



# CTIO OPERATIONS

## Site Survey for the GSMT

*Robert Blum, CTIO*

The Giant Segmented-Mirror Telescope (GSMT) is a top priority for the coming decade in optical/infrared (O/IR) ground-based astronomy (as recommended by the McKee–Taylor Decadal Review: *Astronomy and Astrophysics in the New Millennium*). Science objectives and technology development will emerge in the next few years as this 30- to 100-m ground-based telescope project takes shape.

Perhaps more than ever, the detailed selection of a site for the GSMT will be key to the success of its operation. For example, how important will minimizing wind loading on the massive structure be compared to optimizing atmospheric seeing? The former may be one of the key site parameters for the next generation of very large telescopes, while the latter has been the defining characteristic of current 10-m class observatory sites. As conceptual designs for the GSMT become available, compatible site characteristics will be determined and the ideal site defined. The timescale to find such a site is not necessarily short, so the site testing capability and

rationale must be developed in parallel with the telescope concepts.

In order to successfully find the best GSMT site, AURA has established a site survey working group as part of the GSMT conceptual design work being carried out by its New Initiatives Office (NIO). The site survey group is headed by Alistair Walker (CTIO). It draws on expertise from various AURA organizations (e.g., NOAO/CTIO and Gemini), as well as outside sources. The group has already begun collaborating with the European Southern Observatory

(ESO), the University of Tokyo, and private US observatories to share information on site survey strategies, technology, and results.

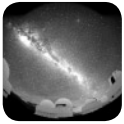
Site selection for the GSMT is currently focusing on northern Chile (detailed characterization of Mauna Kea is also planned to support operations of existing telescopes there). The site survey group is working to determine which properties best characterize a site for the GSMT, given the GSMT's own technological needs and scientific goals. The broader plan is to outline how a large-scale survey can be systematically undertaken to arrive at the best site and then to actually execute the survey. A working outline of the site selection process can be found on the site survey group Web page (<http://www.ctio.noao.edu/sitetests/>).

The first stage of execution of the overall plan is underway, as witnessed by the site group's trip to the Atacama desert in northern Chile in October 2000. The trip was an opportunity to experiment with two pieces of new site testing equipment—a weather tower



*Atmospheric seeing measurements are being made in the Atacama desert of Chile to characterize sites for the Giant Segmented-Mirror Telescope. A robotically controlled differential image motion monitor (DIMM) was used on the 5400-m (17,500 ft) summit of Cerros de Honar. (Photo: Brooke Gregory)*

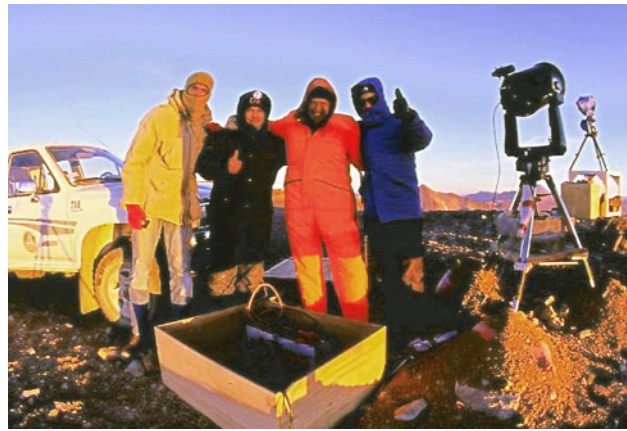
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## *Site Survey continued*

and a differential image motion monitor (DIMM). The final survey will certainly make use of these two instruments for detailed measurements and characterization. The site survey group is thus gaining experience now, and developing reliable technology for the time when the full survey will be conducted.

In making the trip, the site survey group called on our friends at Cornell University (in particular, Riccardo Giovanelli) who are actively characterizing sites on the Chilean national science preserve, known as Chajnantor, for the mid-infrared Large Atacama Telescope (<http://astrosun.tn.cornell.edu/atacama/atacama.html>). This area of the high Atacama desert, located roughly 30 km east of San Pedro de Atacama in the Chilean Andes, is also the site for the Atacama Large Millimeter Array



*The CTIO site survey team celebrates their successful work in the challenging conditions of the high Atacama desert. Left to right: Maxine Boccas, Edison Bustos, Brooke Gregory, and Bob Blum. (Photo: Maxine Boccas)*

(ALMA), a joint venture between the National Radio Astronomy Observatory (NRAO) and ESO (<http://www.mma.nrao.edu>). The site survey group set up a DIMM and a weather tower on the 5400-m summit of the Cerros de Honar ridge near the ALMA site, with the dual goals of operating its first remote DIMM and leaving a remote weather station behind to record basic meteorological data for a minimum three-month period.

The trip was a smashing success for the site survey group. The DIMM, which is described in detail at <http://www.ctio.noao.edu/telescopes/dimm/dimm.html>, is based upon an ESO design by M. Sarazin and F. Roddier (1990, *A&A* 227, 294). The DIMM was operated on parts of four nights, including two nights in which it was left in robotic mode happily making seeing measurements (including acquisition and guiding) on a pre-selected list of targets while the team was sleeping in San Pedro. The robotic mode is particularly important in remote locations like

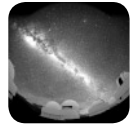
Chajnantor, which tax the human observers to the limit. The weather tower was left logging data from eight sensors (three temperature, pressure, humidity, wind speed, wind direction, and solar radiation). A quick check-up trip on December 23 found the tower to be in excellent shape, despite the harsh Atacama conditions, and taking data on all sensors. A preliminary look at the data downloaded from the tower in December shows wind speeds in excess of 100 km/h. These gusts were recorded on Cerros de Honar and do not necessarily reflect conditions on the ALMA site itself or typical nighttime conditions.

The working conditions on Honar are difficult, owing to the high altitude of 5400 m (17,500 ft). A typical day/night (not including the final nights when the DIMM was operated robotically) consists of four to six hours on site, with three to four hours in transit to and from San Pedro. No member of the site survey group team or the Cornell group had serious altitude problems, but

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*A weather tower was set up over Cerros de Honar to log data over an extended period. Edison Bustos and Brooke Gregory are seen finishing the cabling in late October 2000. (Photo: Bob Blum)*



## *Site Survey continued*

the adverse effects on the body limit what can be accomplished in one day. This is particularly true of the first several days at altitude when the most strenuous setup activity occurs and the body is least acclimatized. A set of safety guidelines is being developed with input from NRAO, Cornell, and ESO scientists working on-site. Little convincing of the need for basic safety is needed once one arrives on Chajnantor. Still, strenuous or not, the work has its own rewards, as anyone who has been to the Atacama can attest.



The site survey group team is indebted to the many CTIO staff whose help with developing the weather tower and DIMM was invaluable. The team is also grateful for the help of Riccardo Giovanelli and his Cornell group (Chuck Henderson and Luke Keller) in preparing for and executing these first characterization measurements.

*The sun sets as night work begins for the site survey team. Atmospheric seeing was recorded on four nights in late October, including two nights of robotic operation. A robotic mode is critical in locations like the high Atacama desert where human observers are taxed to the limit by the altitude (17,500).*

## Light Pollution Control in Chile

*Hugo E. Schwarz*

It has been realized for many years that good, dark astronomical sites are rare, and therefore precious. In recent years it has also become clear that finding and testing sites is not enough; once you have a good site identified and characterized, you must also protect it, especially from light pollution. Light pollution is an increasing threat to ground-based optical and IR astronomy.

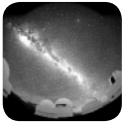
We view the work on light pollution prevention that has been going on at CTIO over the last seven years or so as an integral part of site work, which itself consists of:

- Searching and surveying for new sites for future projects (see "Site Survey Project for the GSMT" in the current newsletter),

- Characterization and comparison of sites, and
- Protection of these existing and potential sites. In total, nine CTIO staff members are involved in all aspects of this work, spending varying fractions of their time on it. Here I will limit myself to the site protection aspect.

Four CTIO employees are involved part-time in site protection ([http://www.ctio.noao.edu/light\\_pollution/english\\_index.html](http://www.ctio.noao.edu/light_pollution/english_index.html)), as well as various staff members in Chile at ESO and Las Campanas. For example, the CTIO Director, Malcolm Smith, has recently been elected Vice President of IAU Commission #50 "Protecting Existing and Potential Observatory Sites"

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## *Light Pollution continued*

(<http://www.jb.man.ac.uk/iaucom50/>), Chairman of its Working Group on “Controlling Light Pollution” ([http://www.ctio.noao.edu/light\\_pollution/iau50/](http://www.ctio.noao.edu/light_pollution/iau50/)), as well as being made a board member of the International Dark Sky Association (IDA), which is headquartered in Tucson. In addition, there are now two full-time employees at the recently created OPCC—Oficina para la Protección de la Calidad de los Cielos del Norte de Chile, or Office for the Protection of the Quality of the Skies in the North of Chile. Information on OPCC can be found at <http://www.opcc.cl>. Most of this Web site is in Spanish, at present.

The local work, which started in late 1993, culminated five years later in a new national-level guideline being signed by the President of Chile. This guideline, with the effect of law, defines the technical aspects required of outdoor lighting fixtures of all types in the Second, Third, and Fourth regions of Chile, i.e., all the regions that host major international observatories. CONAMA, the Chilean equivalent of the US Environmental Protection Agency, has the task of enforcing the new regulations.

Links between the various observatories in Chile have been forged, and the light pollution work now has a working budget provided by all the international optical observatories and supplemented by annual contributions from CONAMA. An excellent collaboration has also been set up between CTIO and the Catholic University of Valparaíso. The university’s photometric laboratory, led by Professor Enrique Piraino, consults on technical issues regarding the modification or exchange of outdoor lighting fixtures to reduce both upward directed light flux and the spectral bandwidth of the light. In many cases, the running costs of the light installations can also be reduced, making this an attractive proposition for town councils.

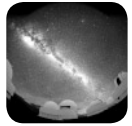
Much groundwork has also been done in the field of public education and awareness related to control of light pollution. A traveling planetarium, donated by Gemini, administered by AURA, and operated by CTIO in conjunction with the newly-formed local RedLaSer schools network (<http://www.ctio.noao.edu/AURA/redlaser/>), has seen much use, especially by school children (see <http://www.ctio.noao.edu/AURA/planetario/>). CTIO donated the telescope, dome, and CCD camera used by the public observatory called Mamalluca (see:

<http://www.angelfire.com/wy/obsermamalluca/principal.html> and the article by Joshua Winn, “Exploring the Sky at Mamalluca,” in the February 2001 issue of *Sky & Telescope* magazine). This municipal observatory has been very successful in attracting astronomical tourism to the town of Vicuña in the Valle de Elqui (Elqui Valley). Indeed, the tourist office in La Serena has published a booklet in English and Spanish for astro-tourism in the Valle de Elqui. The town council of Vicuña has been most collaborative in this effort, changing several hundred street lighting fixtures. This lighting modification has resulted in a reduction of upward flux by a factor of 25 and a lowering, by a factor of 2, of the running costs, while increasing the amount of light on the streets. The reduction of upward flux directly impacts Cerro Tololo positively, as this is the closest sizeable population center.

Other recent successes of the light pollution control effort in Chile include substantially reducing stray light from the “Cruz del Tercer Milenio” in Coquimbo, which is on a direct line of sight to Gemini South; adapting large floodlights at a new shopping mall in La Serena; improving outdoor lighting at the University of La Serena; securing a statement of intent from the mayor of La Serena regarding the improvement of the bright lights along the beachfront, a somewhat delicate issue in the region; and collaborating with an Andacollo mine, which has a line of sight to Tololo, on the placement of floodlights used for nighttime work.

Much more information about these issues can be found on the following Web site: [http://www.ctio.noao.edu/light\\_pollution/iau50/](http://www.ctio.noao.edu/light_pollution/iau50/). Under “Images” is a self-guided presentation on light pollution issues with many pictures. Click on the “A” button to get comments on any selected image. These comments will be updated over time. Click on the “i” button to get an index of slide titles. NOAO Public Affairs and Educational Outreach and the International Dark-sky Association are working to develop an improved version of this approach to document local advances in controlling light pollution.

A couple of related sites are: [http://www.ctio.noao.edu/site/pachon\\_sky/](http://www.ctio.noao.edu/site/pachon_sky/), an analysis of the sky quality above Cerro Pachón, the Gemini and SOAR site; and <http://www.darksky.org/idal/index.html>, the International Dark-sky Association site, which is full of useful information.



## SOAR Update

*Steve Heathcote*

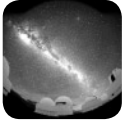
While the SOAR telescope structure and facility are nearing completion, the SOAR partners are working to build SOAR's initial instrument suite—an optical imager being built at CTIO, the Goodman high-throughput optical spectrograph (North Carolina, Chapel Hill), an IFU-fed bench spectrograph (São Paulo), and the Spartan IR imager (Michigan State). With the first generation instruments underway, the SOAR SAC is beginning to plan for the next and would appreciate input from the NOAO user community. Hence, you are invited to review the information on the current and suggestions for future instruments at [http://www.ctio.noao.edu/soar/soar\\_instruments.html](http://www.ctio.noao.edu/soar/soar_instruments.html). Please send us your comments!



*Under the cover of the circus tent-like temporary roof, installation of the facility electrical equipment is almost complete. Over the next few months, several members of the SOAR project team will move to Chile to participate in the process of onsite integration that will culminate with first light in June 2002.*



*The SOAR telescope mount is taking shape at the VertexRSI plant in Texas as the major components are completed and assembled, ready for system-level testing prior to being shipped to Chile.*



## CTIO Telescope and Instruments Available for Semester 2001B

*Alistair Walker*

Prospective users of CTIO facilities in Semester 2001B are reminded that the Schmidt Telescope will be available only for Michigan programs. Patrick Seitzer ([seitzer@astro.lsa.umich.edu](mailto:seitzer@astro.lsa.umich.edu)) is the Michigan contact scientist.

The CTIO Infrared Spectrograph (IRS) and the small-format infrared imager (CIRIM) are no longer available; OSIRIS is the only IR instrument offered at the 4-m and 1.5-m. The dual IR-optical imager ANDICAM remains available on the YALO 1.0-m telescope. We are

making good progress on building our 2K × 2K IR Imager ISPI, and plan to commission it late in 2001, with visitor use beginning in 2002. Full details are given on the Web at [http://www.ctio.noao.edu/ir\\_instruments/ispi/](http://www.ctio.noao.edu/ir_instruments/ispi/).

The single-channel photoelectric photometer ASCAP will be not be offered at the 1.5-m after 2001B. Operations at the 1.5-m are being scaled back to make resources available for running SOAR, which is scheduled for first light in June 2002.

The 4-m Echelle spectrograph is also due to be retired at the end of 2001B. However, whether this is a hard or soft retirement depends on the success of the IFU feed to the Hydra bench Spectrograph; tests of this instrument are due to take place in February. Watch our WWW pages for updates; in particular, [http://www.ctio.noao.edu/telescopes/TheFuture/crystal\\_ball.html](http://www.ctio.noao.edu/telescopes/TheFuture/crystal_ball.html).

## Mosaic II now with 16 Channels

*Knut Olsen, Chris Smith, and Buell Jannuzi  
on behalf of the NOAO Mosaic Team*

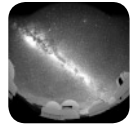
Starting with the 2001A semester, 16 channel readout mode (i.e., two amplifiers per CCD) with the Mosaic II camera will be available. The new mode will be expected to be the default mode of operation. The change means that the shortest possible cycle time between images, such as that between successive zero frames, will drop from 160 seconds to 100 seconds. Whereas before the overhead on a 10-minute exposure was 25%, it will now be only 15%, which is a

substantial improvement. Observers may no longer find themselves so hard pressed to get enough twilight sky frames.

Some changes are involved with the move to 16 channels. The MSCRED reduction package and MSCDB calibrations database have been updated to handle both 8 and 16 image extensions seamlessly. Users may download both packages from <ftp://iraf.noao.edu/iraf/extern/>. One of the most important changes

in MSCRED is the way in which the crosstalk is calculated and corrected; with two amplifiers reading each CCD, every amplifier produces crosstalk in three extensions rather than one. Also, a step has been added so as to merge extensions read from the same CCD into a single extension at the end of the reduction pipeline, resulting in reduced images that look almost identical to 8 channel readout Mosaic images.

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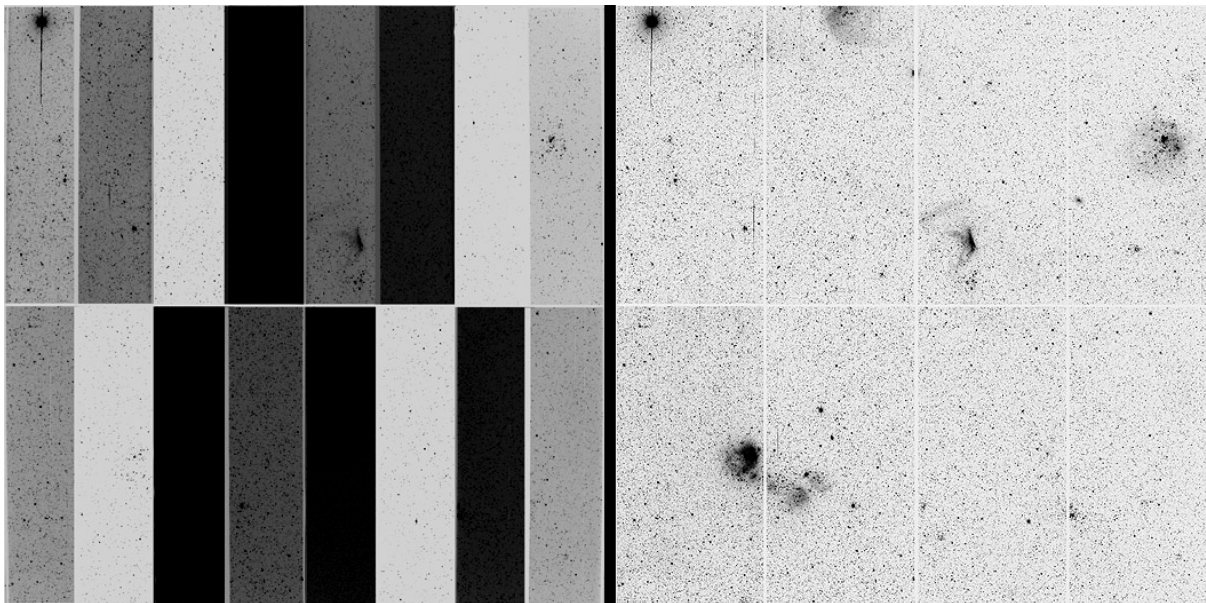
### *Mosaic II continued*

The new MSCDB contains the necessary calibration files for 16 channel readout, including bad pixel masks and astrometric solutions of the correct format, and the multi-victim crosstalk data file. The files used for 8 channel readout mode have also been updated, so users desiring the latest measurements should download the new MSCDB. Indeed, IRAF/MSCREED may surprise you with an error message during your reductions of newer data sets unless you acquire the latest MSCDB.

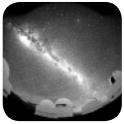
In order to more easily provide you with the correct calibration files, the NOAO Mosaic team is working to provide a single Web-based repository for the files for both Mosaic cameras. The Mosaic Web page (<http://www.noao.edu/noao/mosaic/>) contains an archive of crosstalk files, bad pixel masks, and astrometric solutions that we have produced, including notes about each file. Users of both Mosaics may also like to know that filter names have

been given a standard convention at both sites, as well as added descriptive information within the names.

For those who do not desire to read out each CCD with two amplifiers, 8 channel readout is still readily available. Make your desire known when you fill out your visitor support questionnaire ([http://www.ctio.noao.edu/obsaid/obsaid.html/supportforms/visitor\\_support.html](http://www.ctio.noao.edu/obsaid/obsaid.html/supportforms/visitor_support.html)) or ask Observer Support.



*The northeast quadrant of the supershell LMC-4 in the Large Magellanic Cloud, showing a number of OB associations and star clusters. Taken under conditions of 0.75" seeing with the Mosaic 2 camera in 16 channel mode on the CTIO 4-m Blanco telescope, this 20-second V image contains more than 200,000 point sources at the level of  $5\sigma$  above the background. On the left is the raw image; the image on the right has been processed to remove instrumental artifacts. The seams in the middle of the CCD's visible in the raw image completely disappear in the full reduction process, as do flat-fielding and bias artifacts.*



## Tom Ingerson Leaves CTIO

*Malcolm Smith*

Tom Ingerson, CTIO Senior Support Scientist, is heading north in March 2001 to Boulder, Colorado, to pursue as many of his wide range of interests as time permits. Tom has been at CTIO for almost 18 years. During that time, he has alternated with Brooke Gregory as head of Engineering and Technical Services at CTIO and has had tremendous impact on the observatory's development and implementation of new instrumentation, on operations on the mountain and in La Serena, and on the quality of resident life in the La Serena *recinto*.

It will not be possible to fill the unique role that Tom has shaped for himself with any single individual. His wide intellect and outstanding human qualities will be missed. Fortunately, he will continue a virtual presence at CTIO, continuing to manage (primarily via the Internet) as a consultant the Instrument Selector/Calibration/Guide System project for SOAR.

Tom is a man of amazingly varied abilities and interests. After graduating from the University of California at Berkeley with an A.B. in physics and a short stint as a junior engineer at White Sands Missile Range, he obtained his Ph.D from the University of Colorado with a dissertation in the field of General Relativity. From there he moved to New Mexico and then to Idaho, where he rose to a full professor in physics at the University of Idaho.

Many of us at Tololo first got to know Tom in the mid-70s when he spent a year at the observatory. By then his talents for instrumentation had become obvious to everyone, and in 1983 he was persuaded to return to Chile and stay for a "little while longer."

Throughout his career, Tom has shown a remarkable ability to stay abreast of new developments in technology. His expertise in telecommunications enabled him to design and build a T-1 microwave system between La Serena and Cerro Tololo and negotiate with NASA for the installation of a satellite Internet connection to Cerro Tololo in the late '80s. This was the first such link to be installed in South America. More recently, Tom and Jim Kennedy from the Gemini project obtained NSF funding for a very high speed communications system between La Serena, Cerro Tololo, and Cerro Pachón. Negotiations are now nearly complete for the establishment within the next six months of a fast connection to Internet2 via under-sea fibers.

Tom has applied his ability to produce creative solutions to a considerable range of instrumentation challenges. Examples abound and include the Argus fiber-fed multi-object spectrograph which was used at the prime focus of the Blanco 4-m for many years and the 1.5-m Bench-Mounted Echelle spectrograph (BME). The BME has seen effective

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## New Rates at the AURA Observatory

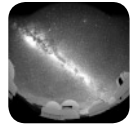
*Elaine Mac-Auliffe*

It has been considered necessary to increase some of the rates charged at the AURA Observatory in Chile in order to maintain the same service and support that has been dispensed to visitors and staff throughout the years. These new charges will come into effect 1 February 2001.

Rooms in the Santiago Guest House will cost US\$50 a night and will include breakfast. For more information on Guest House changes and charges, please see the article on Page 16 of *NOAO Newsletter 64*.

Lodging plus the use of a car on Cerro Tololo will cost US\$45 per day, and US\$35 without use of a car. If you wish to use a car, you will need to bring along your driver's license. The cost for breakfast, lunch, dinner, and night lunch will be US\$15 each. A fare of US\$60 for the round trip on the shuttle (La Serena–Tololo–La Serena) has also been implemented.

Updated information for minor changes in the dollar rate and airport taxes for trips to La Serena can be found at [http://www.ctio.noao.edu/diroff/obser\\_trav.htm](http://www.ctio.noao.edu/diroff/obser_trav.htm).



## *Ingerson Leaves continued*

use in a wide variety of programs, most recently providing emission line lists for use in the analysis of the spectra of AGN. Argus has since been replaced by Hydra-CTIO, for which Tom was the project manager and designer of the spectrograph. The effective collaboration between Sam Barden and Tom Ingerson set a reference standard for effective joint work on instrumentation between the groups in Tucson and La Serena. Hydra-CTIO has brought the ability to take 100+ spectra over a wide field with fast fiber deployment to Cerro Tololo. For work requiring higher throughput and resolution, Tom designed an integral field unit to feed the Hydra spectrograph. It is currently in the commissioning phase.

Wearing his optical engineering hat, Tom initiated and managed projects to design and build wide-field, high-resolution corrector optics incorporating Atmospheric Dispersion

Compensation (ADC), first at Prime Focus (the PFADC) and then at the R/C focus (RCADC) of the Blanco-4m, the former being necessary for Argus and the latter for Hydra.

Because of his interest in networking, Tom became an early devotee and proselytizer of the Internet and Linux when almost no one had heard of either one. He has since become a networking and software expert, and as such, he was the natural choice to head the CTIO Computer Applications Group and act as webmaster of CTIO's WWW site.

Life on the *recinto* changed irreversibly in 1985 when Tom designed and built a 7-m dish to pick up satellite television signals directly from the US. The system, built on a shoestring out of scrap steel and wire mesh, surprised many of its skeptics when it worked the first time it was turned on. It functioned

for years, delivering English language television to grateful *recinto* residents until newer technology eliminated the need for it.

After Tom departs, one of his legacies will continue to grow. The "Arboretum Chileno" that he planted in an unused common area behind his house contains many examples of native Chilean trees and plants, and has provided Tom with sharp insight into the structure of the La Serena desert's natural ecosystem. The arboretum has given all *recinto* residents a place to enjoy and see some of the species of plants that were here before Europeans irrevocably modified the environment. He has taught many of us some of the basics of living harmoniously in close proximity to each other. This has been a vital component of the well-known esprit de corps here in La Serena.

### How to Contact CTIO

|                       |   |
|-----------------------|---|
| The Web               | <a href="http://www.noao.edu/ctio">http://www.noao.edu/ctio</a> |
| Questions             | <a href="mailto:ctio@noao.edu">ctio@noao.edu</a>                |
| E-mail a Staff Member | first initial+last name@noao.edu                                |