

The Green Bank Sattler

You better read it, we could be talking about you!

Volume 6, Number 1 June 1998

Edited by F. Ghigo

Regular Activities:

Aerobics. Monday, Tuesday, and Thursday at 5-6 pm in the tour center. Info: call Janet at 456-4893 or Mary at 456-2236.

TaeKwonDo. Mondays 6-8 pm and Wednesdays 5-7 pm in the Tour Center. Call David Gordon at ext. 315.

Softball. Wednesdays 5-7 pm on the field behind the Green Bank School. Call Jim Braatz for info at ext.327.

Volleyball. Thursdays and Sundays at 6 pm at the Hannah House.

Sunday Menus at the Cafeteria

July 12 Pepper steak, macaroni&cheese, succotash, carrots.

July 19 Baked Ham w/apple sauce, sweet potatoes, green beans, corn.

July 26 Spaghetti & meat sauce w/garlic roll.

Welcome to new employees:

Gareth Hunt, transferred from Charlottesville to head the Computer Division in Green Bank.

Tim Kelly, Fiscal Division.

Stephanie Mullenax, Cafeteria Staff.

James Ruff, transferred from Socorro for the summer, to work as a mechanical engineer for the GBT project.

Loretta Sipe, Cafeteria Staff.

William Vandevender, Plant Maintenance.

Lisa Wray, Electronics Engineering.

Calendar of Upcoming Events

- July 2-3 Holidays.
July 12-14 **SARA Meeting.** Auditorium.
July 15 Tech. Seminar: Mike Stennes, "LO System", Auditorium.
July 19-25 **Hands-On Universe** course. Auditorium.
July 23 Colloquium by **Arsen Hajian** from USNO: "The USNO optical Interferometer". Auditorium 3:30 pm
July 27-29. **GBT Science Workshop.** Auditorium.
Aug. 1 **Annual Picnic.** 1-10 pm. Rec.Area.
Aug.2-15. **Teachers Institute.** Auditorium.
Aug. 19 Tech.Seminar: Wes Grammer, "Q-band", Auditorium.
Aug.19-20. **ARISE science Workshop** Auditorium.
Sept.7 Holiday.
Sept. 16 Tech.Seminar: Roger Norrod,
Oct.?? GBT Advisory Committee Meeting
Oct.8-10 Square Kilometer array workshop.
Oct.12 Holiday.
Oct.16-17 **AUI Trustees Meeting** at Snowshoe.
Oct.19 **Jansky Lecture** by B. Burke
Oct.21 Tech.Seminar: Gary Anderson.
Nov. 18 Tech.Seminar: Steve White,
Nov.26-27 Holidays.
Dec.24 Half-holiday.
Dec.25 Holiday.

Observations of an Iridium Satellite with the NRAO 140-Foot Telescope

by M. M. McKinnon

The Iridium satellite system is a group of 66 satellites, already in orbit above the Earth, that provide portable telephone service anywhere in the world. They present a problem for radio astronomy because they broadcast near the frequency of the hydroxyl molecule (OH), which emits in the range 1610-1614 MHz. This molecule is important for studying the structure of galaxies and processes in star-forming regions. The Iridium Consortium has kindly agreed to limit their signal in the direction of NRAO telescopes, so that studies of the OH molecule will still be possible from the ground. (This means that your portable Iridium telephones will work anywhere in the world -- except in Green Bank and the Plains of San Augustine).

To test whether the Iridium satellites were staying in the agreed-upon limits, observations of the Iridium satellite SV 13 were made with the NRAO 140-Foot Telescope on February 25 - March 3, 1998. Satellite observations were also made in Tucson and at the VLA. The objective of the observations was to measure the spectral power flux density (SPFD) of the emissions from the satellite downlink in the radio astronomy (RA) observing band at 1610.6 - 1613.8 MHz.

According to a Memorandum of Understanding between Iridium and NRAO, the SPFD in the RA band cannot exceed -208 dB (watts/m²/Hz) at all NRAO sites at all times, -223 dB (watts/m²/Hz) at the VLA at all times, and -238 dB (watts/m²/Hz) at Green Bank for a four hour time period during the early morning. Radio astronomers are more familiar with the Jansky (Jy) as the unit of SPFD, and, since 1 Jy = -260 dB (watts/m²/Hz), the limiting SPFDs are very high thresholds by radio astronomy standards (e.g., 1 Jy is a factor of about 10⁴ less than the VLA SPFD limit).

Bob Simmons and Roger Norrod modified the telescope's L-band receiver for the satellite observations. The receiver's low noise amplifiers (LNAs), the first amplifier in the RF section of the receiver, would have saturated at the power level of the satellite signal. To avoid saturation, the cryogenically-cooled LNAs were bypassed, and a sharp cutoff filter provided by Iridium was inserted in the RF signal path before the second amplifier in each polarization of the receiver. The gain and compression point of the amplifiers were measured in the laboratory prior to the satellite observations.

Additional tests in the laboratory also showed that the response of the entire receiver remained linear at the input power levels expected for the observations. The modifications caused the receiver system temperature to be high (700 K) because the RF amplifiers were not cooled and the Iridium filters have a high insertion loss.

An Iridium satellite is above the local horizon for no more than about 15 minutes, and the 140-Foot Telescope cannot move fast enough to accurately track it. Consequently, the observations were made by parking the telescope at a predetermined azimuth and elevation and recording data when the satellite was expected to pass through the telescope beam. Under the most favorable observing geometry (when the satellite is near the horizon and its orbital plane is aligned with the longitude of the telescope), the telescope can change elevation fast enough to stay ahead of the satellite, and data can be recorded for two separate passes through the beam. The equatorial mount of the telescope prevents observations on the north horizon; therefore, most observations were made pointing to the south. Observations near the horizon also minimize the potential pointing error caused by the uncertainty in the satellite's location. The

Observations of an Iridium Satellite, continued.

telescope data were recorded with the NRAO spectral processor.

The satellite can transmit voice channels and broadcast channels. The voice channels carry the actual telephone conversation, and the broadcast channels are used to determine if an attempt is being made to place a telephone call. The satellite was programmed for three different loadings during the observations. Only the broadcast channels were transmitted in one loading, and only voice channels were transmitted in another. The third loading was a combination of voice and broadcast channels. Whenever the voice channels are transmitted, the satellite emissions appear as a continuum across the RA band. When only the broadcast channels are transmitted, the emissions in the

RA band consist of nine distinct CW-like signals spaced at about 330 kHz intervals. The frequency resolution of the spectral processor allowed us to measure the Doppler shift of the CW signals as the satellite moved from zenith to horizon. The SPFD of the emissions in the RA band is higher when the satellite is closer to the telescope (near the zenith). Observational results from all NRAO sites indicate that the SPFD of the satellite emissions will be below the -223 dB limit established for the VLA and thus the -208 dB limit for all sites. The results do show, however, that the SPFD is greater than the -238 dB limit for Green Bank. Iridium will likely alter the number and/or power of the channels to comply with the Green Bank limit.

News about people

Mike Holstine will be taking over as the new Business Manager at the end of September, replacing **Richard Fleming**, who plans to retire after 10⁴ years of excellent and indispensable service.

John Ford will become the new Division Head of Electronics at the end of June, taking over from **Tim Weadon**, who will return to full-time digital engineering.

Glen Langston will have a temporary Visiting Professorship at ISAS (the Japanese Space Agency) in Sagamahara, Japan from mid-September to mid-April. He will be working on analyzing data from the HALCA radio astronomy satellite and on scheduling and other operational aspects of the space VLBI mission. His family will accompany him on his stay in Japan.

Congratulations to **Sue Ann Heatherly** and **Ed Tallman**, who have announced their engagement and plan an August wedding. Sue Ann has been the Education Officer for NRAO-GB since 1989, in charge of education, tours, and outreach programs. In addition to everything else, she was the founder and first editor of the Green Bank Tattler! Ed is a native of Durbin, WV, has worked as an editor and news director, and was recently appointed to the Pocahontas County Commission. We wish them all the best in their married life.

Farewell, and best wishes to **Bob Vance**, and **Bill Vrable**, who retired this year. (By the way, Bill is willing to help anyone out with any snakes that need turning).

Who are the summer students this year?

REU summer students:

Marc Apgar, an Electrical/Computer Engineering major at WVU from Morgantown, is working with Frank Ghigo on software for control of the 85-foot telescopes, and with Wes Grammer on LO systems for the 40-foot.

Naomi Bates, an Astrophysics major at Princeton, from Franklin, WV, is working with Ron Maddalena on high-velocity gas in face-on galaxies.

Keri Eberhardt, a Physics/Math major at the University of Nebraska, from Omaha, works with Glen Langston on the analysis of high redshift radio line data.

Jessica Golub, a Physics/Astronomy major at Vassar College, from Lexington, MA, works with Jim Braatz on water maser and continuum VLA data.

Jennifer Lockman*, a Physics major at the College of Charleston (South Carolina), is working with Jay Lockman* on a survey of Hydrogen emission in the Milky Way.

Patrick Matheny, an Electrical Engineering major at WVU, from Durbin, is working with Dave Parker on GBT laser metrology.

Nicole Wiersgalla, a Physics/Astrophysics major at the University of Minnesota, from Hudson, Wisc., is working with Dana Balser and Toney Minter on turbulence in HII regions and the diffuse ionized gas.

Co-op students:

Steve Hicks, an Electrical Engineering major from the University of Memphis, from Hernando, MS, is working with John Ford on the GBT monitor & control software and hardware.

Stephane Jouteux, a Computer Science major at the University of Le Mans, from Le Mans, France, is working on GBT monitor and control software with Mark Clark.

Jason Ray, an Electrical Engineering major at WV Institute of Technology, works with Dave Parker's group on GBT laser metrology.

Maintenance Trainees, working for the Plant Maintenance department:

**Travis Burner,
Seth Shinaberry,
Dane Sizemore, and
Richard Thompson.**

Pool Lifeguards:

**Joy Carpenter,
Timothy Rexrode, and
Sarah Weadon.**

Tour guides:

**Michael Shank,
Hannah Smith, and
David Young.**

*No relation.

New Wednesday Tour Series: STARS AND TECHNOLOGY

by Cara Rose

The National Radio Astronomy Observatory located in Green Bank will be offering new evening programming during the 1998 summer tour season.

The summer series will be coordinated by Cara Rose, tour director. "I am excited about the programs and hope the staff will show support for our new initiative in developing the tour programs available to the general public."

The programs are designed to allow visitors a peek into the inner workings of the facility including fun hands-on activities.

The programs will be offered each Wednesday, from June 3 through September 2, 1998 in a variety of science forums. The special series of events includes STAR LAB, HANDS-ON-UNIVERSE, HIGH TECH TOURS, and STAR PARTIES.

"In addition to the summer program, my hope is to offer these type programs throughout the year, with advance reservations to private groups." says Rose. "I will turn to staff from time to time in my efforts to provide the best programs possible to visitors."

The programs carry a five dollar fee and do have maximum capacities. If anyone has ideas or suggestions for future programs, please call Cara at 456-2164.

Schedules are available in the lobby of the new Jansky lab area and also at the tour center. If employees have guests during the summer and are looking for a Wednesday evening activity, come on down.

Schedule of "Stars and Technology" Wednesday Night Programs

All programs start at the NRAO Tour Center. CALL 456-2164 or 456-2150 for more information.

* HANDS-ON UNIVERSE:

June 10, July 15, August 19;
at 5:00 pm, 6:00 pm, and 7:00 pm:

Science for fun centered around astronomy and the use of computers to design radio wave images. Limited to 20 per program.

* HIGH-TECH TOURS:

June 3, July 1, 19, August 26.;;
3:00pm, 4:00pm, 5:00pm

Participants will be guided through parts of NRAO normally off limits to visitors, like lab areas where sensitive receivers and other electronic components of radio antennas are designed and built. Limited to 20 people per program.

* STAR PARTY/LECTURE:

June 17, July 22, August 5.,
beginning at 8 pm.

NRAO astronomers will orient guests to astronomy and the star-filled sky, with a night viewing period. Bring your optical telescopes and binoculars. Inclement weather could cancel these programs.

* STAR LAB:

June 24, July 8, August 12, September 2.
5:00 pm, 6:00 pm, 7:00 pm.

Guests will gather under a planetarium balloon for a fascinating 'look' at the sky above. NOTE: wear nice socks because shoes come off. Limited to 15 people per program.

NEWS FROM GREEN BANK PLANT MAINTENANCE

(This actually includes buildings as well as plants.)

by Mike Holstine

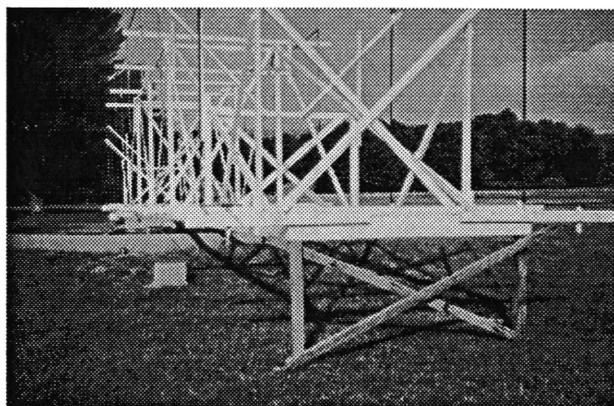
Plant Maintenance (PM) has hired four summer students to aid in the normal rush of summer activities, and you have probably seen them around. Two of the students are returnees - Dane Sizemore, who is studying physics at Westminster College, and Seth Shinaberry, who is at Shepherd College studying math and secondary education. The third is Richard Thompson, who is attending West Virginia University Institute of Technology studying mechanical engineering. Travis Burner, the fourth student, is a recent high school graduate. These students are always a great help to PM in everything from grounds maintenance to various installation projects around the site, and we are very glad they are here.

As you may have seen, PM has been lowering cable trays on the second floor of the Jansky Lab building. What you may not know is that this work is a precursor to installation of air conditioning in this area. The work will entail the cable tray relocation, relocation of some of the hallway fixtures, installation of four A/C units, and installation of the associated supply ducting into each of the offices on the second floor. The A/C units will be mounted on the roof in the positions occupied by the existing large fans you can see in the ceiling of the second floor hallway.

These openings will act as the returns for the conditioned air, providing recirculation of the air from within the offices to the hallway. Provided that nothing major comes up, we hope the system will be operational very soon.

Telescope News: The Jansky Antenna

The Jansky antenna was damaged earlier this year when high winds broke the pintle cross beam, causing the wheels to come off the track. Several spokes for the wheels were broken. The cross beams, which had been deteriorating for years, were replaced with treated lumber. New spokes were made in the shop from white oak. The picture shows scaffolding supporting the antenna while the wheels were being fixed. Since the picture was taken, the wheels are back on, and the antenna is in working order again.



NRAO TaeKwonDo Club AWARDS -

March Through June 1998:

Rank promotions:

Ann Pedtke - 7th Gup

Aaron Gordon - 8th Gup

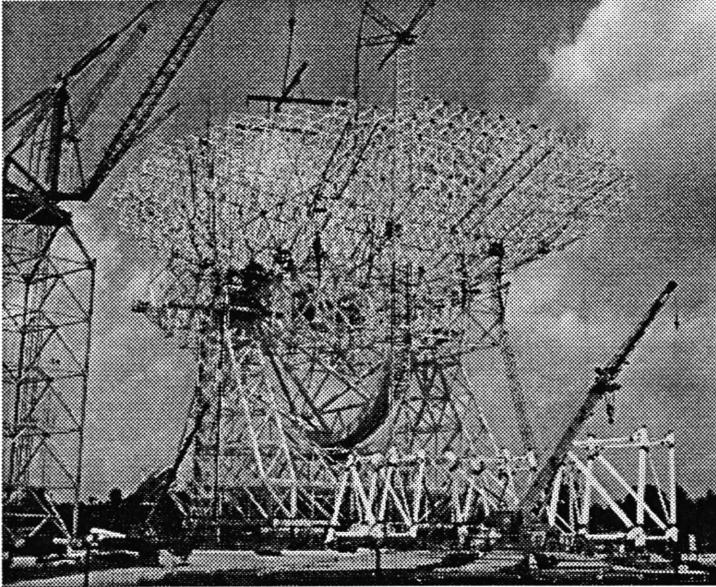
Joe McMullin - 5th Gup

Dana Balser - 2nd Gup

NEWS OF THE GBT

from Sid Smith.

All 22 modules of the dish back-up structure are now in place on the antenna. An all-time high of 120 construction workers are now employed on site. The site is a busy place. By the end of June they will have four tower cranes in operation. These are the ones with the vertical mast with a long jib at the top. They can lift small loads to the center of the dish over the lip of the dish structure.

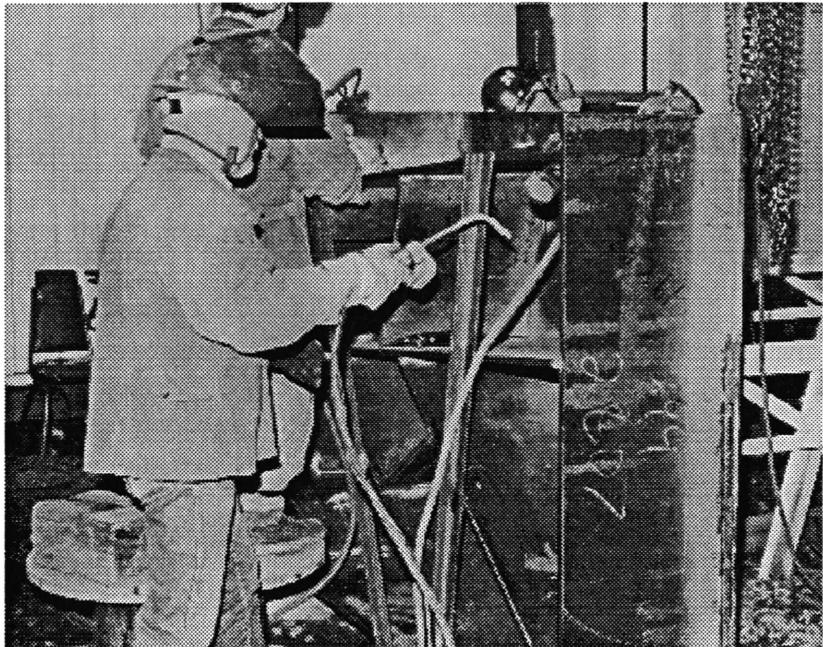


The back-up structure is now sitting on the same seventeen temporary supports as when it was on the ground. The next phase will be to transfer the back-up structure to its permanent support points. Before this can happen, a major re-work of the joints that receive beams from the box structure needs to be completed. The picture (below) shows one of these joints being re-built. Eight of the joints are being rebuilt on the ground, and the other eight in the air. The joint re-working should be complete late this year. The dish cannot be moved on its elevation axis until the permanent supports are complete. This means that final assembly of the

upper part of the feed arm must wait until then because it requires the dish to be tilted so that the feed arm is vertical.

Some in-house work is also being done. The cable wrap for the feeds in the feed room is in place, the eight bulkheads the actuator cables go through into the actuator room have been installed, some cryogenic pipe has been installed, etc.

Jim Ruff, a mechanical engineer from Socorro, has transferred temporarily to help with the site construction.



What's New at the 40 Foot

by Sue Ann Heatherly

With all of the telescope upgrades going on at Arecibo, the Bonn 100 Meter, and the VLA, it was only a matter of time before the 40-foot joined the chorus! Over the last couple of years, the 40-Foot has undergone some changes with more in the works- and a few projects that are in the "wouldn't it be grand" stage. Here's the scoop:

1. Using discarded 300-Foot backend parts the 40-Foot now has the capability of detecting the emission from neutral hydrogen. Hydrogen is the most abundant stuff in the Universe, and hydrogen atoms emit radio waves at one particular wavelength. If you want to see hydrogen you have to filter out radio waves at other wavelengths and zero in on the 21 centimeter wavelength. Our early attempts at detecting hydrogen involved the use of a WWII Signal Corps shortwave radio, but thanks to the demise of the 300 foot we were able to upgrade our capabilities! Some of you might remember the old Variable Frequency Local Oscillator Backend at the 300 Foot. It is a cantankerous system, but the 40 Foot is proud to have it. Now, one of the best projects at the 40 Foot is investigating hydrogen in the Milky Way.



2. Eric Zwirnmann and Ken Peterlin of Beaver College near Philadelphia took on an interesting senior project this year. They have created the 40-ft. Navigator, a computer control/data recording system for the 40 Foot. Their system will allow a user to move the telescope, control the hydrogen backend (see #1), and collect data digitally. The user interface was written using Visual Basic, and it is a thing of beauty. Many thanks to Ron Maddalena and Ray Creager for advising Ken and Eric on this project. Ken and Eric won "Best of Show" at the senior project presentations. As I write this, both guys are here working around the clock with Carl Chestnut to get the Navigator up and running and talking to the telescope. I'll let you know how it all works out!

40-foot News, continued.

3. A new Local Oscillator: We are using some the same old 300-Foot backend to produce the local oscillator signal for the 40-Foot receiver - and as I said before it is cantankerous! The problem is keeping the signal locked at the proper wavelength. Looking at the old log books for this equipment, it doesn't take a rocket scientist to see that these things were "sensitive" from the beginning. Wes Grammer has designed a new LO, and donated some components. Carl's mission (he has chosen to accept it) is to build the LO this summer.

4. "Wouldn't it be Grand?": Did you know that the ground gives off radio waves because it is warm? We know it at the 40-Foot because we can "see" the ground around the edge of the dish! We use two dipole feeds at the focal point of the telescope, and they detect not only radio waves that bounce from the dish, but radio waves from the ground as well. Rich Bradley, engineer at Charlottesville, has been working on an innovative alternative to the feed horn. His new feed design can help eliminate the ground pickup. We want one at the 40-Foot!

The NRAO-Green Bank education programs have resulted in hundreds of 40-Foot users. Teachers, their students, college classes, and amateur astronomy groups have the same wishes as professional astronomers: a stable reliable sensitive telescope, the ability to collect data from a remote location, and the capability to do more experiments! Thanks to the creative thinking and scrounging of folks at NRAO, and students like Eric and Ken, the 40-foot will better serve its users.

More Telescope News: The 140-Foot gets a reprieve.

by J. Lockman

Although planned for shutdown at the end of 1998, the 140-foot will probably continue to operate at least until mid-1999, thank to urging by the NRAO Users committee. The delay in the projected completion date of the GBT to late 1999 makes it desirable to delay the shutdown of the 140-foot.

The regular suite of prime focus receivers covering frequencies up to 5 GHz will be available, as will the GBT receivers at the Cassegrain focus that cover 4-5 GHz (for VLBI only), 8-10 GHz (cannot be used for VLBI) and 18-26 GHz. The available back ends include the MKIV autocorrelator, the Spectral Processor, the Digital Continuum Receiver, and the VLBA and S2 systems for VLBI.

In view of the extended period of operations of the telescope, new proposals will be accepted. Proposals for time in late 1998 and the first quarter of 1999 must be received in Charlottesville by 1 October 1998. Proposals to use the instrument in the second quarter of 1999 should be received by 4 January 1999. Further information on 140 Foot Instrumentation, and instructions on proposal preparation are available on the GB Web site.

The Tatel Telescope turns 40 this year

by F. Ghigo

The Tatel Telescope, otherwise known as "85-1" to its friends, has its 40th birthday this year. It was the first telescope built at NRAO. A commemorative T-shirt is available at the tour center with the design pictured here.

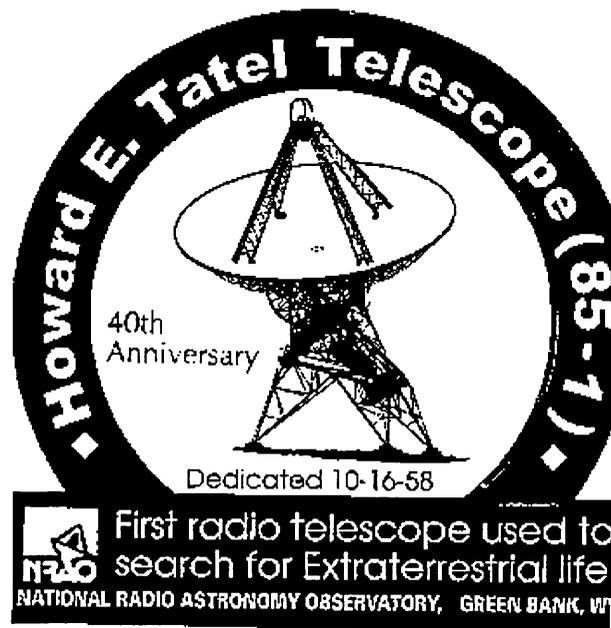
Howard E. Tatel worked for the Carnegie Institute Department of Terrestrial Magnetism (DTM) in the 1950s and collaborated with the Blaw-Knox Company of Pittsburgh to design a telescope for DTM. Blaw-Knox had also received telescope orders from NRAO, the University of Michigan, and the Jet Propulsion Laboratory. Tatel's concept used large diameter gears for the two axes to provide high precision at relatively low cost. Bob Hall, who is now the GBT project manager, was then manager of the antenna division at Blaw-Knox. He expanded Tatel's concept, generated a practical working design, and supervised the construction of these telescopes. Tatel died on a field trip in 1957 and never saw the completion of his telescopes. The

NRAO 85-foot was dedicated in October of 1958, and named in his memory. It began continuous operation in April of 1959. Fred Crews recalls (in "The Observer" for March 31, 1964) that the first observations were done on Friday, February 13, 1959. "Initially there were only two operators [Fred Crews and Bill Meredith], who worked 12 hour [shifts] keeping the telescope going 24 hours a day except for week-ends when the scientists did their own observing."

Although best-known as the telescope used by Frank Drake for "Project Ozma", most of its time was spent in basic exploration of the radio universe. Surveys of radio sources provided accurate positions and flux densities at several frequencies. Surface temperatures were measured for Venus and the Moon. Studies were done of Jupiter's radiation belts. The structure and composition of the galaxy and regions near the galactic center were studied for the first time.

In the mid 1960s, two more 85-foot telescopes were built to the same design to become the three-element Green Bank Interferometer (GBI). This was used for studying fine structure in radio objects. The GBI did the first radio measurement that confirmed to high accuracy the prediction by general relativity of the bending of light (i.e. any electromagnetic radiation) near a massive body. The GBI was the prototype instrument for the VLA. From 1978 to 1994 the GBI was operated by the USNO for studies of Earth rotation and monitoring of variable sources. Today the Tatel Telescope is still in continuous use as part of the GBI, now funded partly by NASA for studies of x-ray and gamma-ray sources.

Fred Crews concludes, in the 1964 Observer article, "The 85' Tatel telescope has now been in operation for 5 years. Its life expectancy is 20 years." Today the telescope has been productive for twice its expected lifetime, thanks to Howard Tatel's initiative, and is still in good working order. How many of us can say the same?



"GETTING CONNECTED AT THE OBSERVATORY"

Carol Ziegler, who answers the main telephone number for the Observatory, reports many of the typical and not-so typical calls she gets from the public :

"N-R-A-O."

"Hello? Is this the place where them satellites are?"

"Well, a..... we don't actually have satellites here, but we do have telescopes. Can I help you?"

"Well, I wanna come and look at your satellites."

"Do you mean you'd like to come for a tour?"

"Yeah."

"Well, let me connect you to our tour office."

"N-R-A-O"

"I have a question I'd like to ask an astronomer."

"What kind of question, so I can figure out who to connect you to?"

"Well, I saw something, and I just wanted to check it out with someone. This morning, the sun came up in the west, and I want to know why."

Long pause..... "Well, sir, I don't really think that probably happened. If it did, we would probably all be dead."

"But I saw the sun come up in the west, and I need to talk to an astronomer."

"Let me connect you to our Public Education Officer."

[There may have been a rational explanation for the "sun coming up in the west", according to Wally Oref, who was in charge of tours at the time. The full moon was very prominent on the western horizon at sunrise. The eastern sky may have been obscured by clouds, and the caller may have seen the moon on the western horizon and assumed it was the sun.]

"N-R-A-O"

"I want to find out about getting a new military ID."

"Well, a.....sir, we do not do that here."

"Is this not the Naval Observatory at Sugar Grove?"

"No, sir, this is the National Radio Astronomy Observatory in Green Bank, West Virginia. We are not affiliated with the observatory in Sugar Grove."

"But I called long distance for information and this is the number they gave me."

"Well, sir, this happens all the time. They give our number out quite regularly. Here is the number for the Naval Observatory....."

"N-R-A-O"

"Is the National Astrology Observatory?"

"No, we're the National Radio Astronomy Observatory"

"N-R-A-O"

"Are you open?"

"What do you need?"

"Are you open?"

"Do you mean, for tours?"

"Yeah."

"Let me connect you to our tour office."

"N-R-A-O"
"Are you open?"
"Do you mean for tours, ma'am?"
"Yeah."
"Yes we are."
"Do you have anything the kids can look through there?"
"Let me connect you to the tour office."

"N-R-A-O."
"Is this the Astronomy?"
"This is the National Radio Astronomy Observatory in Green Bank."
"I wanna know, what is it you all do up there?"
"Well,, let me see if there is someone in our Public Education Office that can help you."

"N-R-A-O."
"I have come to Green Bank to do an observing run.. Can you tell me how I can get there? You're not on my map."

NEWS FROM THE REC BOARD

by F. Ghigo

The NRAO-GB Employee Recreation Association board held their monthly meeting June 18th. The board members present were John Ford (president), Greg Morgan (treasurer), Joe McMullin, Max Gum, Glen Langston, and Tim Glaser.

The company picnic, scheduled for August 1st, was discussed. John is making the catering arrangements. The plans are for barbecued pork and beef to be served. Glen Langston and Jerry Lawrence are in charge of games for children this year; some new games will be introduced.

Pool: new umbrellas and chairs will be ordered soon. What about the pool shelter, a sun shade to go over the patio outside the fence? PM thinks they may not get around to it this summer. Glen suggests we should push Mike to finish the shelter this summer, with volunteers

from the rec board and employees helping. Also suggestions were made to put sun shades, perhaps an awning, near the wading pool, and the grassy area behind the pool inside the fence that many people sit in.

Volleyball court: converting the old tennis courts to a sand volleyball court may be done this fall.
Exercise equipment: efforts are being made to fix the cable on the weight machine and to get an additional weight set so that more than one person at once can work out.

Don't forget that employees get 50% off when buying rec-association products at the tour center, such as shirts and hats. [NRAO is not giving employee discounts on the educational items such as books. Let's complain about this! -- ed.]

First "Light" on the GBT Spectrometer

On May 22-24, the first astronomical observations were done with the GBT spectrometer, using signals piped over fiber optics from the 140-foot K-band receiver. Glen Langston led this effort, with considerable help from many people, including Ray Escoffier (the designer of the spectrometer), Jeff Hagen, Roger Norrod, Mike Stennes, Rich Lacasse, and Keri Eberhardt. The water maser line (22.2 GHz) was observed in Orion, and the hydrogen recombination line H68 α was observed in SGR-B2, both with excellent results. Although routine use of the spectrometer is still a long way off, this preliminary test is very encouraging.