At the VATT

Photos by
• Fr. Richard Boyle s.j. and A.G.D. Philip •

On a mountaintop more than a hundred miles east of Tucson, Arizona, the Mount Graham International Observatory (MGIO) looks through clear, dry desert skies to the wonders of the universe. One of the instruments on that mountain is the Vatican Advanced Technology Telescope – known more simply as *The VATT.*

What is a typical "observing run" like for the astronomers who work at the VATT? We follow here the Vatican astronomer Fr. Rich Boyle and his colleagues Dave Philip, Union College, NY; Luisa Zambrano, Universidad Metropolitana, Puerto Rico; and Olga I. Pintado, Universidad Nacional Tucuman, Argentina. In late spring, they prepare for a week-long stay at the telescope to survey stellar populations in the Milky Way by taking images of selected star fields using the "Strom-Vil" filters. These filtered images will allow them to classify all the stars in their field of view, and help lead to a better understanding of how different types of stars are distributed through the galaxy.

Right *On the horizon is Mt. Graham, as seen from Mt. Lemmon, the site of another set of telescopes north of Tucson also operated by the University of Arizona. Note the white patch of snow just visible on the distant mountaintop.*

The first challenge is simply getting to the mountain itself; it is a two-hour drive through the desert to the base camp outside of Safford, Arizona. A popular stop en route is to have a picnic lunch in a particularly scenic area known as Texas Canyon.

Before heading up the mountain, all observers must check in at the base camp, the local headquarters for the MGIO, to obtain the necessary keys and permits for working on the mountain top. The land on which the telescopes are situated is a delicate ecosystem, managed by the National Forest Service, and access is restricted. (Visitors can see the telescopes on tours arranged during the warmer months at the Discovery Park museum in Safford.)

Above and top *The group stops at Texas Canyon for lunch en route to Mt. Graham.*

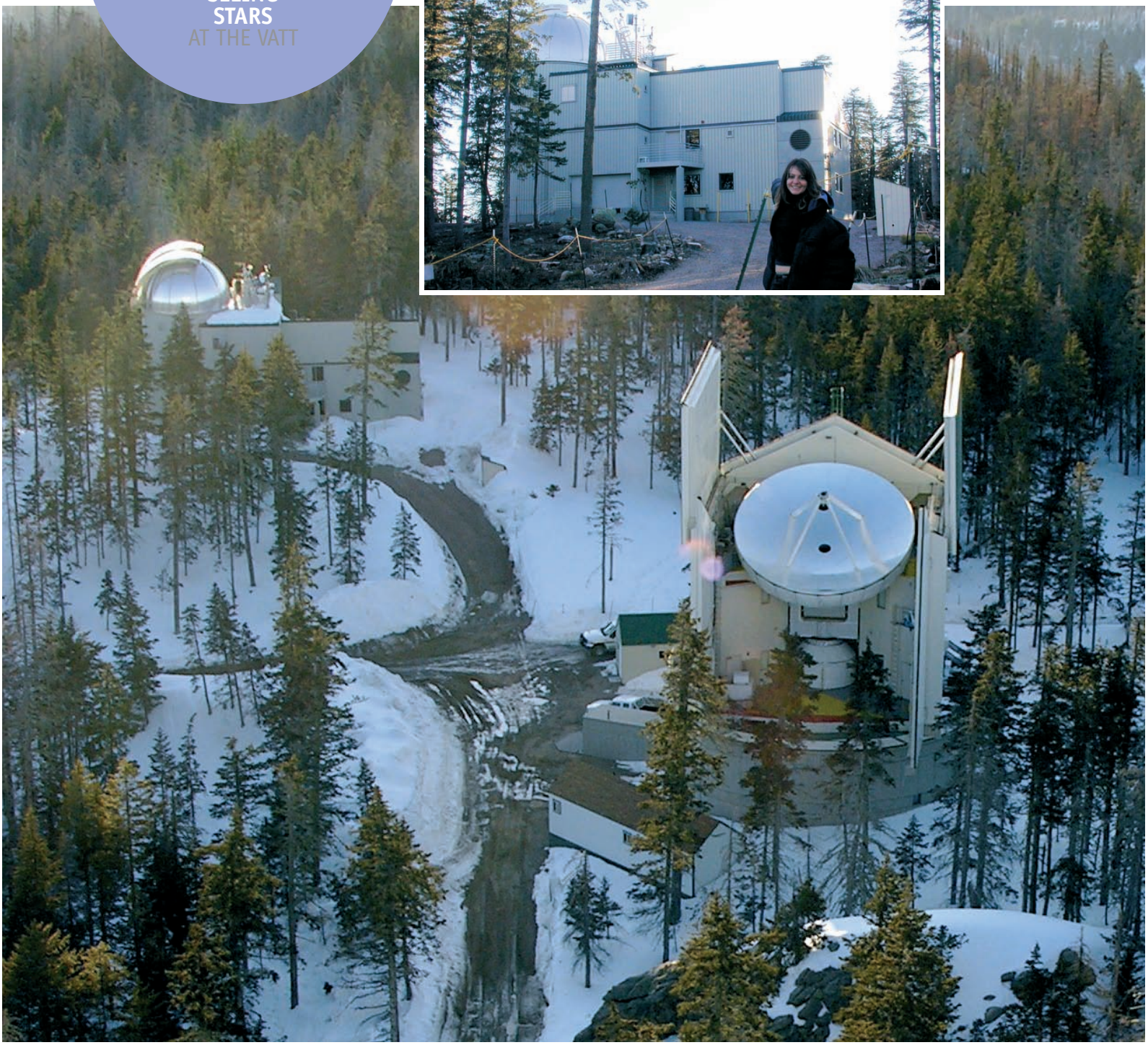
Above *Mt. Graham as seen from the base camp.*
Top *The base camp outside Safford.*

After stopping for permits at the base camp, there still remains more than an hour's drive up the mountain to the observatory. Much of the way is paved, going past summer homes and camp grounds, but the final nine miles is a rough dirt road. And even the paved road is slow going; tight twists and steep climbs limit a vehicle's speed to less than 15 miles per hour (25 km/hr) in many places.

Traveling up the mountain is like traveling north; as the air gets thinner, it also gets colder. Along the way you can see the vegitation change from the semi-arid Arizona desert to pine forests

at the top of the mountain. By the side of the road, dozens of small waterfalls are fed by the melting snow further up the mountain. By the time you reach 10,000 feet, the climate is similar to Canada.

But this is still Arizona, and water can be scarce. Thus the mountaintop is vulnerable to forest fires. Twice in the last fifteen years, fires started by lightning have threatened the observatory. The damaged trees on the last stretch of road leading to the telescopes are a stark reminder of these past fires, and of the many firefighters who protected the telescopes.



At the top of the mountain are the three telescopes of the Mount Graham International Observatory.

Above *This view, taken from the Large Binocular Telescope, shows the VATT (left) and the 10 meter dish (right) of the Sub-Millimeter Telescope (SMT).*

Top *The VATT building, behind Luisa, houses the 1.8 m Alice P. Lennon Telescope and the Bannan Astrophysics Facility, providing technical support for the telescope, along with four bedrooms and a kitchen for the astronomers.*

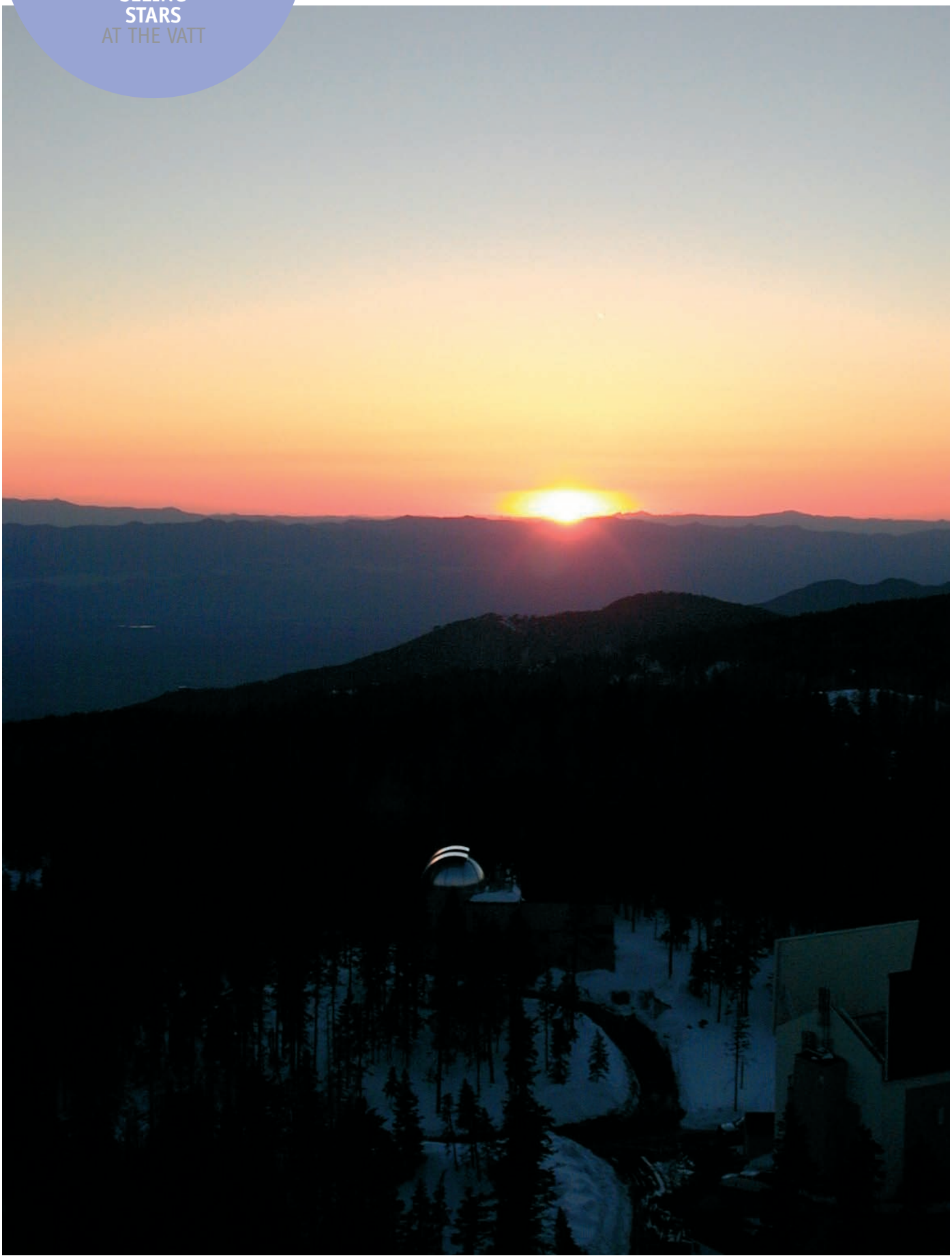
Top *The dome of the VATT peers out from the trees surrounding the observatory. Note also the microwave tower, which provides telephone and high speed internet links for the observers.*

Middle and lower *From the dome of the VATT, one has an unobstructed view of the Arizona sky in all directions.*

A snowy scene greets the observers when they rise. For Luisa, raised in Colombia and Puerto Rico, seeing snow is quite a novelty. But even a New Yorker like Dave is amused at the way the sticky spring snow will sometimes roll itself into a donut shape as it melts and starts to slide downhill.

Life on the mountaintop has its own rhythms. After working all night, the observers generally try to sleep in as long as possible into the afternoon. Late afternoons, they can visit the other telescopes on the mountaintop, and prepare their evening meal before the night's work observing begins.

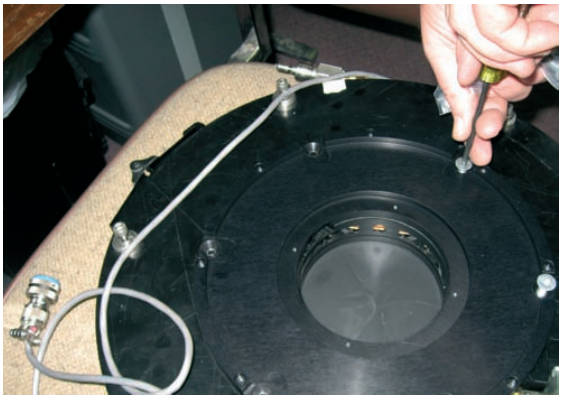
The VATT residence boasts a full kitchen on the ground floor, downstairs from the telescope control room. The observers are responsible for preparing their own meals. (And midnight snacks!)

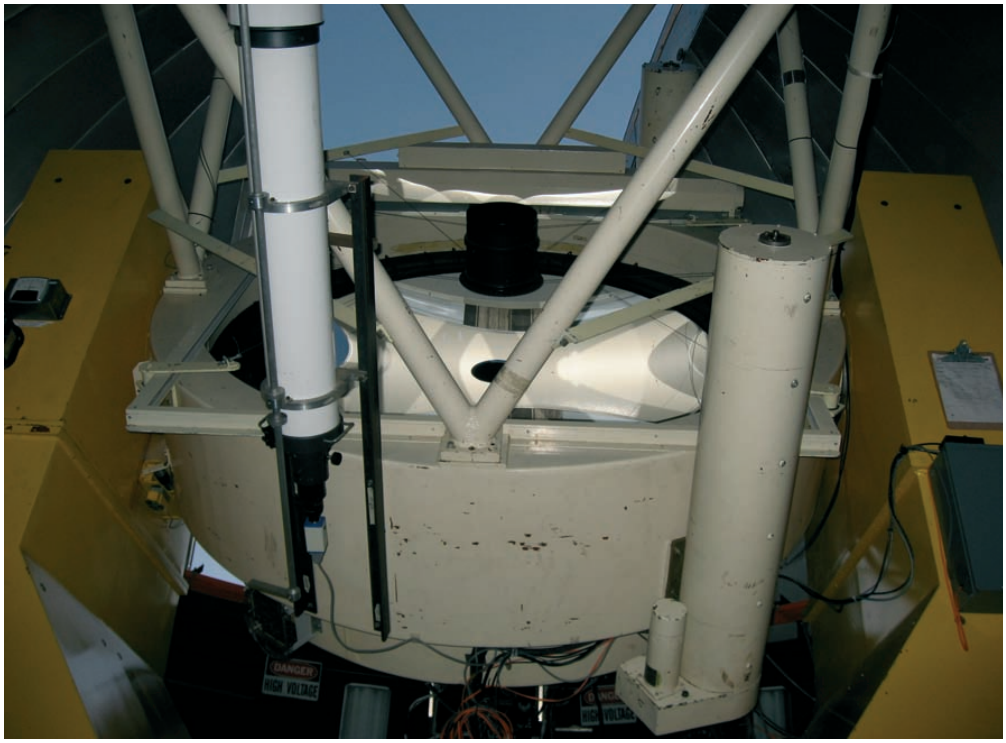


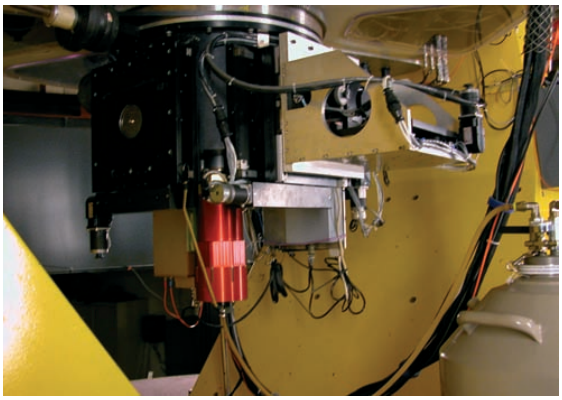
At sunset, the work begins. It's time to open up the dome and power up the telescopes.

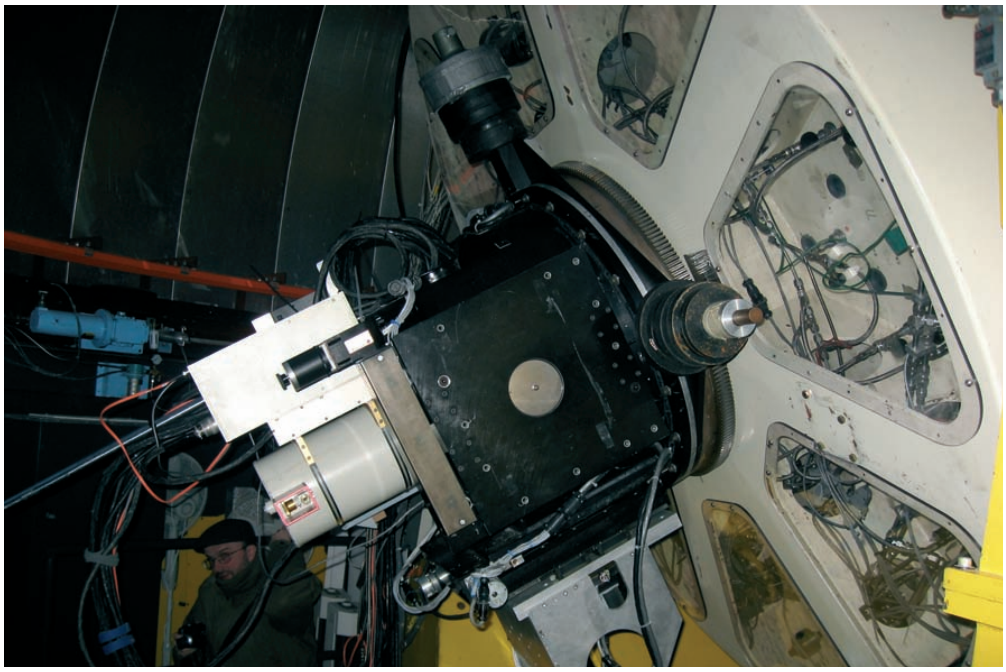
When the domes are opened, the telescopes are pointed to the east *(below)*, away from the direction of the setting sun. This is to prevent the last rays from heating up the inside of the dome or striking the delicate cameras.

SEEING STARS
AT THE VATT







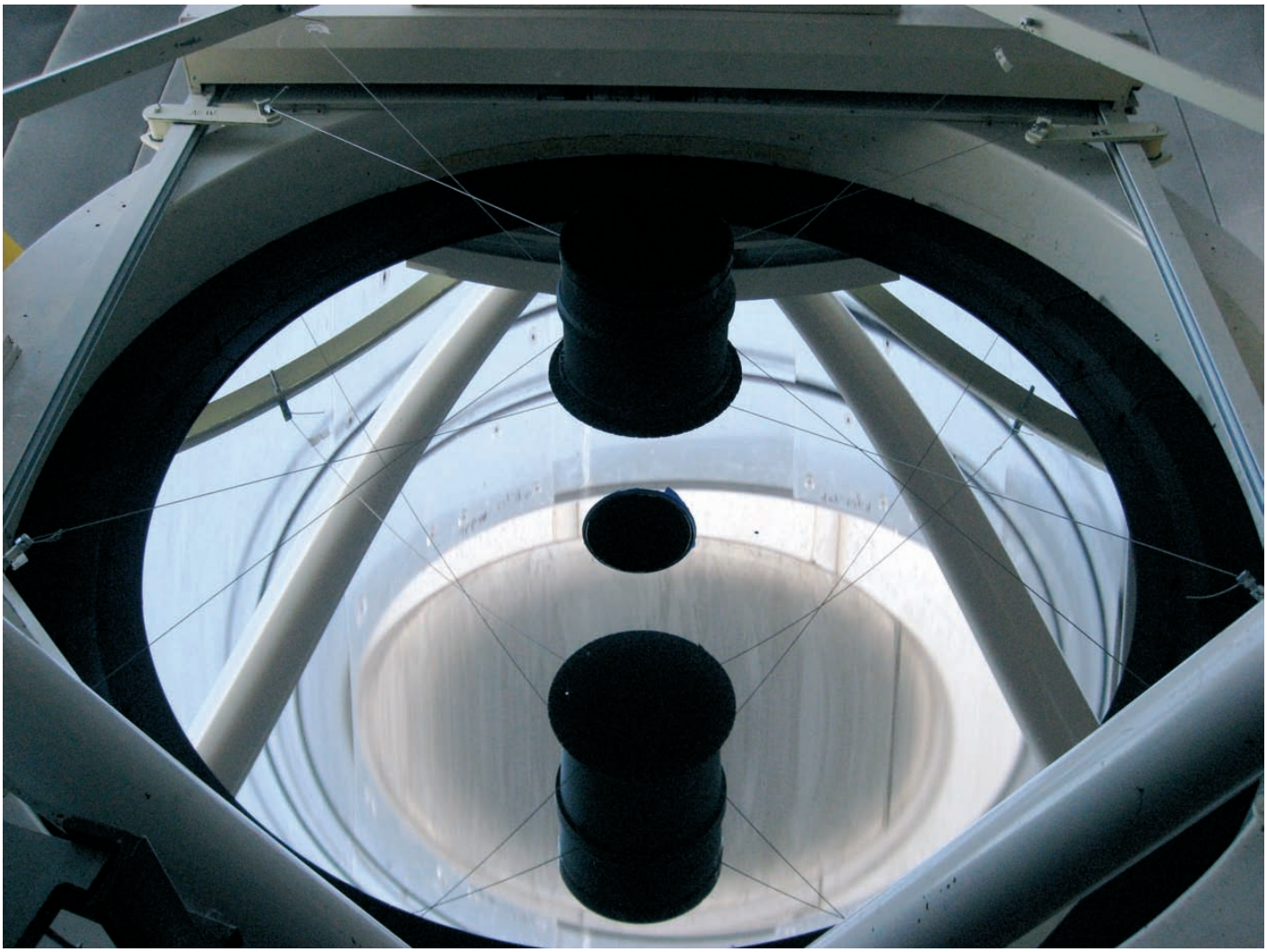


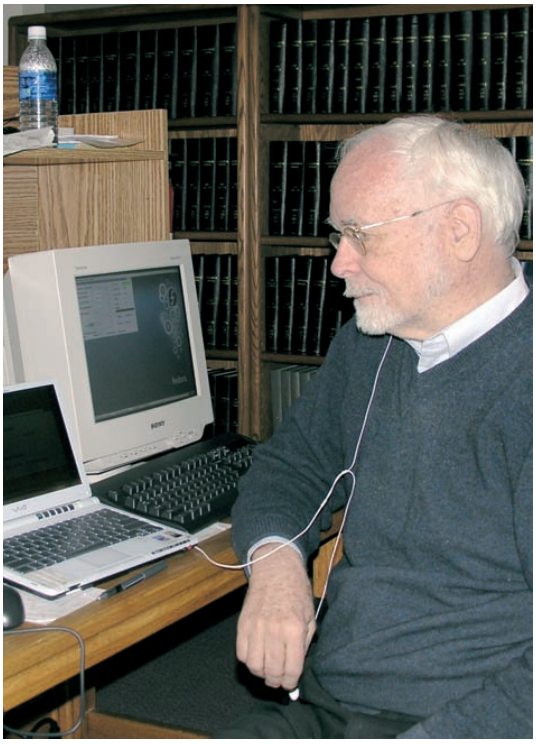
A telescope like the VATT requires a lot of steps to get ready for observing. First, the dome must be opened and the mirror uncovered *(top, right).*

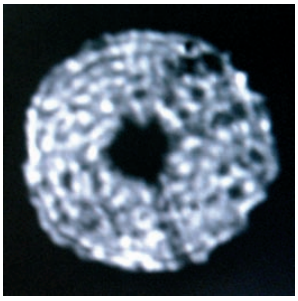
Vents are opened and fans turned on to cool the dome; and a special system brings coolant to the telescope mirror, ensuring that it is maintained at precisely the same temperature as the ambient air to prevent currents that would distort the telescope's images. (Some of the piping can be seen on the back of the mirror, *above.*) The camera shutter itself may need adjusting *(top left).* And every night, liquid nitrogen is pumped into the electronic camera to cool the CCD chip, making it especially sensitive to even the faintest levels of light.

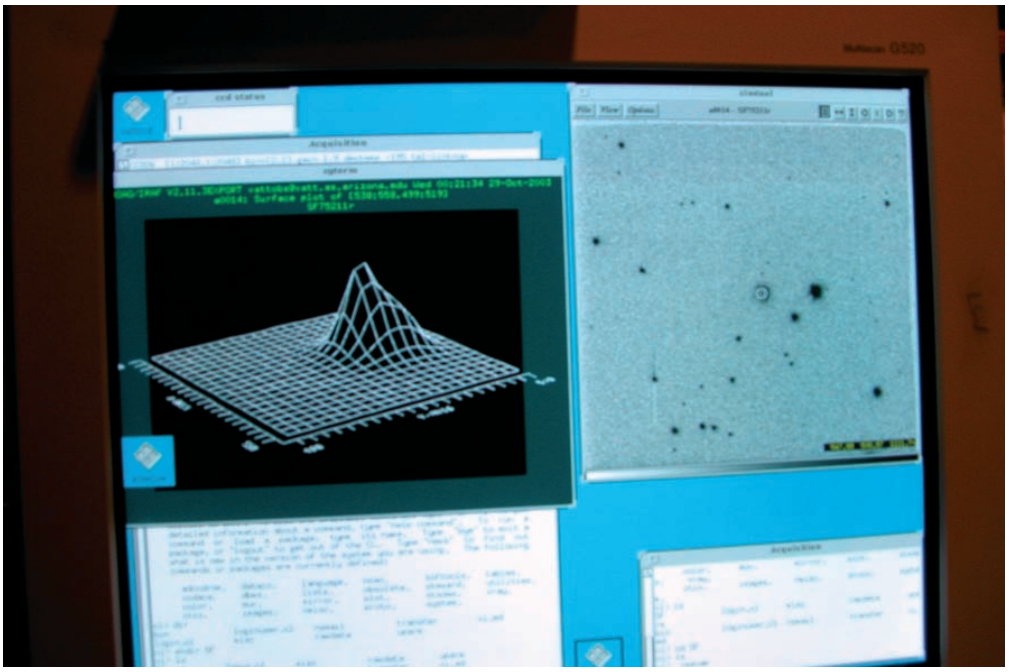
This job, which involves crawling briefly underneath the telescope, is usually given to the youngest member *(opposite top)* of the observing team!


DOME
LIGHT
DANGER
HIGH VOLTAGE









Then the work of observing begins. The astronomers never go into the dome itself while taking an image; the heat of their bodies would stir up the air too much. Instead, all observing is done by computer from a control room, well removed from the dome. All images are obtained by a computer-controlled CCD camera; the VATT doesn't have any eyepieces! Likewise, all control of the telescope's motion is done by computer.

Rich (*opposite top*), and Dave and Olga (*opposite left*), track the motion of the telescope and the images obtained by the science camera. Other monitors display images from TV cameras around the observatory; one is pointed at the night sky so that the observers in the room can be warned if clouds are coming or going, while another camera resides in the dome, where light can be turned on and the telescope watched as it is steered from one object to another in the sky. Other monitors track the CCD camera in the telescope's finderscope, and keep track of the weather station, indicating local conditions like winds or humidity that might affect the performance of the telescope.

One of the first tasks for a night's observing is to point the telescope at a star, and throw the image out of focus *(above left)*. In the resulting fuzzy image, the secondary mirror (and the struts which support it) are visible as a dark spot. By tilting ever so slightly the position of the secondary mirror, the optics can be perfectly aligned and collimated; when that occurs, the black spot is exactly in the middle of the "donut."

And, of course, the computers are also used to monitor the results coming from the science camera itself. Using special software tools *(left)*, the signal from each star can be studied, and the amount of light received by the CCD camera recorded.

After a week, it's time to come down.

The trip down the mountain is bittersweet. After an observing run, the top of the mountain has begun to feel like home, and it can be hard to leave. In addition, the astronomers know that – if they were lucky with the weather! – they have months of work waiting for them analyzing the gigabytes of data on their computer disks, before they are ready to go back to the telescope again.

The cameraderie of the observing group is another feature of life on the mountaintop that will be missed. You become great friends over the course of a week, chatting about family and friends as well as about astronomy while waiting for the images to come from the camera.

And the quiet setting, the peacefulness of working through the night, and the glory of both the mountaintop and the stars, is more than a little reminiscent of life in a monastery. You do feel removed from the daily bustle of life back in the city, and a little closer to Creation.

And if you're lucky, the bad weather you were afraid might spoil your observing run will wait until it's time to leave the mountain. ●