

The O B S E R V E R

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Page 1

THE LITTLEST TELESCOPE



See story on page 4.



With this issue of the OBSERVER, we note a change of the editorship from the very capable hands of Carolyn Dunkle. It was with regret that we accepted her decision to step aside and pass the duties of the editor into new hands. But it is a pleasure to extend our thanks to Carolyn for a superb job in bringing the OBSERVER back to life and guiding it through its growing pains to its present form. Carolyn's tenure as editor and the degree of professionalism displayed by her in these pages is something that we're sure has been noticed by one and all. We hope you will join us then in extending our thanks to Carolyn.

For future issues, we plan to have a series of guest editors. Our first is Barbara Hallman, and we are happy to welcome her.

The Editorial Board

The OBSERVER is a bimonthly publication of the National Radio Astronomy Observatory, P.O. Box 2, Green Bank, West Virginia 24944.

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A special thanks to all of those who helped assemble the OBSERVER.

FROM THE DIRECTOR'S OFFICE

William E. Howard

One thing that sometimes baffles newcomers to the NRAO is the host of committees that descend upon the director and his staff throughout the course of the year. I would like to use this article this time to point out the functions of some of these committees and to explain how they are important to the operation of the Observatory.

The most important of these groups is the AUI Board of Trustees, a body that consists of eighteen scientists and administrators from the nine AUI universities and five Trustees-at-large. This group meets as a full board four times a year, once each quarter, and the Executive Committee of the Board meets eight times a year. During these meetings the directors of NRAO and Brookhaven National Laboratory report to the Board. Our Board of Trustees is responsible for overall AUI policy and for reviewing the actions of Observatory management on a monthly basis. Some of the major functions of the Board are to review the yearly NRAO budget and approve future budget requests, review scientific appointments and grant tenure to the senior scientific staff, approve salary reviews and advise with respect to the long range plans of the Observatory.

The National Science Foundation funds the NRAO through a contract with AUI and we are all employees of Associated Universities, Inc. (not the NRAO!). Each of the Trustees serves on the Board and membership rotates in such a way that each member comes up for reappointment every two or three years. In this way the Board maintains its continuity. Each Board member acts as an individual although the University Trustees are nominated by their universities. The executive part of the AUI Board usually meets in Charlottesville each spring and the full Board meets in Green Bank each October. The latter meeting is always a good one since wives usually attend and the yearly party held for them at the Redwood House

provides the occasion for us to communicate informally.

A standing committee of the AUI Board, the NRAO Committee, consists of three Board members who are also astronomers (Bart Bok, George Field, and Herbert Friedman), a chairman, Carl Chambers, and the AUI President who is an ex-officio member of the Committee. This special committee of the Board meets occasionally and generally concerns itself with specific topics such as the plans for new telescopes or with broad areas such as the role of the NRAO and how its reputation stands internationally.

To insure that the Observatory management is doing its job, that visitors are being adequately accommodated, and that the scientific staff is doing good research, the Trustees appoint a Visiting Committee which generally consists of both praise and constructive criticism. The new Committee members are appointed each year for three-year terms. All are astronomers. This year the Committee met in May and consisted of Alan Barrett (M.I.T., chairman), Frank Drake (Cornell), Alex Smith (Florida), Cornell Mayer (Naval Research Laboratory), and Alan Moffet (Cal Tech), with one Trustee member, Francis Low (M.I.T.) and Dr. Tape, ex-officio.

One of the main purposes of the resident scientific staff at NRAO is to provide input to the director and the division heads, particularly in electronics, computer, and engineering, so that the telescopes, receivers, computers, and other Observatory facilities will continue to be at the forefront of radio astronomy. We recognize that the visitor-users have valuable suggestions too, so twice a year, usually at the end of the first week in May and November, we invite a committee of users to meet with various NRAO staff for two days in Charlottesville. This User's Committee now has 27 outside members and its purpose is to advise the director with respect to steps that can be undertaken which will assure that the development of the NRAO continues to be in the best interests of the radio astronomical community. Each member of the User's Committee not

only speaks as an individual, but also expresses the ideas and reflects the interests of other radio astronomers at his home institution. The advice and guidance provided by this large group of active research workers are important in increasing the effectiveness of the NRAO as a national facility.

In the past the NRAO has appointed ad hoc committees that meet for very special purposes. Although none are in existence at present, committees of this sort have met to review the VLA design, to discuss the design of large, steerable telescopes, and to review the future of line interferometry. We will certainly have more of these ad hoc committees whenever the occasion next presents itself.

Finally, there is a committee of unsung heroes, three anonymous radio astronomers who referee all proposals for telescope time on NRAO instruments, commenting on the scientific merit of over 100 observing requests received by us each year. Although their work for us is done quietly and without fanfare, their judgements and advice are valued by those of us who schedule the telescopes and we appreciate the work they do on behalf of the Observatory.

22 GHz DEMONSTRATION RADIO TELESCOPE

Richard Fleming

A new radio telescope has recently been built at Green Bank specifically for the visitor and tourist program. The telescope is fully equatorially mounted and operates in the 22 GHz (1.3 cm) range. It will be located between the 40-foot and the 140-foot telescopes and will be housed in a small building while the telescope will be mounted twenty feet away. This should give the tourist a feeling for a complete radio telescope

installation.

The sun will be the primary source observed and will be tracked in right ascension by a sidereal clock motor. A reversible declination drive is used for positioning and scanning through the sun. The speed of the declination drive moves the telescope 0.3 degrees per second. The telescope declination drive can be controlled from the local or remote positions. This will allow visitors to control the telescope and to closely observe the telescope movements.

The telescope consists of a two foot spun aluminum dish with a circular to rectangular transition wave guide feed. The local oscillator used is a solid state Gunn Effect diode oscillator. The L.O. signal and the received signal are combined in a K-Band mixer-IF amplifier with a noise figure of 6.7 dB (DSB) and an IF gain of 62 dB with a center frequency of 160 MHz and a bandwidth of \pm 140 MHz. An additional broadband IF amplifier with 30 dB gain drives a crystal detector followed by a square law detector. The total power output is displayed on a chart recorder and also drives an audio amplifier and speaker.

The front-end components are housed in a plexiglas box and mounted directly under the dish. The feed is gold plated brass and is coupled to the front-end box with polished copper wave guide. The entire telescope is painted white with the dish surface painted with a diffusing white to reduce collimation of sun light. The back-end consists of a half-rack that contains the control panel, chart recorder, audio amplifier, speaker, power supplies and accessory panel.

The telescope will be set up and operating prior to the first tour. Who knows, we might discover a new source and be swamped with observing requests! Would you believe maybe ONE request?



THE RUSSIAN-AMERICAN
VLB EXPERIMENT

Part III*

Ken Kellermann

Following the "successful" test run at the end of September we had nearly two weeks before the main observing session scheduled for mid-October. The first few days were spent installing the 6 cm receiver, devising a chain of battery supplies to insure the continued operation of the atomic clock, and trying to establish some sort of communication with Green Bank. The first two projects were rapidly completed but continued attempts at telephoning only produced the now familiar "Amerika Nyet".

Our Russian hosts decided that we were adequately prepared for the observing with more than a week to spare, and that the extra time could be used to expose us to some Soviet culture. They proposed a trip to Middle Asia covering Armenia, Tashkent, and Samarkand.

The trip started out uneventfully with the three hour drive to the Simferopol airport. This being my fourth trip over this route it was beginning to lose its interest. In Simeropol we boarded an Aeroflot plane for Yerevan, the capital of the Armenian Soviet Socialist Republic. Since directly to the north of Yerevan are high mountains, airplanes are forced to manuever south of the city for landing. The Turkish border is only 15 miles south of Yerevan so it is not possible for modern jet aircraft to land without passing over the Turkish border, which would, of course, mean being immediately sited out by the waiting American anti-aircraft guarding the frontier. Thus, we were forced to fly on a relatively slow propeller driven airplane.

Although the flight was supposed to last about two hours, not too long after take off we began to descend. After landing we were told that we were in "Mineral Water", a small resort town (a Russian White Sulphur Springs) in the Georgian Soviet Socialist Republic, and, due to bad weather it would not be possible to land in Yerevan until the following morning. No one bothered to tell us what we were supposed to do in such a situation, so we proceeded to the airport building where we learned that there were some 10 other planes from all over the USSR which were also forced to detour to Mineral Water on the way to Yerevan. Somewhat over 1,000 passengers from these planes were occupying a rather small airport terminal. Our fellow passengers, who had apparently decided to camp out for the night in the terminal, were comfortably spread out on chairs, tables, and the floor in various states of dress and undress. Due to the rather overcrowded conditions and the lack of adequate sanitary facilities, the whole place had the aroma of one large toilet.

I haven't described yet the Russian public toilet facilities. Rules of common decency prevent an adequate description but it is sufficient to say that the best ones were just marginally adequate, while the worst are best left to the reader's imagination. Russian soap leaves one smelling considerably worse after washing than before, so we carefully rationed out our limited supply of soap that my wife thoughtfully imported from Holland. Russian toilet paper, when available, can be compared with a fine grained sandpaper. This is apparently not a result of any basic physiological difference between Russian and American skin, however, since even the Russians apparently find it objectionable. Our radio astronomy colleagues attempted to ease the situation by using chart paper which generally contained no useful data anyway. Unfortunately, however, chart recorder paper is rather slick and has

Continued, next page --

* Conclusion

little absorbability as you can easily demonstrate for yourself in a simple home experiment. Fortunately this situation can be expected to improve as computers come into more widespread use by Russian radio astronomers, and softer computer output replaces chart recorder paper.

To get back to the story, we decided immediately that we would prefer to sleep outside on the street rather than in the terminal waiting room. As visiting foreigners are not allowed to undergo such indignities, Matveyenko went off to seek the local Intourist agent who's job it was to see to the comforts of visitors. After half an hour of "breathtaking" waiting we were ushered into a rather plush Intourist office where we were informed that my wife and I could have the one remaining hotel room in town, and John and Matveyenko could share the floor of the Intourist office. Just in case the reader may think my wife and I had an unfair advantage it should be emphasized that the difference between the hotel room and the Intourist office was negligible compared with the difference between either of these facilities and the public waiting room. All of which goes to prove that although in a Communist state where all people are equal, some are more equal than others.

The following morning, after being treated to a fine breakfast in a private dining room by our friendly Intourist agent we proceeded to Yerevan. There we were met by Dr. Grant Tovmassian from the Byurvkan Observatory. After collecting our baggage following a one hour wait, Tovmassian informed us that during one week every seven years the Armenian church prepares its holy water and Armenians from all over the world return for the festivities. Since, of course, this was the week there were no hotel rooms available, so we were to stay at the observatory. Just before arriving at the observatory he added rather parenthetically that "of course as we must know there is no hot water available." My wife groaned a bit whispering to me, "All we need now are bugs in the bed." Her fears were

justified, but fortunately there weren't too many and they were not very large.

In spite of these hardships we spent several pleasant days visiting the observatory and seeing a bit of Armenia. I was asked to give a lecture at the observatory in their new lecture room equipped with numerous modern conveniences, including curtains which closed automatically by pressing a button. There were technical difficulties, however, with the automatic curtain closer, and there was no means to manually close the curtains, so I had to dispense with the slides.

On one occasion a sturdy looking Armenian thinking I was a Russian newspaper reporter approached me with a threatening look and asked (in Russian of course who I was and why I was taking so many photographs (I was carrying two cameras). I tried to reply in very poor Russian that I meant no harm. Matveyenko then came to the rescue and explained that I was an American tourist. But the Armenian didn't believe this and asked (in Russian, "Then why doesn't he speak English?"

To which Matveyenko replied, "Do you understand English?"

"No," he answered.

"Well!" returned Matveyenko.

By this time we were becoming increasingly curious about whether or not the Green Bank group had found fringes on the tapes we had sent back. We spent two successive evenings until midnight in Tovmassian's office trying to place a phone call to Barry Clark in Charlottesville. In order to impress the Russian telephone operators of the importance of the phone call Tovmassian told them that the observatory director, Prof Ambartsumian, who is not only a prominent Soviet scientist but a powerful political figure as well, was calling. Sometime in the wee hours of the morning of the second night Tovmassian was awakened by a phone call and informed "Amerika - Speak". On the other end the CV operator was told that there was a call from Ambartsumian. Thinking that a call from such an important person must be for the NRAO director, Dr. Heesch was connected to Tovmassian, rather than Barry

Clark, to me. By the time things were straightened out the connection was broken. The next day we received a telegram from Barry stating that the tapes had not yet arrived and inquiring of their whereabouts.

Our immediate reaction was that somewhere either in Moscow, Washington, or both, teams of experts at the CIA or KGB were unsuccessfully trying to decode a magnetic tape containing a sequence of 150 million random numbers which had apparently been smuggled out of the USSR by the diabolical sequence of agents described at the end of the previous installment.

A frantic phone call to the American Embassy in Moscow met with the usual delays, first being told the lines were busy, then it was lunch time in Moscow, and then the Embassy was closed for the day.

That evening we booked, in advance, a phone call to Moscow for the following day at 9 a.m. from the Yerevan Post Office (also a telephone exchange) where connections were theoretically better. Arriving slightly before 9 o'clock we found the Post Office had never heard of us, but the operator arranged to place the call at 12 o'clock. We then had a small discussion about sending a telegram to Moscow.

Matveyenko claimed it was unnecessary since we would have the phone call in a few hours, but I was beginning to become familiar with Soviet efficiency and insisted on the telegram. At 12 o'clock we found a new operator who, of course, knew nothing about our call but she said she would book the call for 3 o'clock. And at three, well, its hard to belive, but there was another operator on duty and we started all over again. We waited around this time until we were informed that it was 5 o'clock in Moscow and the Embassy was closed-or as the Russians say, "not working".

The next day our schedule called for us to fly to Tashkent in the Uzebkistan Soviet Socialist Republic in Middle Asia only a few hundred miles distant from China and Af'ganistan. Apparently the arrangements were a bit confused and our Uzbek hosts hadn't expected us. While waiting for Matveyenko to "decide all

questions", I had an interesting half-hour conversation with another tourist who spoke no English, Russian, or Uzbek, but some strange language which I never deciphered. Finally, however, Matveyenko located a driver and I had to leave my friend still waving his hands trying to make himself understood.

We arrived at our hotel about 3 a.m. where it was necessary for the man on duty to first awaken the receptionist to complete the registration formalities and then the floor woman to give us our key.

After a few hours sleep we began the day's program which started with a lecture at the world famous Tashkent Astronomical Observatory. Following the lecture John and I were taken to the director's office for refreshments of tea and grapes. While enjoying this hospitality the door opened and a little bent up old woman in a tattered dress and shoes shuffled in. John and I looked at each other wondering why they had to send in someone to clean the room at a time like this. So we were a bit suprised when the new arrival was introduced as the "Head of the Solar Physics Division". Following an hour or so of pleasant chit-chat with the Division Head and Director, neither of whom spoke English, the Solar Physics Head insisted on showing us her little telescope in the garage. Then since we were clearly interested in time and frequency standards we had the pleasure of visiting the Uzbekistan Bureau of Standards where one of the local astronomers spent all day comparing an old German crystal oscillator with time station RGB in Rugby, England using a receiver similar to the Loran front-end we used in Leningrad.

For our second day in exotic Tashkent we went to the local bazaar to mingle with the natives. Here for the first time we found thriving Capitalism in the USSR. Farmers and merchants displayed their products on a get-what-you-can-for-it basis. Competition, usually unknown in the USSR was heavy and thriving. The highlight of the day was our introduction to PLOF, the Uzbek national dish. Matveyenko called it "natural food" meaning served as the natives eat it. It was quite an interesting dish

consisting of rice, spices and various kinds of meats. Unfortunately, this fine dish could not be handled by our already overworked digestive systems.

This, combined with the nature of the sanitary facilities, somewhat detracted from enjoying the rest of our stay in the USSR.

The following day was Monday, a working day and another opportunity to call the U.S. Embassy in Moscow. The plan was to spend the day in the Tashkent Post Office similar to the one in Yervan. After breakfast I inquired about the way to the Post Office. Matveyenko, however, having made an independent study of the problem arrived at a solution differing by 180° in azimuth. We then decided to take a taxi and let the driver decide.

After locating the taxi stand we tried unsuccessfully for more than an hour to get a taxi, so we decided to try the local street car. Again there was strong disagreement about which street car to take and in what direction. But it made little difference since it soon became clear that there were so many people waiting that it would be hours before we could get anywhere.

By this time I was getting hungry so we took time off from our project to eat lunch. Starting fresh in the afternoon, Matveyenko announced that there was really no rush because it only takes 15 minutes to get to the Post Office. We reminded him, however, that we spent more than two hours "going to the Post Office" before lunch and had never gotten more than 100 yards from the hotel.

Somehow we made it to the Post Office in downtown Tashkent where we were surprised to find an automatic telephone where for a few cents you could be immediately connected to any major city in the USSR from Kiev to Vladavostok. Getting the U.S. Embassy I found myself overhearing a conversation between the Embassy and a chap in some other remote part of the USSR who had lost his passport. Trying again, I learned that the tapes had in fact been sent to the USA and so we presumed that they had found their way to CV.

There seemed little we could do except

enjoy the remainder of our excursion the next day to Samarkand. Matveyenko decided that it would be more interesting to drive to Samarkand rather than fly. Since there were no observatories there he could not arrange for an official car to take us, so we had to hire an intourist car at a cost of 40 rubles (about \$44) for the four of us. The road outside Tashkent turned out to be a limited access 4 lane superhighway for half the distance. The second half was a primitive narrow road which included a river crossing containing more than a foot of rapidly flowing water. Following a 5 hour drive to Samarkand Matveyenko found that it was not possible to get a hotel, so after a short time of sightseeing we had to return to Tashkent. Most of our time in Samarkand was spent inspecting the ruins of a very old meridian transit instrument carved out of stone.

Back in Tashkent we learned that because we had caused the driver to work more than the regular 8 hour day the fee for the car would not be 40 rubles but the fantastic sum of 160 rubles. The entire following day was spent in elaborate discussions between Matveyenko and various representatives of Intourist and the Uzbek Academy of Sciences - sometimes up to three at a time. By the end of the day the price had returned to the original 40 rubles.

Meanwhile, another problem was beginning to grow. According to the original plan, if preliminary 3 cm tapes did not show fringes Barry was to hand-carry a small crystal clock from Green Bank to Crimea for a direct time comparison. We had been regularly trying, unsuccessfully, to call NRAO since leaving Crimea. We also sent several telegrams informing Barry that we thought we had the time correctly and that everything else was functioning satisfactorily. But not hearing anything about the 3 cm results we had to tentatively plan on Barry's arrival in the USSR and requested that our colleagues in Moscow be prepared to meet Barry at the Moscow airport and to arrange for his immediate travel to Crimea. And, of course, they must also provide batteries for his clock.

Our return trip to Crimea was on a propeller driven aircraft. For the whole

five hour flight the pilot was never able to synchronize the engines. If you have ever experienced this phenomenon you can imagine our mental state upon arriving back in Crimea. Moreover, we had the pleasure of sitting in front of a band of Gypsies that apparently had never taken a bath.

On the way to the observatory the following morning we were told by Moissiyev that "Oh, by the way, the clock stopped the other day". After I recovered from my mild hysteria, he went on to inform us that it only stopped for a few minutes before they started it again! At the observatory we learned that the crystal oscillator had become unlocked from the rubidium cell, but fortunately Kogan, who was faithfully watching it during our week's absence, had immediately relocked it so that in fact no damage was done.

We also received a telegram from NRAO that the tapes had arrived but that there were no fringes. There appeared to be some misunderstanding about the position of the Russian telescope due to my confusion over the way the Russians write the number 7 (similar to the American 4). To add to the confusion, Moissiyev had misplaced the piece of paper on which he had written the "exact" coordinates of the antenna at the time of construction. The best we could do was estimate the distance and direction of the antenna from a nearby optical telescope which is listed in the Nautical Almanac. The optical telescope, which was located on a cliff overlooking the antenna was estimated from sticks, stones, shadows, and some trigonometry to be about a kilometer away.

The new position was sent off to NRAO with the expectation that this would produce the fringes. The answer, received by telegram a few days later from John Broderick stated that there were still no fringes, and that the new position according to his map placed the telescope several miles out in the Black Sea!

By this time we were becoming increasingly annoyed at the poor communications. Telegrams often arrived garbled up with mixed Russian and English characters. Often the same telegram would arrive several

times spread over several days. On one occasion a three page telegram arrived one page at a time on three successive days.

Therefore, I decided to make a major effort to try a TWX machine located in the Intourist hotel in Yalta. Matveyenko, myself, and the local teletype operator spent one entire day trying to contact Green Bank. First we were told by Moscow that all international teletype calls had to go through Kiev. Kiev told us that the Russian teletype was not compatible with TWX. I explained that there was a giant computer in New York which understood all machines and could act as interpreter. Then somehow we got an operator in Vienna (yes, Vienna) who claimed that the Green Bank machine was broken. After many hours we had produced several feet of conversation between various operators, and our local operator excused herself for a short break.

I was alone in the teletype room, when all of a sudden the machine started to print NRAO GB WVA, the call sign of NRAO indicating that at last by some circuitous means our keyboard was directly connected to the Green Bank TWX machine, where unfortunately it was now about 3 a.m. in the morning. A further difficulty was that although the Russian teletype machine contained English letters they were not in the standard locations found on American typewriters. It took about half an hour to type out a single message telling Green Bank that now that we had a communications breakthrough to continue to use TWX instead of telegrams because it was faster and more reliable. The next day we received a telegram from Green Bank wanting to know what we said in the completely garbled and unintelligible TWX message. So much for reliability.

Meanwhile we hadn't given up on the telephone. The usual operator's report was that the lines to the USA were out of order. In a moment of desperation I tried to call Sweden, hoping to speak to anyone in the outside world. Following some clicks and crackles a clear voice asked in English, "Is this Helsinki?"

"No," I replied, "This is Yalta. Who are you?"

"This is New York," she said.

"Can you get me Charlottesville, Va.?"

"Yes, of course, just a moment please."
Pause. Clicks and crackles. Dead line.

The next day word arrived that Barry was in Moscow. But instead of coming directly to Crimea with the clock our Russian colleagues in Moscow felt he should stay a day or so to visit museums.

The crystal clock Barry was carrying was supposed to be accurate to about 50 microseconds per day. Even with the delay in Moscow, we expected that with careful calibration of the rate to be able to compare the clocks with an accuracy of 15-20 microseconds. When Barry arrived in Crimea we went directly to the observatory for the moment of truth. Much to our dismay the two clocks differed by nearly a whole second. We could have done better with Bill Howard's Accutron. Nevertheless, since our rubidium clock agreed with the loran transmissions (only because of the double error described in a previous installment) we had some confidence that we were still in good shape and were prepared for the big observing session about to begin.

John, Barry, and I arranged to work in rotation loading tapes. The Russians divided themselves into three teams of two men. One man was in the control room to operate the antenna while the second man, who was with us, translated and relayed our instructions via a very poor intercom system to the telescope operator. This man was the key to the whole operation as he was the only link between the English speaking tape loaders and the Russian speaking telescope operators.

Before the beginning of the three day 6 cm observing session we went to Yalta and stocked up on Russian sausage, cheese, bread, and fish, and a crate of soft drinks to last us through the session. Due to the lack of adequate sanitary facilities at the observatory, Barry, John, and I planned to take turns in going into Yalta for a bath, etc. For this purpose a car with driver was placed at our disposal. We never did find out what the Russians did about this problem, but with one outstanding exception they apparently managed.

Some hours before the run was scheduled to begin a small boat appeared on the

scene and anchored just off shore about 100 yards from the telescope. When we questioned our colleagues about this vessel we were variously told that it was a "fishing trawler", an "ionospheric research vessel", and an "oceanographic research vessel". At nightfall, a bright spot light on the boat scanned up and down the shore for about one hour. I was tempted to blink back with my electronic flash unit a few times to see what would happen, but John suggested that perhaps this was not too good an idea. There was also a rumor going around Green Bank about a U.S. Navy ship being sighted on Deer Creek, but this was never confirmed.

Since we still had no fringes from the first test run we decided that it was necessary to get some more tapes back to NRAO as soon as possible for processing. This time we would avoid the cloak and dagger operation with the U.S. Embassy and would try simple air freight. Realizing that it just might take a bit of time to arrange to ship a magnetic tape from Crimea to Charlottesville, I planned to leave Crimea on Monday morning to try to make the weekly Pan Am flight to New York leaving Moscow Tuesday afternoon. After the first hour or so when the initial excitement wore off and the numerous spectators began to depart, the operation settled down to an almost normal VLB run. As I had not yet fully recovered from my experience with the "national" dish in Tashkent several tapes were missed for shorts breaks.

At 5 a.m. on Monday morning I left for the 3 hour drive to the airport carrying two tapes. Arriving at the airport we learned that there was a message to call the observatory. Doing this, we were told that Barry had discovered that one of many switches had been set to the wrong position so all that we had done so far was no good. In particular the two tapes I was about to carry to Moscow to put on a plane to New York. There was no alternative but to get back in the car and return to the observatory.

Barry sent a telegram to Green Bank to alert them to our blunder, and since there was no guarantee when or if the telegram would arrive, he also tried to place

a call with the usual negative result. Therefore, I stopped in the friendly In-tourist hotel in Yalta, which we had established as a communications base, to get our friendly teletype operator to send a TWX. Of course, she was told by the operator that the U.S. and Soviet machines are not compatible, then that the NRAO machine was out of order, etc., but she kept trying. Meanwhile, Matveyenko and I were trying to telephone, thinking that we might have better luck from a "major" city such as Yalta than from the observatory.

The situation was fairly critical since the NRAO schedule called for the 6 cm receiver to be removed from the 140-foot as soon as the observing program was finished. Although this was only a few hours away, our colleagues in Green Bank did not know that we had only just begun in Crimea, and that it was necessary to repeat most of the program.

After several hours of fruitless telephoning, Matveyenko performed what must be considered the supreme achievement of the entire experiment. He called the U.S.S.R. Minister for Communications in Moscow and explained our problem. Ten minutes later through the miracle of electronics and some high level influence we were talking to Green Bank and for the remainder of the experiment a telephone call to the U.S. took only a few hours to complete rather than a few weeks.

Needless to say, the Green Bank end was a bit disgusted at having uselessly observed furiously for 36 hours, but agreed to repeat the beginning of the program. I was driven to the observatory, picked up two new (presumably good) tapes, gave a few words of encouragement to Barry and John, who were looking a bit tired and grubby and who now had to do the whole program themselves without time for pit stops in Yalta.

Again we set off on the third trip for the day between the observatory and the airport, my 6th, 7th, and 8th so far (out of a total of 10). John Broderick claims he made at least as many trips between Charlottesville and Green Bank. By this time Matveyenko was as proficient

as a U.S. travel agent at changing plane tickets, so the trip to Moscow was less exciting now that I was only carrying an inconspicuous box which was not even ticking.

The next morning in Moscow I began preparations to ship these tapes, already being one day behind schedule because of the previous day's fiasco. Matveyenko went to the "Akadamy Nauk" in the "official" car to get an "official" piece of paper from the Akadamy that would allow the tapes to leave the country. He was then supposed to meet me at the U.S. Embassy where I went to try to find out how one goes about shipping parcels in the Soviet Union. At the Embassy I was told to bring my tapes to the Pan Am agent at the airport. I had to wait almost two hours for Matveyenko because someone had absconded with his car and driver at the Akadamy. Meanwhile, the Russian cop guarding the U.S. Embassy was becoming suspicious of my pacing up and down in front of the Embassy still holding on to the precious package of tapes. When Matveyenko finally got a new car and arrived he still didn't have the letter from the Akadamy, so we had to return. By this time it was the lunch hour and we had to wait a bit longer for the necessary bureaucrats to finish their lunch.

Arriving with the necessary paper we proceeded to the Pan Am office at the airport where I was informed that because the agent had to "check-in" a group of 120 American tourists he did not have time to help me, but that I would have to go myself to the Aeroflot freight office where I waited in several lines, filled out many forms (in Russian) and paid my money. All this accomplished was to get a few stamps on the package of tapes which no one would take. By now it was almost plane time, so we rushed back to the departure building looking for the Pan Am man and some English speaking help. Not finding anyone I abandoned Matveyenko, flashed my passport and eased my way pass immigration and customs officials, and gave the package to the pilot as he was about to enter the plane.

From this point everything went right. Bill Howard flew to New York and brought the tapes to Charlottesville, setting an all-time VLB record of 48 hours to transport the

tapes from Crimea to Charlottesville - beating the old record of one week from Boston to Charlottesville.

Meanwhile, back in Crimea there was no joy. A telegram had arrived from Green Bank - the hydrogen maser had broken down and a power transformer on the 140-foot had blown up. So far one American, one Englishman, and one Texan had, if nothing else, succeeded in pretty well disrupting the entire political, economic, and social system in the USSR with nothing to show for it. In a little over a month we had dispatched various shipments of people and equipment between Stockholm, Moscow, Leningrad, and Crimea by air, rail, and road. We had made unprecedented demands on transportation and communication facilities, and had apparently cornered the market on all the storage batteries in the Soviet Union. And, particularly at the observatory we had men working endless hours carrying our crates first up, then down, then up again, chopping off pieces of their antenna to accommodate our equipment, and putting our receivers on and off the telescope.

So although preparations proceeded for the 3 cm observations, morale was low all around. Reference to Siberia entered the conversation with increasing frequency. You can therefore imagine the general joy and relief when the telegram arrived announcing strong fringes on 3C 454.3. Vitkevich was at first speechless, but rapidly recovering he cried, "BRING THE VODKA!" Remembering that we still had two days of observing left the celebration was, however, postponed.

The first day of the 3 cm run went smoothly until a telephone call arrived from Marshall Cohen, who explained that due to a few technical difficulties with the 3 cm receiver they had not yet started in Green Bank. I started to complain that we had needlessly worked hard all day running tapes, but remembered the reverse situation which had occurred a few days earlier and decided not to comment.

Our Russian colleagues took the news in stride, and reorganized their assignments to see the run through. Now that the end was in sight, John, Barry and I

thought that we should sponsor a small celebration to show our appreciation for all the help we had received. A cake was carefully designed, and John was sent to Yalta to arrange for its construction. It turned out to be such a big and important job that the details had to be settled at a high level conference between John Payne and the Director of Bakeries of Yalta. John expressed some concern on returning that Sandy Weinreb might not appreciate his spending an entire day arranging to bake a cake.

We had planned our surprise party to follow the end of observing, but as the last hour approached the observing room began to fill with spectators. When the last tape started the Russians produced, in their usual efficient manner, a round of glasses and several bottles of Cognac. and with toasts of Soviet-American friendship and cooperation, the first Green Bank Crimea VLB was declared a success on the basis of having analyzed less than one half of a percent of the data.

The party lasted well into the night. and after a few glasses of cognac, vodka and spirits, the language barrier disappeared. The highlight of the evening was an eloquent speech by Barry Clark delivered in excellent Russian. The following day those of us who were still mobile were treated to a dinner of shashlik (shish kabab), cognac, and champagne by Vitkevich. Following this we were taken to the Crimea Astrophysical Observatory where the director had prepared a small dinner featuring mainly wine and vodka. Back in Green Bank, according to reports, the exhausted observers just went to sleep!

EPILOGUE

Not too surprisingly all the tapes and equipment were lost on the return shipment to the USA. After a week of frantically calling Pan Am and Aeroflot in Washington, New York, and Moscow everything was located in an Air France warehouse in New York!

After much computer processing interference fringes were obtained on 12 sources at 6 cm which when combined with the results of previous expeditions will tell us more

about the structure of very small radio sources. At 3 cm the outcome was less satisfactory due in part to an improperly operating frequency standard in Green Bank. Only through careful painstaking analysis by Matveyenko did we finally find weak fringes at 3 cm, thus setting another VLB baseline record of 285 million wavelengths.

Perhaps more important than the scientific result, however, is the immense satisfaction that all the participants received from working together to successfully overcome what at times appeared as insurmountable bureaucratic, technical, and logistical difficulties. We would like to think that perhaps in some small way we have contributed to an increased understanding between Soviet and American people, and demonstrated that scientific cooperation between the U.S.A. and the U.S.S.R. is possible.

Needless to say, plans are now being made for a bigger and better experiment for next year.



Russian-American VLB cake

BASIC RESEARCH

Beaty Sheets

It is with regret that we note the departure of one of our Associate Scientists, Dr. Ivan Pauliny-Toth, from the Observatory in June. Dr. Pauliny-Toth has been with the Observatory since 1962, coming to us from Cambridge, England. He and his family will reside in Bonn, Germany, where he will be associated with the Max-Planck-Institut.

Others leaving NRAO during the July-August period include Dr. McAdam, Dr. Mezger, Dr. Courtney Gordon, and Dr. Kurt Gordon. Bruce McAdam is going around the world and has spent extended periods of time in both Canada and the U.S. en route. Peter Mezger is leaving to assume his position as Director of the Max-Planck-Institut für Radioastronomie. Courtney and Kurt Gordon are leaving to take on positions at Hampshire College, which is a new college in the 5-college astronomy program.

OLD FRIENDS - NEW FACES

Frances Copper

Observers using the Green Bank telescopes during July and August are as follows:

J. Ball, Harvard College Observatory
 T. Clark, NASA-Goddard Space Flight Center
 J. Dickel, University of Illinois
 C. Gottlieb, Harvard College Observatory
 J. Knapp, University of Maryland
 A. E. Lilley, Harvard College Observatory
 J. Moran, Haystack Facility, M.I.T.
 P. Palmer, University of Chicago
 H. Penfield, Harvard College Observatory
 L. E. Snyder, University of Virginia
 W. W. Warnock, University of Illinois
 H. G. Willis, University of Illinois
 J. L. Yen, University of Toronto
 B. Zuckerman, University of Maryland

Dr. Robert V. Wagoner, Cornell University, will come to the Charlottesville Lab July 9, 1970, to give a colloquium on "The Source of the Far-Infrared Background Radiation."

CORRECTION to the May issue, "Towards Restoration Of The Environment" by Ken Cottrell, instead of being a Festival, it will be "The First West Virginia Rolling Rivers CELEBRATION". Also, the location and date of this event has been changed from Thursday, August 13, 1970 at Ona, West Virginia, to Friday, August 21, 1970 at the State Fair in Lewisburg, West Virginia.

NEWS FROM EUROPE'S BIGGEST BIRD BATH

Peter G. Mezger

Reading the May issue of the OBSERVER, I stumbled over the following note:

"Dr. Mezger had terminated employment with the NRAO and at present is on vacation. He will soon begin work at the Max-Planck-Institut für Radioastronomie".

It is my intention to spare my competitors a heart attack as they will soon see me back at the 140-foot telescope. Therefore, I requested the OBSERVER to print the following correction.

Unfortunately, it is only wishful thinking that I have terminated my employment with the NRAO. Before this happens we will have a nice party.

I am spending my vacation at Europe's largest swimming pool.

Some of my dear colleagues at CV also refer to this machine as a bird bath, however, that appears to be a typical anglo-saxon understatement. This swimming pool has a diameter of 100 meters (=330 ft.), and it is emptied by tilting it toward the horizon. About thirty meters above the vertex there is a cabin which contains a cozy little bar and you may have a drink before jumping. It is certainly reassuring for the swimmers that whatever happens to the pool it maintains a parabolic shape.

Every Saturday the pool is emptied and members of the Max-Planck-Country Club and their guests are invited for a barbecue. For this purpose the swimming pool is pointed towards Cassiopeia and the steaks are roasted in an open fire which for some unknown reason is labeled "focal point". Some like it hot, and some like it tender; for the latter ones our club manager has ordered an autocorrelation grill.

There are more applications for membership in our country club than we can handle. However, my old friends from Green Bank can count on a special treatment when they apply, viz. the same treatment they gave me when I applied for swimming time in your polar mounted subolympic 140-foot swimming pool.

COMMENT: Some wag has noted Mezger's world wide reputation in the field of evaluating antenna performance and characteristics. Presumably he has carefully evaluated these features on the Bonn telescope and his note above summerizes his conclusions.



OUTDOOR RECREATION

G.C. Yost*

Tired of waiting for the Cass Country Club and the Bowyer Bowling Alley to open? Why not take the initiative and see what Mother Nature has in store for you.

The Monongahela National Forest Cranberry Mountain Visitor Center is the place to start exploring the sights and sounds of the mountains. Beautiful and interesting exhibits portray the animals, resources, and life cycles of the forest. Relax in the adjacent auditorium while listening to entertaining conservation programs. Bring the family. The Center is open all summer and the admission is free. The Center is located between Mill Point and Richwood along State Route 39.

After an introduction to the wild country, why not strike out at your own pace to see and enjoy some of it. Interpretative trails are located near the Visitor Center. Also, don't forget to schedule a visit to the Virgin Spruce Trail on Shavers Mountain just west of Durbin. This trail winds among giant evergreens over 100 feet tall. It is truly a magnificent forest undisturbed by man. Other well known trails lace the surrounding countryside.

The Shavers Mountain trail follows the crest of the mountain from the Virgin Spruce area north to near Bemis. The Laurel Fork trail follows the Laurel Fork River from the campground east of Gladys north. This trail follows the stream where some very fine trout have been caught.

A whole series of trails can be found in the Spruce Knob-Seneca Rocks National Recreation area. The hiker or mini-biker can find plenty of satisfaction in the miles of surrounding countryside.

* Mr. Yost is the District Ranger for the U.S. Forest Service in Bartow, W. Va.

Other attractions well known in the area include Lake Sherwood in Greenbrier County, Blackwater Falls near Davis, Smoke Hole, Seneca Caverns and the Sinks of Gandy in Pendleton County, the Falls of Hills Creek, Cranberry Backcountry, Otter Creek and the list could go on and on.

Why not break away from the TV and stretch your legs for a change? For more information, stop by at the District Forest Ranger's Office at Bartow.

AUI DONATES \$15,000 FOR POCAHONTAS COUNTY HIGH SCHOOL SCIENCE LABORATORY



David Heeschen, right, presents M.B. Dilley and Grey Cassell with a \$15,000 check from AUI

On Monday, May 18, 1970, the NRAO gave a dinner party for the school board members and school officials. Following the dinner, David Heeschen, Director of NRAO presented a \$15,000 check from AUI to the Pocahontas County Board of Education to be used for a Science Laboratory in the new high school. Maynard Dilley, President of the Board and Grey Cassell, County Superintendent, accepted the check on behalf of the Board of Education.

300-FOOT TELESCOPE

Ken Cottrell

We at the 300-foot sincerely regret the resignation of Carolyn Dunkle as OBSERVER editor. She has been a singular force in the revival of this outstanding paper.

Foreman, Jack Newcomer, and two of his more intrepid employees, Jim Hill of Charleston and Ronald Ray of Cass, spent maintenance day, May 21st, painting the telescope feed support legs. Jim and Ron revealed the professional's defiance of danger as they hauled and swung their way through the structure, precariously suspended in bos'n chairs. With just a mite of imagination, an observer could hear the triumphant strains of a Tarzan yell somewhere there in the background.

The dull and halting cliches of this reporter's art could never properly honor the dedicated labors of our 300-foot support personnel. The green, folding accolades of Fiscal might be a far more acceptable means to that end - and Fiscal does its best. But something must be said - lest the very stones should cry out - some verbal recognition is in order.

300-foot close support personnel will be provisionally identified as those people who are most often called upon to perform emergency service at the telescope outside of normal working hours. Such service may consist of nothing more than informing a confounded telescope operator, by brief telephone conversation, that the lefthanded fliver switch is improperly set, or it may require politely admonishing some impatient tyro about the fact that nothing can presently be done to stop lightning interference, or it may entail a sleepless night of grueling equipment overhaul. Irregardless of the need, with cheerful mien and efficient dispatch, our support personnel will always answer the call. And with utterly rare exception, they successfully accomplish the job at hand.

Special praise is accorded to the following groups and individuals:
 ELECTRONICS DIVISION - and especially to Bill Brundage and Richard Fleming
 COMPUTER DIVISION - Bob Vance and Joe Greenhalgh
 DIGITAL LAB - Ron Weimer, Ray Hallman, Dwayne Schiebel and Jerry Turner
 INTERFERENCE CHASERS - Jim Dolan and Carl Woodell
 TELESCOPE MECHANICS - Herb Hanes, James Forman, Winston Cottrell and Ronald Gordon.

And to the entire GUARD FORCE for their various, innumerable, indispensable acts of assistance.

In March we were privileged to host the NRAO's Assistant Director, Dr. Morton Roberts, for a week of intense observations on BL LAC, a Vermillion River (University of Illinois) source. Dr. Roberts shared telescope time with NRAO associate scientist Stephen Gottesman. He was searching for neutral hydrogen absorption. Dr. Gottesman was researching galactic spiral arms and mapping Cygnus X.

To indulge in hyperbolic conjecture it would seem that Dr. Roberts may have had an ulterior objective in mind for his program - something like determining the telescope's peak operating efficiency breakdown point. In any event, two operators were kept "busier than bobcats in a chicken coop", one manning the console, and the other manning the Houston Omnigraphic Plotter. The program called for a plot-out every ten seconds of time, which is probably not too far from equipment design capabilities.

Dr. Roberts synchronized operations from his position at the Tekronix memory scope. On signal, he would cue the operators with a spirited, "Wait!" or "Now!", indicating when a plot-out should be made.

Despite the hectic pace all critical schedules were met, and all necessary data was obtained.

Continued, next page --

Joseph Taylor and Richard Huguenin, pioneers of American pulsar research, revisited the 300-foot through late May and early June. Assisted by Amherst astronomy major Tom Troland they continued their thorough and comprehensive investigations of the LGM (Little Green Men) mystery.

The Huguenin-Taylor team was in residence at Harvard when England first disclosed the existence of pulsars. Acting quickly, they were instrumental in launching a crash program for the design and construction of sophisticated receiving equipment with which to study this new phenomenon. Within just six weeks under the adept stewardship of such crack design engineers as George Orsten and Al Rodman, their equipment had been completed and successfully tested. The discovery of pulsars was announced in February of 1968. By late March of that same year the Harvard receiving equipment had been built, transported to Green Bank, and installed for service at the 300-foot.

There were only four known pulsars when Huguenin and Taylor began their March 1968 observing session at the 300-foot. It was an exciting time. An undeclared but undeniable worldwide prestige laden race was on. Overwhelming scientific curiosity and the competitive spirit had become as one. Were there other pulsars to be found?, and, if so, who could give the affirmative answer? The victorious breakthrough came with the discovery of HP 1507 (Harvard Pulsar 1507) only a short time after those historic March observations had been initiated.

Al Hogan, duty telescope operator at the time of 1507's appearance, gained due recognition for his contribution in the effort. ALL 300-foot operating personnel are accountably proud of their association with that unforgettable event. It is a milestone in the Telescope's record of achievements.

Huguenin and Taylor were the first astronomers to research the polarization characteristics of the individual pulses of pulsars. As a follow-up to their double dipole beam switched feed system they also sparked the development of the 300-foot's new and grandly successful traveling feed system. In all but the most recent of their five or six observing periods here they have employed up to four separate modes of data collection - digital tape, analog tape, analog chart, and photographic film. Such diversity is a distinguishing feature of their unique style.

Huguenin and Taylor have subsequently left Harvard to assume professorial and research duties at the University of Massachusetts. Presently under the auspices of that institution, they are overseeing the construction of a 32 antenna low-frequency receiving array which is especially suited to their specialized purposes.

A SMALL CONTRIBUTION

John Wardle

Should ever scorn a

To fill in a corner

No good editor

Very short poem

No good editor

Very short poem

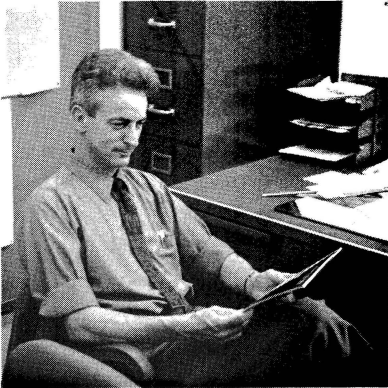
Will ever scorn a

To fill in a corner

(BUT WE'RE STILL WAITING FOR ONE!)

NEW EMPLOYEES

Mary Ann Starr



George H. Conant Jr.
Computer Division - CV



Thomas R. Cram
Computer Division - CV



Jesse E Davis Jr.**
Electronics - CV



Sue A. Hollen**
Scientific Services - CV



Victor Herrero
Basic Research - CV

Co-op Students

Russell B. Bosserman

Fredric K. Showalter

Gary A. Bonebrake



LIFEGUARDS

L - R: Gray Honaker, Harold Brooks
Douglas Morrison

TERMINATIONS

Archie L. Hughes.....Electronics Division

Odell Johnston.....Maintenance

John M. Sutton.....Basic Research

Susan F. Wetsel.....Computer Division

Ivan Pauliny-Toth....Basic Research

Kurtiss J. Gordon....Basic Research

Courtney P. Gordon...Basic Research

Oscar G. Rhudy.....Scientific Services (Co-op)

May B. Daw.....Scientific Services

Betsey P. Chen.....Computer Division

William F. Beyers....Computer Division

** Part-time employee

1970 STUDENTS (CHARLOTTESVILLE-GREEN BANK)

Name	School	Assigned To	Date to Begin
UG *Allen, Michael E.	Ohio State	Tourist	6/15
UG Born, Gary L.	University of Chicago	Gottesman	
G Braly, Kenneth A.	Cal Tech	Brown/Computer	
UG *Bromberg, Kevin L.	Cornell University	Tourist	
UG *Chu, Steven	University of Rochester	Kellermann	
UG *Cooper, Fred L.	Lincoln Memorial University	Tourist	6/8
UG *Cox, Charles H., III	University of Pennsylvania	Mauzy	6/8
UG Daniell, Robert E., Jr.	Purdue	Brown	6/15
UG Day, Christopher T.	University of Pittsburgh	Computer	5/4
UG *Deniston, Dale R.	Carnegie Mellon University	Payne	6/1
UG D'Ippolito, Daniel A.	University of Chicago	Computer	6/15
UG *Donley, Shawn T.	Lehigh University	Coe	6/8
G Gallagher, John S. III	University of Wisconsin	Heeschen	6/8
G Giovannelli, Riccardo	Indiana University	Verschuur	6/8
UG Gonzalez, Juan C.	Manhattan College	Computer	5/25
UG Green, Fred R., Jr.	VPI	Roberts	6/15
G Hemenway, Paul D.	University of Virginia	Buhl	6/1
G Jacobs, Frederic H.	Harvard	Hjellming	6/8
G *Johnson, Keith H.	University of Arizona	Kellermann	
UG *Levine, Alan M.	MIT	von Hoerner	6/8
G Leung, Chun-Ming	U. of California (Berkeley)	Hjellming	6/15
UG McDonald, Lee H.	University of Arizona	McAdam	6/1
G Mottmann, John	UCLA	Webster	6/22
G Nam, Chong Woo	U. of California (Berkeley)	Computer	6/22
UG Neuffer, David V.	University of Rochester	De Young	6/15
G Pankonin, Vernon L.	Cornell University	Clark/Hogg	6/1
G Peters, William L.	University of Texas	Manchester	6/1
G *Pettersson, Bengt	Chalmers University of Tech.	Weinreb	6/1
G Predmore, C. Read	Rice University	Broderick	5/25
G *Rosenberg, Fred D.	University of Virginia	von Hoerner	
G *Rots, Arnold H.	Kapteyn Laboratory	Roberts	
UG Schommer, Robert A.	University of Chicago	Wade	
G *Sengupta, Uday K.	Ohio State	Weinreb	6/15
UG Sonnanstine, Alan E.	University of Michigan	Makano	5/11
G Wallace, David C.	Cornell University	M. Gordon	6/8
UG Wantzelius, Paul O.	Carnegie Mellon University	Maslowki	5/25
UG *Williams, Diane R.	Cornell University	Findlay	6/8
UG Williams, Theodore B.	Purdue	M. Gordon	6/8
UG Yau, Lawrence K.	Princeton	Wardle	

*Green Bank based

ELECTRONICS - GB

Craig Moore

Many things have happened this spring within the Electronics Division at Green Bank. Ron Weimer is reportedly surveying water front sites of his future stream front property. Mike Balister is financing a sailing yacht, complete with a red, white and blue sail, with the income from his real estate lumber and grazing holdings on Back Mountain.

The Jansky lab has an empty spot now that the new interferometer front-end boxes have been installed. This is to be filled shortly when the wideband recording equipment arrives. A solar telescope, to be used with the tourist program this summer, is completed, as is another auto-correlator receiver.

Successful tests have been made on the 140-foot telescope with an antenna measuring device designed by John Payne. The tests yielded information about distortion of the antenna surface and focal point as the dish is rotated, or experiences changes in the temperature. The personnel assigned to the 300-foot telescope are looking forward to a summer of regular hours with no call outs while the antenna is being resurfaced.

We thought the following discussion might be of interest to the non-technical readers of this column.

Its been more than two decades since the invention that enables teenagers to glue their ears to transistor radios and has resulted in solid state becoming a mark of status on almost all home appliances. Most of us now think of the vacuum tube as being used only to fill the large hole in the front of the TV set. However, for all the sophistication of radio astronomy electronics the NRAO front-end boxes are only now becoming "all solid state". The two areas where vacuum tubes have held out for so long are known in the jargon of electronics engineers as the "paramp pump source" and the "noise tube".

The paramp (parametric amplifier) is a solid state device which performs amplification of microwave signals while adding very little noise of it's own in the process. It does this very important service for the radio astronomer by converting microwave energy supplied by the pump into energy at the microwave signal frequency. The pump energy must be at least two times higher in frequency and much, much higher in power level than the amplified signal. The high frequency and power levels (between 2/100 and 2/10 of a watt) is what has kept the pump source from being solid state. It was not until the discovery by John Gunn in 1963 (while working for the establishment company of IBM) that techniques were available for direct generation of microwave energy from solid state devices. In the years that have followed these devices have become capable of higher and higher frequencies and power levels, and now are beginning to appear as pump sources for paramps. The 13cm VLB receiver, recently designed by John Payne, is the first low noise front-end box to be built at NRAO which is all solid state. As the technology advances more of our receivers will be solid state pump sources because of the advantages of increased life time, reduced cooling requirements, smaller size, and no need for high operating voltages and the associated power supplies and cable run.

As for the noise tube? Well, if the electrons at the galactic center don't stop jumping quantum states before the next OBSERVER, perhaps we'll talk about solid state noise diodes.

NOTE OF THANKS

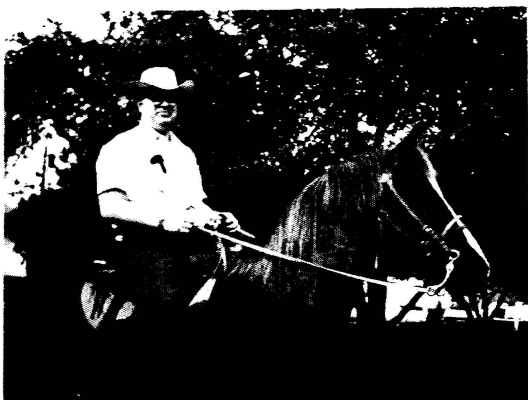
Anna Grace and Clarence Ware wish to thank the Observatory for the use of the ambulance and also the drivers who took Mr. Ware to the hospital. Also, we would like to thank all AUT friends for their acts of kindness and sympathy after the death of Mr. Ware's sister, Erma. Your kindness was greatly appreciated.

NEW LANDOWNERS

Carolyn Dunkle

Belive it or not, electronics work took second place a few weeks ago when two of our engineers went into the land business. Ron Weimer and Mike Balister are bona fide West Virginia landowners.

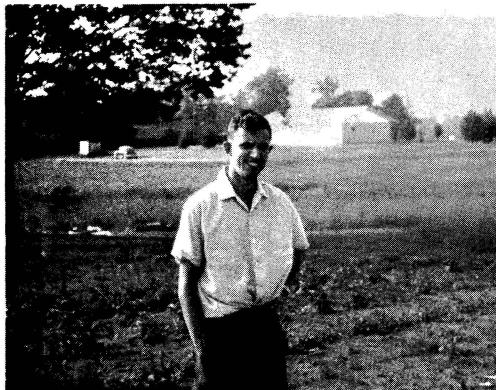
Ron bought a 107-acre farm (formely owned by Willie Sheets) which slightly borders the NRAO property on the south side, and Mike a track of land (approximately 340 acres) on Back Mountain near Cass.



Ron's property consists of a house and umpteen outbuildings (barns, etc., and two outside toilets). However, the house is well equipped with sanitary facilities. He has been very busy painting, washing windows, moving furniture, buying more furniture, etc., and we also understand that he has purchased a few riding horses. Ron is now coming to work with a straw hat perched on top of his head, which is a sign that he is now a wheelin', dealin' farmer.

Mike has been the center of many discussions. During the bidding a hippie (beads, head band, and all) stood beside him. Other bidders and onlookers assumed Mike and the hippie were in cahoots. There were visions of communes and back-to-nature people all over the place. To quote Mr. Balister, "I have never known a true hippie!" He and another caving enthusiast (also a West Virginian) are co-owners of the property. Oh yes, there was another grapevine story that Mike knew there was a gigantic cave on the property and he was going to commercialize it. Mike says

he is unaware of this also. So, sorry, but we had to squelch all those juicy rumors.



Telescope operators and observers please note: you had better remember to call ahead of time if you wish to discuss a paramp or digital problem, 'cause these country squires will no longer be burning the midnight oil in the lab. P.S. Don't tell Sandy Weinreb about this.

FACTS FROM FISCAL*

"To Be Shot Or Not To Be Shot"

An analysis of sick leave records for the period of 9/25/69 to 4/25/70, has revealed some interesting statistics which we thought you might like to share.

1. Of those employees (72 persons) who took flu shots last fall, 26 to 36% had no time off due to illness.
2. Of those employees (76 persons) who did not take flu shots, 17 to 22% had no time off due to illness.
3. For all persons taking shots, the average time off for illness was 3.6 days per person.

Continued, next page --

4. For all persons not taking shots, the average time off for illness was 8.1 days per person.

These statistics do not eliminate non-flu illnesses (broken bones, operations, etc.) nor is the test of a sufficient magnitude for best results; therefore, the reliability of such information may definitely be questioned. However, there would appear to be some indication that flu-shots are beneficial.

This article is not intended to convince any employee that he or she should take flu-shots. That choice is strictly up to each individual.

* Researched and Prepared by the NRAO
Fiscal Division

AUI TRUSTEES SCHOLARSHIPS

Winners of AUI scholarships from previous years are:

- 1965 David Hamed
West Virginia University
- 1965 Carl M. Rose
Marshall University
- 1966 Jane Nottingham
West Virginia University
- 1966 Patricia Waslo
West Virginia University
- 1967 Thomas Brown
Hope College
- 1967 Robert Sheets
Fairmont State College
- 1968 Larry Wooddell
University of Chicago
- 1968 Margaret Copper
St. Andrews Presbyterian College
- 1969 Lisa Heeschen
College of William and Mary

- 1969 Daniel Horne
Virginia Polytechnic Institute
- 1970 Kjeld Hvatum
Massachusetts Institute of Technology
- 1970 Marilyn McLaughlin
Marshall University

LIBRARY

Virginia Van Brunt

The Charlottesville library has recently received a publication which is of special historical interest. **THE FIRST LUNAR LANDING AS TOLD BY THE ASTRONAUTS ARMSTRONG, ALDRIN, AND COLLINS IN A POST FLIGHT PRESS CONFERENCE**, is a 23-page pamphlet including many colorful photographs of the lunar landing as well as the transcript of the press conference. This publication issued by the National Aeronautics and Space Administration, is available for personal purchase by writing and sending prepayment of 75¢ to: Superintendent of Documents, U.S. Government Printing Office, Washington D.C., 20402. A second copy of the publication has been ordered for the Green Bank library, and should arrive shortly.

DO YOU KNOW HOW THE FLOWERING DOGWOOD GOT ITS NAME? This is the reference question of the month, initiated by one of our illustrious staff members. A search of the public library collection has not yet revealed the legend.... Any botanists out there have the answer?

As mentioned in a previous column, both libraries are attempting to wrap up an inventory of the collections at both GB and CV. Soon we will be sending you reminders of books that have been charged out for extended periods of time. If you have any books that are checked out but are not being used, or books that are NOT

Continued, next page --

checked out and are being used, we would appreciate your help in getting the records straight so that we can replace titles that we know are surely lost, and are too sorely missed to be absent from the collection.

INTERFEROMETER

Jon Spargo

After taking part in and witnessing many of the activities taking place around and about the Interferometer for the past two months, I feel that perhaps a better name for this column would be "Strange But True", or maybe even "Believe It Or Not". Probably more appropriate would be "Strange But Believe It". Anyway, our tale begins on that joyous day of April 6, 1970, when the Interferometer, as we all knew and loved it, was shut down for conversion to a dual frequency system (11.1 and 3.7 cm).

To be sure, it would be nearly impossible to recount to you each and every step of our labors. So I'll beg off by relaying instead a few carefully selected items in order that you can perhaps grasp the feel of the situation. Before I do, however, I feel it is necessary to say that although we are back on the air, there are still a few loose ends to be collected. The chief one being that true to form the paint contractor ran short of paint and will have to return in a few weeks to finish the job. This might also be a good time to hand out some bouquets since by and large our modification operation went very smoothly and showed evidence of much planning and foresight. Obviously, to thank all that were concerned with our changeover would be a major undertaking in itself since nearly all departments within the Observatory were involved in one way or another. A hearty "well done" to one and all is more in order, I think.

Now, as promised, here are some of the more interesting aspects of our labors,

that I like to think of as the human elements. A typical work day begins with the ever decision who buys coffee. Once this has been decided and the loser's grumbling has subsided the task or tasks for the day are laid before us. As with any successfully completed task, organization is the key ingredient. And so it was with us. Usually the chore of organization was left to our wise, old, bearded sage from the South (South Dunmore, that is), who would outline the methods for completion of the day's work after much deliberate and considered thought. Once this was completed we again faced another important decision - who would buy for our midmorning coffee break. This being done, the next item was to decide who would be the push (foreman) for the job, followed by choosing the duty clutch (driver). Then came the selection of the procurer whose job it was to provide us with all the necessary materials and equipment for the job. So, with our jobs spelled out, our method of operation defined, our supervisor, transportation, materials, and equipment assured, we energetically launched ourselves into lunch.

During lunch, to relieve ourselves of the pressures of the day's work, numerous discussion and debates were started on a variety of topics, which produced some of the finest oratory ever heard this side of Hosterman Road. After lunch we began in earnest to complete the jobs assigned us, pausing every now and then to insure that our job was done right by taking the time to evaluate the product of our labors along with our methods of work and incorporating new methods as prescribed by our experiences of the day. And so when quitting time rolled around we were each able to depart, knowing that we could derive great satisfaction from doing a job after a careful analysis of it and the correct application of methods and tools to complete it.

In addition, several of our tasks produced some varied and interesting results, some of which defy explanation to this very day. For instance, while servicing and overhauling the communications equipment we ran into a strange animal who was identified on numerous occasions

by a loud and raucous Test-1-2-3-4-5-. While we tried many times to corner this animal, alas, he was too elusive for us, for we never even had a glimpse of the rascal. While working along the baseline cable tray we found that whenever we had to turn over (flip) a cable tray lid to insure proper installation of it, a strange, little animal would cry out "RIBBET!". Although this animal followed us all along the baseline we only knew it by its call, for again we never saw it. Indeed its call became so familiar to us that it was not uncommon to hear one of us challenge another by saying, "I'LL RIBBET you for coffee."

Well, I now feel that perhaps you can grasp some knowledge of our situation as it existed and so I'll bore you no longer with details. Suffice it to say that now that our tasks are largely completed we feel richer for the experience. We would also like to state that we will gladly share our knowledge gained through our work with any and all that are planning an undertaking such as ours. We feel that our experience might aid you in the speedy completion of your tasks while at the same time enabling you to derive much satisfaction from your work.



This photo by an unknown photographer obviously has caught our diligent crew at a moment of indecision where organization, communication have broken down. This problem was neatly solved shortly after we began our modification.

SAFETY COMMITTEE

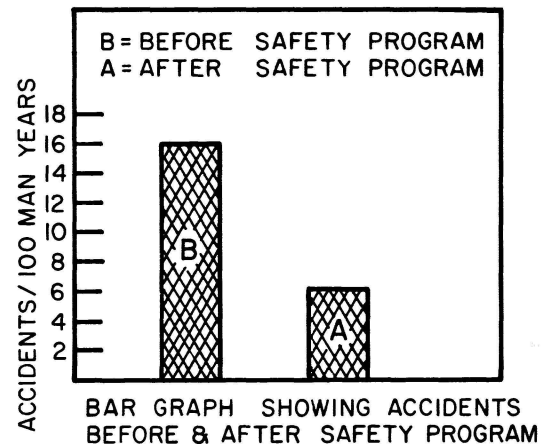
"Self Motivation in Safety"

Fred Crews

What makes an athlete a star or a business man a millionaire? One of the major factors contributing to this sort of success is self motivation - the total devotion of a person to his goals.

Can we as employees of the NRAO apply the idea of self motivation to safety? This would mean that every person would personally think safety as he goes about his job, in his own area. Posters, awards, envelope stuffers, and the inspecting team serve to remind us of safety. Perhaps a hard hat or a safety belt symbolizes safety. But this doesn't make us self-motivated.

The bar graph below is statistically sound and illustrates the results of the safety program so far. One might argue the reasons for the reduction of accidents at the NRAO, but even the most pessimistic approach would indicate that the program has made a measureable contribution to the reduction of accidents.



Where do we go from here? How can we lower that number of 6 accidents per 100 man years? A further substantial improvement must of necessity come from the fact that every employee includes safety in his own thinking. Easily said, hard to do. The safety committee is looking for ideas to improve our safety program. We would be glad to hear your ideas on this subject.

POCAHONTAS COUNTY

Jane Chestnut

Summer students and visitors at NRAO will find that Pocahontas County is a very picturesque county with several places of interest to tour.

Pocahontas County, established in 1821, was named for Pocahontas, the Indian princess. Pocahontas is the third largest county in the state with a 942.61 square mile area. The State and Federal Government own approximately 313,000 acres of the county consisting mostly of forest land which attributes to the excellent outdoor recreational facilities available in the county.

On Route 39, south of Marlinton, one should tour the Cranberry Glades which covers 300 acres with an elevation 3,100 feet above sea level. The glades offer an outdoor lab for botanists and naturalists, and has been likened to the tundra country of Alaska, with reindeer moss and other northern plants and birds.

Near the entrance of the Scenic Highway, being built through the county on Route 39, the Cranberry Mountain Visitors Center is located with one purpose, to introduce you to conservation. The center contains exhibits, dioramas, informed personnel to help you enrich your enjoyment of the Monongahela National Forest.

Hills Creek Falls, off Route 39, is where one can hike through a beautiful forest trail where you will find in a scenic area three waterfalls with heights of 20 feet, 45 feet, and 65 feet.

On Route 219 at Hillsboro, Pearl Buck's Homeplace is being restored in tribute to the noted author and Nobel Prize winner. Pocahontas County will be honored with a visit by Pearl Buck in July.

Droop Mountain Battlefield State Park, Route 219, was the scene in 1863 of the last important battle in West Virginia between the Union and the Confederacy. The park honors the memory of soldiers of both armies.

Off 219 on Droop Mountain is Bear Town. In Bear Town you will find ice in a rock ravine in the middle of July. Also, you

will find a rock formation described by one writer, "Like the setting for H.G. Well's LOST WORLD", with cliffs, "towering like edifices, tree topped and fern ringed".

Travel Route 29 four miles from Marlinton to Edray and you will find the State Trout Hatchery where the fish are hatched and raised until they are stocked in the many streams in the county.

At Watoga State Park, 10 miles from Huntersville, which is the largest park in the state, you can enjoy swimming, boating, horseback riding, fishing, game courts, picnic areas, trails, overlooks, and cabins with available campsites.

Seneca State Forest, 5 miles south of Dunmore on Route 28, is where one can fish in the lake, camp in the rustic surroundings, hike on mountain trails, picnic in beautiful scenery with playgrounds near by.

Cass Scenic Railroad, Cass, is a must for anyone wishing to ride a shay steam locomotive that was used in early logging days. The train ride is 12 miles up Cheat Mountain to Bald Knob, the second highest point in the state. While in Cass visit the Country Store, Civil War Museum, and the Wildlife Museum.

Off Route 250 on Cheat Mountain be sure to tour the Gaudineer Scenic Area, which is a remnant of a vast virgin spruce forest. These spruce trees tower 100 feet and grow 25 inches in diameter. The stand of spruce is about 250 years old.

Several recreational sites where camping and picnic areas are available are; Bird Run - Route 28 east of Frost, Old House Run - Route 250 east of Bartow, and Pocahontas - Route 92 east of Minnehaha Springs.

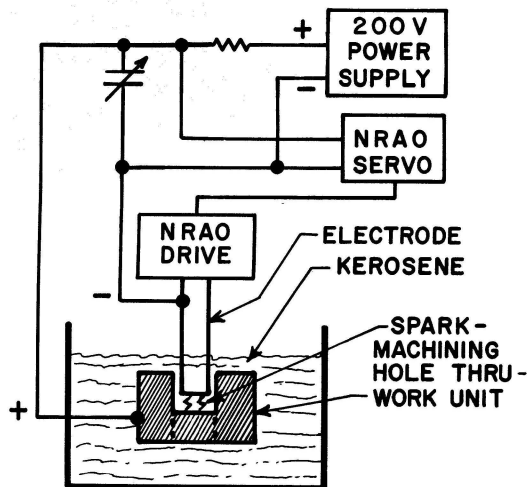
I know you can find many places of beauty just by driving the mountain roads and finding places all your own that are not shown on maps or listed in traveling folders.

ELECTRO DISCHARGE MACHINING

Omar Bowyer and John Payne

Our Charlottesville Machine Shop has just acquired a new and interesting machine known as an Electro Discharge Machine (EDM for short). The principle on which machines of this type work had been known for about 30 years, but it is only during the last few years that the EDM process has been put to work in industry.

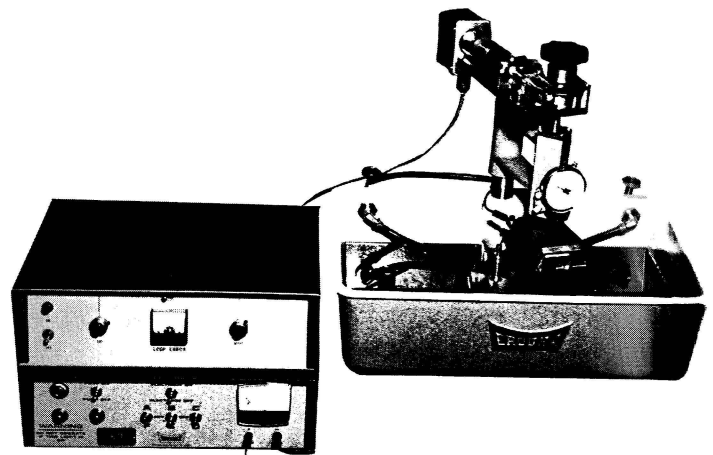
The EDM principle is simplicity itself: An electric spark being used to chip away material to produce the desired machined shape. Suppose you want to machine a very small slot say 0.020" wide and 1/4" long in a piece of brass 1/8" thick. This would be quite difficult to do using conventional techniques, but using EDM it is a very easy job. The first step in doing this job would be to make, preferably out of graphite (a soft easily machined substance), an electrode which is just the size of the slot you want. The electrode is then attached to a holder which can be moved up and down to the work piece. This operation is submerged under kerosene which serves as a dielectric, coolant and also to float away the small particles of metal that are removed in the machining process. The electrode is connected to the negative terminal of a power supply (about 200 volts) and the work piece to the positive terminal. Now the electrode is slowly moved toward the work piece until a spark jumps across the gap. Each spark removes a piece of the electrode and a piece of metal. For the technically inclined reader the capacitor, resistor and spark gap form a relaxation oscillator.



BASIC ELECTRO - DISCHARGE MACHINE

The trouble with this machine is that an operator has to keep advancing the electrode as the metal wears away. For the job mentioned it could take 1/2 hour to 1 hour to cut through the brass plate. To solve this problem we are using a servo system designed by John Payne and built by Ira Jefferies that automatically advances the electrode at just the right rate. This means the machine can run unattended with no problems.

This machine under the watchful eyes of "Lucky" who has already machined 15 diode wafers for the millimeter group. These pieces already machined are considerably better than ones purchased earlier and are more economical.



DOES YOUR LAUNDRY SOAP KILL ?

Conservation Committee
Green Arbor Garden Club

Eutrophication is the condition caused when an oversupply of phosphates and other chemicals contained in raw sewage and detergents enter a lake. These chemicals stimulate a dense growth of certain plants that rob the water of oxygen and may ultimately cause the lake to become "dead" so that fish or beneficial animals can no longer

Continued, next page --

live in it. Eutrophication has hit Lake Erie and threatens Lake Michigan. It will cost more than 1 billion dollars to clean up Lake Michigan.*

The following list tabulates the phosphate content of common washing products. In order to minimize long-term effects of phosphates, one should use a washing product that contains little or no phosphate.

* Quote from BOYS LIFE, May 1970 issue

<u>Washing Product</u>	<u>% Phosphate</u>
Axion	43.7
Biz	40.4
Bio-Ad	35.5
Salvo	35.3
Oxydol	30.7
Tide	30.6
Bold	30.2
Ajax-Laundry	28.2
Punch	25.8
Drive	25.3
Dreft	24.5
Gain	24.4
Duz	23.1
Bonus	22.3
Breeze	22.2
Cheer	22.0
Fab	21.6
Cold Power	19.9
Cold Water All	9.8
Wisk	7.8
Diaper Pure	5.0
Trend	1.5
Blue Lustre	negligible
Borateem	"
Ivory Snow	"
Lux	"
Lux Flakes	"
Tel	"

NRAORA NEWS

Beverly Weatherholt

- May 16 - The Spring Dance was a big success. The center pieces seemed to be liked quite well!!!
- May 21 - The General Meeting was attended by a total of 31 members, all from Green Bank. This total was about 19% of the membership. The Constitution & By-Laws were revised and nominations for the 1970 Board of Directors were taken from the floor.
- May 29 - The pool opened with Harold Brooks, Gray Honaker, and Doug Morrison as lifeguards this year
- June 4 - The votes were cast and counted and the following are the 1970 Board of Directors:
- Jon Spargo
Ken Anderson
Ray Hallman
George Liptak
Dorman Williams
"Buck" Peery
Herb Hanes
Carl Davis
Harry Fox
Marvin Wimer
Frances Copper

The revised Constitution and By-Laws were accepted with only a few dissenting votes. With their ratification, as of July 1, 1970, all employees will be members, without dues. You will receive a card as soon as possible.

GREEN ARBOR GARDEN CLUB

Joey Roberts

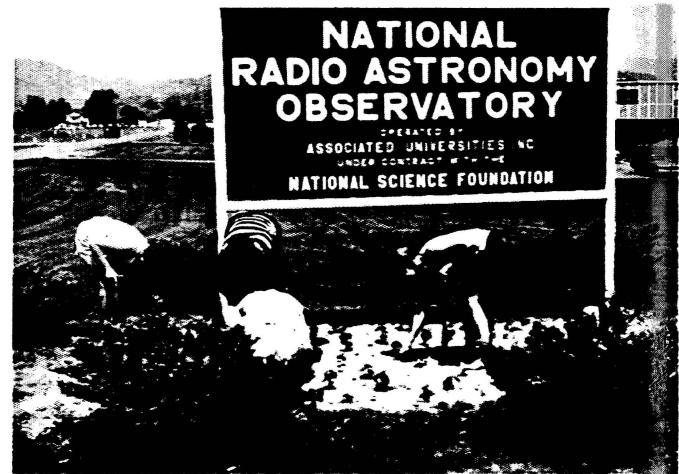
During the last two months the Green Arbor Garden Club has been busy planting. The Forest Service donated 100 Norway Spruce seedlings which were planted by the Redwood House, and also along the road to the Recreation Area. On another occasion other larger trees were added to the site, and groundcover was placed at the Recreation Area.

At the regular May meeting Mrs. Clyde Jones from a garden club in Lewisburg spoke to the group before lunch. She talked about flower arranging, which is her specialty.

The June meeting was a working one when members of the club planted flowers by the entrance to NRAO, at the cafeteria, in front of the Jansky Lab Building, and in front of the Redwood House. Members participating with the planting this meeting were: Marguerite Crews, Joan Hovatter, Joanne Kane, Henny Kellerman, Jane Peery, Joey Roberts, Betty Rots, Marie Louise Van't Hof (Henny's sister), and Lisa Von Hoerner. Pat Coleman, Gene Rexrode and William Waybright were sent from the works area to help us.

The Garden Club, under the active and capable leadership of their president, Mrs. Kay Williams, has undertaken a far-seeing project of planting trees, shrubs, and flowers on the Observatory grounds. On behalf of the Observatory, I would like to extend appreciation and thanks for their planning and work.

Morton S. Roberts



AN INTRODUCTION TO
SPELEOLOGY

Part II

Rosemary and Michael Balister

Choosing a suitable cave for a first caving trip is really quite a difficult task as most have at least one disadvantage. This one - we will warn you right away, so that you can come prepared - is a wet cave, (See sketch below copied from the Canadian Caver). To compensate for this the cave is fairly short, contains no ladder pitches or difficult climbs and has some attractive passages and formations. It is also of special interest to NRAO as it was discovered and first explored by Observatory person-

nel.

The entrance to this cave is on the North Bank of Mill Run about 100 feet below Hilltop Cemetery. A small hole leads straight into the stream passage of the cave which we follow for 1,100 feet until progress is halted by a sump. There is one large room about two thirds of the way where you can stand up properly. The stream passage of this cave is really very attractive - notice particularly the rock bridges and the mud stalagmites.

If you have not been put off by this description and are still interested in visiting this cave, please let either of us know. An electric flashlight with a spare battery should be sufficient lighting. A notice will go up in the Observatory some time in the next few days when we have arranged some details.



New Employees, continued from page 18



Front Row:

- Arlie H. Ryder,** Administrative Services
- Neil A. McLaughlin,** Maintenance
- Patrick W. Coleman,** Maintenance
- William N. Waybright,** Maintenance

Back Row:

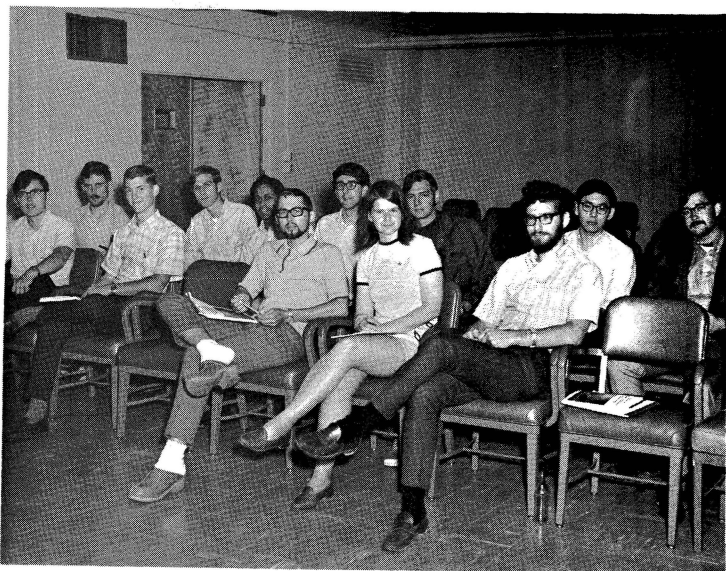
- Dewey H. Galford,** Maintenance
- Lewis C. Snyder,* Administrative Services
- Alan Bridle, Basic Research
- Charles Rexrode,** Maintenance

- Susan Gillispie,* Administrative Services
- Claudia L. Peery,* Administrative Services
- Irene Shinaberry,* Administrative Services



GREEN BANK SUMMER STUDENTS

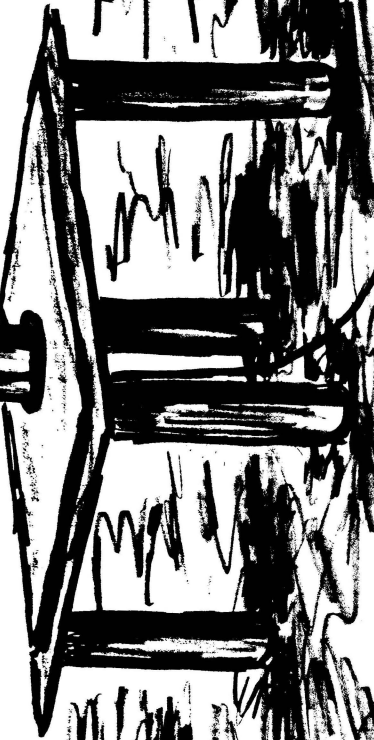
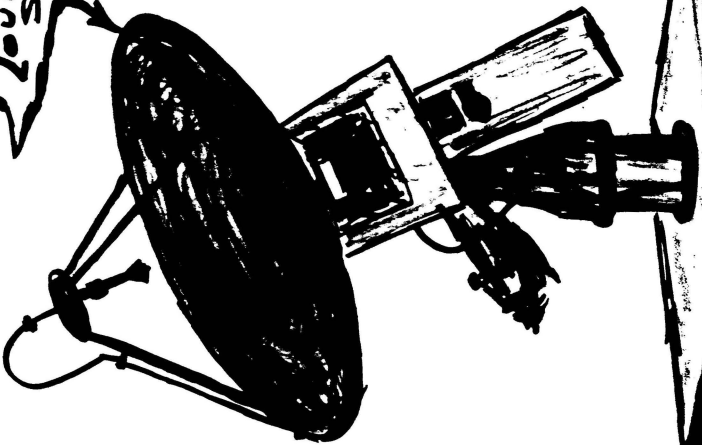
- Front Row: Shawn Donley, Dale Deniston,
Benget Pettersson, Diane Williams.
Alan Levine
- Back Row: Arnold Rots, Kevin Bromberg, Uday
Sengupta, Charles Cox, Michael
Allen, Steven Chu, Fred Cooper



* Temporary employee
 ** Part-time employee



Tourist
Scope



IT REALLY
WORKS?
OH! WELL
AFTER RUSSIA -
I'LL USE
ANYTHING!



DR. KELLERMANN