There are open questions about the models of close binaries with orbital periods of about two days and shorter. Observations obtained on La Silla during several years have shown that X Gru (P = 2ᵈ1) and V 505 Sgr (1ᵈ2) have slightly variable light-curves outside the eclipses. Apparently some other phenomenon is here added to the characteristics of the Algol systems as described above. As matters now stand, the origin of this variability may be surmised on the basis of results from recent investigations of two systems with similar periods, U Cep (2ᵈ5) and TV Cas (1ᵈ8). It appears that the long-period variations of the light-curves are controlled by the precessional periods of the rotational axes of the primary components. This as yet unknown and quite unexpected property of close binaries which is closely connected with the gas streams flowing towards the primary components may be realized by accurate photometric observations of the shape of the total eclipse, as it was shown for U Cep (Walter, *Astron. & Astrophys.*, **42,** 135 (1975)) or by observations of the light-curves outside primary eclipses like for TV Cas, where periodical fluctuations could be found and explained in this way from the reduction of observations obtained over six years (in preparation for publication). Recalling earlier experiences of observers with W UMa variables the question arose, whether it would not be worthwhile to test some southern W UMa variables by means of a good instrument under the clear Chilean skies.

W UMa Variables

In 1975, Dr. H. Duerbeck and I began to observe some W UMa stars on La Silla. We decided to observe them with an unusual method. Because of the suspected transient characteristics of the light-curves of very close binaries, we decided not to observe our three programme stars, ST Ind, RV Gru and AE Phe, in the usual way, where each star is continuously observed for as long a time as possible to get a complete light-curve within a few nights. We went the opposite way and tried to distribute the observations of all programme stars as uniformly as possible over the whole allotted observing period of about two months, with the aim of obtaining in this way true *mean* light-curves and also accurate *deviations* of the individual observations from these curves. Indeed all three observed variables showed systematic, time-dependent deviations. They were present in the case of RV Gru and AE Phe in a very clear manner and indicated a periodic behaviour. Thus the results of 1975 strengthened our suspicions about the transient characteristics of W UMa light-curves.

In the astronomical literature some large variations of W UMa light-curves have been reported, among them the very interesting case of AH Vir (Binnendijk, *Astr. Journ.* **60,** 372 (1965)). This variable was found in 1957 to exhibit a light-curve for which three-quarters of the phases were several hundredths of a magnitude lower than that in 1955; and one-quarter, a descending branch, did not change. Almost exactly the same was observed in 1976 with AE Phe, as compared to 1975. Additionally, during the 1976 observations the gradual return to a light-curve very similar to that of 1975 could be followed. It is difficult to believe that the repetition of such a peculiar variation of the light-curve, as observed first in AH Vir and now in AE Phe, should not be caused by a typical property of the close binary model. But to answer the question what really happens within these systems, many more observations, photometric as well as spectrographic, are needed.

What Does the Helium Abundance in Young Stars Tell Us About the Universe?

Dr. Poul Erik Nissen from the Astronomical Institute of the Århus University in Denmark has recently used the ESO 1-metre telescope to investigate the very early moments of the Universe just after the "Big Bang"! Many people may wonder how a comparatively small telescope can penetrate into the area of astronomy that is normally reserved for the largest telescopes. The surprising answer is given by Dr. Nissen in the following introduction to the theoretical and practical aspects of his programme:

According to current cosmological theories the Universe has expanded from a hot dense state—the so-called "Big Bang Primeval Fireball". The isotropic microwave background radiation can be explained as emitted from this Fireball and cooled down to a temperature of 3 degrees Kelvin due to the expansion of the Universe. Furthermore the model of the Fireball predicts that the ratio between the number of helium and hydrogen atoms in the Universe should be in the range from 0.07 to 0.10, which agrees well with the ratio of 0.10 observed for interstellar gas and young stars. However, most of the accurate helium abundance determinations refer to gas and stars that are rather close to the Sun. It is therefore of great interest to extend helium abundance determinations to more distant objects in order to see whether a helium-to-hydrogen ratio of 0.10 is really universal.

The Echelle Spectrophotometer

The helium abundance of O and B stars can be determined from equivalent widths of helium absorption lines. Normally equivalent widths are measured on photographic spectrograms of stars, but this method is cumbersome and limited to the brightest stars. In order to observe the strength of helium lines for rather faint stars I have therefore developed a photoelectric method that is based on the use of the echelle spectrophotometer shown on Fig. 1. In this instrument a spectrum is formed by an echelle grating on a rotatable wheel with different exit slots. The light passing one of the slots is imaged on a photocathode and the intensity measured by pulse-counting techniques. Thus the intensity ratio of nearby spectral bands can be observed just by turning the wheel forth and back. Quite narrow

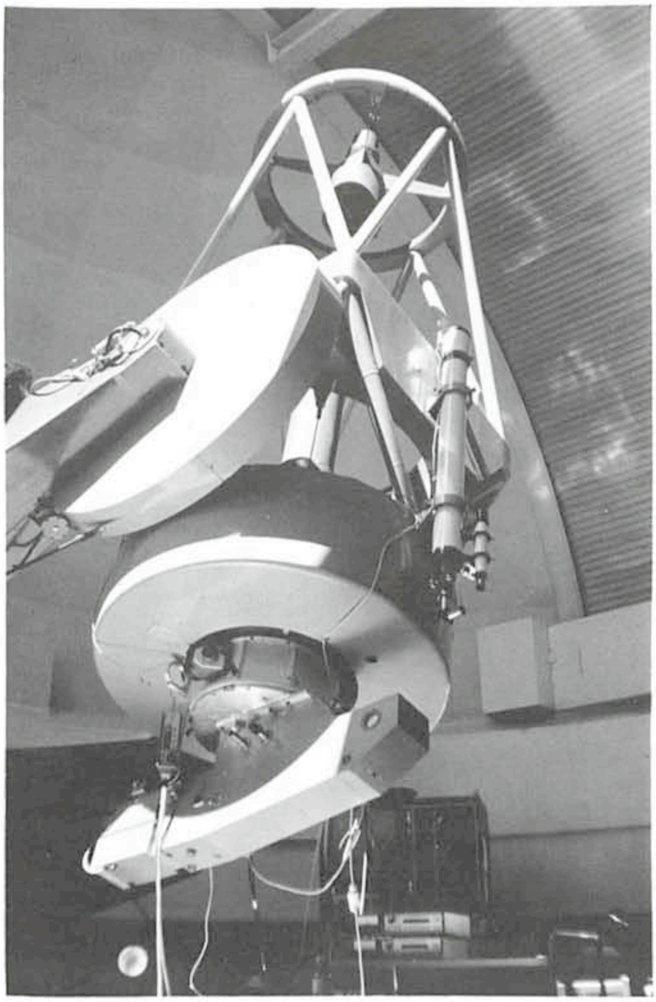

Fig. 1. — *The echelle spectrophotometer attached to the ESO 100-cm telescope on La Silla.*

spectral bands can be accurately defined, because of the high linear dispersion of the instrument (2 Å/mm). In the case of the helium abundance observations, the stellar flux in a 14 Å wide band centred on the strong helium absorption line at 4026 Å is first measured. Then the combined flux of two 6 Å wide continuum bands on each side of the helium line is measured. The ratio of the two measurements expressed in magnitudes, i.e. I(4026) = 2.5 log (flux ratio), is then an index of the equivalent width of the helium line, because the flux in the line band decreases with increasing strength of the absorption line. Normally 10^5 photons are counted in the two spectral regions, which takes half an hour of integration time for a 10th magnitude star observed with the 100-cm telescope on La Silla. The corresponding accuracy of I(4026) is 0.005 magnitude.

Models

In order to derive the helium-to-hydrogen ratio of a star, I(4026) is compared with the β index, that is a measure of the strength of the H_β hydrogen absorption line. From models of stellar atmospheres with different values of the effective temperature, the surface acceleration and the helium-to-hydrogen ratio, one can compute relations between I(4026) and β. Fig. 2 shows such relations for 3 different values of the helium-to-hydrogen ratio. From left to right along a given curve the effective temperature decreases from 30,000°K to 20,000°K, which corresponds to the spectral range B0–B3. The curves of constant helium-to-hydrogen ratio are not affected very much by a change in the surface acceleration, and furthermore the diagram is used only for young stars that lie on the main-sequence, i.e. with nearly the same value of the surface acceleration.

Observations

The observations of I(4026) have been obtained with the 193-cm telescope at Observatoire de Haute-Provence, France, and the ESO 100-cm telescope on La Silla. They include several hundred northern and southern B stars, most of them members of clusters or associations. As an example the observations of I(4026) and β for stars in the h + χ Persei cluster and in the Scorpio-Centaurus association are shown in Fig. 2. It is seen that the mean helium-to-hydrogen ratio of stars in Sco-Cen is close to 0.10, whereas the mean value for stars in h + χ Persei is found to be 0.06 ± 0.005.

The other results from the observations may be summarized as follows. Stars in our local region of the Galaxy, i.e. field stars that lie within 500 pc from the Sun, and the Sco-Cen, Orion, and Lacerta associations, have a helium-to-hydrogen ratio of 0.10 ± 0.01. The NGC 6231 cluster, that lies in the Sagittarius spiral arm, 2,000 pc away from the Sun, is also found to have a helium abundance of about 10 %. On the other hand the Cepheus III association and the h + χ Persei cluster, both situated in the outer regions of our galaxy, 1,000 and 2,000 pc away respectively, have a helium-to-hydrogen ratio of 0.06 only. Thus the main conclusion from the work is that a helium-to-hydrogen ratio of 0.10 is *not* universal. Significantly lower values are found in our galaxy.

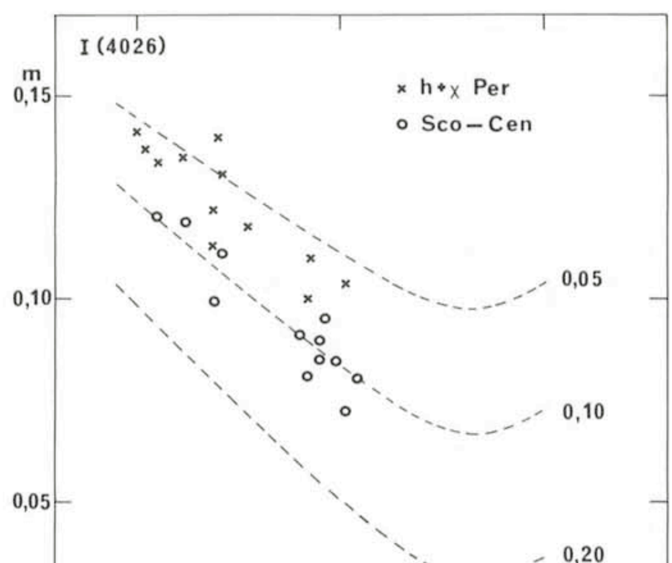

Fig. 2. — *The β-I(4026) diagram for stars in the h + χ Persei cluster and the Scorpio-Centaurus association. The curves give the relation between β and I(4026) as computed for model atmospheres of main-sequence B0–B3 stars with three different values of the helium-to-hydrogen ratio: 0.05, 0.10 and 0.20.*

"Big Bang"

As mentioned in the beginning, the model of the Big Bang Primeval Fireball predicts values of the helium-to-hydrogen ratio from 0.07 to 0.10. The value found in h + χ Persei and the Cepheus III association is slightly out of this range. No mechanisms are known that can deplete the interstellar gas of helium, but in view of the uncertainty of the absolute values of the helium-to-hydrogen ratio, the discrepancy is not serious. The difference in helium abundance that is found between stars in the outer regions of the Galaxy and stars in the local and inner regions is more interesting, because it means that a considerable amount of helium has been formed since the Big Bang Primeval Fireball. Possible sites for this helium production are massive stars or the so-called "little Big Bangs" in the centre of our galaxy.

HD 80383: The Faintest Known β Cep Variable

Until recently no β Cephei stars fainter than 7^m were known, but now observations on La Silla by Dr. Ulrich Haug of the Hamburg Observatory seem to have pushed this limit to 9^m. He found light variations in HD 80383, a faint B star in the southern constellation Vela, which are typical of the β Cep class of hot, pulsating stars. Dr. Haug reports about his interesting discovery:

The high number of β Cephei (or β Canis Maioris) variables among the bright stars allows us to predict β Cephei characteristics for about 5 per cent of all stars of spectral types B0 to B3. Nevertheless there are no confirmed variables of this type among the stars fainter than 7th magnitude.

During my last observing run on La Silla in January 1977 I found that the photometric data for HD 80383 leave almost no doubt that this is a new β Cephei star of about 9th magnitude. HD 80383, which was on my observing list for "interstellar absorption in Vela", was discovered to be variable in 1976. When a period of only 4.45 hours became evident already at the beginning of my observations in 1977, many measurements were made during each available night. Very quickly the amplitudes of the light variations turned out to be variable. This excludes the possibility of an eclipsing or aspect variable double star. But both the period and the beat period (about 10 days) make the classification as a β Cephei star highly probable.

This is also supported by a discussion of the photometric parameters given in the table for the variable and another B-type star in my Vela programme which is being used as comparison, CPD -54° 2147.

M_{bol} and log T_{eff} can be calculated either from UBV and β according to relations applied to other β Cephei stars by Lesh and Aizenman (*Astron. & Astrophys.* **22,** 229 (1973)) or from uvby and β according to similar relations used by J. Scott Shaw (*Astron. & Astrophys.* **41,** 367 (1975)). The results, $M_{bol} \approx -5.4$ and log $T_{eff} \approx 4.35$, show that HD 80383 is situated well above the main-sequence in the Hertzsprung-Russell-Diagram, in a domain known as "the instability strip" of β Cephei stars.

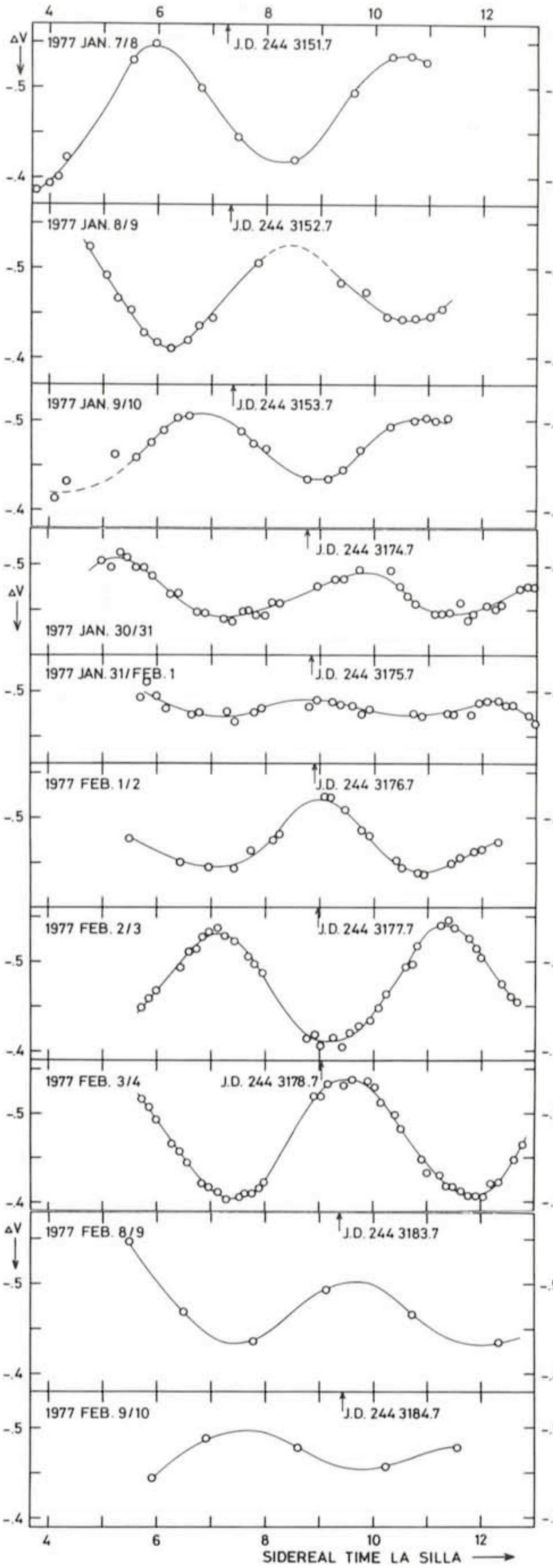

Fig. 1. — *Light variation of the new β Cep variable HD 80383 on ten nights. The difference ΔV = V (HD 80383)–V (CPD -54° 2147) is adopted from the on-line V measurements. Note how the amplitude is variable and how the beat phenomenon may be recognized, in particular on the nights of Jan. 31/Feb. 1 and Feb. 9/10.*