OBSERVED RELATIONS BETWEEN PHYSICAL PROPERTIES AND MK CLASSIFICATION AS FUNCTIONS OF METAL ABUNDANCE FOR F5-K4 STARS

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Abstract. The Geneva photometric system has been calibrated in terms of [M/H], θ_{eff}, M_v in the spectral range F5 to K4. As the spectral type is a datum generally available, we derive empirical relations showing the coupling of θ_{eff} and [M/H] at given spectral type and luminosity class. Similar relations are offered for the absolute magnitudes and provide a more accurate means for deriving spectroscopic parallaxes. Systematic effects on the estimation of the luminosity class are also shown.

The influence of the chemical composition on the MK classification is examined from the point of view of detecting the possible selection biases arising when star samples are defined by an interval of spectral type (ST) and luminosity class.

In order to estimate these biases the knowledge of two sets of relationships is necessary: the coupling between T_{eff} and [M/H] at given ST and luminosity class, the local dependence between luminosity class and gravity as a function of metal abundance.

As a large number of stars, with known ST and well distributed in metal abundance, is needed to establish these relations, they are deduced from a calibration of the Geneva photometry for the late-type stars. The main properties of this system and the methods of calibrations are described elsewhere (Grenon, 1975a, b). The necessity of a homogenisation of the published lists of [Fe/H] before applying them to statistical investigations is pointed out.

Figure 1 shows the T_{eff} vs [M/H] diagram with the mean loci at constant ST for the dwarf stars; the [M/H] ratio is taken at 0.15 for the Hyades. At given S.T., the range in T_{eff} reaches 700 K, and since the scattering in ST is really small, the internal consistency of the spectroscopic couple of data [Fe/H] and T_{eff} can be checked. From this nomograph can be deduced the minimum interval in ST which must be considered to ensure the completeness in abundances for a stellar sample, in a given range in θ_{eff} or in mass.

A similar diagram M_v vs [M/H] has also been calibrated in ST, for unevolved stars; it can be used for deriving more accurate spectroscopic parallaxes if the abundances are known, since the range in M_v, at constant ST, may be as large as 1.5 mag.

Figure 2 shows the T_{eff} vs [M/H] diagram for the giants. The definition of spectral type appears strongly dependent of [M/H] and most of the samples defined by a given interval of ST lead to biased distributions of metal abundances since we collect objects in differently populated portions of the giant branch. In particular, the choice of ST, later than G8 favours the selection of metal-rich stars. On the other hand the G2-G5 interval appears almost entirely populated by metal-weak and double stars with composite spectra.

B. Hauck and P. C. Keenan (eds.), Abundance Effects in Classification, 75–78.

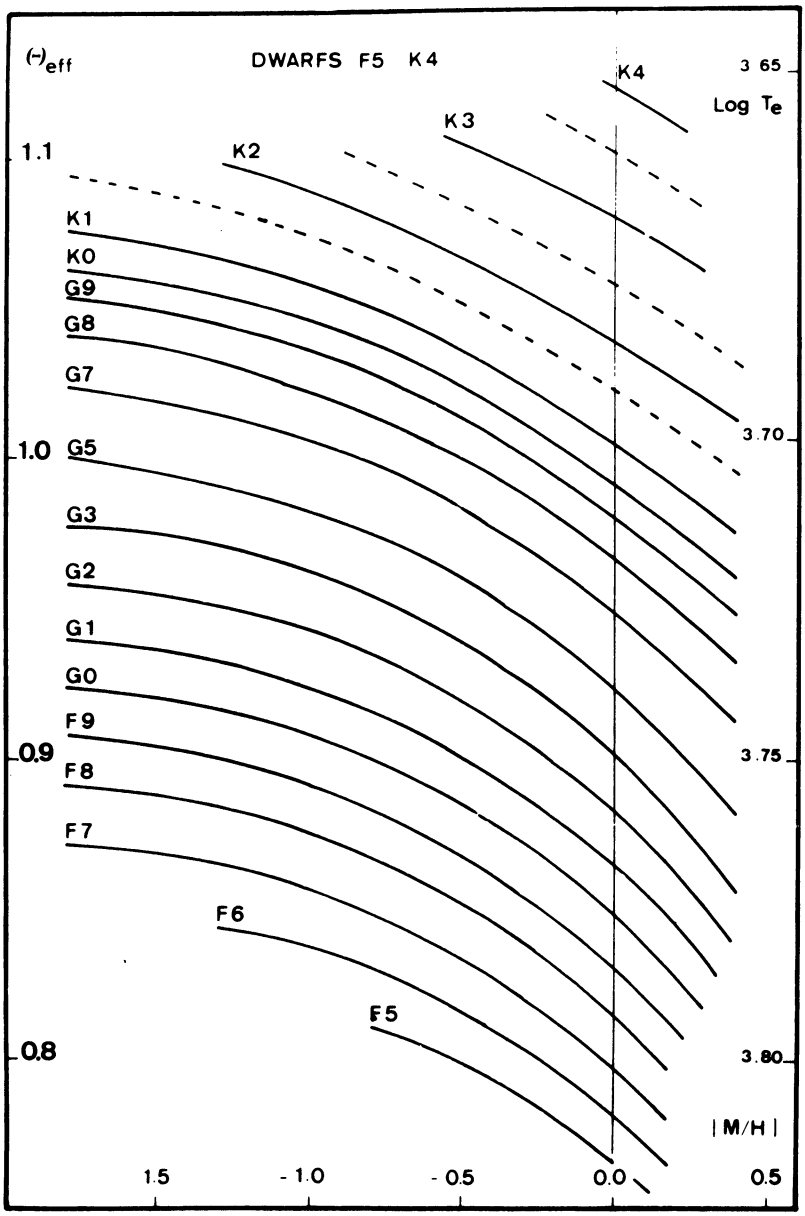

Fig. 1.

The halo giants are generally classified as subgiants or even dwarfs. The tendency to underestimate the luminosity class of metal-poor stars or to overestimate that of the metal-rich ones, is general and valid even for small changes in abundance. At constant gravity this systematic drift can reach one class for a variation of a factor 2 in abundance. In the interval of −1.50 to +0.50 in [M/H], we observe a mean deviation of ± one

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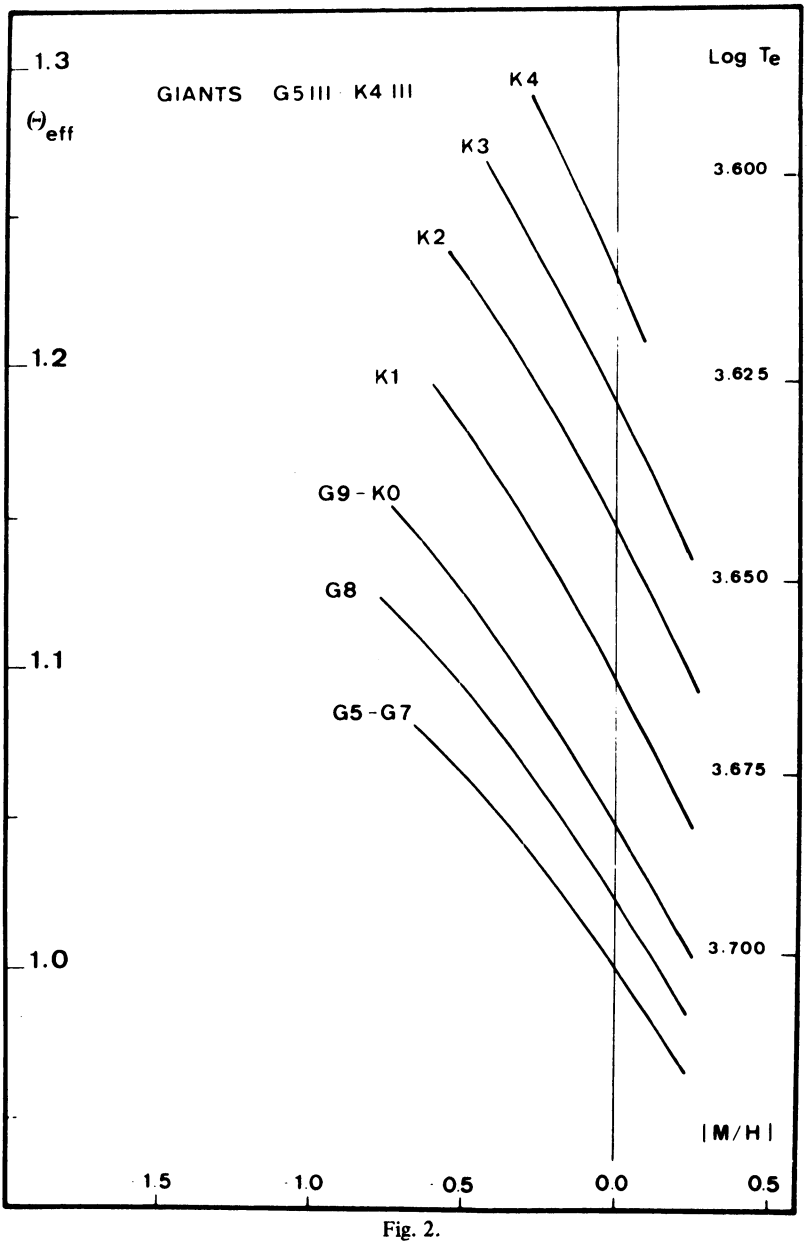

Fig. 2.

luminosity class for a change of ± 0.40 in [M/H]; this tendency suffers many exceptions, nevertheless an interval of completeness in abundances can generally be determined. A selection of stars according to the luminosity class favours metal-rich objects if we choose the class III, rejects some SMR stars if we take the class V. The class IV appears seriously contaminated by metal-deficient giants and binaries formed by a red giant and a main-sequence star.

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Grenon M.: 1975a, *Dudley Obs. Report*, 9, 413.
Grenon M.: 1975b, Thesis (in preparation).

DISCUSSION

Cayrel: What is the luminosity MK class you attributed to HD 122563, 165195 and 221170?
Grenon: The second one is not yet analyzed, but for the two others, it is a class II.

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