velocity and density fields in and near the equatorial plane have been derived for steady-state solutions corresponding to rotationally forced ejection at a constant rate. This problem has the general character of the solar wind problem but differs from the latter in the following four essential respects: (1) the force field is augmented by centrifugal forces, (2) the geometry departs from spherical symmetry, (3) turbulence is expected to play an important role, and (4) the envelope is required, by assumption, to move matter outward at a rate set by the evolution of the body of the star. It has been shown that physically consistent steady-state solutions appear to be possible under rather general conditions, and these solutions will be used to test further the hypothesis of rotationally forced ejection as an explanation of the Wolf-Rayet phenomenon and of possible related phenomena (cf. *Astrophys. J.* 139, 1251; 140, 386). However, it has also been shown that stars with velocities of escape that are too large (e.g., certain subdwarfs and all white dwarfs) cannot maintain circumstellar envelopes at the temperatures required for steady-state conditions to carry off mass at any appreciable rate. It appears that any such star that is subject to rotationally forced ejection would ultimately react by explosively ejecting matter. The observational data pertaining to novae and to related objects have been examined with a view to their possible interpretation in such terms. The hypothesis appears to be quite attractive in a number of respects, ranging from the position of the explosive variables in the H-R diagram to their frequent occurrence in close binaries and to the frequent appearance of axial symmetry in the ejection process.

Explorer XX Measurements of Galactic Spectral Flux Density. DONALD S. LUND, *National Bureau of Standards, Boulder*.—Explorer XX measures galactic spectral flux density at six frequencies between 1.5 and 7.2 Mc/sec. This experiment is capable of (a) providing synoptic measurements (in contrast to rocket flights) [Alexander, J. K., and Stone, R. G. (to be published); Huguenin, G. R., Lilley, A. E., McDonough, W. H., and Papagiannis, M. D., *Harvard College Obs. Rept.* HSRP-107, 1963; Walsh, D., Haddock, F. T., and Schulte, H. F., *COSPAR, 6th Plenary Meeting, Warsaw 1963*]. (b) providing measurements above most of the ionosphere [in contrast to ground-based measurements (Ellis, G. R. A., *Nature* 204, 171, 1964)], and

(c) providing calibrated measures [in contrast to Alouette I (Hartz, T. R., *Ann. Astrophys.* 27, 823, 1964)]. Typical values found for a hemisphere centered near the galactic north pole are:

Frequency	Spectral flux density
1.5 Mc/sec	Less than 3×10^{-20} W m ⁻² cps ⁻¹
2.0	4×10^{-20}
2.8	3×10^{-20}
3.7	1.4×10^{-19}
5.5	2.2×10^{-19}
7.2	2.1×10^{-19}

Variability of flux density by factors of 3 or 4 are often observed. This variability seems to stem from a number of factors, of which the following have been considered: (a) Man-made interference, (b) naturally occurring interference (such as sferics), (c) temperature effects in receivers, and (d) detuning of antennas by local plasma.

Determining the Circulation of a Planetary Atmosphere from the Motion of Identifiable Features. NORMAN J. MACDONALD AND FRED WARD, *Air Force Cambridge Research Laboratories, L. G. Hanscom Field*.—It is interesting to speculate how an extraterrestrial observer might measure the motions of the earth's atmosphere and the conclusions he might reach concerning the nature of that circulation. The observer might choose to measure the daily proper motions of some easily identifiable feature such as regions where the albedo is relatively high or low. In the terrestrial atmosphere, such spots are associated with concentrations of vorticity that can be easily discriminated and tracked each day. There is an exchange of material between these features and the surrounding environment. The vorticity concentrations are also interacting with the general circulation. Nevertheless, by measuring the motions of these earth spots the observer could correctly deduce the basic nature of the terrestrial circulation including the role the eddy structures play in maintaining the earth's angular velocity gradient. The implication of these results to the study of the circulation in the solar atmosphere is discussed.

On the Association of Solar Flares with Sunspots. PATRICK S. MCINTOSH, *Sacramento Peak Observatory*.—The first sunspot group photographed with the Sacramento Peak continuous white-light patrol (described in *Sky and Telescope* 27, 280) has been studied for the relationship between the sunspot evolution and flare activity. Near the time of the explosive importance 2+ flare of 20–21 September

1963 there occurred changes in the proper motions of the larger sunspot umbrae, a change in the position and configuration of the magnetic neutral line of the longitudinal magnetic field, and a rapid growth of penumbra in the group. An importance 1 flare on 19 September 1963 occurred near two strong spots of opposite polarity and at the time when their relative proper motions brought them closest together. Faint "lanes" or arcs in the photospheric granulation appeared between spots of opposite polarity at the time of maximum brightness of an importance 1 flare on 24 September 1963. The arcs lay directly under the flare.

These observations suggest that the larger and brighter flares may be accompanied by observable changes at the photospheric level. A study of more cases is needed to establish a more definite relationship between changes in sunspots and solar flares.

Positions of Certain Recurrent Flares, 12-16 July 1959, Relative to Sunspots and Features of the Calcium Network. SUSAN M. P. MCKENNA (introduced by Helen Dodson Prince), *The University of Michigan*.—A study is in progress of the flares and subflares that occurred in the great center of activity at $N 15^\circ$ that traversed the solar disk between 8 and 23 July 1959. A number of these flares consisted, in whole or in part, of brightenings of apparently the same portions of the calcium plage. One such pattern of repeatedly flaring regions dominated many of the flares observed 12-16 July inclusive.

During this interval, as has been shown already by Bruzek (*Z. Astrophys.* **50**, 110, 1960), the associated spot structure was undergoing continual change. At the photospheric level the relative positions, numbers, and field strengths of the sunspot umbrae changed radically with time. At the chromospheric level, the most notable feature of the flares was their marked similarity in position relative to one another and to features in the calcium plage. Seven individual areas with hard, well-defined outlines can be identified day after day as the site of flares and these impart to the separate events a common pattern. The components of this pattern retained their positions relative to one another in the chromospheric network in spite of the changing pattern exhibited by the underlying sunspots.

The leading spot which was the main umbra of south polarity drifted westward faster than the motion imparted to the chromospheric layers by solar rotation, and the flaring regions moved westward faster than did the following spots of northern polarity. As a consequence, several of the components of the flare pattern appeared variously with time over umbral, penumbral, and "normal" photospheric regions.

The study is based on concomitant records of flares and sunspots obtained with the spectroheliograph of the McMath-Hulbert Observatory, using a telescope of 40-ft focal length, and on photographs from the worldwide flare patrol organized by H. Smith.

Some Consequences of Large Redshifts. G. C. MCVITTIE, *University of Illinois Observatory*.—Seven zero-pressure models of the universe, whose characteristics are as different as possible, are employed to calculate the luminosity distances and the linear diameters corresponding to an angular diameter of $1''$, of sources of radiation with redshifts up to 3. The intrinsic emissions at 10^{15} cps of the nine quasi-stellar radio sources, whose redshifts are now known, are calculated in each of the seven models. These emissions turn out to be very similar in any one model, except perhaps in the model of the steady-state theory where an increase of intrinsic emission with redshift is suggested. If the emission at 10^{15} cps is indeed constant for quasi-stellar sources, a new determination of the value of the Hubble constant and of the acceleration parameter should be possible.

Beryllium in G- and G-Type Dwarfs. ANN E. MERCHANT, *Lick Observatory*.—The abundance of beryllium has been determined in 10 F- and G-type stars, for comparison with the lithium abundances in these same stars. One hundred twenty-inch coude spectrograms with a dispersion of 8 Å/mm were used. Since the resonance lines of Be II used for the analysis lie in the ultraviolet ($\lambda\lambda$ 3130, 3131) where the spectra are very crowded with metallic absorption lines, special care was taken in establishing the position of the continuum with consistency.

Two of the stars, α CMi and θ Cyg, were found to show no detectable Be; upper limits on the Be content of 25 times less than the solar value were assigned. Neither of these stars has a detectable amount of Li. The evolutionary effects of the companions of these two stars are considered as a possible explanation. The other eight stars and the sun all have approximately the same amount of atmospheric Be.

Four of these latter eight stars were found by Herbig (*Astrophys. J.* **140**, 702, 1964) to have appreciable Li⁶. The presence of Li⁶ is taken to mean that there has been no destruction of Li or Be by convective mixing to high enough temperatures for (p, α) reactions to take place. The mean abundance ratio for these four stars is +0.6 with a variation about this mean of 50%; it is expected that a constant ratio of Li/Be should result if these light elements were produced by spallation reactions.