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METAL ABUNDANCE IN A STARS

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ABSTRACT

It is shown that variations in Strömgren's $[m_1]$ index in A stars are due to abundance variations rather than to microturbulence and that the calcium abundance varies by a factor of 2 in A stars near the Sun; this calcium abundance shows no apparent correlation with stellar space motion.

A photoelectric slot photometer has been used to measure the strength of the K-line of singly ionized calcium in A stars (Henry 1967). This work will be reported in detail elsewhere, but, as it is directly relevant to questions raised by Conti and Deutsch (1966, 1967), some of the results will be discussed briefly here.

Conti and Deutsch have maintained that variations in Strömgren's m_1-index in solar-type stars, and probably also in A stars, are largely due to differences in microturbulence rather than in abundance. Barry (1967) has presented observational evidence that such is not the case for F stars. This has been confirmed by McNamara (1967), using the data of Price (1966), by arguing that the equivalent widths of both the very weak and the very strong lines should not be affected by microturbulence and by showing that a correlation exists between Price's sodium D-line strength and Strömgren's $\Delta[m_1]$ for solar-type Hyades stars.

A similar comparison is made here for the K-line, which is also a strong line in the sense that microturbulence plays no role in determining the equivalent width of the line. (This was confirmed by line-strength calculations.) The object was to extend the work of Barry and of McNamara to earlier spectral types. A k index is defined by the relation

$$k = -2.5 \log_{10} (L_K/L_C) ,$$

where L_K is the intensity in an 8.5 Å band centered on the K-line, and L_C is the corresponding intensity for the neighboring continuum; values of k have been obtained for each of sixty stars believed, on the basis of spectroscopic classification, to be normal A stars. The deviation Δk of the k index for each of these stars from the relation found between k and $b - y$ color (for these bright, unreddened stars) is plotted in Figure 1 versus the Δm_1 index of Strömgren (1966). Typical rms internal-error bars are shown; the scatter is hardly larger than would be expected on the basis of the photometric errors. The relation obtained is strengthened at the low-abundance end by including the known low-metal-abundance F2 V star σ Boo (HR 5447) (Danziger 1966), the star λ Boo (HR 5351), and the F0 V star HR 4914.

This correlation indicates that Strömgren's m_1-index is predominantly determined by metal abundance in the A stars also. However, it is difficult to relate the m_1-index directly to metal abundance (Fischel 1964), owing to the number and variety of metal lines contained in the bands. Such a comparison is much easier for a single line and has been made here for the K-line, where the principal uncertainty lies in the electron damping constant. The value of Bréchot and van Regemorter (1964), as corrected by Bréchot (1967), has been used, and formation of the line in pure absorption has been assumed.

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This latter assumption is certainly unrealistic, but the *relative* line strength for stars of the same temperature (Cayrel and Cayrel 1966) is regarded as quite meaningful.

The result is that low-velocity main-sequence A stars in the solar neighborhood are found to have a range in calcium abundance of about a factor of 2. No correlation is found between abundance and space motion. This result will be described fully elsewhere, with a discussion of the absolute abundance.

Professor Bengt Strömgren was the indispensable guide of this work.

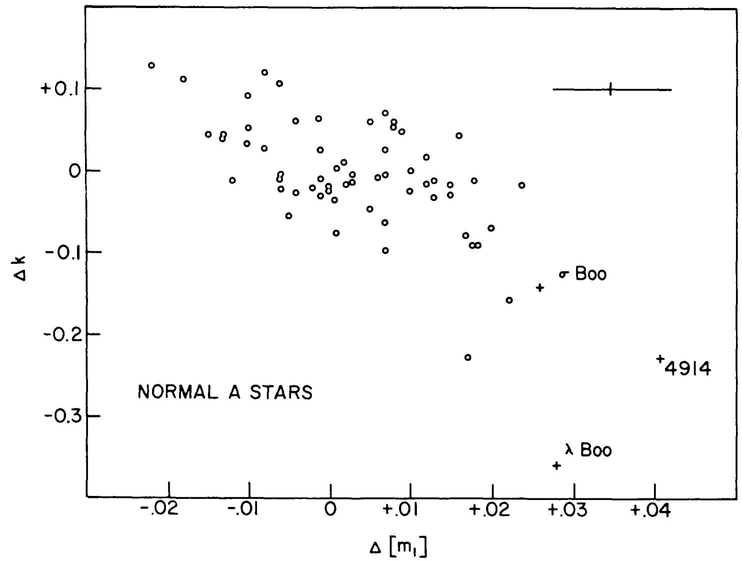

FIG. 1.—An index Δk of the deviation from normal (for stars of a given temperature) of the strength of the K-line of calcium is plotted against the deviation from normal of Strömgren's m_1-index, for a group of sixty normal A stars.

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