who spent some months of 1977 with ESO in Geneva, the brightness distribution is quite different in these two galaxies. This was the reason why a series of photographs centred on the group was taken by Svend Laustsen with the 3.6 m telescope in May 1977.

Figure 1 shows a reproduction of a 90-minute exposure in the prime focus on a baked IIIa-J plate with a GG 385 filter which covers the centre of the cluster. The different character of the two ellipticals may be seen already on this plate. Figure 2 is a 15-minute exposure with the same plate-filter combination. There, we surprisingly found a very marked absorption lane (dark cloud) at the very centre of NGC 3311. A close inspection shows a small bright spot just outside the eastern edge of the dark cloud. Also one may suspect an extremely narrow luminous bridge crossing the absorption lane from south-east to north-west, although this should be confirmed on other short exposures in very good seeing.

Malcolm Smith and Daniel Weedman (*Astrophys. Journ.* **205,** 709, 1976) using the 4 m telescope at Cerro Tololo discovered a large number of globular clusters surrounding NGC 3311 appearing at a magnitude of B $\approx$ 23.5–24. This halo of globular clusters is well seen in Figure 1, thus indicating the limiting magnitude of this 3.6 m plate.

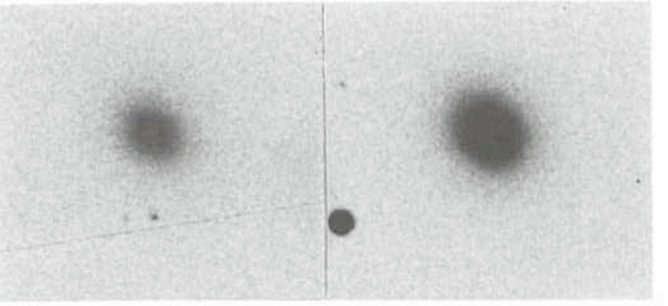
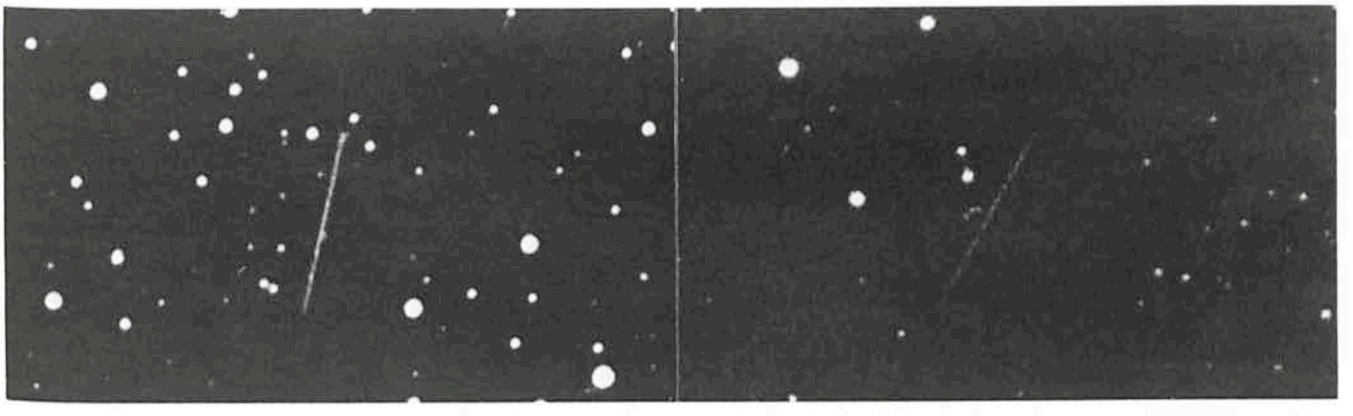


Fig. 2. — *The centres of NGC 3311 (left) and NGC 3309. The small dark cloud in 3311 is readily seen. 15-min exposure on IIIa-J + GG 385, ESO 3.6 m telescope.*

The cluster Abell 1060 is a relatively weak X-ray source with a large error box and with a luminosity of $1.5 \cdot 10^{43}$ ergs/s which is similar to that of the Virgo cluster.

The cluster is also a radio source. While the original Ohio position is more than half a degree off the cluster, M. Disney and J. Wall (1977, *Monthly Notices Roy. Astron. Soc.* **179,** 235) have now derived a new position with the Parkes telescope. The source is situated in the immediate neighbourhood of the two elliptical galaxies .

Latest Asteroid Discoveries at ESO



Two new minor planets were discovered with the ESO Schmidt telescope in April-May 1977. The photos show the discovery trails. To the left is that of MP 1977 HD which was seen on a 90-min red plate, obtained on April 27. It is remarkable because of its southern declination: it reached –67° in June. MP 1977 JA (to the right) was discovered on May 15. Both have very unusual orbits; 1977 HD belongs to the very rare Pallas *type (high inclination, semi-major axis 2.7 Astronomical Units) and 1977 JA is of* Phocaea *type (high inclination, semi-major axis 2.3 A.U.). Discoverer of both was ESO astronomer H.-E. Schuster.*

Design of the Coudé Auxiliary Telescope (CAT)

A unique feature of the ESO 3.6 m telescope is the Coudé Auxiliary Telescope that will feed the large coudé spectrograph. The design of the CAT is now virtually finished and ESO engineer Torben Andersen from Geneva reports:

Coudé Auxiliary Telescope

The ESO 3.6 m telescope will be equipped with a coudé spectrograph. Whenever the telescope is used in Cassegrain or prime focus, it would not be possible to use the coudé spectrograph unless another means of collecting star light were available. To provide a second light source for the spectrograph, a coudé auxiliary telescope (CAT) will be built and installed close to the 3.6 m telescope.

A model of the CAT is shown on Fig. 1. The telescope will be placed in a 24 m high tower (Fig. 2) which is already erected close to the 3.6 m building. The CAT will have an alt-alt mounting. This permits the exit light beam (passing through the hollow shaft of the south bearing) to remain on a fixed axis during its passage to the coudé spectrograph of the 3.6 m telescope. The light will pass from the CAT tower to the 3.6 m building within a steel tube, thereby preventing air turbulence between the buildings from deteriorating the optical quality.

Configuration

The CAT is primarily intended for spectroscopic use. Although a photometer could eventually be mounted on the centre section (in a Nasmyth mounting), it is unlikely that this will happen during the first years of operation.

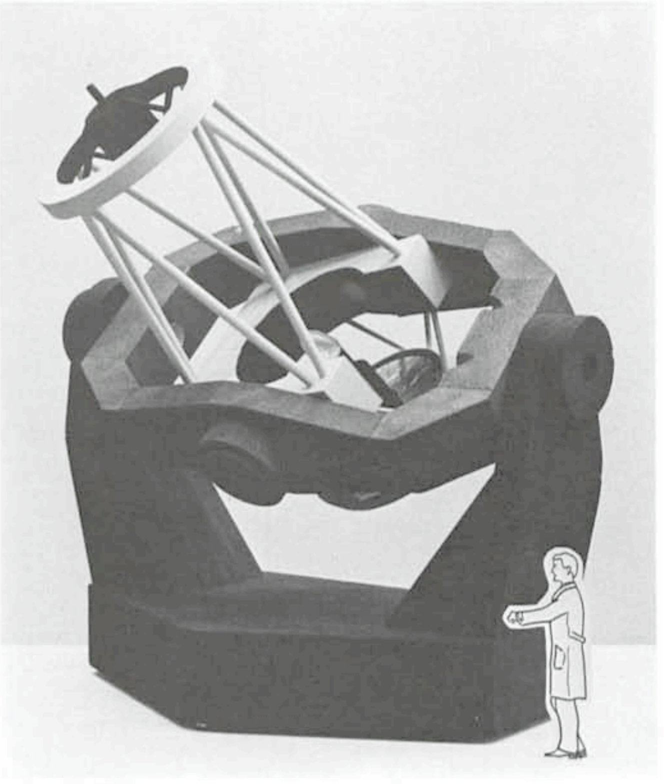


Fig. 1. — *Model photo of the coudé auxiliary telescope.*

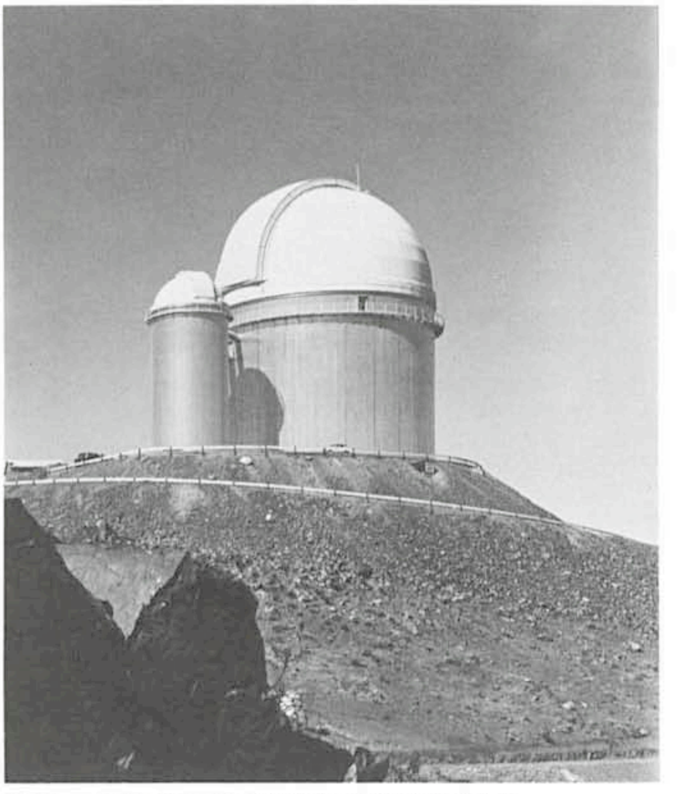


Fig. 2. — *3.6 m telescope building with CAT tower.*

The CAT will be equipped with a total of six mirrors. The primary will have a diameter of 1.47 m and a thickness of 19 cm. There will be four secondaries mounted on a turret. These mirrors will all have the same geometry, however three of them will be dielectrically coated (for different colours), and one will be integral. The observer may choose the mirror that suits his application best by remote control. Mirror 3, which is flat, will receive a normal aluminization. During observation, this mirror will turn slowly with respect to the tube to keep the outgoing light-beam fixed in space. The mirror rotation will be performed with a high-precision servomechanism.

The optical layout of the telescope follows the Dall-Kirkham principle with an ellipsoidal primary and spherical secondaries. The telescope will have an f-ratio of f/120. In future the telescope may be used at this f-ratio, but its immediate use will be with a focal reducer converting to f/32 (as for the 3.6 m telescope). The field of the CAT will be approximately 2 arcminutes.

The CAT will have an alt-alt mounting, the principle of which is clearly seen on Fig. 1. None of the telescope axes will be parallel to the rotational axis of the earth. This will normally require that both axes move during tracking, a feature easily obtained by computer control. The alt-alt mounting leads to a field rotation, which, in most cases, is not important for spectroscopy at the coudé focus.

The telescope tube will have a normal Serrurier structure to support the primary and the secondaries. The flat Nasmyth mirror will be supported by a pedestal which is fixed on the main mirror cell through the central hole of the primary. A counterweight will be added on the lower side of the main mirror cell to counterbalance the weight of the Nasmyth mirror and the pedestal. The counterweight will be attached to the pedestal in such a way that it tends to cancel out angular deflection of the pedestal, leading to a rotation of the Nasmyth mirror.

The tube will be supported by a cradle-formed welded structure via axially preloaded radial groove ball bearings. On one side of the cradle the drive will be mounted, on the other side a safety brake. The drive will be composed of a large Inland torque motor with a peak torque of 414 kpm, an Inland tachogenerator with a sensitivity of 514 V/rad/sec and an Inductosyn incremental encoder with an increment of 0.06 arcsec. All of these components will be coupled directly to the tube-shaft ("δ" axis) without any sort of gearing. Such a configuration is very attractive, since it leads to a stiff and fast servo.

The safety brake on the other side of the cradle will be spring-loaded. In the event of a power failure this brake will prevent the telescope tube from turning in an uncontrolled manner due to unbalance or wind forces.

The rotational axis of the cradle will be almost horizontal and will coincide with the axis of the light-beam path to the spectrograph. Rotation will be carried out with a drive and a safety brake of the same kind as that used for the δ axis. Here also, radial groove ball bearings will be used.

The pedestal supporting the cradle and the tube will be supported on three adjustable feet.

The CAT will be equipped with a computer-control system, which will resemble that of the 3.6 m telescope. It is intended to place the main control panel for remote control of the CAT in the coudé room of the 3.6 m. The computer will continuously control four servomechanisms: two main drives, the Nasmyth mirror drive and the focusing drive. Since the first three require continuous coordination, manual control will not be possible.

The main servos will comprise current-, acceleration-, velocity and position-loops. Finally a guiding loop may be added as required.

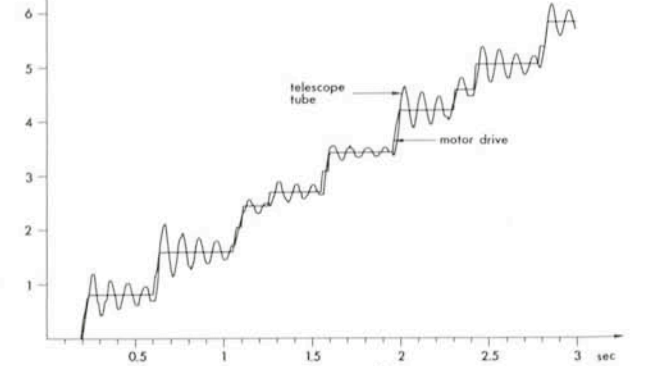


Fig. 3. — *Simulation curve showing how the servo system behaves during tracking if the bearing friction is too high.*

Design Techniques

The CAT will be a telescope of a new generation. It will have a non-traditional mounting and will use direct-drive motors. The design process of this telescope has been facilitated by the fact that modern and effective calculation methods are finding more use and are becoming generally available. In the following a few of the calculations performed during the design will be described.

During tracking the main servos drive the telescope tube about two axes simultaneously. During this activity the velocity of each axis may vary in the range 0-25 arcsec/sec. It is thus sometimes required to run a drive very slowly; the servos must therefore have good slow-running characteristics. To ensure that the selected components (motor, tachogenerator, encoder, etc.) will perform adequately well, some servo calculations were carried out.

A *linear* calculation has given information on the necessary loop gains and on the spectral noise sensitivities of the system. A *non-linear* simulation of the servodrives, using the "Continuous System Modelling Program" from IBM, has given information on transient responses of the drives and on the sensitivity to non-linear effects such as friction.

An example of a curve from such a simulation is seen on Fig. 3. This shows what happens during slow tracking and in the hypothetical case that the bearing friction is far too high. A stick-slip effect would occur and the drive would move in jerks. As a result of this effect and the resilience in the mechanical link between the tube and the drive, an oscillation in the tube position would occur. This curve alone does not give sufficient design information; however, together with a number of similar curves a reasonable evaluation of the proposed servo system is possible.

Experience shows that gravity deflections in a well-designed telescope do not tend to originate from deflection of one single element of the mechanical structure. The displacements of the optical elements normally occur as the result of a large number of minor deflections at different places in the telescope. Therefore, simple calculations, based on models with only a few beams, tend to become too optimistic. This is especially so when the eigenfrequencies of the telescope are computed.

A realistic calculation of the gravity deflections is desirable since it serves as a basis for the design of the structural members of the mechanical construction. A computer analysis of the CAT, to predict gravity deflections and resonant frequencies, has therefore been carried out with a finite element programme called EASE. This programme has calculated deflections and forces in an imaginary structure looking very much like the CAT, but only consisting of beams. Fig. 4 shows the beam approximation model of the telescope. The computer programme has furthermore predicted that the lowest resonant frequency will be around 10 Hz.

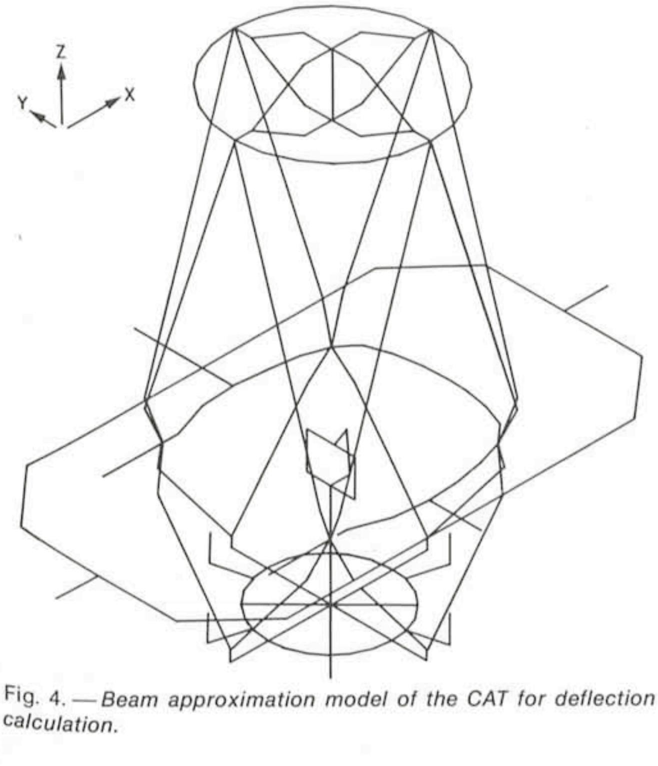


Fig. 4. — *Beam approximation model of the CAT for deflection calculation.*

Due to the use of this optimization technique (and to the use of an alt-alt mounting) the CAT will only weigh 16 tons. This is less than half of the normal weight of a 1.5 m telescope.

The configurations of the mirror cells of the primary and the flat Nasmyth mirror have been calculated by Dr. G. Schwesinger, who is acting as a consultant for ESO on the CAT project. Dr. Schwesinger has calculated that a main mirror cell with 12 axial supports situated on one ring can be used. Nine of these are of the astatic lever-arm type and three are fixed. The radial support system consists of 8 push-pull astatic lever arms carrying the entire load and three temperature-compensated fixed supports carrying no load.

The Nasmyth mirror cell will have 7 axial supports and 1 lateral support in a central hole.

Time Schedule

The mechanics of the CAT are now completely designed and manufacture will start this autumn. This is also the case with the optical elements. The electronic hardware is currently being designed and the parts will soon be manufactured or ordered.

It is planned to perform a test assembly in Geneva in one year from now, i.e. fall 1978. The telescope will go into regular operation in Chile about one year later, around January 1980.

All of ESO/La Silla

ESO photographer Bernard Pillet obtained this aerial photo of La Silla from the "Navajo" plane that ensures the Santiago-Pelícano connection. In the lower left are the bodega and the garage, the "New Pelicano" and the clubhouse. Higher up the mountain is the new astronomy building and the hotel together with the "dormitories". The telescopes on the long, flat ridge are from below: the ESO 50 cm, the Danish 50 cm, the Bochum 61 cm, the 1.52 m, the 1 m, the GPO and the Danish 1.5 m. The Schmidt dome is seen in front of the "old camp" (now removed), next to the new Astroworkshop. Near the watertanks on the lower summit stands the Swiss 40 cm telescope and finally, at the La Silla summit, 2,400 metres above sea level, the 3.6 m telescope with the CAT tower.

After all that talk about the ESO CAT (p. 21) the reader may well need assurance that the ESO dogs are still going strong. The undisputed canine ruler of La Silla, SONIA, poses proudly for a portrait in her tenth year on the mountain. We regret that her principal subject, German shepherd LORD, untimely and in great haste abandoned the studio when certain noises from the nearby ESO kitchen announced the approaching dinner hour.

SONIA, la indiscutible reina entre los caninos en La Silla, posa orgullosa para el fotógrafo con ocasión de su décimo año en el cerro. Lamentamos que su compañero de juego más importante, el pastor alemán LORD, haya abandonado el estudio prematuramente y con gran apuro, cuando ciertos ruidos desde la cercana cocina anunciaban la próxima hora de comida.

ALGUNOS RESUMENES

1962 hasta 1977—15 años ESO

El día 5 de octubre de 1977 la ESO festeja su décimoquinto año de existencia. Con la firma de la Convención de ESO por los representantes de cinco países europeos, nació la ESO el día 5 de octubre de 1962. Fue ratificada un año más tarde, y en el año 1964 se eligió La Silla como lugar para el observatorio. Las observaciones astronómicas comenzaron en el año 1968 con el telescopio fotométrico de 1 m, al cual le han seguido hasta ahora ocho telescopios. más.

El nacimiento de la ESO fue de gran importancia para la astronomía europea, y también en el futuro la organización jugará un papel importante en la astronomía, cuya influencia pasará mucho más allá de los límites de sus países miembros.

El telescopio de 3,6 m de excelente calidad óptica

Para comprobar la calidad óptica del telescopio de 3,6 m, el grupo óptico de ESO ha examinado detalladamente los focos primario y Cassegrain. Como indicado por el Dr. Wilson, jefe del grupo óptico, se encuentran a disposición los resultados preliminares de estas pruebas. Ellos muestran claramente que la óptica del telescopio es casi perfecta, y las esperanzas puestas en el telescopio más grande de la ESO no sólo se han cumplido totalmente, sino que hayan sido probablemente superadas en gran escala.

Los primeros astrónomos visitantes para el telescopio de 3,6 m

Por primera vez el telescopio de 3,6 m es puesto a disposición de los astrónomos visitantes. La demanda fue tan grande que sólo casi la mitad de los programas propuestos pudieron ser aceptados. Fue especialmente satisfactorio el gran interés por la investigación extra-galáctica, la cual hasta ahora había sido solamente posible en forma restringida debido a la falta de telescopios grandes en Europa.

Se descubren dos nuevos sistemas estelares

Durante la evaluación de las placas del telescopio Schmidt para el «ESO (B) Survey» se descubrieron dos sistemas estelares hasta ahora desconocidos. Se encuentran en las constelaciones de Eridanus y Sagittarius. Ambos objetos fueron luego fotografiados con el telescopio de 3,6 m.

El objeto en la constelación de Eridanus (ver pág. 13, fig. 1) podría ser un cúmulo estelar en forma global cuya distancia fue estimada en 300000 hasta 800000 años luz por los astrónomos H.-E. Schuster y R. M. West.

El sistema estelar en la constelación Sagittarius (ver pág. 14, fig. 2) es probablemente una galaxia enana irregular a millones de años luz de distancia.

Para aclarar definitivamente la naturaleza de estos objetos se necesitarán sin embargo más observaciones.

LATEST NEWS

Ariel 5 Confirms LMC X-4 Optical Identification!

Things move fast in astronomy these days. In the last issue of the *Messenger*, Drs. Chevalier and Ilovaisky reported the probable optical identification of the LMC X-4 X-ray source. They found a 1.408-day period in the light-curve of their candidate star. Now, Drs. N.E. White and P.J. Davison of the Mullard Space Science Center report in IAU Circular 3095 (August 18, 1977) that: "Ariel 5 observations during July 15–23 reveal LMC X-4 to eclipse for 0.206 ± 0.008 day every 1.413 ± 0.007 days; mideclipse occurred on July 18.114 ± 0.004 UT. The coincidence of the X-ray period and phase with the optical values (.....) confirms the identification."

ESO, the European Southern Observatory, was created in 1962 to... establish and operate an astronomical observatory in the southern hemisphere, equipped with powerful instruments, with the aim of furthering and organizing collaboration in astronomy... It is supported by six countries: Belgium, Denmark, France, the Federal Republic of Germany, the Netherlands and Sweden. It now operates the La Silla observatory in the Atacama desert, 600 km north of Santiago de Chile, at 2,400 m altitude, where nine telescopes with apertures up to 3.6 m are presently in operation. The astronomical observations on La Silla are carried out by visiting astronomers—mainly from the member countries—and, to some extent, by ESO staff astronomers, often in collaboration with the former.

The ESO Headquarters in Europe will be located in Garching, near Munich, where in 1979 all European activities will be centralized. The Office of the Director-General (mainly the ESO Administration) is already in Garching, whereas the Scientific-Technical Group is still in Geneva, at CERN (European Organization for Nuclear Research), which since 1970 has been the host Organization of ESO's 3.6-m Telescope Project Division.

ESO has about 120 international staff members in Europe and Chile and about 150 local staff members in Santiago and on La Silla. In addition, there are a number of fellows and scientific associates.

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