making use of the excellent conditions there, of the improvements that the photometer had undergone in the meantime, and of a new promising method discovered during the analysis of the large VBLUW material on galactic pulsating stars.

The Walraven photometer measures simultaneously in five passbands of intermediate width (cf. J. Lub. *The Messenger* No. 19, 1979). This gives four independent colours, but since the W signals for Magellanic Cloud Cepheids are too faint (W lies at 3230 Å!), we are left here with only three. The composition effects that we want to determine have to be separated from at least three other factors: temperature and pressure in the stellar atmosphere, and interstellar reddening. This makes 3 observed quantities with 4 unknowns, but fortunately there occur "degeneracies" in certain colour combinations, where some of the unknowns cancel out. It is such a situation that we apply in our metal index [B-L].

The method is illustrated in Fig. 2. Since [B-L] and [L-U] are defined to be independent of interstellar reddening, this diagram is reddening-free, but [B-L] is very sensitive to the abundance of heavy elements (mainly Fe and other metals). Fig. 2a shows schematically the effects of temperature, pressure, and metal content around temperatures of 6500 K. In this temperature range the intrinsic lines for a fixed composition form a sharp vertical boundary. [B-L] at this boundary is almost purely sensitive to metal content. This range around 6500 K is reached by the maxima of large-amplitude Cepheids, and this allows us to determine the metal abundance in these stars in a temperature-, pressure- and reddening-insensitive way. The results obtained at La Silla for 14 SMC Cepheids and 11 LMC Cepheids are shown in Fig. 2b. After calibrating the

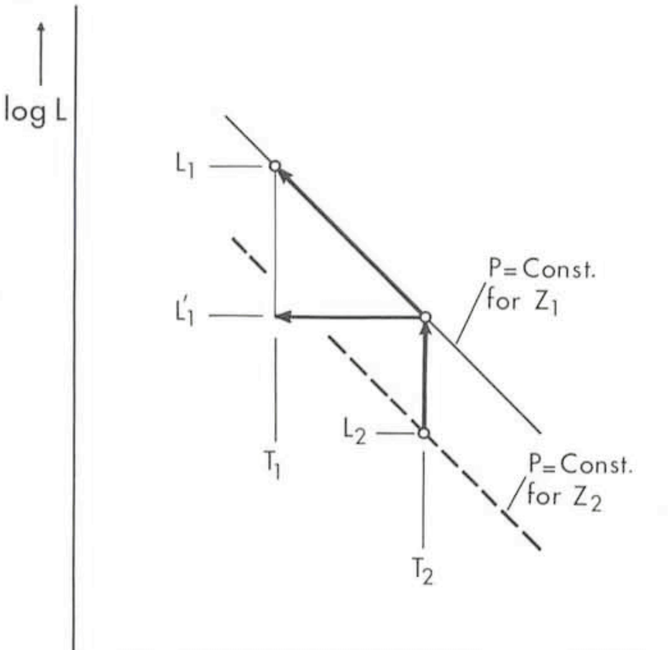


Fig. 3: *The sensitivity to Z of the P-L-C relation. $T_2$ and $L_2$ are the real temperature and luminosity of a Cepheid with period P, colour C, and $Z = Z_2$. When applying a P-L-C relation for $Z = Z_1$ ($Z_1 > Z_2$) to this star, we assign a higher temperature, $T_1$, to the same colour C, and also use a too luminous line of constant P. The result is that we put the star at ($L_1$, $T_1$), and overestimate the luminosity. For $Z_1$ = 0.02 and $Z_2$ = 0.005 the error is $L_1$–$L_2 \simeq$ 0.5 magnitude.*

diagram by means of the theoretical spectra by Kurucz, and by stars with spectroscopic abundance analyses, we find a mean metal deficiency of a factor 5 for the SMC Cepheids, and a factor 2 for the LMC Cepheids (compared to their galactic counterparts). Observations of non-variable F-type supergiants in the Clouds by Van Genderen confirm these numbers. These results agree within the uncertainties with the data of Harris for the SMC, and they are also consistent with spectroscopic calcium abundances for Magellanic Cloud supergiants by Smith (H. Smith, *Astron. J.* **85**, 848, 1980), who finds that calcium is low by a factor 4 in the SMC and a factor 1.6 in the LMC.

This new information on abundances in Magellanic Cloud stars is still very limited, but it fits well with the existing data on emission nebulae in the Clouds (cf. Pagel and Edmunds, *Ann. Rev. Astron. Astrophys.* **19**, 1981), and it is clear that we can no longer ignore composition differences between the Cepheids in SMC, LMC, and Galaxy, or between those in inner and outer regions of the Galaxy. One of the most far-reaching consequences of these differences is the effect that they have on the P-L-C relation, which is particularly sensitive to Z. We saw already in Fig. 1 that a decrease in Z shifts the constant-period lines towards lower L. At the same time the C-T relation changes, making the colour of a Cepheid at a given temperature bluer for lower Z. The result of both effects is (Fig. 3), that by applying a "solar" P-L-C relation to Cepheids with low Z, we overestimate their luminosities. If we assume that metals are representative for the overall heavy-element content, the SMC Cepheids have probably $Z \simeq 0.005$. In this case a P-L-C relation for $Z = 0.02$ would give 50 % too high luminosities, or distances that are 25 % too large.

This example, although schematic and incomplete (e.g. we did not yet discuss the effects of Y), demonstrates that abundance determinations are not only necessary for a better physical understanding of Cepheids, but also for improved accuracy of the Cepheid distance scale, which still remains one of the "steps towards the Hubble constant".

## List of Preprints Published at ESO Scientific Group

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