



The Danish 1.5 m Telescope in Operation!

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On November 20, 1978, Danish astronomy passed a milestone: The Danish 1.5 m telescope on La Silla made its first astronomical observations. This marks the beginning of an era we have long looked forward to, when this powerful new tool will vastly increase the scope as well as the extent of our possibilities for research in the southern hemisphere.

The early history of the Danish telescope project and its progress are described in the ESO Annual Reports from 1970 and onwards, and will not be repeated here. We believe readers of the *Messenger* will take more interest in the pos-

sibilities offered in the future, when after a test period the telescope will become available to ESO staff and visitors half of the time.

The Telescope

The telescope mounting, built by the company of Grubb Parsons, Newcastle, England, is of the asymmetrical type, closely resembling the 1.5 m telescope on Cerro Tololo. The drive employs large worm gears on both axes, with torque motors mounted directly on the worm shaft. A 500-kg mechanical preload applied through steel wires eliminates gear backlash. The tube is a classical open Serrurier structure. Primary mirror support is by astatic levers, radial support by levers acting in push-pull on brackets cemented to the edge of the mirror. There is no provision for changing secondary mirrors, as the Ritchey-Chrétien focal station is the only one used. This allows a simpler and more rigid mechanical design and greatly assists in maintaining accurate optical alignment. The telescope is capable of carrying auxiliary instruments weighing up to about 250 kg.

The Optics

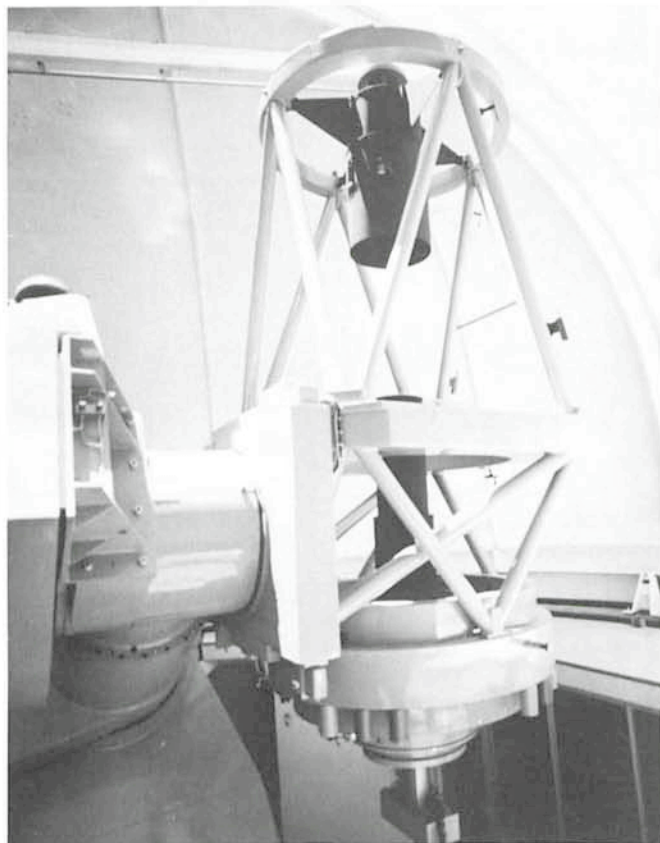
The optical system is a classical Ritchey-Chrétien configuration, with a primary mirror of 154 cm diameter, primary focal ratio $f/3.5$, and final focal ratio $f/8.6$. The focal length is thus close to 13 m, and the plate scale $16''/\text{mm}$. The usable uncorrected field is about 80 mm in diameter ($20'$), with a



This is one of the first photographs obtained with the new Danish 1.5 m telescope on La Silla. It shows the nebula NGC 2081 in the Large Magellanic Cloud and was made with the 9 cm McMullan electronographic camera at the Cassegrain focus, on Ilford G5 emulsion behind a sky limiting filter (DSB = "Dark Sky Blue", central wavelength 4900 Å and width 800 Å). The exposure time was 30 min, and the picture shows fainter details than a similar 15 min direct photograph of the same object from the 3.6 m telescope.

Further observing programmes for the 25 m VLT on page 17.





The new Danish 1.5 m telescope on La Silla.

two-element corrector up to about 200 mm (50'). The optical figuring was also done by Grubb Parsons. The contract specifications as well as the very comprehensive acceptance tests were drawn up in close collaboration with the Optics Group at ESO TP Division, based on their extensive experience from the testing of the ESO 3.6 m telescope. Laboratory tests of the mirrors, both separately and in combination, show a concentration of geometrical energy of 80 % in $0''.45$, an excellent result. The stellar images obtained during the test observations are quite satisfactory, but entirely limited by seeing which up to now has not been brilliant. Hartmann tests of the optics in the telescope will be made for a final assessment of the optical quality.

Small collimation mirrors cemented to the telescope mirrors enable us to rapidly and accurately check the alignment of the mirrors at any time. Utilizing these and other special accessories in a systematic alignment procedure also worked out together with Optics Group, the mirrors were aligned in the telescope so as to produce an E-W collimation error of less than $15''$ and a decentering coma of only $0''.1$. Tests with the telescope at 45° zenith distance N,S,E and W show that the combined effects of flexure in tube and mirror support produce a total of less than $0''.25$ of coma. We have every reason to believe that the telescope is able to take full advantage of even the nights of very best seeing.

Control and Guiding System

The computer control system for the telescope, complete with its torque motors and encoders, was built by the Controls Group at ESO TP Division. It is of the same general type as that for the ESO 3.6 m, and closely similar to those long in use at the ESO 50 cm, 1 m, and Schmidt telescopes, which simplifies its use and maintenance. Its general features (pre-setting, files of programme stars, observer control of tele-

scope speeds, etc.) will therefore also be familiar to most readers. Pointing corrections for mechanical and optical misalignment or for flexure are not yet included, but the pointing accuracy is already of the order of $10\text{--}15''$. All control and acquisition electronics and their terminals are located partly in a room on the floor below, partly in a small control room on the observing floor with a large window overlooking the observing area.

The optical characteristics of the telescope make it especially suitable for direct observations with photographic as well as more advanced detectors. For sufficiently accurate guiding of long exposures an automatic guiding system is essential, particularly because the asymmetric mounting of our telescope makes access to the focus inconvenient—to say the least—in many positions of the telescope. Since we had a common interest in the development of automatic guiders, ESO and we entered a collaboration whereby the Copenhagen University Observatory supplied the mechanical, optical and electronic hardware, and ESO, in the person of ESO programmer Alain Perrigouard, the software.

In the autoguider actually built into the Cassegrain adaptor, a movable probe picks up the light from a guide star near the edge of the field and sends it to an image dissector tube, which performs a cross-scan in the α and δ directions. If the star is not centered, the photon counts are combined to form an error signal, which after suitable checks for statistical significance is fed into the control system to correct the position of the telescope. Our laboratory measurements indicated that the device should be able to guide to an accuracy of $0''.1$ on stars as faint as 14^m and practical operation to now seems to confirm this figure.

Auxiliary Instruments

The agreement signed with ESO, and approved by the ESO Council, specifies that the telescope, complete with optics and control system, and the dome are supplied by the University of Copenhagen, and the building by ESO. It is further laid down that after an initial period of testing, ESO and Danish observers will each have half of the observing time, ESO being responsible for maintenance of the telescope, and that each side will provide its own auxiliary instruments.

Discussions are pending with the ESO Directorate concerning arrangements under which some or all the Danish auxiliary instruments might become available also to future ESO observers. At the moment, we shall therefore just briefly list those existing or under design and construction:



Spiral galaxy NGC 1637, photographed with the 4 cm McMullan electronographic camera. Ilford G5 emulsion, DSB filter. This 45 min exposure provides more detailed information about the central region than the $200''$ reproduction in the Hubble Atlas of Galaxies.



Omega Centauri, the brightest globular cluster in the sky. 10 min exposure in (Johnson) V colour. The plate was taken by S. Frandsen and B. Thomsen for the purpose of checking the electron optics, in particular the acceleration potential. There is therefore a slight elongation of the images at the edges.

An instrument adaptor with field and slit viewing optics, focusing, and autoguider; a Quantex integrating ISEC TV camera acquisition and guiding system; a small-field (80 mm) photographic camera (ESO is planning a large-field camera); 4 and 9 cm McMullan electronographic cameras with filter and shutter unit; multichannel *uvby* and $H\beta$ photometers similar to those already in use at the Danish 50 cm telescope on La Silla; a two-channel (star + sky) general filter photometer; the existing Echelle Line Intensity Spectrometer (ELIS); and a fully computerized instrument-control/photon-counting/data-acquisition system for all these.

We are collaborating with the Geneva and Marseille observatories and with ESO to use a copy of the radial-velocity scanner CORAVEL on our telescope, and the spare Boller and Chivens spectrograph for the 3.6 m should also occasionally become available. Finally, ESO has provided an

Reappointment of Director-General

The ESO Council, at its 33rd meeting on December 7, 1978, reappointed Professor L. Woltjer as Director-General of ESO for another five-year term (1980—1984).

HP-1000 computer system with disk and magnetic tape for data acquisition.

Future Programmes

At the moment, the telescope is in the testing phase where it is used by Danish observers, partly to obtain useful observations, but primarily to gain experience and find as many of its weak points as possible. Unavoidably, with a complex telescope system like this, in a dome with quite limited space, there have already been and will be many unforeseen problems which must be solved before we reach the level of stability and safety required for operation by visitors. And, as always, it is difficult to predict the time needed to solve unknown problems!

Nevertheless, the excellent quality of the long electronographic exposures already obtained, of which three are shown here, is a proof that a powerful tool is now at our hands. It will be used to continue and expand our various research programmes on Galactic structure, but the new opportunities for extragalactic work now at our disposal will not be neglected, as witnessed by the many programmes presently in preparation.

Acknowledgements

The project was kept alive through long years of technical and financial adversities by the enthusiasm and perseverance of Professors B. Strömberg and A. Reiz. We express our appreciation to the firm of Grubb Parsons for their excellent craftsmanship and cooperation, and to all parts of ESO for much help during the project—in particular to F. Franza, M. Le Luyer, A. Perrigouard, and R. Wilson of TP Division, whose expertise and enjoyable collaboration has been a constant source of pleasure.

Naming Minor Planets

According to old tradition, the discoverer of a minor planet has the right to give it a name. Nowadays, a minor planet is considered as "discovered" and worthy of receiving a number and a name, when it has been observed in at least three oppositions.

Discoveries of minor planets with the ESO Schmidt telescope started in 1975, when plates were taken near Ecliptica. Some of these planets have in the meantime been reobserved at ESO and other observatories and recently, some were observed in the third opposition. More will be coming during the next months.

The first ESO-discovered planet to be named was found on a plate that was obtained in February 1976, by Hans-Emil Schuster, in charge of the ESO Schmidt telescope. Its preliminary designation was 1976 DA. It received the number (2105) and has been named GUDY by the discoverer. The Minor Planet Circulars contain the following dedication: "Named by the discoverer for Mrs.

Gudrun Werner of Hamburg in sentimental reminiscence of college days. This Phocaea-type minor planet was found on the same blue survey plate as the large-perihelion comet Schuster 1975 II".

Minor planet 1978 AC was discovered in January 1978 by ESO astronomer Richard West. It was observed at various occasions in 1978 and on the basis of a preliminary orbit calculation, Dr. Conrad Bardwell of the Minor Planet Bureau in Cambridge, Mass., USA, was able to prove that it was identical to 1936 VJ, 1951 YJ1 and 1975 VW8. These observations were made in Nice, France (1936), Fort Davis, Texas, USA (1951), and Crimea, USSR (1975), but were too few to establish the orbit. The ESO observations therefore count as the discovery, and since 1978 AC has already been observed in four oppositions, it has now received number (2117). Although a sample of two cases may not be statistically significant, sentimental reasons seem to prevail; this planet is now called DANMARK and the dedication reads: "Named in honour of the country of origin of the discoverer."