cycle just ending have been the greatest since 1870. Another interesting possibility is that the alternation in recurrent storm activity is related to the 23-year magnetic cycle of the sun. If the spot fields are related to an alternating general field with a period corresponding to the double spot cycle, as proposed by Grottrian² and Babcock,³ or to large-scale toroidal fields of similar period, as Richardson and Schwarzschild have suggested,⁴ then the dissymmetry of such a field with respect to the 11-year cycle may influence the formation and persistence of M regions. Further, the interaction of large-scale solar fields with the earth's field may influence the propagation of solar particle streams into the earth's atmosphere in such a way as to produce a dissymmetry in the incidence of recurrent magnetic storms during alternate sunspot periods.

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1. Croxton and Cowden, *Applied General Statistics*, p. 317 ff., 1941.
2. *Naturwissenschaften* 7, 163, 1950.
3. *Nature* 166, 249, 1950.
4. *Acad. Naz. Lincei, Convegno Volta*, No. 11, Sept. 1953.

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Savedoff, Malcolm P. Color magnitude array of M 13.

A color magnitude array based on 1400 stars in the globular cluster M 13 was obtained from plates taken with the Hale reflector at Mount Palomar by W. Baade. Unblended images were chosen for measurement by comparison of one-minute, three-minute, and thirty-minute photovisual exposures. This criterion introduces a selection against the brighter stars, but does not affect the distribution in color of stars of the same visual magnitude.

The diagram presented is based on measures of four IIA-O plates with GG1 filter and four IO3a-D plates with GG11 filter, all three-minute exposures, and all taken within a period of less than two hours. These plates were measured on the Eichner astrophotometer at the California Institute of Technology. The photometer readings were converted to the photoelectric system of W. Baum by interpolating between the unpublished measures by Baum and H. L. Johnson of 15 and 42 stars, respectively.

The principal result of this investigation is that the array for M 13 differs appreciably from that

for M 3 and M 92. In addition, the blue extension of the cluster-variable branch extends past the eighteenth magnitude photovisual. It should be noted that color standards for very blue stars are not sufficient for detailed intercomparison.

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Schopp, John D. Determination of upper limits to the abundance of carbon 13 in normal red giant stars.

High dispersion spectra (10 Å/mm) of 28 stars were taken at the coudé focus of the Mt. Wilson 100-inch. The program included 20 stars of luminosity class III normal red giants, and 8 stars of luminosity classes IV, III-IV, II-III, and II, all 28 being in the spectral range G8 to K5. Tracings of these spectra were measured to determine upper limits to the abundance of carbon 13 in their atmospheres.

Pseudo curves of growth were obtained from depth measures on 25 FeI lines in the region $\lambda 4000$ to $\lambda 4100$, and from relative stellar log X values for these lines. The log X values were derived from solar log X values, given by Barbara Bell,¹ by means of effective temperature obtained from photoelectric colors measured at the Princeton 23-inch. The colors were tied to the Johnson system.²

By comparing computed and measured strengths of absorption lines in the ultraviolet (0, 0) band of $C^{12}N^{14}$ near $\lambda 3883$, and predicted lines in the isotopic band, $C^{13}N^{14}$, lower limits on the ratio C^{12}/C^{13} were obtained. For the 15 stars in the spectral group G8 to K1 this ratio ranged from 23 to 7, while for the stars K2 to K5 the ratio ran from 15 to 0.6. Low ratios in the second group can probably be attributed to the fact that the strength of the CN band falls off considerably thus making the test insensitive. The results for stars of the first group are probably significant enough, however, to warrant the conclusion that carbon 13 is not present in the atmospheres by as much as one part in four. Since an equilibrium ratio of C^{12}/C^{13} of the order of three is predicted for carbon involved in the carbon-nitrogen cycle, we may say that if these stars have ever generated energy in this way, there has been no appreciable mixing between the core and the atmosphere. It may be recalled that McKellar found carbon 13 abundant by one part in four in several R-type stars.³

In addition it was found that CN reaches maximum strength at about K0 or K1 in normal giants.