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The Dutch Telescope on La Silla

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> *Welcome to La Silla!*
>
> *As the latest newcomer in the family of telescopes at ESO, the Dutch 90 cm "Lightcollector" has now been installed and, as expected, it performs very well in its new environment. Dr. Jan Lub from ESO/Chile is in charge of this instrument and reports about its transfer from the African to the South American continent. His article also contains important information for all prospective users.*

The 90 cm photometric telescope of the Leiden Southern Station, better known as the *Lightcollector,* was transferred from South Africa to Chile during the fall of 1978. When, on December 1978, the agreement between ESO and the Stichting Leids Sterrewacht Fonds, owner of the *Lightcollector,* was signed in Leiden, the telescope had already arrived on La Silla. The same team responsible for its dismantling in September 1978, viz Messrs. A. de Jong and G.v.d. Nagel of the Leiden workshop and D.F. Stevenson, electronician and manager of the Leiden Southern Station, also took care of the reconstruction of the telescope and its peripherals. They could start work by mid-January 1979 in the old 1 m dome (also known as the *Chilimap* dome) and the project was substantially finished during the first days of March. Simultaneously ESO had an extension to the dome constructed in order to provide some office and storage space. After the final astronomical tests of telescope and equipment by Dr. J.W. Pel (Roden) and the author, regular observations could be started again by the end of March after an interruption of less than seven months! Unfortunately this was just at the end of the good period. Figure 1 shows the telescope (in sunlight) in its present state.

The Telescope

Over the years the site in South Africa on the Republic Observatory Annexe at the Hartebeespoortdam, where the telescope was first erected in 1958, had considerably deteriorated. This was mainly caused by pollution from the nearby big cities of Pretoria and Johannesburg. The discussion to look for a new site had been going on for some time in Leiden and it was finally concluded that the best solution would be to seek from ESO an arrangement such as that already existing for the Danish national telescopes. An important consideration was here the near equality of the latitudes of Hartebeespoort (–25°46') vs. La Silla (–29°15'). This would require that a new pillar would have to be only slightly inclined.

ESO and the Dutch astronomical community will each have access to 50 % of the available time, evenly distributed over the year. It is hoped that the presence of the *Lightcollector* will take some pressure off the heavily oversubscribed ESO 1 m photometric telescope.

The telescope and its control-and-drive system were built by Rademakers (Rotterdam) and the Leiden workshop in 1955. It can be considered as a prototype of the well-known ESO 1 m telescope. Some technical/optical data are collected in the table below.

Lightcollector Technical Data	
Cassegrain fork mounting	
Dall-Kirkham optics	
Primary diameter:	90.8 cm
Secondary diameter:	24.9 cm
Overall focal ratio:	F/13.8
Usable (uncorrected) field:	5′
Setting speed:	100°/min
Pointing accuracy:	20″
Clearance in fork:	83 cm
Maximum weight of instruments	~ 100 kg

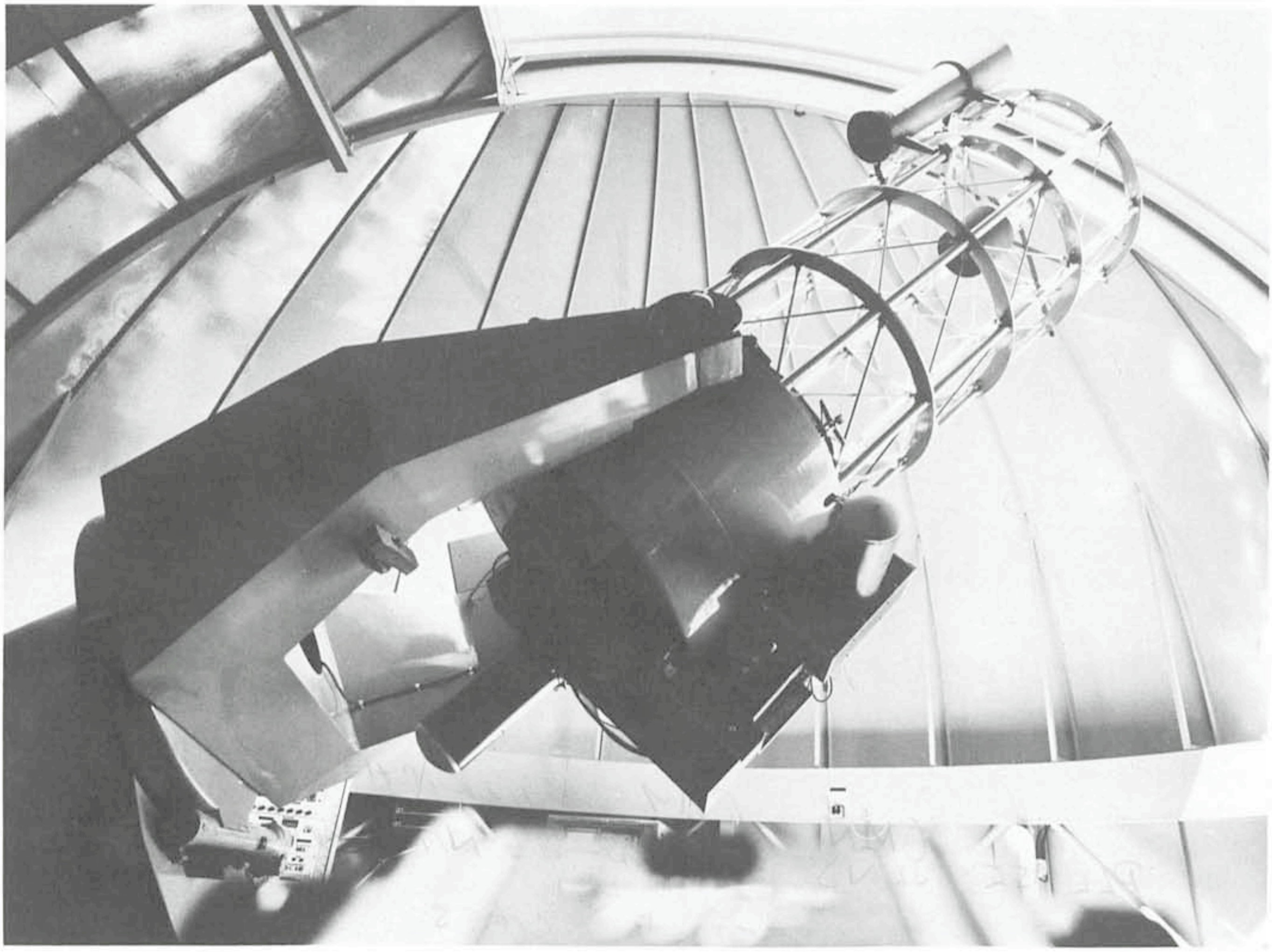

Fig. 1: *The Lightcollector.*

An important design consideration has been to provide a fast, accurately pointing and efficient telescope. These expectations it has amply fulfilled during more than 20 years of service in South Africa. The telescope control is particularly convenient in that coordinates can be preset on a set of dials while a measurement is going on. When it is finished, the telescope will move automatically to the new position. The mechanical functioning has been rather smooth up to now on La Silla.

The Walraven Photometer

Since 1958 the *Lightcollector* has been mainly used with its standard instrument: the five-channel simultaneous Walraven photometer. As can be seen in figure 2 this photometer looks as if it were built around the telescope. The principles of this spectrophotometer have been first described by the Walravens (Walraven, Th. and Walraven, J.H., 1960, *Bull. Astron. Inst. of the Netherlands,* **15,** 67). The data-acquisition system is still largely the same as described by Rijf, Tinbergen and Walraven, 1969, *Bull. Astron. Inst. of the Netherlands,* **20,** 279, with the provision that since 1975 the data are no longer recorded on paper tape but on two cassette-units. We also refer to their paper for further technical details, which would lead us much too far here, and urge prospective users to carefully read their work.

We now briefly describe the working of the photometer (see figure 2 for the general layout). The light first passes a turnable prism which deflects it either towards the eyepiece or towards the photometer. In the latter case, the light passes through the beamsplitter which makes two complementary beams of light and dark bands. One beam then passes through two quartz prisms, dispersing the light and deflecting it upwards along the telescope tube and is then imaged by the condensor. The resulting spectrum is cut at the dark bands by little prisms to give four photometric bands: V, B, U, W, and then reaches four photomultipliers, two on each side of the spectrograph, mounted in dry-ice-cooled dewars. In this way seeing variations do not have any influence upon the form of the passbands. Moreover, the light efficiency is very high due to the use of quartz elements (especially important in the ultraviolet). The second beam is deflected downwards into a third dewar. Using a glass filter the photometric L-band is selected.

During the transport of the telescope from South Africa to Chile, the photometer was flown back to Holland, where Dr. J.W. Pel and the Roden workshop carried out a long-needed revision. The lower part of the photometer was made easily removable, whereas the part along the telescope tube was restructured so that it will remain forever attached to the telescope and needs no realignment. In this way it will be easy to accommodate other instruments at the Cassegrain focus. Dr. Pel also recalculated the optical light-path in the instrument and this proved highly useful when the whole photometer was realigned on La Silla using a laser. Measurements and calculations showed perfect agreement.

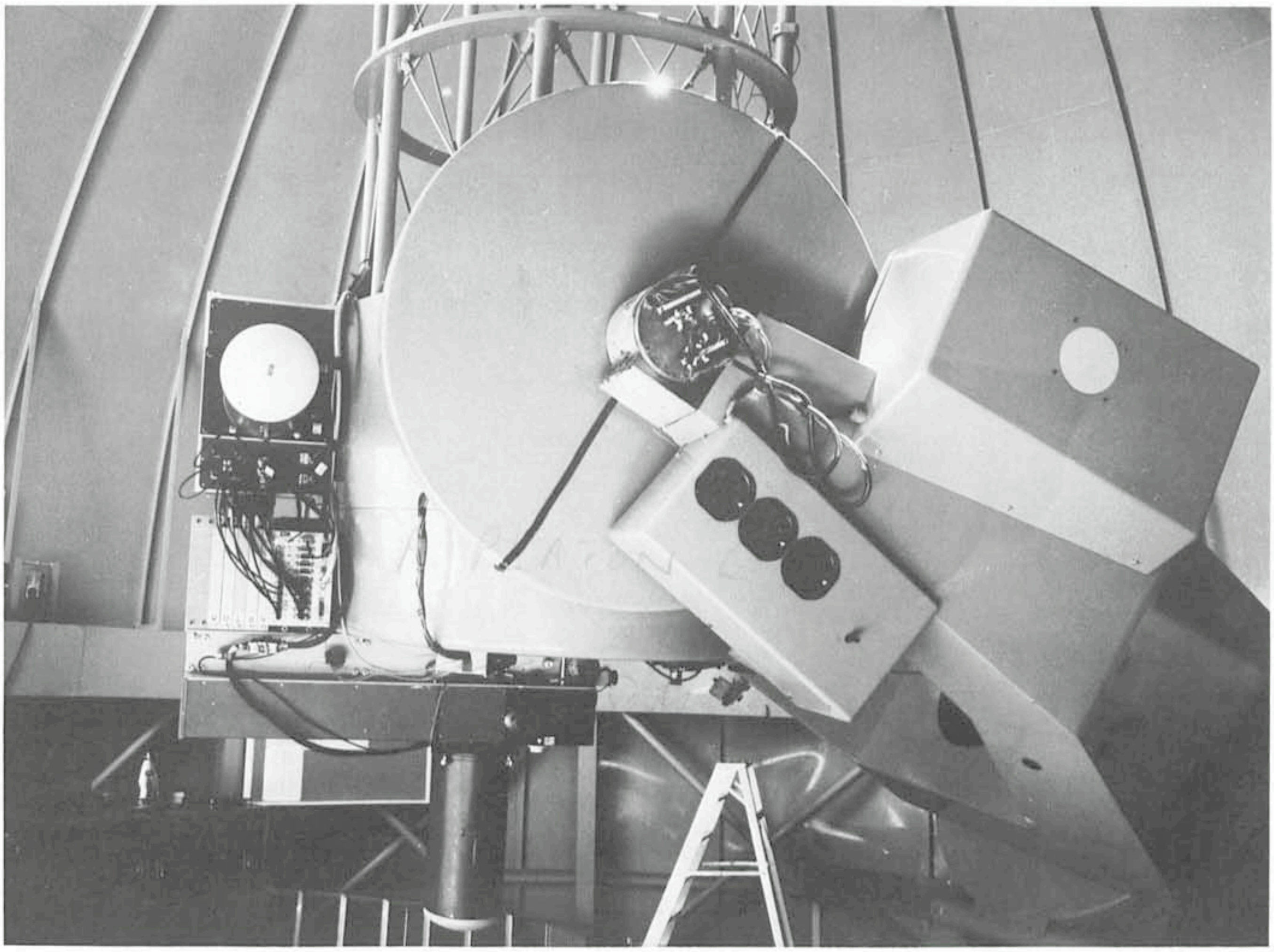

Fig. 2: *The Walraven photometer. One sees the L-form of the photometer. The dewar containing the L-photocell sticks out below and the one containing the B–W-photocells protrudes forward. The eyepiece is directly below the telescope axis. Further visible are declination motor and worm.*

The data acquisition is based upon a DC-mode operation. To each photomultiplier there belongs one integrator which incorporates a set of three auto-ranging condensors. When a measurement is finished these five integrators are read out sequentially by a digital voltmeter. Each measurement normally consists of two such integrations; in between and afterwards the integrators are shorted automatically. This causes a delay of at most 4 seconds, so that this is a kind of minimum useful integration time. For very bright stars a mechanical optical attenuator—a rotating drum with slots—can be introduced into the light beam giving roughly 3^m attenuation. In this way a dynamic range of 2^m to 15^m is assured. The system is capable of an overall accuracy of 1‰. Reduction of the measurements is at present only possible in Leiden; facilities have been made available to ESO observers (contact Dr. J. Tinbergen, Sterrewacht, Leiden).

Telescope Performance on La Silla

With new and more sensitive photomultipliers (Hamamatsu R928 S-20 sidewindow, replacing the 20(!)-year-old set of IP21), freshly aluminized mirrors and the better transparency on La Silla, a substantial gain in sensitivity, especially in the ultra-violet, was predicted. This agreed with the author's extensive tests in April. All these improvements have slightly changed the photometric pass-bands as published by Lub and Pel (*Astron. Astrophys.*, **54**, 137, 1977), the new values are summarized below in table 1. These data were determined in two ways: first from the known properties of the beamsplitter (Pel and Lub, in preparation) and, second, by scanning through the spectrum with a narrow slit. From stars of known absolute energy distribution and a range of spectral types one can then determine the zeropoints of transmission from the spectral features visible. Agreement exists to within a few Ångstroms between both methods. As an illustration of the high transparency on La Silla I mention that we still measure quite some flux at 3100 Å.

Relative transmission	V	B	L	U	W
0	(6600)	4783	(4190)	3894	3398
1/2	5783	4494	3952	3735	3313
1	5413	4262	3845	3614	3232
1/2	5078	4062	3738	3504	3157
0	4783	3894	3616	3398	3073
λ_{eff}	5422	4270	3845	3617	3234
Band-width	705	432	214	231	156

Table 1: *The present Walraven pass-bands as determined by Lub and Pel (La Silla, March 1979). All wavelengths are in Ångstroms.*

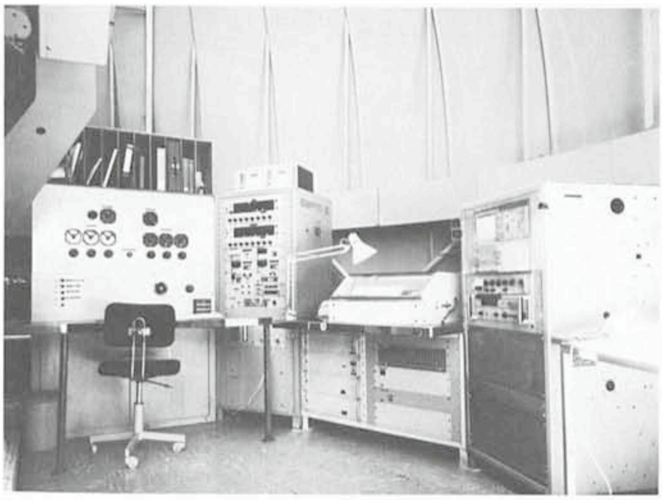

Fig. 3: *Overview of telescope control and data acquisition. To the left the telescope controls; in the middle the data-acquisition rack—on top of which the two cassette-units—and the IBM typewriter/printer.*

The filter system was conceived by Dr. Walraven in order to be able to measure properties of the continuous and line spectrum in stars of spectral type O to middle G which relate directly to effective temperature and surface gravity and, as it turns out, also to heavy-element-line blanketing. The central wavelengths of his five bands were chosen to match the well-known Paris (or Barbier-Chalonge-Divan) classification based on spectrophotometry on photographic spectrograms. Not surprisingly, the possibilities with the VBLUW or Walraven system are in many ways the same as with the well-known Strömgren uvbyHβ system. I refer to the above-mentioned paper by Lub and Pel for more details. Important applications have been to pulsating variable stars (Pel, Lub); the highly luminous OB supergiants in the Magellanic Clouds (Walraven and Walraven) and X-ray binaries (van Genderen and van Paradijs). References may be found in my paper in the 1979 Albany Workshop on *Problems of Calibration of Multicolour Photometric Systems,* edited by A.G. Davis Philip, Dudley Observatory Report No. 14.

I hope to have given a flavour of the possibilities of the present instrumentation on the Dutch telescope. Before long, ESO will install a computer, tape unit and fast printer for faster data acquisition and, possibly, on-line reduction. However, the complete reduction, including the analysis of the linearity of the digital voltmeter still has to be done in Leiden. During 1980 ESO will construct a (high-speed) one-channel photometer for the standard photometric systems such as UBVRI (Cousins) or uvbyHβ. Compatibility with other equipment on La Silla will be assured. Until this is finished the Walraven photometer is the only instrument available to visitors.

Acknowledgements

We wish to thank the Board of Directors of the Stichting Leids Sterrewacht Fonds for permission to give new life to the *Lightcollector* on La Silla. We would like to mention in particular the support given by Prof. A. Blaauw and Dr. J. Tinbergen of Leiden Observatory. The collaboration of Messrs. A. de Jong and G.v. d. Nagel during the reconstruction phase was always a great pleasure; they cheerfully and ably solved all arising small mechanical problems. Dr. J.W. Pel did a fantastic job on the photometer and the optics. ESO staff did as much as they could to provide additional support.

28 Canis Majoris—a Short-period Be Star

D. Baade

Are Be stars nothing but β Cephei stars? This far-reaching possibility is supported by new observations of the Be star 28 CMa, which shows spectral variations with a period of 1.36 days. Dr. Dietrich Baade of the Astronomical Institute of the University of Münster, FRG, recently obtained spectra of this star with the large coudé spectrograph at the ESO 1.52 m telescope. Here is his report about this important discovery.

Among the confusing variety of stars with unusual properties, Be stars probably form the group with the largest number of known members. This is in part due to their high intensive brightness. But the fact that 10 to 15 per cent of all non-supergiant stars of spectral type B exhibit emission lines also shows that the Be phenomenon is important. Moreover, Be stars are quite attractive objects for observations, since most of them undergo unpredictable spectral and photometric variations, which in some cases are fairly drastic. Nevertheless, Be stars are far from being understood.

Some Empirical Aspects of Be Stars

The main reason for this lack of comprehension is exactly the irregularity in the behaviour of nearly all Be stars. Thus, observations of individual stars normally are not expected to contribute much to the improvement of models for Be stars. Only statistical treatment made it possible to derive several types of variability representative for the Be phenomenon. Erratic long- and short-term photometric variations with amplitudes up to several tenths and a few hundredths of a magnitude, respectively, are common. Most important, however, are the spectroscopic changes, among them the characteristic V/R variations, i.e. the changing relative equivalent widths of the blue and red components of double-peaked emission lines.

V/R variations are in many cases cyclic but not strictly periodic. The duration of a (long) cycle differs from star to star within the range of 100 days to several years. The longer the cycle, the fewer cycles occur before the variation ceases gradually or abruptly. Short cycle lengths in the range of minutes or even seconds are reported for an increasing number of stars. They are, however, even less stable and have in no case been confirmed by a second series of observations.