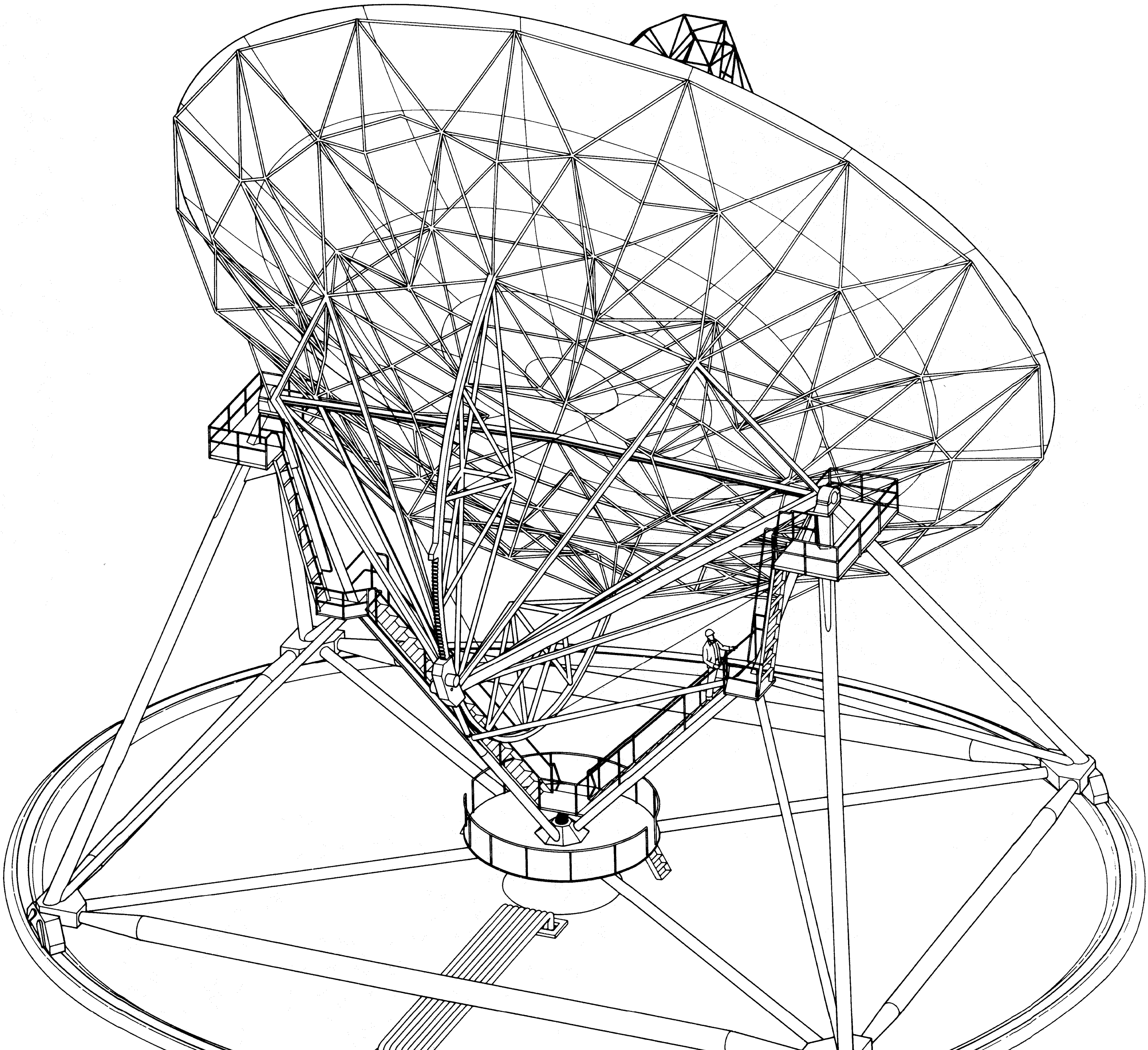
THE OBSERVER

AUG '75



THE **25-METER** TELESCOPE

story on page 3

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A special thanks to the people who contributed articles and who helped with the assembly and distribution of the OBSERVER.

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NOTE: Most of the credit for articles in this issue must go to Ed Fomalont. Ed did most of the leg work and contacting while I was vacationing in the majestic Allegheny Mountains.

Wally Oref

THE 25-METER TELESCOPE FOR MILLIMETER WAVELENGTHS

Barry Turner

Budget crunch or not, the NRAO has decided that it is time to plan its next major instrument, to follow the VLA. Just as the VLA provides a greatly increased capability for centimeter-wave radio astronomy, our new proposed instrument, a 25-meter (82-ft.) dish operating to 1 mm wavelength or shorter, will enormously expand mm-wave astronomy. The largest existing mm-wave telescope, the NRAO 36-ft. dish, has opened up new areas of radio astronomy in the past six years, by largely establishing the field of interstellar molecules and using it as an unprecedented tool for the study of the cool, dense regions of the interstellar medium. A totally new insight into interstellar chemistry, and the processes of star formation, has emerged. Yet despite improvements in mm-wave receivers by factors of over 10 in the past six years, the limitations of the 36-ft. telescope, both in size and in wavelength capability, are beginning to impede our ability to follow up the existing achievements at millimeter wavelengths, and to make new breakthroughs. The lack of dish size seriously restricts the 36-ft. resolving power, and hence the ability to study the fine structures we know exist in molecular clouds. The small size also limits sharply the sensitivity of the 36-ft. telescope for most continuum sources. And the limited surface accuracy (0.35 mm rms) restricts the telescope pretty well to 2 mm wavelength and longer.

A new mm-wave telescope is therefore needed that is both larger and more accurate than the 36-ft. instrument. Several technological improvements have become possible since the 36-ft. was built (in 1965), the most important being the idea of homologous structure by S. von Hoerner. A telescope dish is ideally parabolic in shape, but when tilted under the force of gravity the surface of most telescopes deviate from parabolic and the rays are no longer focused perfectly. Hence the telescope efficiency is reduced and so is the limiting wavelength. A homologous structure is one which always deforms into some parabola, no matter what the tilt angle is. The parabola differs for each tilt angle, but that only means the focus changes, and this is easily calibrated and set for any elevation angle. Von Hoerner was able to derive structures theoritically that would behave in this way, and such a structure was used in the design of the NRAO 65-meter telescope. This telescope, was designed to operate to 3 mm wavelength. The homology principle is also used successfully in the Bonn 100-meter telescope that operates to 1 cm wavelength. A homologous structure permits a much larger diameter, for a given surface accuracy, than a non-homologous structure. In addition, modern methods of machining now allow considerably greater accuracy in the fabrication of surface plates than was possible 10 years ago.

In April of 1974 we began the task of defining the next major mm-wave telescope for NRAO. The three principle questions we had to answer were: a) what telescope? b) what, if anything, do we put it in? 3) where do we put it?

The answer to the first question was guided by the present scientific needs by the relationship between achievable diameter and wavelength capability for homology designs, and the transmission properties of the earth's atmosphere for mm waves. The atmosphere gets more and more opaque to radio waves the shorter they get. Basically there are three main "windows" of fairly good transmission in the mm-wave region. One extends from about 80 to 116 GHz (the 3 mm window) and is closed at both ends by absorption from oxygen. Another is from 135 to 170 GHz (the 2 mm window). The third goes from about 210 to 300 GHz (the 1 mm window) and is closed at both ends by absorption from water vapor. The 1 mm window is not very good above 250 GHz, and requires a site of exceptionally low water vapor (a high mountain site) to be very useful. There are actually semi-windows at even frequencies. A narrow one is centered at 340 GHz (0.88 mm) but will transmit probably not better than 75% at the zenith even on the best high mountain site under ideal weather conditions.

These atmospheric windows define the choices we had in selecting our new telescope. Any telescope operates with reasonable efficiency (i.e. at least 50%) as long as the rms surface accuracy is smaller than about 1/16 of the operating wavelength. (Of course astronomers are always demanding to use telescopes beyond this limit.) So the shorter the desired

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wavelength, the more accurate the surface must be, and the smaller the dish size we can build in order to achieve that accuracy. If we wanted to operate only to 3 mm wavelength, our homology design would allow a dish diameter of 65 meters. To get into the 2 mm atmospheric window, the telescope could be as large as 40 meters. To reach the 1 mm window, 25 meters is the limiting size. If we wanted to go all the way to the 0.88 mm window with an efficient telescope, it could not exceed about 14 meters in diameter.

So far, so good; these choices are dictated by laws of nature that not even astronomers can argue about. But you can bet they argued (and still are) when it came to deciding among these possibilities. It wasn't only the science they argue about, but the added consideration of the site. Telescopes operating to 2 mm wavelength and longer don't particularly need a "good" site --that is, an exceptionally dry one. But telescopes meant to be used at 1 mm wavelength and shorter must be at very dry sites. Even the Sahara desert isn't good enough for this purpose. One must go to a high mountain where you literally get above much of the atmospheric water vapor. Such sites are obviously expensive and logistically difficult.

Even scientifically, it wasn't very clear which telescope was best. The bigger telescopes have better resolution and more sensitivity at the longer mm wavelengths, while the smaller ones can get to the shorter wavelengths never before observed. We decided on the 25 meter dish, operating to 1 mm wavelength, as the best compromise for current scientific needs. The 40 meter dish (operating to 2 mm) was a close second.

Before answering the second question (what, if anything, do we put the telescope in?), I will describe something of the telescope design and its limitations. The telescope is an alt-az instrument (see cover photo) like the 36-ft. dish, but unlike the 140-ft. telescope (the last of the great equatorials). Alt-az mountings are "symmetric" with respect to the direction of gravity and therefore can be built larger, for a given allowed surface inaccuracy, than can equatorially-mounted structures. Unlike the 36-ft. telescope, the 25-meter instrument is "wheel and track", the track referring to the broad-based circular structure around which the telescope rotates in azimuth, and the wheel referring to the elevation wheel which drives it in elevation. The telescope is built up of a series of structures, beginning with the tower, which consists of all major support members resting on the azimuth driving trucks, up to and including the elevation axis, bearings, and the elevation wheel. Upon the the elevation bearings is supported the main "backup structure", which basically defines and supports the parabolic surface of the telescope. It also contains the feed support legs, which are an integral part of the homology design of the backup structure. In the cover photo, only the azimuth track, trucks, tower, and backup structure are shown, for clarity. But there is much more. There are 60 key junctions in the backup structure which are called homology points. No matter which way the backup structure is tilted, all 60 of these points are designed to deflect under gravity so as always to define a parabolic surface. The backup structure is therefore homologous. The 60 homology points are too far apart, however, to allow connecting the surface plates directly to them. The plates would sag too much in the middle. So another series of structures, known as "intermediate" or "panel" structures is required to bridge the gaps between homology points. There are several different types of panel structures and every one must itself be independently homologous, that is, have a set of homology points to which the surface plates are attached. There are 528 surface plates, each about 60 inches by 25 inches in our design. A plate will consist of a cast aluminum surface with supporting rib structure; the surface will be machines to final tolerance using a numerically-controlled milling machine. It is in the manufacture of the surface plates, and their subsequent setting on the telescope, that we will push modern technology to its limit. John Findlay has devoted much effort to just this problem of how to measure and set surface plates.

Since we have emphasized that the major sub-structures of this telescope are designed to be homologous, exactly what limits the surface accuracy? It is best to answer this question in two parts. First, imagine that the telescope is located in an ideal environment--no wind, and completely constant temperature. Then our error analysis indicates we might achieve a surface accuracy of about 2.3 mils

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(thousandths of an inch) rms, or an "efficient" telescope at a wavelength as short as 0.95 mm. What is even more interesting is that fully 50% of the surface error, by present estimate, is in the fabrication, sag, and setting of the surface plates. Another 25% or so is in the machining and gravitational sag of the subreflector (the telescope will be used in both prime focus and Cassegrain configuration). The main backup structure and panel structures together contribute only 25% of the total error, this error arising partly because of limitations in the homology design, and partly because of expected tolerance limits in the construction.

In a realistic environment the 25 meter telescope doesn't do quite so well. Winds increase the surface errors slightly, but affect the pointing much more seriously. Note that the beamwidth of the 25 meter dish will be only 10 arc sec at 1 mm wavelength, so we must be able to point the instrument to roughly 1 arc sec absolute. This isn't possible if wind speeds exceed about 10 mph, a condition we certainly may expect much of the time on a mountain top site.

The problems incurred by temperature changes and gradients are equally serious. These affect both pointing and surface accuracy. Under sunny skies we may expect temperature gradients of as much as 9°F over different parts of the telescope structure. This will produce a pointing uncertainty about as large as a 10 mph wind, but has a much worse effect on the surface accuracy. The wavelength at which the telescope is 50% efficient would go all the way up to 4 mm, and the instrument would not be usable at all at wavelengths shorter than 2.5 mm. Under night-time conditions, thermal gradients of about 1.5°F can be expected over the telescope, and these reduce the 50% efficient wavelength from the (ideal) 0.95 mm to about 1.1 mm.

To overcome the effects of wind and temperature, we plan to enclose the 25 meter dish in a radome. Even inside a radome we will still have temperature gradients as large as 1.5°F, so the telescope will work about as well as it would outside at night. The radome might be a spaceframe--a spherically-shaped structure with a steel honeycomb frame covered with a fabric that transmits short wavelengths well. Some modern (but expensive!) fabrics transmit up to 1000 GHz with no more than 20% loss. However, to this must be added another 10% loss from the steel framework. More hopefully, the telescope might be housed in an astrodome--a radome with a door that can be opened for observing under good weather conditions, thus avoiding the 30% transmission loss inherent in a spaceframe. We cannot build an astrodome like the one that contains the 36-ft. telescope, because that design cannot be made large enough, and because we cannot use a door that flexes as it opens (the low-loss fabrics that we must use are not flexible). One possible astrodome design that we have been considering is shown in Figure 1. The movable door is actually a

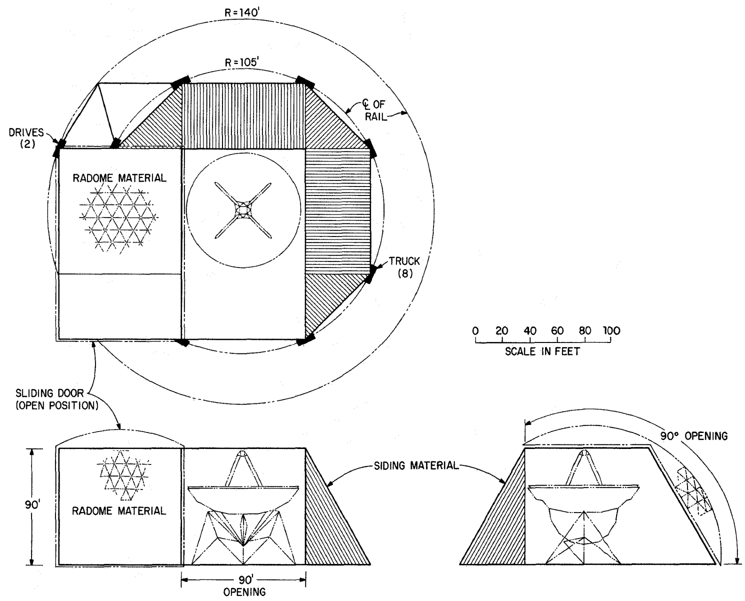

Figure 1

segment of a spaceframe and slides open sideways. This design will be very expensive, and it is accurate to say that at present we do not know whether an astrodome will be feasible for the 25 meter telescope.

The final question (where do we put the telescope?) has perhaps been the most contentious. Not everyone agrees that it is worth the effort to go to a very dry, i.e. high mountain, site. So we included in our site survey several kinds of locations, some of exceptional dryness but posing severe logistic problems, and others which are not so good meteorologically, but which are relatively amenable and inexpensive. Table 1 shows the sites we have studied.

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Table 1.
Sites Considered for the 25 Meter Telescope

Site	Long.	Lat.	Elev.
Mauna Kea, HA	155°28'	19°50'	13700
White Mt., CA	118°15'	37°37'	14300
Pikes Peak. CO	105°02'	38°50'	14110
Mt. Evans, CO	105°38'	39°36'	13900
South Baldy, NM	107°11'	33°58'	10800
Mt. Lemmon, AR	110°47'	32°36'	9190
Mt. Hopkins, AR	110°53'	31°41'	8585
VLA Site, NM	107°37'	34°01'	7200
Kitt Peak, AR	111°36'	31°58'	6750

From existing water-vapor data, which is not always as extensive or reliable as we would like, it appears that White Mt. is the driest site, closely followed by Mauna Kea, Mt. Lemmon, and the Colorado sites. Some of us earlier favored White Mt., despite difficult access and its rather northerly latitude (which excludes more of the Galaxy from view than does a more southerly site). The existing access from the nearest town, Bishop, includes 26 miles of rugged mountain road that is virtually impassible in winter unless improved. We envisioned over-coming this difficult problem by building a cable car directly up the mountain-side adjacent to Bishop. However, the more we examined the cost the more prohibitive it became. We have also learned of certain adverse weather patterns affecting White Mt. on occasion, which were not apparent in our earlier studies. These factors have caused us now to all but rule out White Mt. as the chosen land. Although they are probably also very dry, the Colorado sites have not received very serious consideration, because there is no water-vapor data for them. Mt. Lemmon is as dry as Mauna Kea, but is probably unsuitable for our needs because of a large number of radio and television transmitters on or near its summit. The Plains of San Augustin, home of the VLA, is not a strong contender because of its relatively high water-vapor content.

We have pretty much come down to two possibilities, Mauna Kea and Kitt Peak (as a backup). Mauna Kea is the strong favorite, and unless unexpected difficulties are encountered, it will be chosen. Mauna Kea is a dormant volcano, situated on the island of Hawaii, about 40 miles by good road from the town of Hilo (pop. 28,000) and about 20 miles from Launa Loa, an active volcano. There is already a large astronomical community on Mauna Kea--an 88-inch optical telescope and several smaller ones, the 150-inch Canadian-French-Hawaiian optical telescope presently under construction, and plans for the U. S. National Infrared Telescope and the U. K. National Infrared Telescope. At present, the astronomers and most of the staff associated with these instruments live in Honolulu, one hour away by jet, but NRAO would be located in Hilo, to provide the necessary rapid access to the telescope site. Needless to say, it took several trips to Hawaii by selected members of the NRAO staff to insure that Mauna Kea was indeed a suitable site. Mauna Kea means "White Mt." in the Hawaiian language.

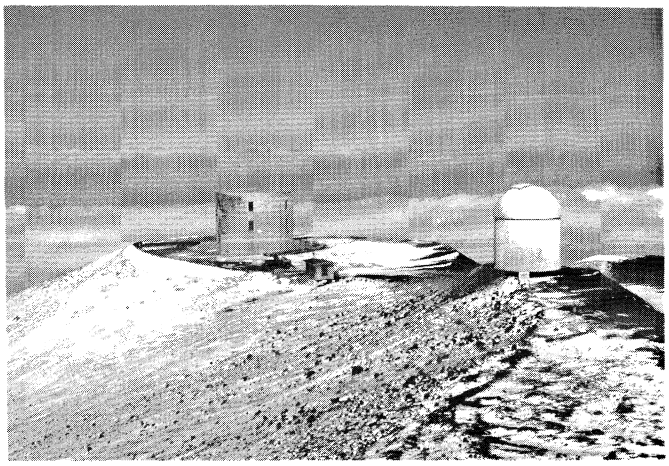

Figure 2. A view of the summit area of Mauna Kea; the structure on the left is the tower of the 150-inch optical telescope, and the dome on the right houses the 88-inch telescope.

How much will the 25 meter telescope project cost? Until we know the site for certain, and the nature of the radome, we cannot give a firm figure. The telescope itself, including computer, is estimated at $4.4 million in 1974 dollars, or $6.3 million in 1977 dollars. Possibly $1 million more is required to build it on a remote site like Mauna Kea. To enclose the telescope in a spaceframe will cost at least $2 million in 1977 dollars, and much more if an astrodome is built. At least $1 million will be needed for site development at Mauna Kea.

At present, the basic telescope structures have been designed, although some detailed work remains to be done on the subreflector assem-

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bly, surface plates, and bearings. Shop drawings must eventually be made up for all components. These steps will occupy well over a year's work, but as best we cannot receive funds for construction sooner than two or three years from now. We will submit a formal proposal to the National Science Foundation very shortly, for funds for the project. This will occur before the final site or radome selection, so a firm cost figure will be submitted later. The NSF is fully aware of our plans, through meetings and informal discussion, and it appears that they view our proposal favorably. This does not mean that funding is assured or even likely. A recommendation for funding by the NSF (in whose budget the 25 meter telescope project is large enough to appear as a line item) must be approved by the Federal Office of Management and Budget, and then finally by Congress. If all goes smoothly, we could get capital funds by 1978 and start construction shortly thereafter. The telescope could start operation in 1981. While these estimates are the optimistic ones, there is a reasonable hope that the 25 meter, mm-wave telescope will be NRAO's next major instrument, after the VLA.

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AN ODE TO KNEES

I think that I shall never see
A thing as ugly as a knee.
Above whose gnarled and knotted crest
The mini-hemline comes to rest.
Or one that's even worse than that
When padded with repulsive fat.

A knee that may in summer wear
Nothing at all, but be quite bare.
Behind whose flex there oft remains
A network of blue and broken veins.
Some knees continue to perplex -
How can they form the letter "X"?
While in another set one sees
A pair of true parentheses.

Small nuts write verses such as these,
But greater nuts display their knees!

Author Unknown

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THE NRAO TOURS

Doris Hungerbuhler

Well, believe it or not, despite economic woes, inflation, tight money, and high gasoline prices, this year has been a really great year for our tours. Up to August 3rd we've already had over twelve thousand people since we opened on June 12th and the tourists are still coming on strong.

Mr. June Riley, the bus drivers, and I have been having a pretty good summer meeting with all the nice people from all over the place. As a matter of fact, we've had visitors from forty-five states (doesn't include the National Youth Science Camp that comes every year to visit) and from a number of foreign countries such as Thialand, Venzuela, Iceland, Holland, Germany, and many others.

People seem to like our tour because we've had a lot of compliments. While most everyone seems to enjoy the movie, they generally are more talkative about the bus ride. Some are simply amazed! We love to see the reactions on their faces when they see the 300-foot telescope moving down into the pit, or when they see deer on the site. For some, it's the first deer they have ever seen and sometimes it is the high point of their whole vacation. A lot of people say they just can't get enough pictures and take the tour twice. Probably because our tours are free, people spend the money saved on admission for books and post cards we sell, and it just might be that they want to learn more about radio astronomy.

When the people come back from the tour, many of them have questions to ask and the one question we are asked the most often is why did they pick Green Bank, West Virginia, as the site for the NRAO? Generally, we give them only the main reasons why we are here: for example, our surrounding mountains keep out a lot of man-made radio interference, Green Bank is away from industrial centers, and metropolitan areas, and the area itself is sparsely populated.

Daily tours end on Labor Day, but we will continue tours on weekends through September and October. We hope we continue getting nice people for the rest of the season. If by chance you've never taken our tour, come by and spend an hour with us. See you later!!!

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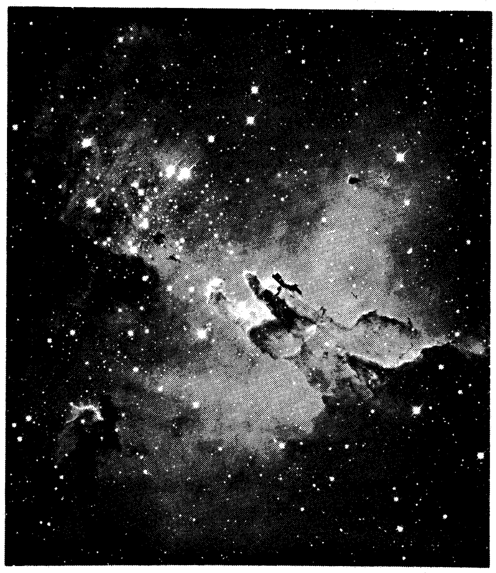
REPORT FROM THE MOUNTAINTOP V. MORE MODERN PROBLEMS OF OPTICAL ASTRONOMY

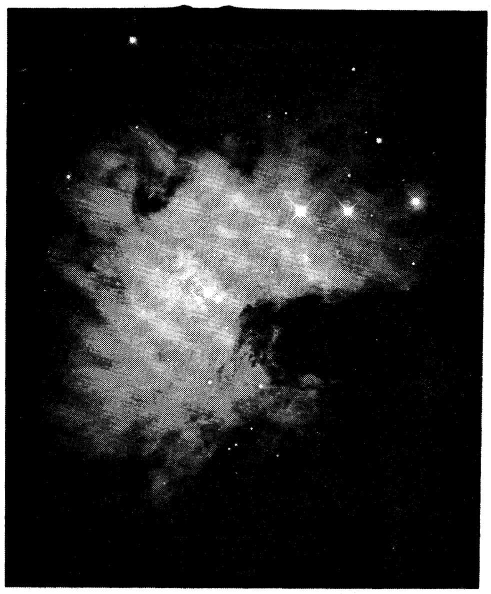
Bruce Balick

Last time we discussed individual stars. Many of the most beautiful sights in the heavens consist of stellar systems and the gas and dust often associated with them. These do not appear as unresolved points of light, but often as ragged yet colorful patches or, in the case of galaxies, as spiral patterns of amazing symmetry. In this article we review some of these stellar systems. We shall also discuss some of what is known and not known about these magnificent objects.



M16 is a cloud of luminous gas illuminated by the hot, young stars of the cluster near its center. Dark lanes of dust appear against the bright nebulosity. (120-inch reflector)

Aggregates, or clusters and associations of stars are often found in the skies. The smallest groups consist of only a few dozen stars, generally very young. If some of the stars are hot, they will energize the clouds of dust and gas out of which they originally formed. The ultraviolet light from the hot stars strips electrons from atoms and heats the electrons to many thousands of degrees. These clouds are the very colorful and beautiful "ionized nebulae" or "HII regions". The stripped electrons have grazing collisions with one another and in the process generate strong radio emission. HII regions, such as Orion, Sgr B2, W51, W3, DR21, and M17 are familiar objects to telescope operators in Green Bank. Near these nebulae are often found clouds of molecules. The largest of these HII regions are too far away to be seen optically because of the galactic dust.



The inner region of the Orion Nebula which is found in the sword of Orion, the hunter. The innerpart of the nebula glows with a brilliant green color. Some other features appear deep red, and the stars are blue-white when seen through a large telescope.

Other clusters of stars can contain many thousands of stars. In some clusters, called globular clusters, the stars are arranged symmetrically. Globular clusters lie just outside our galaxy but are bound to the galaxy by gravitational forces. These are systems of extremely old stars formed at the same time as our galaxy. All the massive hot stars have long since died, and cool lower mass giant stars dominate the observed light of the globular clusters.

The largest systems of stars are the galaxies themselves. Galaxies generally contain between 100 million and 100 billion stars. Our galaxy, the Milky Way, is known to be a fairly large galaxy as galaxies go. However, we can only see a small portion of it optically because of the large quantities of dust in the plane of the galaxy. (We should be thankful for

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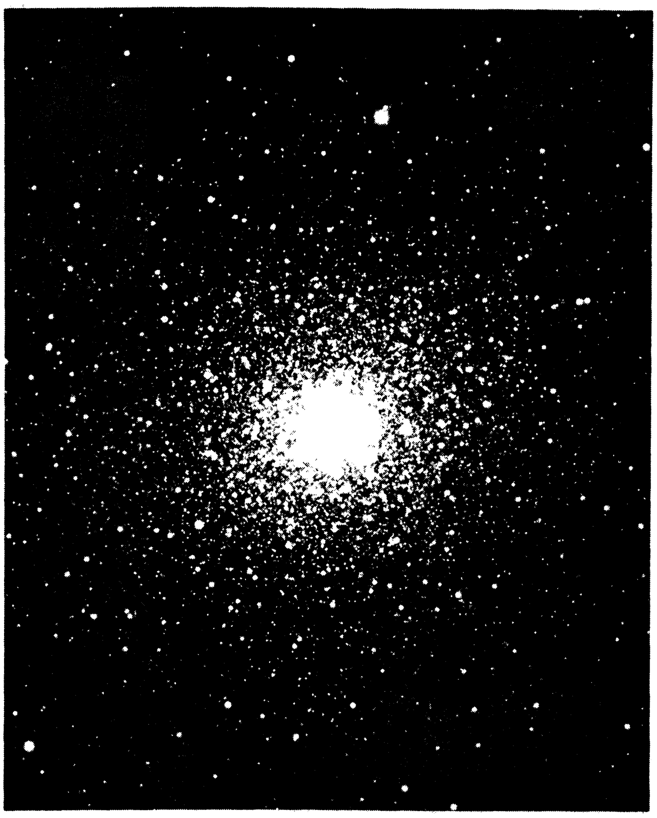
this dust since without it star formation would stop and the skies would be filled by a rather uninteresting collection of old cool stars).

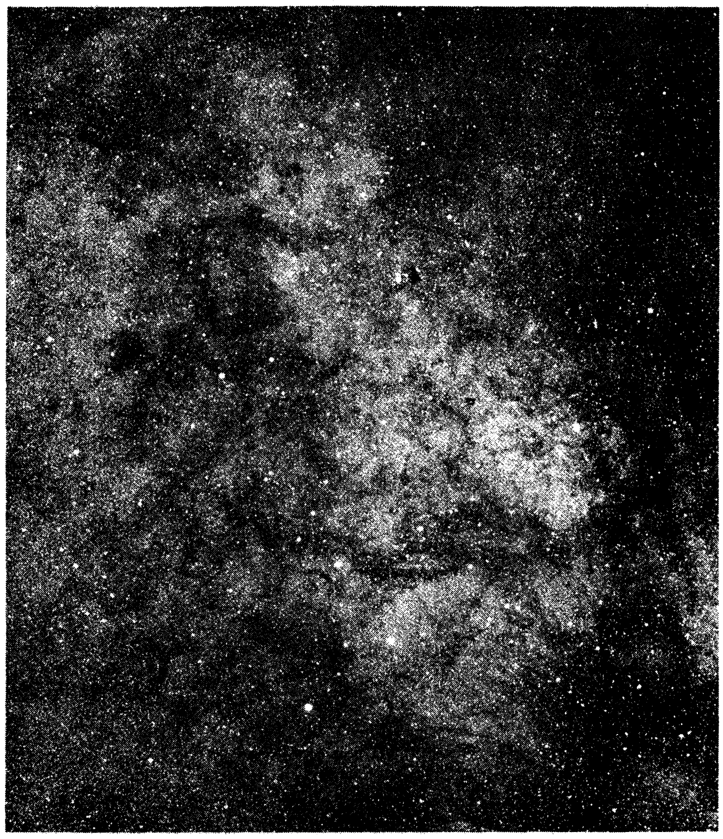


Messier 92 is a nearly globular cluster. About a hundred such clusters are seen just above and below our galaxy. These are in orbit about the galaxy and actually go through the galactic plane from time to time.

Because our galaxy has the general shape of a disk, and because we are located within this disk (about 2/3 of the way out from the center to the outer edge), the Milky Way is seen as a band of light across the sky. It is during the summer months that the earth moves between the sun and the inner part of the galaxy, so that during the summer night the brighter parts of the galaxy swing into view. Because of the dust we can't see into the central parts of the galaxy optically; however, at radio and infrared frequencies the galactic center is known to be quite strong and active.

The problem of determining the structure of our galaxy is a very difficult problem indeed. One big problem is that we are on the inside of the galaxy, and finding the shape is much like trying to determine the shape of a Coke bottle from a fixed point in the interior! The presence of the dust doesn't help either.

By making use of the fact that the galaxy rotates, not as a stiff disk (like a record) but differently (like cake batter in a bowl when mixed at the center), some idea of the structure can be gleaned from studies of stellar or gas motions. Most recent work in this field has been done at radio frequencies using the 21 cm line, and I'll not discuss it further here. It seems likely, however, that when seen from the outside, our galaxy resembles the galaxies shown on the next page.



A portion of our own galaxy, the Milky Way. Irregular splotches of dust are seen in projection against the stellar background. Dust prevents us from seeing all very nearby regions of our own galaxy optically. Distant parts of the galaxy have been mapped, however, by radio astronomers.

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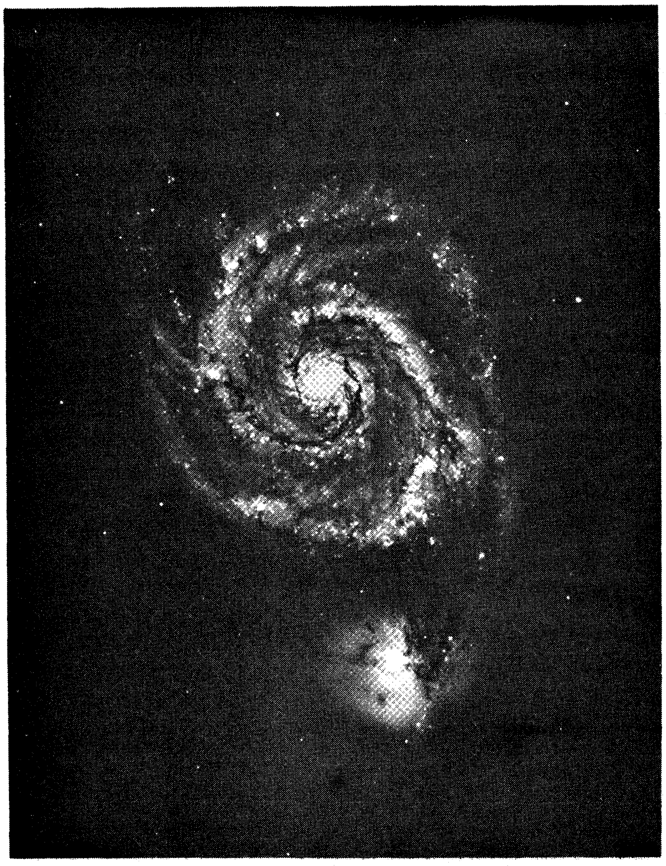

The Whirlpool Galaxy seen here may closely resemble our own galaxy.

Seen edge on, the galaxy NGC 4565 shows clearly the dust which hampers our view of our own galaxy.

I find it most interesting that only fifty years ago the existence of galaxies as very distant collections of billions of stars was very controversial (a sign of my age). Only with the advent of very large optical telescopes capable of isolating individual types of stars (e.g. giant stars, variable stars, etc.) against the background of many fainter stars (all smeared by the incessant turbulence of the earth's atmosphere) was the question of the distance to the "spiral nebulae" finally resolved. Most galaxies are at great distances, and only the brightest of the most distant galaxies can be seen. The spiral structure seems the dominant feature in many galaxies, and the reason for the spiral shape (as opposed to other shapes) is still not completely understood. Galaxies are known to rotate and it seems plausible that the spiral arms of galaxies are lines of stars being "wound" around a central spool. However, modern theories of galactic shapes involve very different concepts (a good topic for an OBSERVER article by someone else). Optical astronomers, working closely with radio astronomers, are studying the distributions and motions of the stars, gas and dust of galaxies in ever increasing detail. Of separate interest are the nuclear regions of galaxies which often seem to have an existence and activity of their own, along with a depleted gas content and an older population of stars.

Other types of galaxies include elliptical galaxies (without any spiral arms) and irregular galaxies (which usually appear to be disorganized or disrupted spiral systems). Fantastic and grotesque radio and infrared sources are sometimes associated with the centers of irregular galaxies implying that eruptive events have taken place in the recent past (here I mean "recent" by cosmological standards). Just as medical research focuses attention on sick or abnormal people, so too much

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of the most active areas of research in optical astronomy is centered on these strange and pathological galaxies.

Another interesting area of research in modern optical astronomy is the enigma of the quasars. Quasars, or quasi-stellar objects went unnoticed by optical astronomers until a decade ago because they appear, at first sight, as faint but undistinguished blue stars. When radio astronomers found very strong radio sources coincident with these objects, the quasars were called back to the attention of optical astronomers. Detailed optical studies gave totally perplexing results for a few years until it was realized that many quasars are moving away from us (and presumably each other) with velocities approaching the speed of light. These objects had to be the most distant ever observed, and their luminosity is that of not a billion stars, but as much as a million galaxies! What a fantastic discovery!

Much of what we have learned about quasars has come from optical observations. However, quasars deserve an OBSERVER article of their own. Quasars, and these irregular galaxies that closely resemble them, are a subject of intense study at Lick Observatory and elsewhere. These objects are spread over enormous distances and velocities, and here we approach one of the most difficult and tantalizing problems of all, that of cosmology field theory.

In many areas of astronomy, but especially in cosmology, theory and speculation easily out-distance the ability of modern instruments to make decisive measurements. Every new piece of information raises new questions, and each seems to require several answers (paradoxically for most astronomers this situation breeds stimulation, and not frustration). I've now let the discussion wander from modern research in optical astronomy. I must soon stop, for this article is already far too long.

In re-reading the manuscript I realize how fast I've covered the field of modern optical astronomy, and how many stones I've left unturned. Optical astronomy occupies a small portion of the frontier of astronomical knowledge. Many surprises and new problems await detection at all wavelengths, but for the foreseeable future, optical studies will remain the keystone of astronomical research.

Let me conclude with an observation and a suggestion. Observing at radio wavelengths can be, indeed is, not only interesting but fun as well. Yet because we humans have no ability to "see" radio waves, observing at radio wavelengths is somehow very, very abstract. By comparison, there is much excitement in seeing the realities of the heavens directly with your own eyes through even a small telescope, and especially through a larger one, that can never be realized in radio astronomy.

In my four years at the NRAO I looked through a moderate sized optical telescope only once, and I now know that this was a real mistake. I encourage all of you who can visit a nearby observatory (e.g. U.Va.) to make the arrangements to do so. In fact, it would be terrific if the NRAO were to arrange for a special night of viewing at one of the larger telescopes, say the 36" at U.Va., at least once every six months or so. If you've never seen the heavens through a telescope of this size, I promise you that you're in for a real thrill. It isn't even necessary (though it helps) to know something about astronomy in order to appreciate the wonders of the heavens. As they say, SEEING IS BELIEVING.

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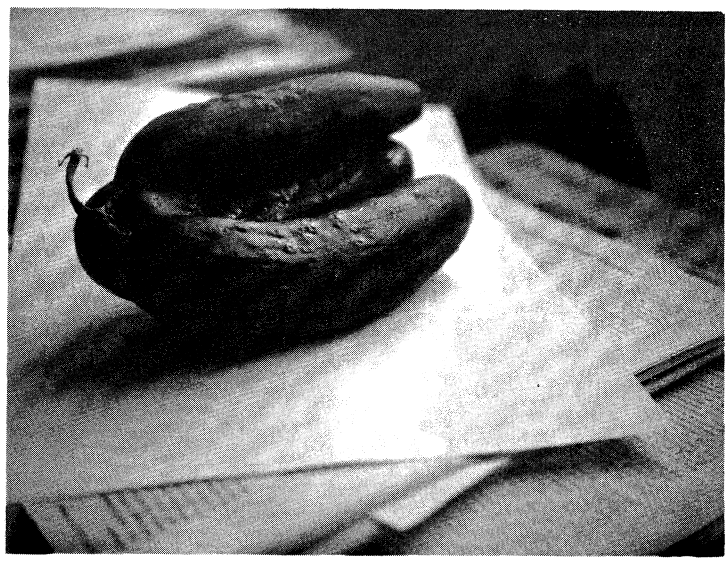

Don Hovatter brought in this "trimese" cucumber.

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THE OBSERVATORY EMERGENCY ORGANIZATION AT GREEN BANK

Bill delGiudice

In the last issue of the OBSERVER we introduced you to the new emergency organization and went on to describe the new ambulance and the emergency medical services available. In this issue we intended to go into more detail on how the fire brigade works but perhaps this can best be done by describing what happened at the last serious fire the brigade responded to.

On June 15th, just after 5:00 a.m., two men who had been sleeping in a small cottage just behind a vacant two story frame house in Green Bank, awoke to find the large house totally engulfed in fire. The cottage was exposed to the intense heat of the fire and in danger of itself catching fire. One of the occupants ran next door to alert those in that dwelling and to call the BFD Fire Co. The fire company in Durbin simultaneously retransmitted the alarm to the Observatory fire brigade and responded with two fire engines. The Observatory responded with both fire engines and eight men. The first Observatory engine (with two men) to arrive laid a hose to protect the cottage which was by now smoking and blistering paint. The second Observatory engine put a hose into operation on the fire building. The first Durbin men arrived and assisted the Observatory men until the first BFD fire engine arrived, and also worked to cool the fire building. The large dwelling was already beyond saving when the fire was discovered but prompt and efficient action by the Observatory brigade saved the cottage which was within seconds of becoming involved in the fire.

This fire demonstrated the efficiency of the mutual aid system with the public fire company, the efficiency of the Observatory's new system for calling the fire brigade together and the effectiveness of fire suppression operations. In the short history of the new organization the cottage was the second structure which the brigade has saved from serious damage or destruction. On May 5th the brigade was able to stop the spread of a fire which destroyed the Cass Railroad Depot just two feet short of the Shay Inn.

The fire brigade presently consists of twenty-seven (27) fighters, including the guards, and operates two fire engines. This is the closest fire service from Frost to Boyer. Public fire service engines are located in Durbin, Cass, Marlinton, and Hillsboro. Fire brigade membership is open to any employee; for details ask any fire fighter.

I TAKE CARE OF THE FILING

I don't have to say that my grandmother died
    If I want to turn out for the Giants:
My boss won't grumble, my boss won't chide,
    I've got it down to a science!
I don't have to faint or resort to tears,
    Or use any feminine wiles--
They can't fire me--for the past two years
    I've been keeping the office files.
Yes, I have a system that's all my own
    And it can't be explained and it can't be shown.

I file by number, I file by letter,
I file by ways that are ten times better!
I file by subject, I file by date,
I file by city, I file by state.
I shun the trite, and I scorn conventions,
My filing system has four dimensions.
I regard "In re" at the top of a letter
As something to make it balance better.

I pay no attention to underlining
    And seldom get down to the person signing.
I've got the names of the Bureau's officials
    Neatly arranged by their middle initials;
Customers' letters I've files instead
    By the color and size of their letterhead.
So they can't fire me, no matter how cross,
    No matter how mean and riling!
I'm Garbo herself--I'm the boss's boss,
    For I take care of the filing.

Author Unknown

* * * *

RECREATION ASSOCIATION NEWS

Chuck Brockway

PICNIC

Congratulations are in order to the following contest winners in events held on July 26 at the NRAORA picnic:

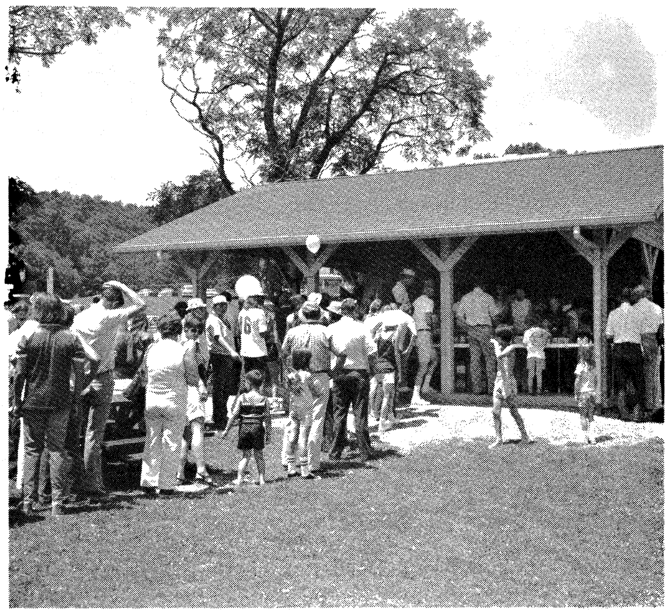
Crawling Contest .... Matthew Crist
Golf Ball Pickup .... 1st - Billy Joe Carpenter; 2nd - Kelly Gordon
Balloon Race - Girls .... 1st - Nida Hively; 2nd - Lorna Gottesman
Balloon Race - Boys .... 1st - Paul Fomalont; 2nd - Stevie Workman
Crab Race - Girls .... Tabatha Beale
Crab Race - Boys .... 1st - Matthew Barkley; 2nd - John Monk
Three Legged Race - Girls .... Johnna Ralston and Shannon Barkley
Three Legged Race - Boys .... Darrell Schiebel and Pat Smith
Shoe String Race - Girls .... Jennifer Fleming and Kusum Menon
Shoe String Race - Boys .... Scotty Howell and David Campbell
Sack Race - Girls .... Regetta Cassell
Sack Race - Boys .... Danny Dolan
Back to Back Race - Girls .... Susan Vance and Anita Oliver
Back to Back Race - Boys .... Chuck Weaver and Danny Dolan
Egg-Spoon Race .... Kim Dunkle
Football Passing Contest .... Stan Conley
Wheelbarrow Race .... Lou Schiebel and George Patton
Egg Throw .... Gerry and Jo Valencia
Horseshoe Pitching .... James Carpenter and Gerry Valencia
Golf Driving .... Bill Radcliff
Casting Contest .... James Carpenter

Swimming Contests

10-11 - Freestyle - Girls .... Jennifer Howard
10-11 - Freestyle - Boys .... Barry Williams
12-14 - Freestyle - Girls .... Amy Vrable
12-14 - Freestyle - Boys .... Danny Dolan
15-17 - Freestyle - Girls .... Cathy Patton
15-17 - Freestyle - Boys .... Chuck Brockway
10-13 - Underwater Distance - Girls, Boys .... Ed Somers
14-17 - Underwater Distance - Girls, Boys .... Chuck Brockway

THE RECREATION ASSOCIATION BOARD OF DIRECTORS WISHES TO THANK THE LADIES AT THE CAFETERIA, THE MEN AT CENTRAL SHOPS AND PLANT MAINTENANCE, AND THE MANY VOLUNTEERS WHO HELPED SERVE FOOD, RUN GAMES, AND HAUL MATERIALS ON PICNIC DAY FOR THEIR MUCH NEEDED AND APPRECIATED HELP!

Swimming Contest Winners



The chow line was long but the food was worth it.

BALL FIELD

In the spring of this year, some Rec. Association members approached the NRAORA Directors and asked if the ball field could be graded in the infield in an effort towards improvement. Since partial grading has already been done a year ago anyway, it was decided to grade the entire infield. Once this was done it was discovered that some players prefer grass to a clear infield. The ball field now stands graded and is dragged periodically to smooth it further and to keep the weeds down. It is ready for use - which will additionally smooth out the infield. If it is not used by those who like a clear (and fast) infield, we will probably go back to grass (and weeds) in a further attempt to maximize its use.

TEEN PARTY

There will be a dance party at the picnic shelter at the Rec. Area from 8 to 11 p.m. on Friday, August 15, for members and guests between thirteen and nineteen years old. Ray Hallman's music machine will be there along with soft drinks and hot dogs. Details on bulletin boards.

REC. AREA REGULATIONS

The Board of Directors has been working for the past few months on amending and clarifying the Rules and Regulations for the Rec. Area. This is a time-consuming and slow-moving process due to the workload on the Board and because some of the rules involve much discussion in the interest of fairness and full consideration to all users of the Rec. Area. The complete Rules and Regulations will be posted as soon as they are finished; in the meantime, those parts of the rules that have already been passed on by the Board will be sent to those individuals who have approached the Board with specific questions or problems regarding that particular rule. In this way, we hope to keep concerned members informed of the Board's position in the shortest possible time.

* * * *

MAJOR MEDICAL INSURANCE MAXIMUM INCREASED

Monroe Petty

Effective August 1, 1975, the maximum lifetime benefit payable under the NRAO major medical program has been increased for both active and retired employees.

Formerly, active employees and their dependents could receive up to $50,000 in lifetime major medical benefits. This benefit maximum has now been raised to $100,000 for each insured individual.

Retired employees and their dependents who participate in Medicare are covered by a supplemental medical insurance program provided by the Observatory. Formerly, the supplemental insurance was limited to a $25,000 lifetime benefit maximum. This limit has now been increased to $50,000.

For active employees and their dependents, major medical benefits apply after all basic hospital, surgical, and diagnostic benefits have been paid by our insurance carrier. In order to establish a major medical claim, an insured individual must incur $100 in out-of-pocket medical expenses during a calendar year. Major medical benefits are then payable at the rate of 80% (50% in the case of out-patient mental treatment of a dependent) for the balance of the calendar year.

For any calendar year in which $1,000 or less is received in major medical benefits, there is no deduction from the $100,000 lifetime maximum. If the benefits exceed $1,000 for a calendar year, only those benefits over $1,000 are charged against the $100,000 maximum.

Employees who wish additional information concerning this benefit change should contact the Personnel Office in Charlottesville.

* * * *

CREF UNIT VALUES - 1975

January	$30.67
February	32.79
March	33.77
April	36.12
May	38.07
June	39.88

* * * *

BUT WHERE IS IT???

Sarah Martin

Since NRAO's library collection now spreads over five locations (CV-Edgemont Rd., CV-Ivy Rd., Green Bank, Tucson, and Socorro), sometimes it's a bit difficult to determine where a particular title is in the system. To make your search less difficult, the following is intended as a brief guide to the collection.

The main library in Charlottesville and the library in Green Bank have duplicate card catalogs. Electronics, Tucson, and the VLA do not have card catalogs. However, they have printouts arranged in call number order. There printouts are also in the Charlottesville library.

These catalogs contain cards for every title in the NRAO system. The trick is to learn to read the notes on the cards to determine just where a particular title is located.

For instance:

> If the card specifies no location; the title is in Charlottesville.
>
> If the card's call number begins with TJ or TK and no location is indicated, the book is in the electronics library on Ivy Road.
>
> If a duplicate copy is also located in Green Bank, its card will be stamped "also in GB" below the card number and/or a note in the body of the card will tell you, for example, "GB-Copy 2".
>
> If the only copy is in Green Bank, the card will tell you this too.
>
> If the Tucson or VLA locations are noted on catalog cards, it means that the only copy is at that location.

I hope this brief explanation will help you understand our library system. Perhaps everything isn't clear yet. In that case, if you have a specific question about a title, give the Charlottesville library a call.

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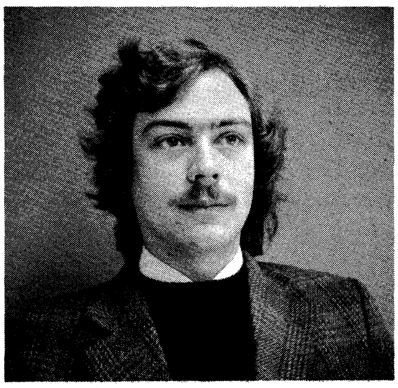
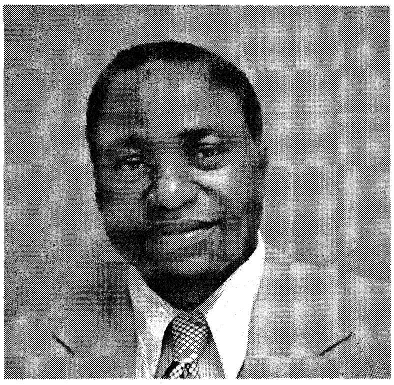
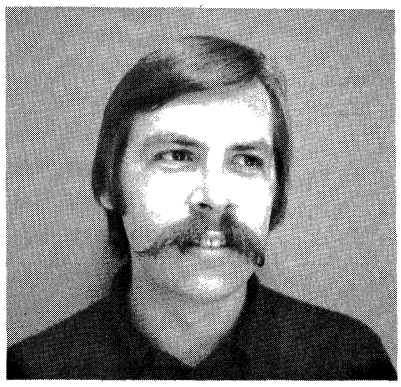
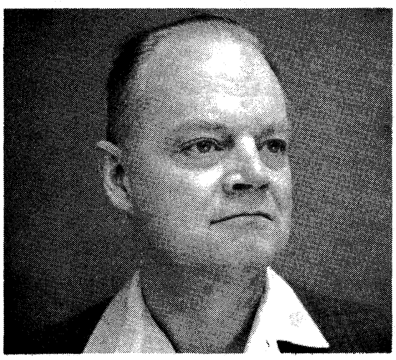
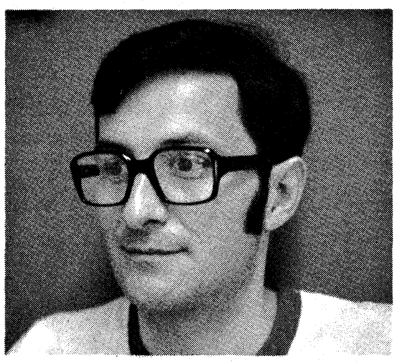
NEW EMPLOYEES

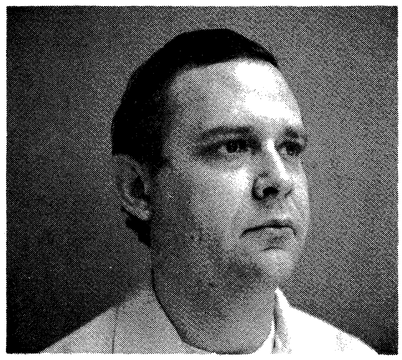

Richard W. Porcas
Research Associate
Basic Research - CV


Samuel E. Okoye
Vis. Assoc. Scientist
Basic Research - CV

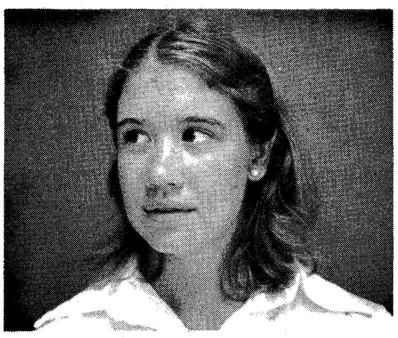

Joseph S. Gray
Designer
VLA Project - CV

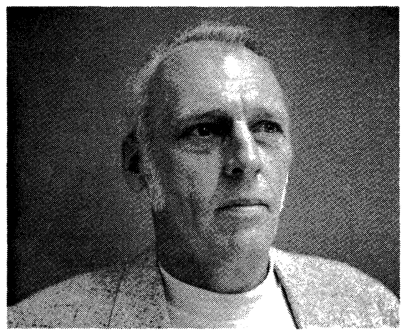

John Granlund
Electronics Eng.
Electronics Div. - CV


Jean Bulabois
Vis. Applied Physicist
VLA Project - CV


Nash K. Burger, III
Computer Operator
Computer Div. - CV


Kenneth M. Barbier
Tech. Specialist
VLA Project - NM


Michele DeBell
Secretary
Electronics Div. - CV


Robert T. Schweigert
Sr. Technician
VLA Project - NM

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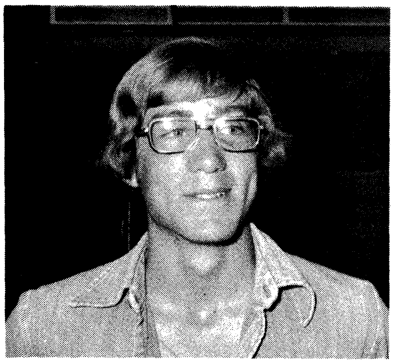


Kris D. Kuhlken
Laborer/Lifeguard
Plant Maintenance - GB

Rosalie G. Douglas
Technical Specialist
VLA Project - NM

OTHER NEW EMPLOYEES (PHOTOS NOT AVAILABLE)

Socorro/Magdalena, N.M. - VLA Project

David B. Archuleta - Special Services Asst.
James F. Cope - Technical Specialist
Florence C. Foster - Secretary
Marion B. Gallagher - Secretary
Theodore J. Jorgensen - Senior Buyer
Judith S. Kampf - Secretary
Eugene G. Keyes - Accountant
Harlan Martinez
Emily M. Mathieu - Accounting Clerk
Ramon Molina - Telescope Mechanic
Theodore E. Neubauer - Staff Shop Tech.
Mikio Ogai - Electronics Engineer
Ernst Raimond - Visiting Mathematician
Donovan L. Swann - Sr. Administrative Asst.
Lester M. Temple - Mechanical Engineer
Emilio Vallez - Stores Clerk

Tucson, Arizona

Margie Brown - Typist
William E. Schoknecht - Electronic Eng.
Steven K. Wilson - Janitor

REHIRES

Saundra M. Mason - Charlottesville
Stephen L. Galhouse - Tucson
Michael S. Hersman - Tucson
John D. Liebenrood - New Mexico

TERMINATIONS

Richard A. Sramek	Basic Research - CV
Phillip D. Rupp	Tucson Operations
Paul R. Woodward	Basic Research - CV
Elizabeth H. Godwin	VLA Project - CV
Rosemary L. Lafrance	Basic Research - CV
George H. Purcell	Basic Research - CV
James F. Wooddell	Plant Maintenance - GB
Jesse E. Davis, Jr.	Electronics - CV
Richard D. Trent	Fiscal Division - GB
James C. Peele	Computer Division - CV
Robert A. Stobie	Computer Division - CV
Victoria L. Taylor	Adm. Services - GB
Timoteo Ruiz	Tucson Operations
John E. Miller	Tucson Operations
Robert A. Turner	VLA Project - CV
H. William Sutton	VLA Project - CV
Grover L. Barkley	Adm. Services - GB

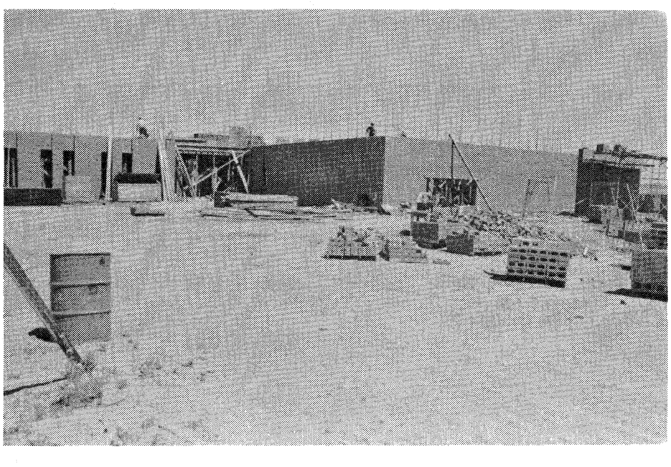
REPORT FROM THE HIGH PLAINS

Jon Spargo

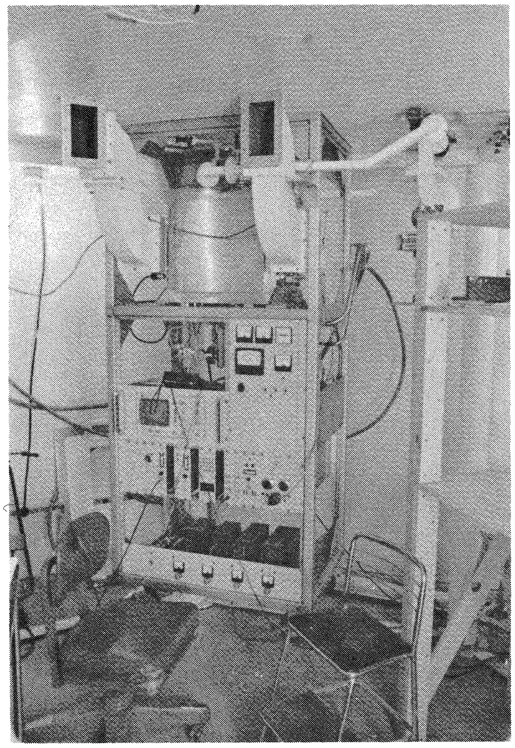
Well, I thought it would work but it didn't. One learns that, at NRAO, one cannot hide from Wally Oref. So, when the phone rang the other day I shouldn't have been so surprised to hear, "Hey, Jon!, how about sending me something for 'The Observer' about what's happening out there."

The key word to describe what is happening around here these days is organization. The months of June and July saw the arrival of most of the VLA people from Green Bank and Charlottesville. For a while, at least, things were rather hectic as people were scurrying everywhere unpacking their long lost treasures and then finding space to work on them. Now that everyone is more or less settled, the work pace is picking up rather rapidly as the date for the completion of the first antenna draws near.

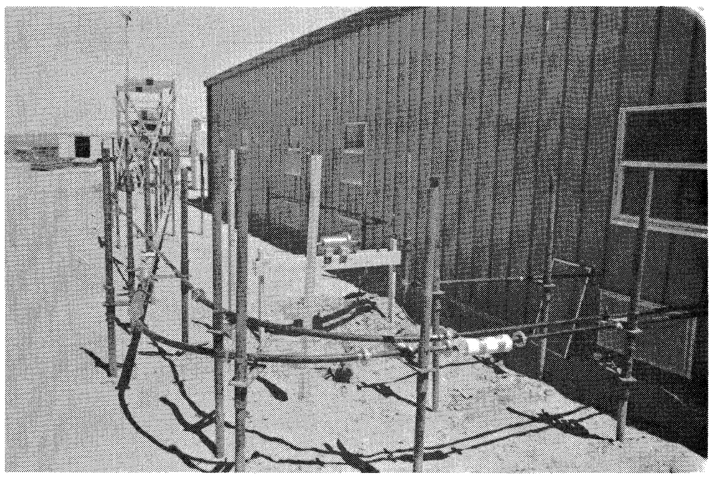
Since the visual aspect of the progress being made is probably much more preferable to my verbal ramblings, the rest of this report will be mostly pictures accompanied by brief explanations. In the future, as we become a little more organized we hope to provide regular contributions to "The Observer", by a variety of people, to keep you informed of our progress.



This shows construction proceeding on the control building. This building plus the adjacent cafeteria are scheduled for completion early next year.



VLA receiver number 1 shown installed and undergoing tests in a mock-up of the antenna vertex room.



This tortuous test track belongs to Mr. Ogai, our resident Japanese waveguide expert, and is designed to test how well 20 mm waveguide stands up to the rigors of being bent, twisted and turned when installed on a telescope.

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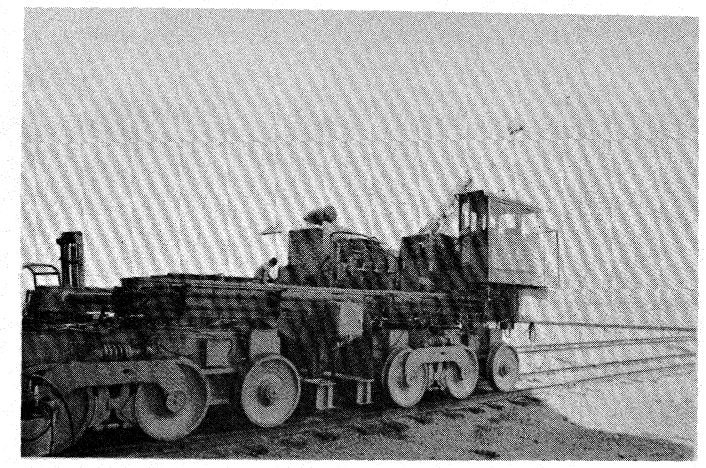
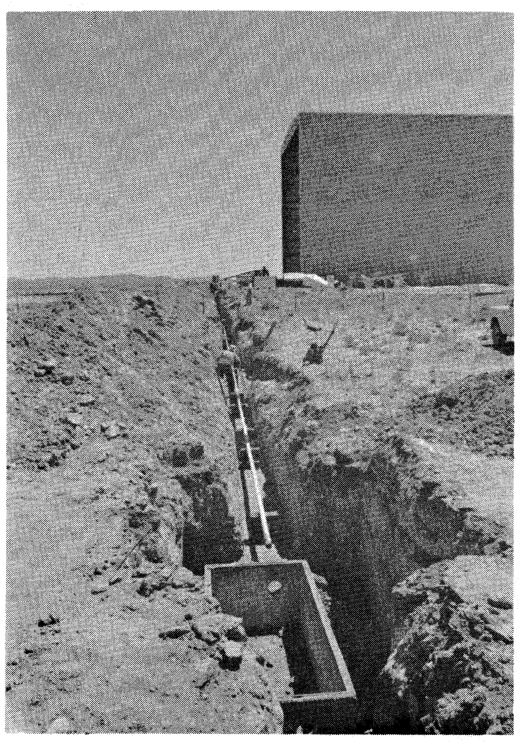
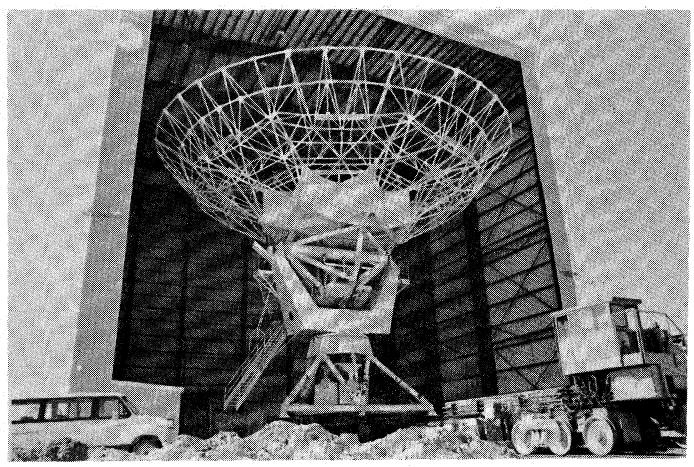
If all goes will, i.e., no sand in the threads, this is how two 16-ft. sections of waveguide are coupled together.



The great orange choo-choo, otherwise known as an antenna transporter, nearing completion on the track just outside the antenna building.



No, this is not the Alaska pipeline--only a portion of the first waveguide run being readied for burial.



Antenna No. 1. shortly after the dish had been bolted to the pedestal and yoke.

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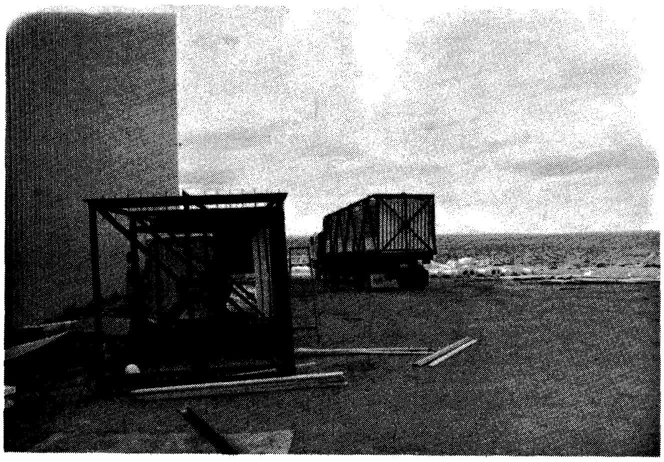
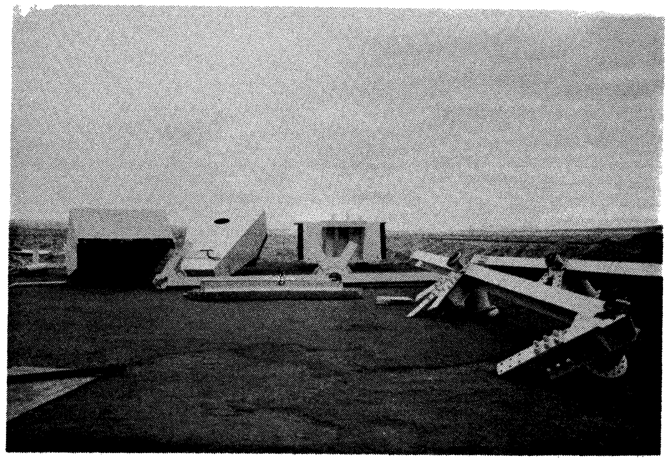
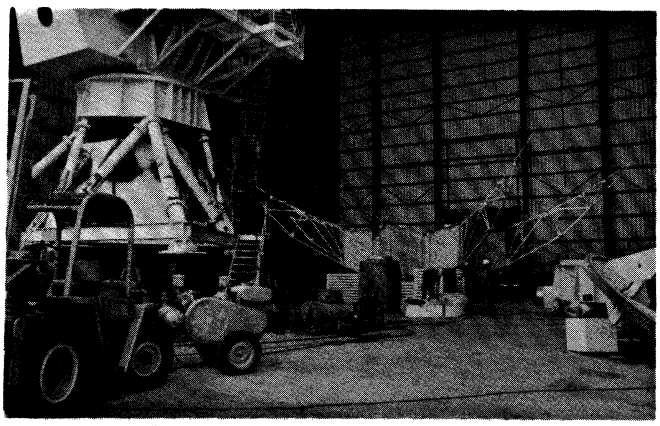


Another load of surface panels arrives for Antenna No. 1.



Parts of Antenna No. 2 awaiting assembly.



In the background, Dish No. 2 is seen taking shape as Antenna No. 1 in the foreground nears readiness for roll out. When No. 1 was under construction the dish was assembled in a similar manner while the pedestal and yoke was put together on the forward set of pads as shown. The transporter was then backed under the pedestal and yoke assembly and lifted it off the pads. The dish was then raised by hoists and the transporter with the pedestal and yoke was positioned under it. The dish was then lowered and bolted to the yoke, after which the whole antenna was repositioned on the forward pads as shown in Photo No. 7.

* * * *

Around the end of July Henry Taylor charmed this rattlesnake with several one pound rocks near the interferometer track. First report from Henry was that it was nine feet long and had about 20 rattles. Actually it was a small one: 47 inches long with 13 rattles.

* * * *

SUMMER STUDENT PICNIC

Jeffrey S. Waldhuter

Summer student picnic was held Saturday, June 21, 1975, and consisted of the summer students and their advisors and families. The weather couldn't have been better. We started out with a softball game, the Green Bank Mountaineers versus the Charlottesville Theoreticians. After a two hour battle the Mountaineers defeated the visitors 11 to 5, with Jim Dolan (pitcher) taking the victory. Then came chow, which consisted of roast beef, chicken, potato salad, fresh salad, ice cream and other goodies one finds at a picnic. I must stop at this point to thank the cafeteria staff for a job well done, everything was delicious. After everyone was contented food wise, we commenced with the most favorite sport of Green Bank, volleyball (better known as Wallyball), with the games continuing into dusk. Now with everyone pooped we lit our annual summer student bonfire, with the help of one solid case of computer paper. Then topping off the day with a midnight snack; hotdogs, chili and toasted marshmallows. Overall, everyone had a fantastic day. I would like to conclude by thanking Ray Hallman for supplying the music and the rest of the NRAO staff who assisted me in turning out a great picnic, I could have not done it without them.

Standing (left to right): Michael Carter, Kevin Baines, Judith Soukup, John Brasunas, Jeffrey Waldhuter, Richard Glassco, Alan Marscher, David Berg, Kenneth Cosner, Jack Burns, Walter Gorman

Sitting (left to right): Edward Teyssier, Alice Kust

* * * *

TUCSON OPERATIONS: THE 1974-1975 SEASON

M. A. Gordon

This year continues to be a hectic one for Tucson Operations. Considering the excellent support we receive from every quarter of the NRAO, I'm beginning to believe that confusion is an intrinsic part of millimeter-wave astronomy. This year Tucson Operations accommodated at least 120 observers from more than 40 institutions, all of this within one approximately 320-day season. In addition to the United States, the observers came from Great Britain, France, Australia, Canada and the Soviet Union.

To accommodate these diverse programs, we're going to make changes in our physical plant. In September, the space downtown will increase from 4800 sq. ft. to about 6400 sq. ft. to provide additional storage and laboratory facilities. On the mountain, we shall construct a 2500 sq. ft. building to service the heavy and delicate cooled-receivers. The old mountain electronics lab (250 sq. ft.) will be converted into an office area for observers.

Along with this growth, there have been some personnel changes. Margie Brown has joined us as a part-time secretary, coming in when Maxine Thomas is on vacation or ill and when our clerical work becomes unmanagable. Ron Womeldorff has joined the Electronics Division to help with construction of new hardware, as has Bill Schoknecht, who has been analyzing the correction of the 36-foot's surface. Paul Rhodes has become chief telescope operator, thereby replacing John Miller who accepted an irresistable offer to return to his old company in Phoenix. Marty Tester is now assistant chief telescope operator. We are pleased to welcome Rosalie Douglas as a new telescope operator, who brings a feminine touch to our mountain operation along with her considerable technical abilities. And finally, because of our and their increased size, Kitt Peak National Observatory is no longer able to furnish us custodial service on the mountain on a pro rata basis. Therefore, Stewart Wilson has joined us on a part-time basis to keep our mountain facilities clean.

The major technical activity this year has been in three directions. Bobby Ulich (and Bob Haas) have tried to devise a technique for correcting for atmospheric absorption, which is a major obstacle to quantitative observing at millimeter wavelengths. The Astrophysical Journal will publish their article in its Supplement Series. Along with this work, Bobby has been experimenting with other potentially useful techniques to provide absolute calibration of telescope over a wide frequency range.

John Payne, Mike Hollis, John Findlay and Bill Schoknecht have been making great progress understanding the surface of the 36-foot telescope with the aim of improving it. With the aid of a 2-ft. long cart carrying a distance transducer, they have made contour maps of the surface to an accuracy of approximately 0.04 millimeters (0.0016 in.). Computer analysis of this surface illuminated with our existing feeds reproduces the observed aperture efficiencies, the astigmatism and the focal curves. These signs all point to the reliability of the contour map. During this summer, they are planning to apply self-sticking aluminum foil to the low points in the surface. The computer predicts an 80 percent increase in aperture efficiency at 115 GHz when this has been done. However, hard-learned experience tells us to adopt a wait-and-see attitude.

The third area of concentration has been in the reliability and performance of the receivers. The cooled-mixer receiver covering 80 to 120 GHz has increased the sensitivity of the 36-foot telescope by a factor of 3, so much that two more are now under construction. The builders of this new device, Tony Kerr, Jesse Davis, Neil Horner, Jack Cochran and Sandy Weinreb, can rightfully feel a great sense of accomplishment. Not only have many new spectral lines been detected, but the sensitivity of this one receiver has reawakened continuum astronomy at millimeter-wavelengths. There have been many other improvements in hardware which, because of their diverse nature, are more difficult to single out except to say that the observer complaints appear to be shifting more to weather and to living conditions in the trailers rather than to shortcomings of the hardware.

The last year has certainly not been all work. In October, we enjoyed our first family outing on Kitt Peak itself. With the aid of Kitt Peak National Observatory (particularly Art Hoag), our families enjoyed a tour of the

(continued--next page)

36-foot telescope (with Ned Conklin at the controls), a barbecue picnic (with Dewey Ross unable to get his fire started), a number of public information movies about NRAO, a tour of the optical telescopes while in use, and even the use of one of KPNO's 16-inch telescopes to look at Jupiter and at the moon.

Our Christmas Party was held at a famous ice cream shop, where we gorged gallons of ice cream before noon and watched an excellent magician baffle our judgement. And, we had a spring picnic in Saguaro National Monument, where I learned the hard way that West Virginians are born to the game of horseshoes--in addition to their enormous capacities for charcoal-broiled steaks.

During early spring Dewey Ross and I had to go to White Mountain to investigate some areas that had been overlooked in an earlier visit. White Mountain is the second highest mountain in California (14,250 ft.) and overlooks the Owens Valley, near Bishop and the CalTech interferometer. Its location makes air travel tedious and inconvenient from Tucson, requiring pre-dawn flights out of Tucson to Los Angeles and then a change of airports to pick up commuter service to the Owens Valley. For our convenience and for the opportunity of investigating the locale in detail, we decided to drive directly to White Mountain and camp on the way. Leaving Tucson at 11 a.m. after buying groceries we arrived at Death Valley National Monument at 10:30 p.m. in 30-40 mph winds following passage of a cold front. With considerable effort, we managed to erect our 2-man nylon mountain tent in the winds and darkness, moving the car out of the camp-site's driveway to serve as an upwind anchor for the flapping rainfly. Once inside, the flapping of the tent was so loud and violent that I wondered about being blown away with us lying on its sewed-in floor. But, within an hour the winds subsided, only to be replaced by three carloads of college students who had picked out our unused driveway in the nearly deserted campground to practice slamming car doors, pounding metal stakes, and shouting to each other for the next two hours. Unlike the earlier flapping tent, this noise was extremely discordant, their occasional tripping on our tent lines really raised our blood pressure, and sleep seemed impossible.

The next morning, we awoke at 6 a.m. to a spectacular, beautiful day and enjoyed some revenge with our noisy preparation of breakfast. At 7 a.m., we left and arrived in Bishop at noon. For consistency, of course, we declined motel comforts and camped at the University of California's rather primitive facilities east of Bishop. After being taken to the summit area by helicopter, we accomplished our objectives of investigating a possible cablecar route by exploring on foot and by helicopter the upper and lower regions of Milner Canyon during the next two days.

The trip home began late one afternoon when we crossed the Inyo-White Mountain range and drove east into western Nevada. We camped at 7500 ft. near abondoned gold mines, on a site overlooking a monumentally desolate but beautiful valley. Although we had no difficulties with wind at this campsite, Dewey spent a miserable night shivering in a non-mountaineering sleeping bag when the temperatures dropped well below freezing (I had been fortunate in borrowing a down sleeping bag)! I knew the novelty of a camping-business trip had ended when, out of the corner of my eye, I spotted Dewey pushing my exquisitely boiled potatoes off of his breakfast plate into the garbage pit; clearly it was time to return to the comforts of home.

All-in-all, this trip was a pleasure for both of us, in spite of the occasional inconveniences. We were able to meet all of our objectives as well as gain other highly useful information regarding White Mountain's feasibility as a site for a new millimeter-wave telescope.

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THOUGHTS WHILE EATING A ROAST BEEF SANDWICH AT THE OBSERVATORY CAFETERIA

Jennifer Howard

All Scientists seem to be up in the air;
Some look as though they aren't anywhere!
Some are mighty and some are meek;
All of them use wacky terms when they speak.
You can't understand the long words they use,
Ask them to yield and they only refuse.
Those words they use are so huge and keen,
I think even they don't know what they mean!

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SUMMER STUDENTS' COMMENTS

Best of all I like the Southern Belles. They knock me out when I'm down there. The weather is least likeable.

An Anonymous Slave

The most wonderful aspect of my stay in Charlottesville is the amazing weather. If it rained just a little more, I could paddle to work in a canoe. This is my first stay in "Dixie", so it's a challenge learning to talk like the natives - but they're often easier to understand than radio astronomers!

R. G.

Being from Charlottesville, I was not overwhelmed, as the other summer students here were, by the ever-exciting night-life of this "Las Vegas of the Southeast Piedmont". However, I do greatly appreciate being able to concentrate my time on research and not having to worry about where the next payments for my Cadillac and 40-foot yacht are coming from. Playing ice hockey and softball and eating lunch with Barry Turner, et al, have successfully prevented me from working on science more than 10 hours per day, a condition known to lead to such disorders as speaking in FORTRAN and addiction to Pepsi-Cola and Zero candy bars.

Al Marscher

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NATIONAL YOUTH SCIENCE CAMP - 1975

Dr. Howard received a nice letter thanking him and the NRAO for making the 1975 National Youth Science Camp a success. Here is an excerpt from his letter:

Dear Dr. Howard:

At the close of each year's camp we like to express our gratitude to those many who help make the National Youth Science Camp an experience that the one-hundred delegates will not soon forget. No doubt there are many more at NRAO who help us than we realize. This years camps was judged to be one of the best ever because of all of their efforts. This could not have happened without the support and active help of many. I hope you will express the appreciation of the Science Camp Staff to the NRAO Staff for their many kindnesses and considerations during our stay at Bartow.

Signed...
Joseph M. Hutchinson, Jr.
Director

Dr. Howard also asked us to include a thanks to the staff members who gave camp lectures, who acted as guides, and to visiting observers who spoke to small groups of students at the telescopes. In addition, he wanted us to include a special thanks of appreciation to the personnel of the Electronics and Telescope Divisions.

One group of National Youth Science Campers listening to Jim Dolan tell it how it is. Campers were here for a morning visit on July 9, 1975.

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BOWLING

Those men interested in bowling in the 1975-76 season which starts September 2, 1975, contact Dick Hiner, ext. 309 GB.

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