regions, several arguments from the photometric data are consistent with the hypothesis that the central luminous source may be effectively a hyper-star of radius ~ 0.02 light year, $\bar{\rho} \sim 2 \times 10^{-10}$ g cm $^{-3}$, and mass 10^6 – $10^7 M_{\odot}$.

Geneology of Solar Flare Source Regions.

HENRY J. SMITH, *National Bureau of Standards, Boulder*.—The need to forecast solar flare incidence generates a need to know how flare productivity relates to the history and development of active regions. One convenient method of tagging and studying centers of activity is by the associated calcium plage regions. The IGY flares, numbering roughly 6000, can be associated with approximately 850 plage regions. Using published identifications of recurring plage regions, one can trace the genealogy of families of plage regions. Such a family presumably defines an uninterrupted appearance of plage associated with a unique center of activity. Thus approximately 336 families can be constructed from the 850 plage regions.

The table shows the frequency distribution of plage family durations (in solar rotations). Nearly half fail to survive for a second rotation, though many persist for two to six rotations, and a few as long as nine rotations. In this respect the calcium plage families differ significantly from the active regions tabulated in *The IAU Quarterly Bulletins*.

Duration	Frequency	Duration	Frequency
1 rotation	151	6	15
2	63	7	5
3	39	8	3
4	34	9	3
5	25		

The relation of flare incidence to region age is obscure in the many cases where plages seem to undergo fusion or fission, as most long-lived regions do. The greatest flare production rate (as high as 98 flares per rotation) occurs sometimes at the inception of a region, usually in its middle life span, but never at its end. The majority of great flares (importance 3 or 3+) occurred in the second, third, or fourth rotations of regions lasting five to eight rotations. However one occurred in a prolific region seen in only one disk passage. This study documents clearly in eight cases the tendency of a single region to yield two or even three great flares in a single rotation.

An Investigation of the Variable Stars in the Globular Cluster NGC 6712. L. L. SMITH, A. R. SANDAGE, D. LYNDEN-BELL, AND R. H. NORTON,

Mount Wilson and Palomar Observatories.—The variable stars in the moderately strong metallic-lined globular cluster NGC 6712 previously studied (Smith and Sandage, *Astron. J.* **67**, 121, 1962) have been investigated using photographic plates and a photoelectric sequence obtained with the 200-inch telescope between 1955 and 1961. A number of variables were found in a blink survey and we confirm all of Sawyer's previous discoveries. Seven of the variables appear to be RR Lyrae members of the cluster. Periods and light curves in the *B* and *V* bandpass were obtained for all seven members, six of which are of Bailey type *a* or *b*, and one is of type *c*. Four variables are of long period and lie at the end of the red-giant branch in the color-magnitude diagram.

The purpose of the study was to see if the group characteristics of the variables in NGC 6712 differ from the characteristics in metal-weak clusters such as M3 or in very metal weak clusters such as M15. Although it appears to be well established that the mean period of type *a* or *b* variables in globular clusters correlates well with the metal abundance (longer mean period occurs in the metal-poorer clusters), the six variables in NGC 6712 are not a large enough sample to apply the test because the observed $\bar{P}_{a,b} = 0^d54$ has little weight. A more stringent test is the differences of the period-amplitude relation between weak- and strong-lined clusters. Defining $P_{1.0}$ as the period at which the amplitude in blue light is 1.0 mag., we get $P_{1.0}$ values of 0^d66 , 0^d65 , 0^d60 , and 0^d57 for M15, M92, M3, and NGC 6712, respectively, placed in the order of increasing metal abundance from the spectroscopic evidence. This decrease of $P_{1.0}$ may be significant. It agrees with a model designed to explain the difference in mean period $\bar{P}_{a,b}$ between clusters (Sandage, 1958 Vatican Symposium on Stellar Populations, p. 51) but accurate data for more clusters are needed before the test can be said to be satisfactory.

Dust in Comet Arend-Roland. RICHARD B. SOUTHWORTH, *Smithsonian Astrophysical Observatory*.—Comet Arend-Roland (1956 *h*=1957 III) is well remembered for its "spike" or "anti-tail" apparently directed towards the sun. Published photographs obtained with fast cameras also show, in addition to the ordinary tail and the spike, some features of larger angular size but lower surface brightness. Because of changing perspective due to the earth's motion, it has been possible to find the position in space of different parts of the comet. There were seven recognizable tails, spread in a fan that subtended about 80° at the comet's nucleus. The ordinary (partly gaseous) tail formed one edge of this fan, and the spike was the tail at the other