

# *The* O B S E R V E R

Vol. 10, No. 2

March 1970

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## NRAO TEN-YEAR EMPLOYEES



Here ten people meet the eye;  
Fourteen others are alumni.  
A distinguished crowd  
Of whom we are proud  
For them, more years is our cry!

Front row, l. to r.: Bill Kuhlken, Phyllis Jackson, Verna Tracy, Naomi Daniels, and Cleo Harper.  
Back row, l. to r.: Ted Riffe, Omar Bowyer, Jamie Sheets, Bob Viers, and Hein Hvatum.

Story on page 2.

10-YEAR AWARD DINNER
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Beaty Sheets

At a dinner held in the Green Bank cafeteria on Wednesday evening, January 21, 1970, the following NRAO employees were awarded the AUI 10-year pin and certificate of recognition for 10 years of faithful service at the Observatory :

Omar Bowyer  
Naomi Daniels  
George Grove  
Cleo Harper  
Hein Hvatum  
Phyllis Jackson  
Bill Kuhlken  
Ted Riffe  
Jamie Sheets  
Verna Tracy  
Bob Viers

All the above employees were present at the dinner except George Grove, who is located in Tucson. Wives and husbands were also guests, along with the Observatory division heads and assistant directors.

The pins and certificates were presented by the Director of the Observatory, Dr. David S. Heeschen, in a small ceremony following the dinner.

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The ten year pin, we think  
Is fine for Associated Universities, Inc.

This may sound hazy  
and a little bit crazy

The women would much prefer mink!

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A special thanks to all of those who help assemble the Observer.

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FROM THE DIRECTOR'S OFFICE

William E. Howard III

The NRAO is totally Federally funded. It gets its money from the National Science Foundation in Washington and its yearly budget currently lies between five and six million dollars. Of this, about 10 percent is going into construction items, which this year amount to the new 300-foot telescope surface and control building. About 80 percent of our total budget is used for operations and almost two-thirds of the operations budget goes for salaries and benefits of our employees. By operations we mean every expenditure the Observatory makes in the areas of salaries and benefits, travel funds, computer rental costs, payments for telephone, postage, and electric power, and all other materials, supplies, and services paid for the NRAO throughout the year. The remaining 10 percent of the NRAO budget is allocated to research and operating equipment. These are principally expenditures we make each year to keep our telescopes and receivers up to date. Over the past few years the Observatory has spent 700 to 800 thousand dollars each year on updating its receivers, installing on-line computer systems at each telescope, expanding the frequency coverage of the interferometer, testing and installing the traveling feed and the four-feed system for the 300-foot and other such capital items. We look upon the research equipment item as a very important component in the budget.

While the vagaries of the budget process allow us to be relatively confident of our budget for only one year at a time, the internal budget for research equipment is done in three-year blocks. Thus at any given time, say today, we are planning new receivers and other types of research equipment for the current budget year CY 1970, next year CY 1971, and the following year CY 1972. We are fairly certain that about half a million dollars of new funds will be available for research equipment this year, and we are hopeful that an additional 1 to 1-1/2 million dollars will be available in CY 1971 and 1972. Our current three-year research equipment plan reflects this expectation.

Since the Assistant Director for Technical Services has the primary responsibility for research equipment planning and since the Electronics Division spends most of the money for research equipment, Hein Hvatum and Sandy Weinreb produce the three-year expenditure plan and update it about four times a year as our internal priorities change and the budget situation becomes clearer.

In the following table I have summarized the current version of the three-year plan as it applies to each telescope system.

System	CY 1970	CY 1971	CY 1972
<u>140-FOOT</u>			
1. 5-10 GHz receiver	→		
2. 24 GHz receiver	→		
3. 2 cm cooled paramp		←→	
4. 3 cm, Model 2		←→	←→
5. 6 cm, Model 3			←→
6. Computer control system	←→	←→	
7. Cassegrain system, planning	←→	←→	
<u>300-FOOT</u>			
1. 21 cm receiver	→		
2. 3 feed, 11 cm system	→		
3. 4 feed, 11 cm system		←→	
4. 11-21 cm traveling feed	←→		
<u>INTERFEROMETER</u>			
1. 3/11 cm system	→		
2. Spectral line backend	←→	←→	
3. Computer addition	←→		
4. Additional front ends			←→
<u>36-FOOT</u>			
1. 3.5 mm receivers	→	→	←→
2. 6 mm paramp	←→	←→	
3. Diode development		←→	←→
4. 9.5 mm, Model 3		←→	←→
5. Spectral line system		←→	
<u>OTHER</u>			
1. VLB processor	→		
2. VLB terminals	→		
3. 400-ch. autocorrelator, Model 3	→		
4. Autocorrelator, Model 4			←→

The left-hand tip of the arrow indicates the starting date and the right-hand tip indicates the approximate completion date. It is important to

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stress that the table is only a current "snapshot" of the plan. It includes only the major items; it is subject to change in priorities especially at the CY 1971-72 end of the plan. There are a number of reasons why the priorities may change. The most obvious reason is that the budget may be cut and items will have to be postponed or totally deleted. In addition, the research work we do and the scientific discoveries we make here and elsewhere will change the priorities. For instance, the recent discoveries of pulsars and interesting molecular lines have caused us to build new receivers and other special types of equipment, the funds for which were originally planned for some other types of equipment that now have lower priority in the plan.

Thus research equipment is one of the critical areas in our budget planning. It is periodically updated and reviewed by the NRAO Council to retain the flexibility we must have to meet the requirements of our visitors and the NRAO scientific staff for the research they wish to do at Green Bank and Tucson.

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#### OLD FRIENDS — NEW FACES

Frances Copper

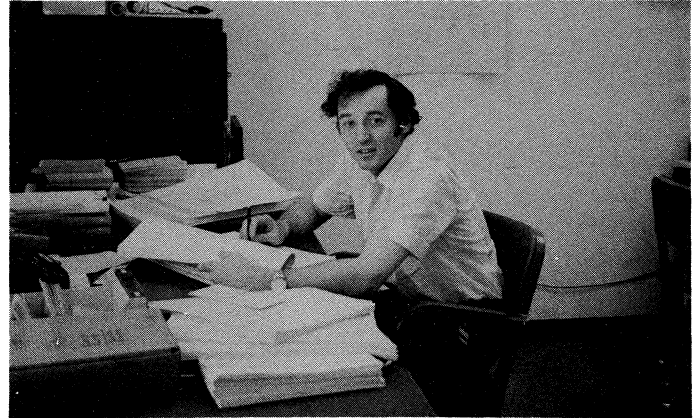
Colloquium speakers for March include Dr. Sydney van den Bergh from the David Dunlap Observatory, University of Toronto; Dr. B. T. Ulrich from the University of Texas; and Dr. Martin Rees from Princeton.

Observers who will be using the Green Bank telescopes in March include Dr. Michal Simon from the State University of New York at Stony Brook, and Dr. Carl Heiles and Dr. D. D. Cudaback from UCLA, Berkeley.

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#### PULSARS

John Sutton



Pulsars were first announced to the world almost exactly two years ago, in the February 24, 1968 issue of Nature. Like many important discoveries, they were discovered accidentally. Jocelyn Bell, a radio astronomy student at Cambridge, England, noticed that a peculiar type of interference was appearing on chart records 4 minutes earlier each day, i. e., at the same sidereal time each day. Closer inspection showed that it had a period of 1.3373 seconds and that it occurred only at a particular declination. Unless some other student was playing a practical joke, these signals were coming from a particular direction out in space. The first pulsar was CP 1919.

At the time of writing there are 50 known pulsars including 28-1/2 discovered at the Molonglo Observatory, Australia and 5-1/2 at Green Bank. The most striking property of each pulsar is the constancy of its period. Periods vary from 33 milliseconds for NP 0531 and 89 milliseconds for PSR 0833-45 to 3.75 seconds for NP 0525. Although it first appeared that a collection of superclocks had been discovered, it is now known that the period of each pulsar is gradually increasing with time. If we assume that the period is constant and measure time by counting pulses, then NP 0531 accumulates an error of 40 seconds in one month, comparable to the accuracy of an Accutron watch. The other pulsars accumulate errors of 0.0001 to

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4.0 seconds per month. NP 0531 and PSR 0833-45 have also had small, sudden jumps in period.

The distance of a pulsar can be estimated from the arrival times of the same pulse at different frequencies. Pulses arrive first at the highest frequency, and the arrival at lower frequencies is delayed according to the total number of electrons between the pulsar and the Earth. (Pulses take 6,000 years to reach us from NP 0531 and arrive 18 seconds later at 100 MHz than at 200 MHz.) Combining this total number of electrons with an average interstellar electron density of about 1 electron per cubic inch gives pulsar distances ranging from 100 to 10,000 light years. Alternatively, the detection or non-detection of neutral hydrogen (the 21 cm line) in front of a pulsar enables us to place the pulsar at a distance relative to known hydrogen clouds.

Each pulsar has a characteristic average pulse shape. Typically, radiation is received for only 5% of the period, i. e., for 5 to 50 milliseconds. Average pulse shapes come in all shapes and sizes. Some are single, many consist of two pulses, and a few have 3 or 4 components. Sometimes the width and shape of the average pulse vary with frequency. The shapes of individual pulses vary greatly from pulse to pulse. However, systematic changes in pulse shape have been observed in several pulsars, where the strongest part of the pulse systematically moves from one edge of the average pulse to the other. In a similar manner there are great variations in the intensities of successive pulses. However, careful analysis reveals periodic variations in intensity in some pulsars. For example, every second pulse is strong in CP 0834. Another interesting property is the high degree of polarization in some pulsars and the way in which the polarization varies across the pulse. The strong polarization (sometimes 100%) indicates intense magnetic fields near the pulsar.

The most famous of them all, discovered with the 300-ft telescope, is NP 0531 which is situated in the center of the Crab Nebula. The Crab Nebula is one of the strongest radio sources

in the sky (Taurus A) and is the remnant of the supernova of 1054 A.D. which was recorded by both the American Indians and the Chinese. It is a unique astronomical object. In fact, it has been said that astronomy can be divided into two categories — the study of the Crab Nebula, and the study of the rest of the Universe. At the moment, NP 0531 is the only pulsar observed optically. The accompanying figure shows two time exposures of the central peculiar star, long suspected as the remnant of the supernova. In one case the shutter is opened only while the pulsar is on; in the other it is opened only while the pulsar is off. Just to show there is no trickery, nearby stars are present on both photographs.

The current theory is that pulsars are remnants of supernova explosions. This is based on the association of NP 0531 with the Crab Nebula, and the association of PSR 0833-45 with the suspected supernova remnant Vela X. However, the failure to detect pulsars in other historical supernovae (1006, 1572 (Tycho), 1604 (Kepler)) indicates that only some supernovae produce pulsars. It seems that the other pulsars are sufficiently old (100,000 to 10 million years) that the associated nebula has long disappeared.

It is now generally believed that pulsars (or supernova remnants) are in the form of neutron stars. Matter as we know it on Earth is made of atoms, and in these atoms the majority of the mass is concentrated in atomic nuclei which occupy a very small fraction of the volume. Neutron stars consist of such nuclei squashed together without any empty spaces. It is predicted that the mass is slightly less than the Sun, but compressed into a ball about 10 miles in diameter. The density is of the order of 100 million tons per cubic inch. Then set this thing spinning at between 30 and 0.3 revolutions per second and you may have a pulsar. It appears that radiation is beamed out only in special directions, like a lighthouse. As each beam sweeps past the direction of the Earth we see a short pulse. The details of the pulse shapes, the beaming and the basic radiation process are not understood; but there are hundreds of people working on it.

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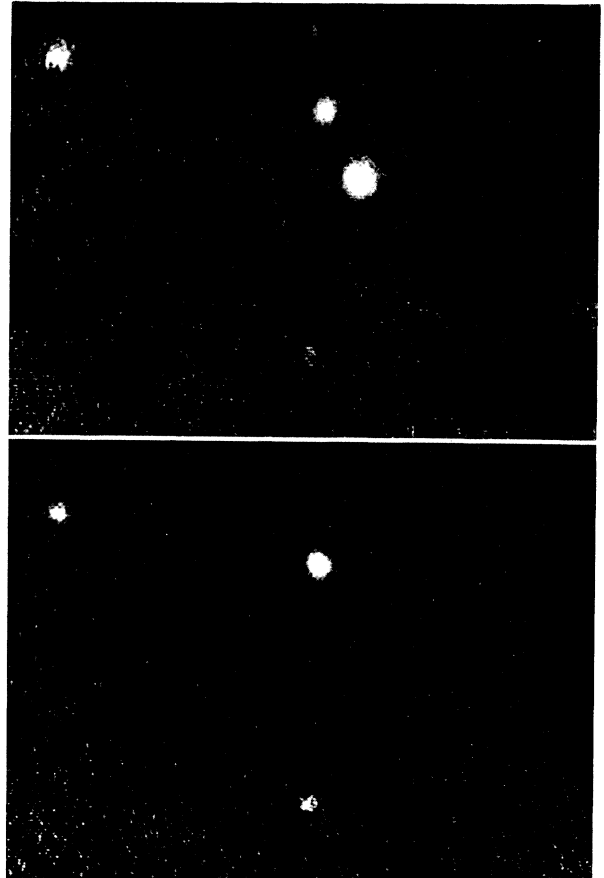
Pulsars are probably the closest we have come to detecting intelligent life elsewhere in the Universe. The first pulsars were called LGM 1, LGM 2, etc., where LGM stands for Little Green Men. Telescope operators will tell you that pulsars have maintenance days. Pulsars certainly give the impression of galactic navigation beacons, each with its characteristic period and pulse shape. One can then imagine the variations in intensity from pulse to pulse as messages in cosmic Morse code. However, there are several factors which weigh against pulsar signals being generated by intelligent beings: (1) broadcasting over the wide frequency range from 100 to 2000 MHz for communications purposes is an unnecessary waste of power (it also violates FCC regulations); (2) radiation between 100 and 500 MHz is strongly affected by the interstellar medium; (3) all pulsars are slowing down; and (4) identification of one pulsar (NP 0531) with a naturally-occurring object (the Crab Nebula). However, since the Crab Nebula is so unique it may be debated whether or not it is a naturally occurring object. There is always the possibility that the NP 0531 beacon got out of control. Another point of view is that pulsars are naturally occurring objects, but that intelligent beings are somehow controlling the pulse intensities to produce coded messages.

Although pulsars themselves are very interesting things to study, observations of them can also tell us something about the interstellar medium, the low density regions in between the stars and through which the pulsar radiation passes in coming to us. Clouds of electrons alternately amplify and diminish the intensity of the pulses on scales of minutes and hours. They also make the same pulse strong at some frequencies and weak at others. Studies of these effects for different pulsars will eventually tell us much about these clouds of electrons and how their properties differ in different directions.

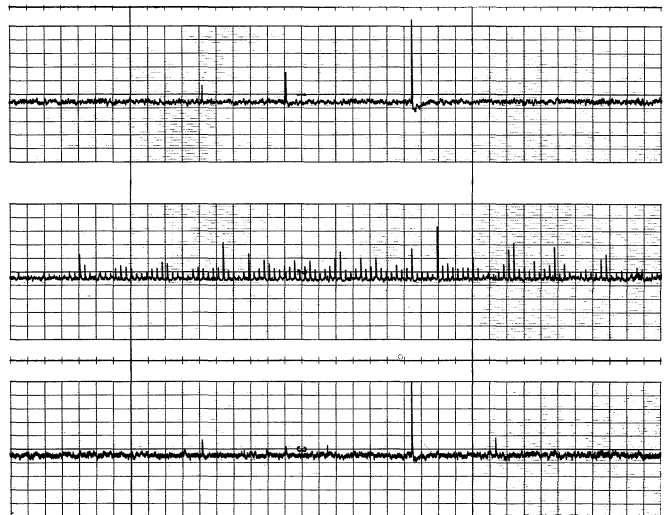
Pulsars have accounted for about 25% of the observing time on the 300-ft in the past year plus a much smaller amount of time at the 140-ft. Experiments usually involve as many racks of equipment as can be fitted into the control room. It may be difficult to completely fill the new control room for the 300-ft, but we are already working on it.

### NP 0532 (Crab Nebula Pulsar)

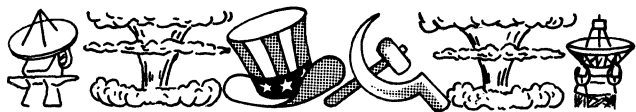
Now you see it.



Now you don't.



CP 0329 — Cosmic Morse Code (?)



THE RUSSIAN-AMERICAN  
VLB EXPERIMENT

Part II\*

Ken Kellermann

Faced with the problem of 1) not being able to get enough local oscillator signal to the telescope focus, 2) losing our time synchronization, and 3) not being able to communicate with Green Bank by TWX, we had to make some quick decisions in order to be ready for the first observations, scheduled for September 30; this was the night of September 25.

The time problem solution seemed straightforward enough—someone had to carry the Swedish clock back to Leningrad and synchronize it with the NRAO clock that was still running (hopefully) at the Pulkova Observatory. Only in the USSR one does not just go to the airport and buy a ticket for Leningrad, particularly if you happen to be carrying an atomic clock (size about 4 x 2 x 1 feet, weight 150 pounds) with you. To make matters a bit worse, it was the end of the tourist season and the planes leaving the Crimea were booked solid. Matveyenko was assigned the task of somehow obtaining two return tickets from Crimea to Leningrad.

The communication problem was already being worked on. As soon as John had arrived in Crimea and learned that the TWX was not working, he began to put pressure on our hosts to get it fixed. Actually, a TWX machine had been installed and was operating. Only there were no lines from the Observatory to Yalta to handle TWX messages. The telephone was not much better.

About 50 percent of the words were unintelligible, and it was not surprising to find out that calls to "far off" Moscow (not to mention Green Bank, West Virginia) were nearly impossible.

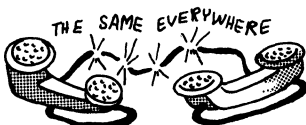
The man who was responsible for arranging the TWX was an assistant director of the Observatory (the local Ted Riffe). Unfortunately, he had been having some heart difficulties and had been sent to one of the local sanitariums to recuperate. Since he seemed to have played a critical role in the arrangements, John and Ivan Moiseyev went to the sanitarium to get some action. Upon arriving they learned that the poor man's electrocardiogram had gone off scale, to which Moiseyev replied that all he needed was a 10 dB pad, and he was hauled out of bed to negotiate with the telephone company. By the time I arrived on September 25, nothing had been accomplished, and on the morning of September 26 Matveyenko and Moiseyev put on their Sunday clothes and went to confront the phone company. For the next few weeks whenever either Matveyenko or Moiseyev showed up in their suit and tie, we knew it was time for another session with the phone company.

Nothing ever came of these deliberations, however, and we never did get the TWX working at the Observatory. Since it was only a few days from the first scheduled observations we thought it would be a good idea to telephone Green Bank and let them know we were still alive. Since the phone line to the Observatory was clearly marginal we called from our hotel in Yalta. The international operator stated that she would place the call at midnight. At 1 a.m. the phone rang—no answer; back to sleep. Half an hour later the same sequence. After a few such go arounds someone finally spoke to me and in a mixed broken English-Russian conversation we learned that the call would come through the following night. The following night, again after a few false starts, the message was "Amerika Nyet". The telephone lines were out of order, and it would be at least two weeks before we could call the U.S.A.

The only means of communication left was a telegram. At the telegraph office, I waited in a few lines, filled out a telegraph form, only to be

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\* Continued from January issue.



told it was the wrong form, and was handed a special form for international telegrams and was led to the international desk, where the "chief" spoke French (which was no help to me). She examined the telegram, looked in a big black book, and indicated she couldn't find Green Bank in her directory of U.S.A. "cities". It took a while to explain that Green Bank was not a major U.S. city and the telegram went off — or so we thought. Four days later the telegraph office called me at the hotel. They still wanted to know where Green Bank was.

Meanwhile, John was trying to get our 3 cm front-end installed and running on the telescope. Although there was an ample crew of local telescope mechanics, John was having considerable trouble getting them organized. They kept telling him that this was Russia, not America, and he should relax, have some Vodka, and not be in such a hurry. John was running around, tearing at his hair, mumbling "why didn't we bring Omar". Somehow, after three or four days they managed to get all six bolts in, to attach the receiver to the telescope.

Finding there was insufficient local oscillator signal reaching the mixer, Moiseyev remembered that there was another cable that might have lower loss going from the control building to the telescope a few hundred feet away. Since there was so little time remaining, John and I decided not to experiment with various cables but to move the VLB equipment over to the telescope. It took some courage to announce this decision, because the control room was on the second floor of the building, and it had taken the better part of a day to get the two heavy VLB racks installed. But our Russian friends took it in good spirit, and in order not to damage the equipment insisted on repacking everything in the crates. Unfortunately, the crates had been damaged in opening them up, and the better part of Friday morning (Sept. 26) was spent rebuilding the crates. Getting the crates down the stairs (which were only a few inches wider than

the crates) was a formidable task, but not nearly as difficult as trying to get them up to the operating room of the telescope structure which was about 15 feet above the ground, and accessible only via a narrow staircase. For this task a crane was summoned from the Crimean Astrophysical Observatory about 100 miles away. Even with the aid of the crane, access to the control room was blocked by a steel railing running around the whole telescope. This problem was easily solved with a hack saw, and the VLB equipment was ceremoniously hoisted into place in front of 15 to 20 spectators.

Meanwhile, Matveyenko and Kogan spent the day constructing a deluxe cardboard and wood box to carry a spare storage battery to provide extra power for the clock, sufficient for any reasonable emergency.

After a few hours sleep, the following morning I departed by car at 6 a.m. with Kogan and our rubidium clock to catch a 9 a.m. flight to Leningrad. The Swedish NiCd batteries had been recharged and were expected to be good for 10 hours. (Actually, when we got back to Green Bank and received a bill from Sweden for \$500 we found out that they were our batteries.) In addition, we carried a 50 ampere hour car battery in a deluxe box which provided about another 25 hours of safety. The plan was to fly to Leningrad, arriving about noon; have the afternoon to set the clock and recharge the batteries, and return on an evening flight to Crimea. Arriving at the airport we found that the plane was full and we would have to wait until 5 o'clock before leaving. Matveyenko then suggested that perhaps meanwhile we might like to visit a few museums and churches, which of course as he pointed out were as spectacular as the many museums and churches we had already seen in Moscow and Leningrad.

Just before plane time, the local "chief" at the airport (a rather formidable looking Russian "lady") wanted to know what was in our box, and why couldn't it go in the baggage compartment

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and also "where was our personal luggage." We tried to explain, carefully avoiding the use of the term "atomic clock" and had some difficulty in convincing her that we had no personal luggage because we were coming back in a few hours! (Imagine a Russian trying to get on a flight from Miami to New York carrying a strange looking box (ticking, of course) with wires and batteries, and having only a voltmeter, pair of plyers, and a large screwdriver for luggage, and you get the picture.)

When we arrived in Leningrad at 8 p. m. it was cold and raining (it's always cold and raining in Leningrad) and we were greeted for the second time by Pariskii and his colleagues. Unfortunately, he explained there was some confusion about when we would arrive (not too surprising), and there was no car to take us to the Observatory. After getting a good soaking in the rain, we finally hailed a taxi (about the same whoever-gets-to-the-door-first priority as here); and at Pulkova we resynchronized the clock, charged the batteries, and were ready to return to Crimea. Unfortunately, being the end of the tourist season, not very many people were flying to Crimea this particular Saturday night and so to save some rubles, Aeroflot had cancelled our return flight.

The rooms at the Observatory dormitory were all occupied, but I was shown to a room that had an "extra bed" and sacked out for a few hours to wait for our flight which was now scheduled for 10 a. m. I guess the occupant of the room was a bit surprised the following morning to find he had a "roommate". (Again, for comparison, imagine waking up one morning in the Green Bank dormitory to find a Russian who can't speak English sleeping in your room.)

I tried a few words of greeting and quickly departed. About this time my friend Kogan reappeared as mysteriously as he had disappeared the night before. We were given some breakfast and told to wait for the driver to take us to the airport. The driver showed up soon enough but apparently

couldn't find the (VW type) van to take us to the airport. A sedan-type car finally showed up at the last minute. There then followed a "small discussion" on whether the "clock" would fit into the car. Someone got the brilliant idea that if the spare tire were removed the clock would fit into the trunk. But the driver objected, because we might get a flat on the way to the airport (about 5 miles away). I argued that it was already so late that if we had a flat we would miss the plane anyway, even if we had a spare. This "decided the question" and for the second time Pariskii and his group said good-by, wished us luck, and we departed for the airport and Crimea.

Halfway to the airport I remembered I had forgotten my Simpson voltmeter. A quick calculation (including a reasonable estimate of how late the plane would be) indicated that we had time to return to the Observatory and collect the meter. The send off party had not yet disbursed and so we received yet another send off and round of "good luck wishes".

This time we made it to the airport, only to find that there was a mistake on our ticket, and that actually the plane would leave at 11 o'clock, not 10 o'clock. Just to be safe I suggested that since we had to wait an hour we should plug the clock in and not drain the batteries. Upon opening the box to get the power cord, we found that the clock had stopped again! This time the batteries had lasted less than one hour. We consoled ourselves that after all it could have been worse and that it was fortunate that the plane had not left as expected.

It was easy enough to cancel our flight, but a major problem to book a new flight. In Russia you can't buy airplane tickets at the airport, only at your hotel or at the Aeroflot ticket office in Leningrad. However, we were not staying at a hotel and, in fact, I wasn't supposed to be overnight in Leningrad at all, but we had all long ceased caring about details like travel restrictions. Also, as I mentioned before, you usually

TITLE  
 THE RUSSIAN-AMERICAN  
 INTERNATIONAL CLOCK TEST

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have to make reservations at least three or four days in advance. To further complicate the situation, it was Sunday, and in Russia no one works on Sunday, including the airline ticket office. Nevertheless, I told Kogan to go into Leningrad and get us a ticket for an afternoon flight while I went back to the Observatory to "reorganize" the clock and batteries. (I was beginning to have blind faith in my Russian colleagues' ability to overcome all bureaucratic obstacles.)

Arriving back at the Observatory I was again greeted by Pariskii, whom I was sure by this time was getting tired of seeing me keep returning to the Observatory.

It was becoming increasingly clear that we were doing something wrong with the batteries. Someone suggested that maybe they were being charged backward, and perhaps the Russian definition of + and - was not the same as the American (or Swedish as the case may be) definition. The discussion then degenerated into the difference between "electrical" + and "physical" + and electrons and holes, etc., which was clearly all nonsense.

We later realized that our problem was that each night the line voltage which was nominally 230 volts would drop to about 190 volts and slowly discharge the NiCd batteries which were attached to run the clock in case of power failure. Since NiCd batteries were sealed there was no way to measure the state of charge until the terminal voltage began to drop, which occurred only as the batteries were nearly discharged.

Just to be safe, we abandoned the Swedish clock and batteries at the Observatory and packaged the NRAO clock and 50 ampere hour car battery for reserve. Although this increased the size and weight of our "portable clock", we figured we had enough reserve now to make it back to Crimea.

Kogan had telephoned that he had managed to get us two plane tickets for a 4 o'clock flight and that he would meet me at the airport before flight

time. Following another big send off and round of handshakes and good wishes, we departed once again for Leningrad airport. Only we could not find Kogan who was supposed to handle the arrangements for getting the clock on the airplane. He finally showed up at the last minute and explained that the bus he was riding on had a flat and he had to wait for another bus.

This time we didn't take any chances on the batteries running out and during the 3-hour flight Kogan and I took turns every 15 minutes running to the rear of the plane to check the batteries with our voltmeter. In order not to look too conspicuous, I pretended each time to be going to the toilet, but after a few sessions realized that that was even more suspicious looking.

We made it to Crimea and managed to transfer everything to the car without mishap. Toward the end of the plane ride the NiCd batteries had begun to fail and we switched over to the auto battery which we were carrying. Half-way during the car trip to the Observatory this too began to run down and we had to go over to the battery that was running the car. With this we made it to the Observatory and got the clock attached to the 230 (more or less) V AC. Moiseyev handed us a pair of wires which he said went to a 100 ampere hour, 28 V DC supply, deep in the basement of the telescope. After hooking up this "emergency" supply in case of power failure, we went off for a badly needed meal. All we had had to eat since breakfast was the usual Aeroflot "dinner" consisting of a crust of bread, an apple and some luke warm tea.

The next morning we found that our 28 V DC emergency supply had dropped to 22 V and so of course had discharged the "ultimate" 28 V 15 minute internal reserve battery. This was a very dangerous situation indeed since even a momentary power failure would mean disaster. We managed to get a good battery hooked up and Kogan was directed under threat of exile to Siberia to see to it that the batteries were

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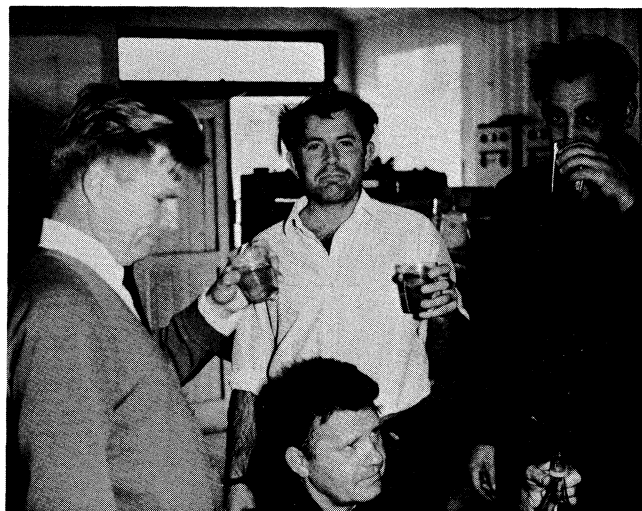
always kept charged for the rest of the experiment.

The following day (Monday) we were making some last minute system checks when it was announced that there was a telephone call from Green Bank. It was Mike Balister; we each yelled into our respective telephones for a while (sometimes alternately, sometimes simultaneously) trying to communicate, but without much success. Russian telephones make the GB-CV tie lines sound like a high-fi set. After about 10 minutes of this nonsense, Mike asked to speak to Ken Kellermann. He thought he had been talking to John Payne. I found it hard to believe that I could really be mistaken for John, until a few weeks later when I was handed the phone and told "Green Bank". The noise at the other end said, "This is Howard." and thinking I was talking to William E. Howard III, I proceeded to transmit some information about our return trip—visas, etc., which obviously were not being understood at the other end. I later realized that I had been talking to Howard Brown at the 140'.

About all I learned from Mike was that they were ready to observe the following day, and that he would try to call again. Mike also gave me some numbers relating to the error in the time transmissions from the Loran C station in Turkey, but I could not understand what the numbers meant. The same numbers were sent to us by telegram with small changes every few days for the next few weeks and did little but add to my confusion. Finally, after two weeks of trying to figure out what it was all about, a letter arrived from Barry Clark, which he had mailed a month earlier, containing a nominal ephemeris for the true transmissions. Realizing that the many telegrams and letters were giving just the corrections to this nominal ephemeris, I made a quick calculation and was delighted to find that the time derived from the Loran transmissions agreed with the time we imported from Sweden to within  $\pm 10 \mu\text{sec}$ . This was really a remarkable achievement because we later

realized that I had forgotten what day it was and had calculated the time for the previous day. This was fortunately cancelled by an error of 1 day that Barry made in computing the ephemeris.

The first observations were planned just as a test for the main run two weeks later. The plan was to run a few tapes on 3C 273 and 3C 454.3, the two strongest sources at 3 cm. The run on 3C 454.3, unfortunately, came about 3 a.m. local time in Crimea. So when it was finished John and I looked about for a ride back to our hotel and some badly needed sleep. We found our Russian colleagues upstairs breaking open the Vodka, Cognac, and the little square bottle of "Spirits". After completing 2 percent of the scheduled observing it was clearly time for a celebration. Following two hours of eating, drinking, and declarations of Soviet-American friendship and cooperation (see photo) we were finally taken to our hotel.



The following morning (late) we were met by Moiseyev, had a leisurely lunch, after which we were told "oh by the way" a telegram arrived this morning. It was from Barry. The frequency

Continued, next page --

had been set wrong at Green Bank and he wanted to repeat the run on 3C 273 in about two hours. Although we had left instructions at the Observatory to remove the 3 cm receiver and put up the 6 cm one in preparation for the next run, the telescope crew fortunately had declared a holiday and were still celebrating. We made a quick trip out to the Observatory, arriving with about an hour to spare. John and I were a bit dismayed to find the telescope locked, and no one seemed to know the whereabouts of the key. But Moiseyev finally arrived to open the door and we managed to run the tapes on time.

The plan was to immediately return the tapes to NRAO for processing before the next run two weeks later. Considering that it usually took from a few weeks to a few months to get tapes back from reasonably accessible places like Puerto Rico, Sweden, or California, this might be thought to be wishful thinking. But it had all been carefully arranged in advance. Immediately following the second 3C 273 run, the tapes were quickly packed up and driven to Yalta, where Vitkevich was waiting to leave for Moscow — there he would deliver the tapes to the foreign office of the Soviet Academy of Sciences where they would be collected by a driver from the U.S. Embassy, who would bring them to the U.S. Scientific Attache at the embassy who would then give them to a returning American "geologist" who was flying to Washington that afternoon. Having been alerted by the State Department, Barry would be at Washington to collect the tapes when they arrived. It seemed like a "sure fire" scheme and we could relax until the next run, scheduled for two weeks later. Actually, our real troubles hadn't started yet; but more about that next issue.

(To be continued in the May issue.)

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Any rural mother can state her role sardonically enough in a sentence: it is to deliver children—obstetrically once and by car forever after.

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### A SHADY ANNOUNCEMENT

Jon Spargo

Rumor has it that Millman, the moon god, will attempt revenge on Earthlings for stealing his rocks by shutting off the sun on March 7, 1970. Millman informs us that the beginning of this truly amazing feat will occur at roughly 1004 EST, with the real fireworks scheduled for about 1303 EST. However, skeptics claim that he will not succeed and that by 1511 EST it will be all over.

If, with the aid of a telescope, you would like to witness Millman's attempt, otherwise known as a solar eclipse, you are cordially invited during the previously stated times to join the fun (weather permitting) at a choice location in my back yard on Pine Grove Road. Don't forget to bring your camera. Millman will appreciate the publicity.

P.S. I suggest that your camera be of the type capable of focusing at 12-18 inches. I also suggest black and white film with a medium ASA rating. Filters optional.

\*\*\*

### GRANDPARENTS

Beaty and Jamie Sheets. Their daughter, Becky, and husband John O'Brien are the proud parents of Christopher Shawn born January 20.

Sis and James Michael. Their daughter, Jane Kay, and husband Gene Kirk are the proud parents of Christopher Michael born February 8.



**NEW EMPLOYEES**

Mary Ann Starr

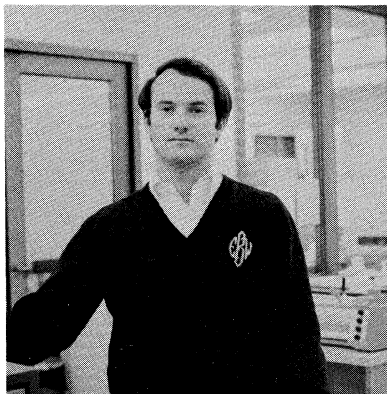
Co-Ops →



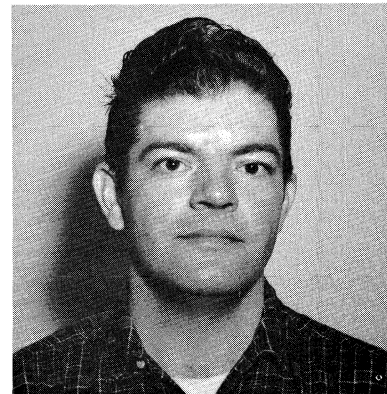
(l. to r.): C. Williams, G. Bonebrake, J. Riehm



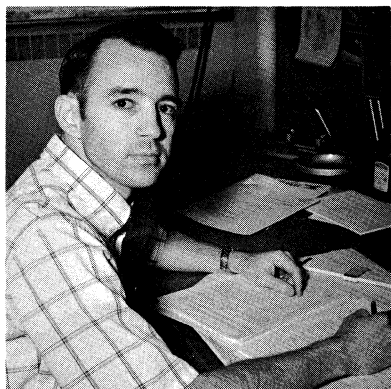
Jane Chestnut  
Plant Maintenance - GB



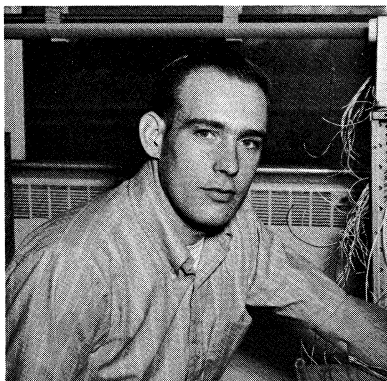
Wayne Bostain  
Computer - CV



Winston Cottrell  
Central Shops - GB



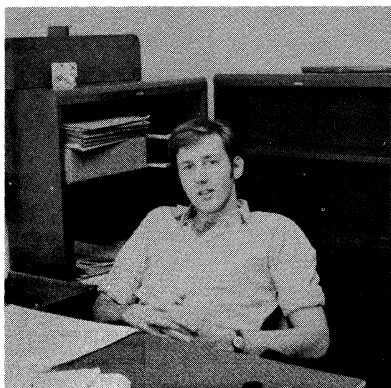
Richard Fleming  
Electronics - GB



Kermit Friel  
Electronics - GB



Dewey Ross  
Electronics - Tucson



John F. C. Wardle  
Basic Research



Sue Winkler  
Comp. /Elec. - CV

**RATHVON NAMED AUI SECRETARY\***

N. Peter Rathvon, Jr., Associate Legal Counsel of BNL and Assistant Secretary of AUI was named Secretary of AUI and Legal Counsel of BNL as of January 1, 1970. Rathvon succeeds Charles F. Dunbar, who retired on December 31 after serving as Secretary to AUI since January 21, 1949.

Peter Rathvon joined the staff of BNL in October of 1956 as General Attorney and became Assistant Secretary of AUI in January, 1964. Before coming to BNL, he was associated with the firm of Milbank, Tweed, Hope and Hadley, and had done legal work connected with the founding of the National Radio Astronomy Laboratory in Green Bank, West Virginia.

Born in Westchester County, Rathvon was educated at Yale University and UCLA before World War II. During the war, as a member of the USNR, he served as aerologist of an aircraft carrier in the Atlantic. After the end of the war, he went to Cornell Law School where he earned his law degree in 1948.

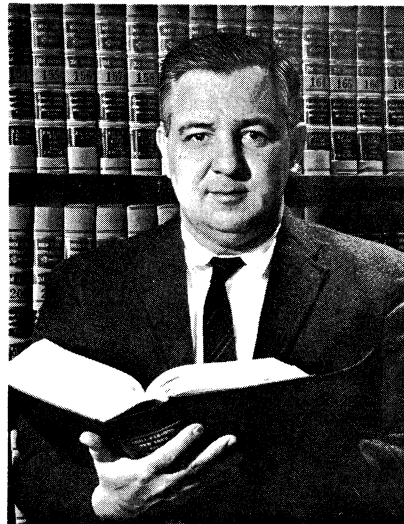
Peter and Sally Rathvon and their three children live in Setauket, where Mrs. Rathvon teaches in the Three Village School District.

Charles F. Dunbar came to BNL as Resident Legal Counsel in April, 1947. In January 1949 he was named Secretary to AUI, the position he has held ever since.

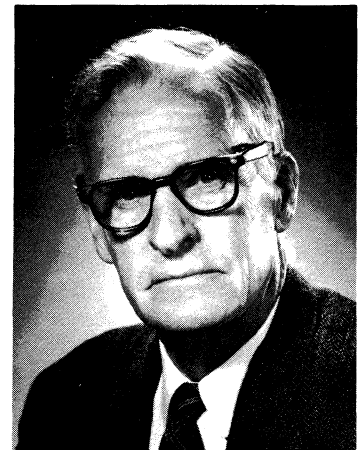
As Resident Legal Counsel of BNL, Dunbar was one of the signers of the first contract between the AEC and AUI for the operation of BNL. Previous to the signing of the first contract on December 23, 1947, the Lab had operated under a letter of intent from the AEC that was renewed every few months.

Mr. Dunbar will continue to serve both BNL and AUI during his retirement in the capacity of consultant.

\* Copied verbatim from the Brookhaven Bulletin, Vol. 24, No. 2, January 15, 1970 (with permission).



N. Peter Rathvon, Jr.



Charles F. Dunbar

(Photos courtesy of the Brookhaven Bulletin.)

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**TERMINATIONS**

- Charles Udell ..... Computer Division
- Helen Carpenter ..... Plant Maintenance
- Michael T. Waslo ..... Electronics Division
- Susan S. Brown ..... Computer Division
- Forrest Levin ..... Co-Op Student
- Peter Stumpff ..... Head, Computer Division

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## GREENVALE KINDERGARTEN

Mike Davis

Every fall a remarkable transformation occurs at the Hannah House down in the NRAO Recreation Area. The ravages of the past season's crop of summer student residents are repaired, and a truck backs up to the door with a jungle gym, a large bookcase full of children's story books, a particularly venerable old rocking horse, and all the other paraphernalia required for the reopening of Greenvale Kindergarten. For nearly ten years now pre-school education has been available to the four- and five-year-olds in the Green Bank area through this private, non-profit organization. Supported through the parents' tuition payments, and a generous subsidy from the trustees of Associated Universities, Greenvale is one of the relatively few fully accredited kindergartens in West Virginia.

With twelve to twenty students each year, the emphasis is on personal attention combined with a well-thought-out program for each of the two age groups. The teacher, Mrs. Troy Henderson, has been the motivating force behind the kindergarten program since its inception. She has skillfully handled problems ranging from Observatory visitors' children with no knowledge of English to sagging jungle gyms and recalcitrant record players. As a parent of four children, I find it incredible that one person can teach up to five times that many in just this most robust and vociferous age group, and still come up smiling.

Children from as far away as Durbin and Clover Lick have made the daily round trip to the Hannah House. This converted farmhouse, far from collapsing under the strain of housing summer students one season and kindergartners the next, is very well-equipped and beautifully situated for its purpose. It is not unusual for the children to find deer or other wildlife on the lawn, and the bird feeders on the front porch are a regular stopping place for Evening Grosbeaks. Inside, the children have ample room to study, to look at books they have chosen from the library, or to let off steam in the "horse" room.

This year for the first time the children come to school on the County School Bus system, considerably easing the transportation problem. This was made possible through the cooperation of the Superintendent of Schools, Grey Cassell, and of the County School Board. We hope that in the not-too-distant future this cooperation will lead to the creation of public kindergarten in the Green Bank School, so that all the children in the area can have the benefits of pre-school education. In the meantime, Greenvale will continue to provide these first learning opportunities to the best of our ability.



## Greenvale Kindergarten

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The teacher complained that it was bad enough that he was the worst behaved boy in the entire school. "But on top of that, he has a perfect attendance record!"

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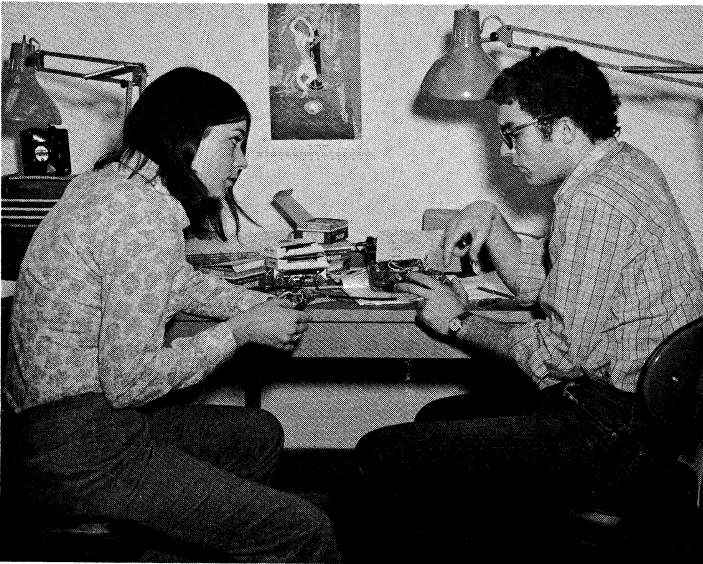
WHAT'S GOING ON IN THE BASEMENT  
OF THE JANSKY LAB BUILDING?

Several people have inquired about the change taking place in the lab basement. The carpenters replaced the chicken wire cage with plywood and the painters then put on a couple of coats of white paint. Where there was one room, now there are two. Here is what they will be used for:

Autocorrelation Construction — One of the rooms will be used by Ann (at least that is what we call her) and Wolfgang Wiedenhoever, a husband-wife team from the Max-Planck-Institute in Germany, for the construction of the Bonn auto-correlator. It is a duplicate of the NRAO one except it is for a 2-receiver system instead of a 4-receiver system. NRAO assistance will be provided by Art Shalloway and Bernie Pasternak, CV, and Bob Mauzy and Steve Mayor, GB.

We would like to welcome Ann and Wolfgang to Green Bank and we hope they enjoy their stay here.

Measurement Room — The other room will become part of the Test Equipment Facility. See the following article by Jim Dolan.



Ann and Wolfgang Wiedenhoever

TEST EQUIPMENT FACILITY

Jim Dolan

The NRAO now has approximately \$600,000 capital investment in electronic test equipment and about \$1,000,000 in research equipment. Keeping this complex equipment operating is largely the responsibility of Carl Chestnut and Ken Anderson of the equipment maintenance section. Carl and Ken's biggest complaint is the failure of equipment users to turn in a report on faulty instruments. It would help considerably if people would report malfunctions as soon as possible. It also saves time if the trouble is described in clear, concise terms. Helping keep equipment in proper condition also helps the users since one never knows who will be using the instrument next.

Precision measuring is an important part of our modern radiometer design and testing. Test set-ups are also time consuming as most everyone will agree, particularly if he has run around trying to gather up the necessary components. With a little money and a lot of ambition, we have initiated a project to improve the system. We have a room (located across from the instrument repair lab) that will be used as a measurement room. Plans include a wideband swept-signal source covering the bands from 0.1 to 26 GHz, X-Y recorder, precision detectors and attenuators, a ratiometer and other related hardware. Hopefully, with our new lab, most ordinary measurements such as gain, attenuation, bandwidth, frequency, etc., can be made with a minimum set-up time. Expert assistance, if needed, will be available to assist in the measurement. We are just beginning to get underway with the new facility and our time scale is on the order of 6 to 9 months. Right now we are looking for the right signal source, the heart of the facility. Other items will follow as soon as funds are available.

\* \* \* \*

\* \* \* \*

ADMINISTRATIVE SERVICES — GB

Sis Michael

A much needed improvement has been made at the Green Bank installation — the mail room, formerly located in the upstairs hallway of the Lab, has been moved to the first floor just across the hall from the switchboard in Room 116. It's really neat — same style as used by the U.S. Post Offices, except there are no locked doors, only open slots. Nevertheless, it must be agreed, it is a great improvement.

Statistically-Wise — Month of January:

There were 266 purchase orders processed. Bev's claim to fame—she typed 253 of this total in addition to placing umpteen calls and serving as receptionist.

There were 249 orders, or portions thereof, checked in at the Warehouse by the Receiving Dept.

Fifty-nine persons took advantage of the Residence Hall -- 26 visitors and 33 employees. A number of these people checked in and out at various intervals during the month. This suggests Mr. McLaughlin, and the girls who work with him, were kept quite busy.

Vehicle Bang-Ups: The "hex" sign must have been put on the diesels during December and January.

December 5 - Jorn Wink was driving the blue stationwagon down near the 140' when he struck a patch of ice, causing the vehicle to go over a small embankment.

December 26 - Dwayne Schiebel was piloting one of our on-site trucks, in the vicinity of the 300'. His vision was impaired by an iced-up windshield. He rounded a bend in the road and collided with the green diesel sedan driven by Steven Gottesman.

January 25 - Barry Turner was in the driver's seat of the blue diesel sedan. He drove into an unexpected patch of fog (visibility naturally nil at this point) and a deer jumped from the side of the road directly into his path. Quite a surprise for Barry.

All accidents were of minor nature; so far as the drivers were concerned — no casualties. The vehicles were not so lucky. The word has sifted around that if we can't keep the diesels on the

road, we might try reverting to the horse and buggy... and someone even suggested dune buggies. \*

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WHAT ARE YOUR ODDS?

Ever wonder what your chances are for having certain things happen to you? A publication called "Supervision" publishes the following table:

On fathering twins, the odds are 88 to 1 against you.

On being dealt a royal flush, the odds against you are 649,740 to 1.

On being struck by lightning, the odds are 89,450 to 1.

On winning the Irish Sweepstakes, the odds are 44,000 to 1.

On living to collect Social Security, the odds are 2 to 1.

On being investigated by the Internal Revenue Service, the odds are 24 to 1 -- unless you make over \$10,000 a year. Then the odds are 6 to 1.

On becoming a millionaire, the odds against you are 1,250,000 to 1.

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COFFEE CONSUMPTION

Guess how much coffee GB employees drink a month (20 days and does not include lunch or dinner consumption)? Bill McLaughlin kept a pretty close count and, are you ready, the answer is 20,000 cups per month.

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\* We forgot to mention that bicycles won't do either. Dr. Hugh Johnson and bicycle crashed into the site gate. In this case, however, the bicycle was not hurt, but Dr. Johnson sustained cuts and bruises. (This may be a good one for Ralph Nader.)

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NRAORA BASKETBALL
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Dave Williams

The basketball season is moving along at a torrid pace (even if the players are not) with nine games already completed. This includes one game against a Green Bank team. There are several more games yet to be played. So, anyone who wishes to play, come on over to the Cass Grade School on Thursday nights at 7 p. m. and join the fun.

We are in need of more jerseys which have not been turned in from last year's players. Will anyone who has one please turn it in to me or to Ron Monk.

Below is a listing of scoring of games thru Feb. 5. The scoring leader in both average and total points is John Riehm, a co-op student from the University of Louisville working in the Electronics Division. Ron Gordon (4 for 4) and Benny White (1 for 1) have proved to be the best foul shooters, closely followed by Ken Anderson (8 for 10).

I think the old veteran NRAO basketball players would be ashamed of themselves for letting a young whipper-snapper like John show them how the game is played. Carl Davis said if he were a few years younger (I don't know if he meant decades or scores of years), he would show him some of the finer points (knees and elbows, I guess) of the game. Don't teach him any bad habits, C.D.

Name	Games Played	Field Goals	Fouls		Total Points	Average
			Made	Attempt		
John Riehm* . . . . .	7	88	36	51	212	30.3
Len Howell . . . . .	4	45	5	8	98	24.5
Benny White . . . . .	2	23	1	1	47	23.5
Ron Monk . . . . .	7	56	11	27	123	17.6
Chester Cassell . . . .	4	27	14	20	68	17.0
Brown Cassell . . . . .	2	13	3	8	29	14.5
Wendell Monk . . . . .	9	53	10	23	116	12.9
Russell Poling . . . . .	9	47	11	23	105	11.7
Tom Carpenter . . . . .	7	36	8	11	80	11.4
Ken Anderson . . . . .	3	12	8	10	32	10.7
Bob Vance . . . . .	4	17	6	11	40	10.0
Maxie Gum . . . . .	8	29	19	41	77	9.6
Jerry Shears . . . . .	7	26	2	5	54	7.7
Ronald Gordon . . . . .	4	10	4	4	24	6.0
Bill Vrable . . . . .	7	16	9	12	41	5.9
Bill Brundage . . . . .	8	20	6	14	46	5.8
Carl Davis . . . . .	3	7	1	3	15	5.0
Gary Bonebrake* . . . .	4	9	1	3	19	4.7
Basil Gum . . . . .	3	5	1	2	11	3.7
Claude Williams* . . . .	4	6	1	2	13	3.2
Bob Nichols . . . . .	4	1	1	3	3	0.7

\* Co-Op Students.

\*\*\*\*

## 140-FOOT TELESCOPE

Bill Hunter

Many visitors while touring our site will stand at the portals entering the 140-ft telescope and gaze with awe at the massive structure gliding across the sky and eventually stare at the odd arrangement at the eastern side of the pedestal and inquire as to what the strange looking house on stilts is for. This is the service tower and a most important asset to the operation of our instrument. It is used to mount and service equipment located at the vertex, or focal point, of the antenna. The incoming radio signals from a radio source billions of miles away are very, very weak. They strike the antenna surface and are reflected to the focal point of the feed.

Receiver installations at this telescope are quite fast and furious, taxing both the Electronics Division and the installation crew to be prepared for a multitude of changes and revisions to suit the needs of different groups of observers in a given period. There may be as many as ten to fifteen similar, but different, programs in operation in a one-month period. To meet these demands, a safer, more efficient method of front-end service was mandatory. Formerly, this work was accomplished with the aid of an extension type, portable elevator, still used to service the 85's and in an emergency the 140-ft. Each piece of equipment, by and large, had to be handled mostly by an artful act of balancing and various means of jury rigging (chain falls, pry bars, grunts, groans, etc.) to eventually secure to the mount. Once in place the elevator had to be re-located in order to get to different components of the receiver. These procedures were carried out many times in adverse weather conditions and were time consuming and very hazardous.

The service tower provided quite an improvement to expedite this portion of our operation. It consists, literally, of a house built on long steel supports. The whole structure is mounted on railway wheels. The telescope is lowered to a pre-measured angle and secured by application of the stowing brakes. As soon as the duty operator acknowledges that the telescope is secured in the

proper, safe position, he grants permission for the tower to be moved. Two large doors are opened; the top portion of the tower is moved back and safety hand rails opened to permit the tower to completely engulf the ring, or doughnut, in which the front-end equipment is mounted. Bolts are provided to lock the tower in place. They also trip a switch which de-energizes power to Capstan power control. An interlock is also provided which prevents the operator from releasing the brakes or otherwise moving the telescope, until the tower is moved beyond the clearance point.

The front-end receivers are unloaded directly from a truck, rolled onto an elevator and hoisted to the tower level. It is then picked up by a hydraulic jack, designed and built in our NRAO shops, to exactly fit our standard front-end boxes. The jacks position the box to the correct angle, and the receiver is rolled into the mount, aligned to the dowel pin holes and bolted into place. The necessary cables are quickly attached. The "E" or "H" vector of the feed is set to a reference NS or EW and rough focus measurement taken. The final focus is adjusted by measuring a curve on a point source.

The whole procedure is carried out usually in about one hour as opposed to from three to four hours with the old method. Electronics people then make various tests to insure the receiver is functioning properly. The tower is rolled back and observing begins immediately, if not sooner.

\* \* \* \*

A man's uncle died and left his nephew a nice sum of cash. The man told a friend:  
"Yesterday at five in the morning, my uncle and I passed on to a better life."

\* \* \* \*



PAST HAPPENINGS

Dec. 29, 1961 — First Observer published. . . Phyllis Jackson editor. . . Otto Struve resigned. . . Joseph Pawsey, CSIRO, appointed new director . . . first NRAO dance. . . the Lynds left for Tucson . . . Brian Hogg was born. . . the 40-ft tested and results perfect.

Jan. 31, 1962 — Work started on 300-ft control building. . . Bob Vance's second girl arrived.

Feb. 28, 1962 — New employees were Tony Hamed, Lyndell Brooks, John Rader, John Hensley. . . total number of NRAO employees — 115. . . Ewen-Knight's 10 cm on 85-ft with NRAO 750 MHz receiver. . . Heeschens have son, third child.

\*\*\*\*

COMPUTER LETTERS

Often the secretary goofs on an address, usually in the form of a street number or a zip code, but when the time-saving, never-makes-a-mistake computer goofs, it is in a big way. See the following for an example:

Mr. M.B. Weems, Ch. Illus. Photo.  
NATNL. RADIOASTRONOMY OBSERV.  
Edgemont Rd.  
Charlottesville, Va. 22901Mr. Weems

Dear non-stop platemaker & light  
table with leg levelers:

If you have received a computer-goof letter, please give it to one of the Observer reporters. We will then publish it along with the others received.

\*\*\*\*

MEDICAL INSURANCE FOR  
DEPENDENT STUDENTS

Jim Finks

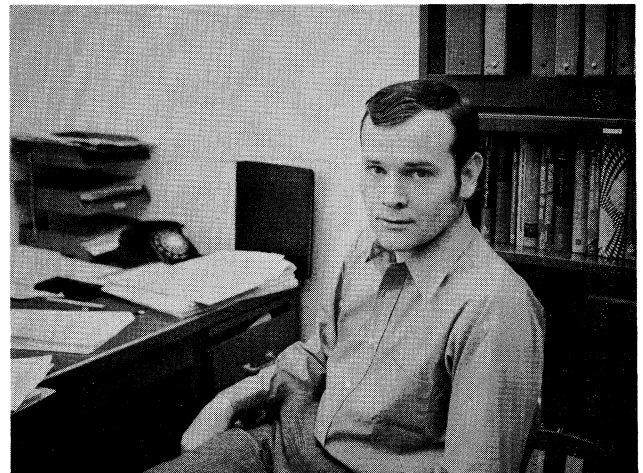
Children of Observatory employees are regularly covered under the employee's Family Medical Insurance Plan until the December 31st following their 19th birthday. Dependent Student Coverage is available for a child over 19 provided he is attending school on a full-time basis and the employee applies for this coverage.

If you have a full-time student in your family who will reach age 19 this year, be sure to apply for Dependent Student Coverage on his behalf as soon as possible. There is no additional premium required to obtain this coverage.

Application can be made through Beaty Sheets at Green Bank or Personnel in Charlottesville.

Employees with children who are no longer eligible for Dependent Student Coverage should notify Personnel (Green Bank, Ext. 209; Charlottesville, Ext. 312).

\*\*\*\*



Dr. Robert Burns has been promoted to Acting Head, Computer Division. Congratulations, Bob!

\*\*\*\*

300-FOOT TELESCOPE

Ken Cottrell

Al Hogan bagged an eight and one-half pound turkey hen this past season --- says he got it on the wing as it sailed down from a ridge up on Salsbury Run.

The drafting department has finished reproducing Troy Henderson's ten circuit prints of the 300-ft. drive and control system. A number of copies have been made to be included for general dissemination in a forthcoming NRAO internal report. These prints are detailed and easy to follow. Together with the written report, which is being prepared by Bob Viers, they will be a significant contribution to the in-depth efficiency of 300-ft. operations. There has been some earnest debate, however, on whether Troy's prints will ever actually be needed. There are those operators who maintain (with formidable substantiating evidence in their behalf) that the present 300-ft. drive and control system is virtually failure proof. Conceding the point, it is a reasonable contention that we must, nonetheless, prepare for an uncharted iceberg (so to speak) in the seas of possibility. In any event, proper records should be left for the operators who will be responsible for 300-ft. maintenance in the next millenium, after our retirement.

In early January it was our good fortune to take part in another first for the 300-ft. It was the first time that the 300-ft. had been employed in a VLB experiment with the Naval Research Laboratory's installations at Maryland Point and Sugar Grove. Dr. William Erickson and Al MacDonald, both from the University of Maryland's astronomy department, personally conducted the Green Bank phase of the experiment. The objects of observation were pulsars and quasars, and we are told that things went quite successfully.

One notable interference problem arose during this experiment. It was discovered that the encoders of 85-2 and 85-3 were pulsing across the VLB observing frequency. On the first day of observations, someone was available at these telescopes to turn the encoders off each time a VLB scan was run at the 300-ft. On the second day, a

remote hookup was installed so that this could be done from the interferometer control room. Also, the interferometer and 300-ft. operators were linked by intercom so that schedules could be arranged with little loss of observing time at either instrument.

John Sutton and his colleagues from the Massachusetts Institute of Technology have just completed another of their sessions of pulsar research here at the 300-ft. The MIT group includes Dave Staelin, Marc Price, Marty Ewing, and Bob Batchelor.

Marty Ewing and Bob Batchelor executed a catalogue source program.

John Sutton, Dave Staelin, and Marc Price did a "swept LO" program. At least one of them would be at the telescope to call the plays whenever their observations were being made. They would make on-the-spot calculations, effect profuse equipment changes, instruct the operator... all the while whisking their slide rules about, pacing absent-mindedly around the control room, muttering mystical extemporizations concerning "outriggers" and "marching" pulses. They characterize the type of people which these astronomers truly are. There is something of the artist in them, something rather awesome as they struggle at the threshold of knowledge, their minds striking creative fire. The heady edge of exultation and fulfillment is there. May their tribe increase!

\* \* \* \*

FOR SALE

1964 Corvair - Maroon. Call Henry Taylor, 456-4351. (Maybe Henry is selling this car because it is too fast for him?????)

1967 Chevelle 396, 350 hp, 4-speed transmission, new paint, new tires, motor overhauled less than 300 miles. 4-8 track car stereo plus tapes. See Bev Weatherholt or call 456-4877 after 4:30 p. m.

WANTED

Home for a 6-month old Beagle (?) pup. Contact Mike Davis, 456-4812.

\* \* \* \*

CV MACHINE SHOP

"Safety Glasses"

Welford Luckado

In 1957 I started working in a machine shop which required us to wear safety glasses. This was my first time for wearing glasses, and after a few days my nose and ears were really sore. I was told by my supervisor I had to wear them for protection; so I packed cotton and gauze on the sore spots and continued to wear them, but not happily.

A few months later, one fellow in the shop was working with hot lead and something went wrong; the hot lead splattered on his face. He ended up with bad burns on his face, and his glasses were completely coated with the lead, but thanks to safety glasses, his eyes were fine. My supervisor hung the coated glasses up in the shop as a reminder to always use them.

This sure made me aware of the fact that safety glasses do protect your eyes, and no one knows just when that something out of the ordinary is about to happen.

On January 13, I was using a milling machine with a diamond saw to cut quartz and everything seemed normal; suddenly, something almost knocked my glasses off. I looked at them and saw a cut or scratch on the lens and then found a shattered piece of quartz on the floor. I don't know what caused this quartz to come flying out as it did, but I do know what was going through my mind, and you probably can guess: "Man, am I glad I had on safety glasses!"



More than just luck for "Lucky"

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GREEN BANK RIFLE AND PISTOL CLUB

Fred Crews

The Green Bank Rifle and Pistol Club got its 1970 shooting activities off with a literal bang on February 14, which will be remembered as one of the worst possible days for competitive shooting because of the cold and the continual downpour of snow.

The course of fire was the NRA short course pistol match fired at 25 yards, including slow, timed and rapid fire, with a possible score of 300.

The scores were as follows:

George Liptak	240-1X
Leroy Webb	217-1X
Fred Crews	211-1X
Dave Williams	188-2X
Ron Monk	186
Wendell Monk	129-1X

The GBRPC is currently planning and scheduling a comprehensive shooting program for the year which will involve pistol, rifle, and shotgun matches. Recognition and awards for highest scorers in each of the three types of shooting and in the aggregate are being planned. This looks to be a lot of fun and it is further felt that such competitive activity will improve the hunting skills of participants. You can participate in this competition by joining the GBRPC. See any of the members or officers (listed below) for details.

- President . . . . . Dwayne Schiebel
- Vice President . . . . Howard Brown
- Secretary . . . . . Leroy Webb
- Treasurer . . . . . Jim Dolan
- Range Officer . . . . Fred Crews
- Assistant
- Range Officer . . . . George Liptak

COME AND JOIN IN THE FUN AT THE GBRPC

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INTERFEROMETER NEWS
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William R. Campbell

Dunmore, West Virginia (OP)

This reporter recently learned that one of our number has come into some oil royalties. Oil was discovered on land owned partly by Mr. Charles Sutton in Dunmore. Mr. Sutton is employed by the NRAO as a telescope operator at the Interferometer. The following interview was conducted with Mr. Sutton on January 29, 1970:

Reporter: How do you happen to own this property?

Mr. Sutton: I was wise enough to choose a grandmother who willed it to me.

Reporter: Are you a controlling shareholder?

Mr. Sutton: Yes, I control my entire share.

Reporter: How much is your share?

Mr. Sutton: 1/64.

Reporter: How big is the strike, and what is the quality of the oil produced?

Mr. Sutton: That is a rather crude question.

Reporter: What oil company is working your strike?

Mr. Sutton: Eureka!

Reporter: It that a company or an expression?

Mr. Sutton: Both.

Reporter: Mr. Sutton, how much—in round figures—do you realize in royalties?

Mr. Sutton: I expect enough to keep my family in shoe laces — but of course I have a very small family.

Reporter: Wow! Have you a financial adviser?

Mr. Sutton: I have subscribed to the Wall Street Journal.

Reporter: Are you investing your windfall, saving it, or just spending it... you know, living the good life?

Mr. Sutton: I am considering a trip to Frost, W. Va. I am also interested in acquiring some things that really count. Perhaps I will purchase some adding machines.

Reporter: Do you plan to continue working for NRAO, or do you have other plans ... retirement, the Riviera, or a board position with some giant corporation?

Mr. Sutton: No comment.

Reporter: Mr. Sutton, there are now two oilmen living at Dunmore--yourself and Mr. Rockefeller. Has the attitude of your neighbors changed in any way since your good fortune?

Mr. Sutton: People are suggesting that I give a canopy-covered picnic for my neighbors—with catering service.

Reporter: Do you plan to purchase any large tracts of real estate and build a home on the scope of Mr. Rockefeller's holdings?

Mr. Sutton: I plan to buy some lumber and build a new dog house—I also have some cats.

Reporter: As you know, Mr. Rockefeller—Jay—is a very influential politician. Do you plan an entry into politics as an opponent to or in conjunction with his rise in government?

Mr. Sutton: Well... I once dated a Senator's daughter.

Reporter: Has Mr. Rockefeller sent you any congratulatory messages or invitations of any kind?

Mr. Sutton: He sent his regrets that I could not attend his picnic.

Reporter: Could you give your views regarding oil depletion allowance, and have your views been altered or reversed since you became an oilman?

Mr. Sutton: Until recently, I was completely against it. Now, I am completely for it.

Reporter: By "recently", do you mean since you began receiving oil royalties?

Mr. Sutton: No comment.

Reporter: How has your life changed?

Mr. Sutton: It's not true what they say about getting middle-aged.

Reporter: How has your family reacted?

Mr. Sutton: My son is more reluctant to loan me money now.

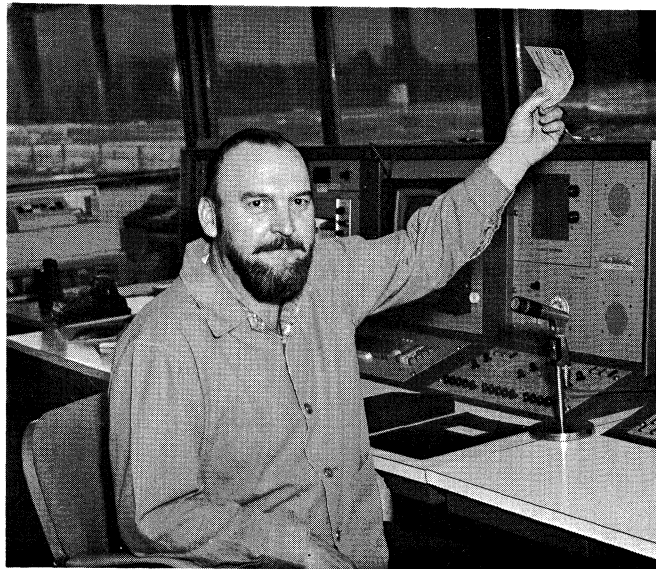
MARY ANN  
STARO

Continued, next page --

- Reporter: Do you think your beard had anything to do with your sudden wealth?
- Mr. Sutton: Not in a financial sense.
- Reporter: I have heard that you plan to launch a Sutton Foundation. Is this true?
- Mr. Sutton: There is no foundation to that rumor.
- Reporter: There is an organization at Dunmore called the Dunmore Community Association, with headquarters at the Dunmore Community Center. Do you think they may change the name to Sutton Center in your honor?
- Mr. Sutton: Suttonly not.
- Reporter: I understand you recently became Committee Chairman of some community organization. Was this appointment due to your sudden wealth, and do you care to expand on this question?
- Mr. Sutton: Affluent members of society should not disregard their civic duties.
- Reporter: Will you remain a one-car family?
- Mr. Sutton: I'll take that up with my chauffeur.
- Reporter: I hear that Mr. Rockefeller will build an airstrip on his property to land his private plane. Do you plan to build an airstrip at your home?
- Mr. Sutton: Since this oil well is heirship property, some arrangements will have to be made.
- Reporter: We'll let that one pass. Will you continue to make your own beverages, or has your money changed all that?
- Mr. Sutton: I expect to be able to buy 25 extra caps per month.
- Reporter: Did your money have anything to do with giving up music and selling your guitar?
- Mr. Sutton: Have you ever heard me sing?
- Reporter: Do you plan to allow your friends, neighbors, and co-workers to continue calling you "Shep", or is it to be "Mr. Sutton"?
- Mr. Sutton: "Mr. Shep" will be fine.

See photo

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NRAORA

Beverly Weatherholt

I-M-P-O-R-T-A-N-T... Each year the Board of Directors of the NRAORA is faced with the same problems that are never solved and each year new problems are added. As a result of these problems it has been suggested that the Rec. Assoc. be turned back to the Observatory with all employees as members and a Board of Directors as advisors to an appointed person acting as Recreation Officer. This means that the Rec. Area will be open to all employees and no dues will be paid. The way is looks now, July 1, 1970 will be the date for the turnover but nothing is definite yet.

The Board of Directors would appreciate very much to hear everyone's views on this subject. Please write your "pros and cons on the Rec. Assoc." and give them to any Board member so we will know how the other members feel about the future of the NRAORA.

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ELECTRONICS — GB
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Ray Hallman

Scientific work is progressing at a very rapid rate here at NRAO. In fact, it can probably be said that at no time other than the present has scheduled activity been at a greater pace. Fantastic! This effort depends heavily on the electronics equipment and services afforded the scientists here at Green Bank. Let's talk about one such service, namely, the Observatory clock and time keeping system.

The function of the clock room is to enable an observer to know exactly when a given bit of data was obtained at a given telescope site. The above "when" is answered, at the telescope site, to an accuracy of only one-two hundredth of a second. Few watches can run more than 30 seconds without losing or gaining that much time! And yet, it is required that the Observatory clock never gain or lose that much time.

Several factors can introduce error into any good clock system. These are generally referred to as phenomena since they are not easily explained. Some of the more interesting gremlins will now be discussed for the readers' interest although the errors introduced into the clock system are usually not great enough to cause any actual concern. Error is introduced into the accuracy of a precision clock by the rising and setting of the sun. No kidding, this has been noticed and is the cause of some concern by scientists. For example, if you set a precision clock at midnight and if you are very careful in your time observations, you can note an error in the reading of the clock at sunrise. This error is exceedingly small. If you then check the clock at sunset, you will note that the clock has apparently corrected itself! Amazing? Actually, it is easy to explain!?! There is a precise sunrise error that is countered by a sunset error. This error can be found in all atomic clocks. The sunrise and sunset errors are thought to be a result of the mass of the sun. At night the clock and sun are separated by the Earth, but in the daytime this is not the case. Hence, the indication of the clock is altered by this proximity phenomenon.

The "Webb Phenomenon" is named after its discoverer, Leroy Webb, who is in charge of the Observatory clock systems. It explains why a clock can gain 37.5 millionths of a second per hour when checked by accurate methods but in reality it is gaining only 22 millionths of a second per hour.

The reader might also find the clock motion phenomenon interesting. If a clock is transported from one location to another, it loses time. This is predicted by Einstein. It seems that the farther and faster you move it, the more time it loses. This is due to the magnetic fields it is moved through and also other unknowns. Don't ask why this effect isn't named after Einstein when one is named after Webb.

Now that the reader is armed with these facts, he can go out into the world and wind his clock knowing that it may never indicate the correct time. But, if this worries you, then don't wind it at all and then it will be accurate exactly twice a day!

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PLANT MAINTENANCE
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Jane Chestnut

Being a new employee of the NRAO Plant Maintenance Division, I am not familiar enough with the work of the departments to be able to write much of a report as to the work that is being done in this Division.

Bob Elliott says that his men will be very busy the first week of March moving the 42-ft. scope to Spencers Ridge.

The house moving project has progressed nicely. Glen Grandon says the houses are on foundation, and they are waiting for better weather conditions before pouring the cement floors.

The Electrical Shop reports that the material has been ordered for installing the Wang Calculator System in 25 rooms at the lab building. Ten kW heat is being put in the Auxiliary Generator Building to provide quicker and better starting of the generator in cold weather.

Clifford Barkley was injured February 11 and was taken to the Memorial General Hospital in Elkins.

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IT'S A CO-OP'S LIFE
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John G. Riehm

Route 28 after driving several hours of interstate is not an impressive sight; seeing the 140' rise out of the wilderness like the Martian machines of H. G. Wells is, though. All of the facilities at Green Bank are impressive, at least to us co-ops.

Because both my roommate, Gary Bonebrake (U. of Akron, Ohio) and I (from U. of Louisville, Ky.) are E. E. majors, the Electronics Division is ideal. With the equipment at our disposal here, this is paradise. For Gary it is paradise being a ham for five years, because of the amount and calibre of test equipment. Personally, it's great because of the exposure to even simple electronics which I never got at my other co-op jobs with G. E., Xerox, and Texas Instruments. This is my fourth and final co-op job and Gary's second. He worked at the computer center at his school previously. Claude Williams, the third member of the present co-op trio, is a freshman from Georgia Tech and presently working under astronomer Mike Davis on his first co-op job.

Outside of work, there's ... well, the outside. And that's about it. I'm talking about winter now, because it would be quite a different story during summer. Though we've heard quite a bit about the summer facilities here, there remains only the pool room and the ping pong table during winter. Now the pool room is "under repairs" and we've resorted to cards, TV (which has just recently been fixed), and basketball several nights a week. The basketball games are about the only means of reliable exercise not considering hiking on those rare warm days. None of us are joggers, either. We've been warned more than once from more than one local resident that we're in Green Bank during its worst three months of the year. Some consolation.

After staying in the Residence Hall, we've come to appreciate the comforts it offers for a relatively low price, especially myself, being a veteran of apartment hunting and trying to find one close to work. It's nice to be able to walk to work

in one minute. The cafeteria has, in my opinion, excellent food, though I understand their prices have just recently been raised. Between it and stocking the refrigerator upstairs in the Residence Hall, we manage to eat well for moderate prices — not cheap, but not expensive. It would really be a help if there were a stove in the kitchen upstairs, but I understand there are regulations against that. Considering there are relatively no shopping centers, movies, plays, sports events, etc., to blow our monthly paycheck on (without driving for several hours, that is) and the pay is at least average compared to other co-op jobs, the cost of living in Green Bank is not extravagant.

The work itself is what makes NRAO a good co-op job. Claude, a physics major, is tediously helping Mike Davis prepare and analyze data for Mike's current observations on the 300'. Even though it has required late hours several times, Claude still thinks it's "groovy". Gary and I have worked for several of the engineers here but lately most of our efforts have been directed towards low frequency multiplier and comb generators for Bob Mauzy. What is so great to us are the supplies and test equipment available (with enough patience). Items like the digital frequency counter, spectrum analyzer and signal generators we use are a far cry from the Army surplus back at our schools' labs. This equipment plus a full stock of components and construction materials eliminates the "insufficient equipment" condition from our work. And the work itself is interesting, varied, and challenging.

I have a bet with a close friend of mine back home that once this co-op job is over, I will admit it has been a wrong choice of jobs. He is counting on the isolation of Green Bank in mid-winter to overshadow any possible benefits from the job. Looks like I'll win myself an easy bet.

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(See "New Employees" for photos of John, Gary, and Claude.)

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LIBRARY
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May Daw

In both our libraries, a reference shelf stands just around the corner from the door. We all expect to find dictionaries and encyclopedias there, with their official-looking labels: "Not to be taken from this room", but there are many other useful reference tools which many people may not be aware of. Did you know about Books in Print, a yearly index listing all books published in the U.S. which are still in stock at the publisher? Here you can answer your question about the exact title of a new science fiction book somebody was talking about last week, and find out how much it would cost. Or if the book in question is a government document on income tax exemptions, the Monthly Catalog of U.S. Government Publications (CV library only) will tell you where to write for it. Perhaps your child is thinking about colleges, or you are interested in taking additional courses. Each library keeps a small collection of current college catalogs for you to consult. The GB library has catalogs from all four-year schools in West Virginia. If the college you are interested in is not one of these, American Universities and Colleges will give you a thorough description of the degree requirements, special programs, and characteristics of students and staff for the college you have in mind.

If you're wondering where your boss worked before he came here, try looking him up in American Men of Science to find a capsule biography. A few of our staff may even be listed in Who's Who in America, where you will also find prominent politicians and entertainers and learn where they worked before they became famous. If the famous American you had in mind is no longer living, his biography has been transferred to Who was Who in America (CV library only). The comparable volumes for famous Englishmen are simply called Who's Who and Who was Who. Finally, if you've misplaced your favorite book of math tables, there is always a copy of the CRC Standard Mathematical Tables on our reference shelves, standing next to the Ephemeris and Local Apparent Sidereal Time.

A new addition to our shelves is the National ZIP Code Directory—the large edition which the post office claims lists the ZIP code for every street in the nation. They missed one, though: a very insignificant little street called Edgemont Road, somewhere in Charlottesville, Virginia!

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FACTS FROM FISCAL*
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"New Form 1040"

Don Hovatter

In case you haven't noticed, there is only one Federal Income Tax Form for 1969, the Form 1040. Gone is the old 1040A or "short form". All taxpayers must now use the one form.

According to the IRS, this change is strictly for the taxpayer's benefit. Whether you believe that or not is strictly your decision.

Read the form carefully and be sure to include all information asked for. There are quite a few changes from previous forms; for instance, you should now attach your W-2 to the back of the form instead of the front. (How's that for an earth shattering bit of information?)

The Fiscal Office has a tax guide and a copy of the Federal Tax Regulations which you are welcome to use. Please feel free to request our assistance.

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Sickness prevailed at NRAO this past month. Fifty employees were on the sick list, some off for only one-half a day and others for a couple of weeks.

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\* Information supplied by the NRAO Fiscal Division.

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This Valentine letter was written over 100 years ago. Today, most of us simply buy a card which requires only the signature. Somebody else has written an appropriate verse and it has been printed on lovely paper. We believe that none of the "store bought" can compare with the following:

Miss Anna:

Emboldened by the license afforded by the day, I shall venture to beg you to be my companion in a journey I propose taking, it may prove an important event in your life. It will be but justice to give you some information as to the character of our ride.

The vehicle in which I would go is called matrimony. We will drive along the road of life. My horse is an old grey steed named Time and he is a rapid courser having ascended the vehicle by steps called love — fashioned by a cunning artifice, Cupid by name. The door will be closed upon us by a clergyman and he will lock the door and throw away the key. We shall find in the road certain rough places caused by the stones and roots of selfishness, pride, vanity, and temper, which have never been entirely removed from the pathway of life. That we might get over there without injury, the carriage is provided with springs of mutual affection which assist in most wonderfully softening every jolt, and indeed if we would keep those springs oiled with sympathy of mind,

our whole journey will be as pleasant as we desire. The vehicle is furnished with glasses called cheerfulness or content, which we may draw up if

Miss Anna Vaughn was a relative of Dick Hiner. She lived at Durbin, W. Va.

assailed by storms of adversity.

Moreover, the whole landscape looks pleasant

through the medium of those glasses. Such is their magical powers.

At some points along the way, we shall be in doubt as to which path to take and shall be met by two individuals, duty and inclination, who may direct us differently. But to assist in such dilemma the ruler of the country, through which the road runs, has published a guide book containing rules for such, together with many valuable directions about the road - also keeping the vehicle in good repair, etc. (for the road is a long one). Moreover, if we follow aright the directions of the book, our journey will terminate at the portals of a beautiful region, lovely as paradise, into which we will be admitted by a porter whose name is Death. Where as if we neglect the rules of our guide our road will infallably lead into a region darkness.

It is in hope that you will assist me in interpreting this book, that I now invite you to accompany me and I faithfully promise that your safety and happiness shall be my first and constant case and in hope that my effort may prove successful:

I remain ever your devoted

Valentine

The letter was written by Dr. Wm. Tucker of Amelia County, Virginia.

14th of

February 1861



HOBBIES OF NRAO EMPLOYEES
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"Madness: Or How to Spend Your Free Time"

By JAC (Just Another Crank)

"A thing of beauty is a  
joy forever: "...Keats

To a sportsman, a fine, understanding wife, and fine weapons with which to hunt are joys forever (in that order). ... The Author.

Getting interested in hunting and using firearms seems to have been something I contracted in early childhood along with measles, mumps, and other communicable diseases. Happily, all adverse effects from these have long since passed with the single exception of a long and happy respect and love for hunting and the use of firearms.

It deeply troubles me, in this era of high crime, that many uninformed persons and, too, many informed but insensibly staunch anti-gun critics, refer to the firearm instead of the human factor as a primary cause of crime. Since we must in this day rely heavily upon statistics and being free-minded individuals to consider all sources thereof, there are too many competent sources revealing statistics that prove that restricted use of firearms does in fact have little or no effect on the rising violent crimes committed in this country. So even says the latest FBI report for 1969! With this and other facts in mind, I feel that it makes as much sense saying guns cause crime as pointing the telescope skyward keeps the rain clouds away and causes draught, or pointing at a star may cause the light to go out. (I will check with J. Spargo to make sure the stars are not affected with all that gazing.)

To most of us (call us hunters, gun-nuts, or what-have-you), we may possess the same unexplainable feelings that perhaps existed with the bearded caveman eking out an existence for himself and his mini-skirted, long-haired mate. (Have times really changed so much?) You can call it the "caveman urge" or refer to us as "blood-thirsty hunters" or whatever you like, but when "the frost

is on the punkin' " time of year arrives, you make an appointment with the wife and children to use the telephone and call Dave, Tom, or Leroy and drive up to George Grove's farm. You all know where George Grove's place is? That's where all the apple trees wear seats and where the same old deer keep entertaining our ardent bow-hunters until gun season. (True conservationists!)

However strong the hunting urge is or the enjoyment derived therefrom, I think perhaps there is also a unique pride and enjoyment derived from the firearms used — whether it be a brand-spanking new gas-operated, clip-fed .297 caliber Mash-Em-Flat Magnum (got everything but hot and cold running water), to the sad, little hand-fed single shot .22 caliber held together with bail-hay wire and friction tape around the split stock, match-stick front sight, and 10 penny nail filed down for the firing pin — fond memories accompany the owners of each.

Rifles and shotguns may have different values to different people: first of all, the money value. This may be the first gun purchased as a young boy with five dollars down and a dollar a week earned by stealing pop bottles or, perhaps, even by honest endeavors — or, perhaps, the one you go to the local sporting goods store and plunk down twenty wrinkled old tens for. Too, it may be the rifle of a life time, a custom built job that you spent hours and days dreaming of and seeing to its birth after committing yourself to something akin to a second mortgage.

Secondly, value may be derived from the fact that the old smoke-stick has been handed down from generation to generation, from Great-Grandpap shootin' Redskins from horseback (honest) down to your occasional plunking at a tin can or even to permanent retirement above the fireplace. Too, it may be the one with which you downed a beautiful 23-1/2 point buck at a full 429 yards (paced off by said storyteller), shooting downhill in a blinding snowstorm. These wonderful old pieces will in most cases acquire as many or more miles as most Pullman Porters.

How-so-ever, in my mind the greatest value, since my Great-Grandpap couldn't find any Redskins to shoot at in Poland and since I have never

Continued, next page --

figured out where to hold shooting uphill or downhill without a snowstorm, the enjoyment of seeking the utmost accuracy out of a rifle determines the value I place on the piece. Whether the piece is old or new, if it is in a shootable condition (safe, of course) then each piece has its Nth degree of accuracy and that is what I like to find.

It is hard to believe, perhaps, but today the record for ten consecutive bullets fired into a target at 200 yards is less than 1/2 inch! This is accomplished by aiming and shooting at the exact same spot ten times and then being determined in group size by measuring the extreme spread (the two bullet holes farthest apart) and taking this measurement from center to center of these two holes. Not too many years ago you were most confident in owning a rifle that would put shot after shot into a Budweiser can at 100 yards, and yet here today accuracy minded nuts are most adept at punching out the "B" in Budweiser. Most factory built rifles now as they come from the shipping carton, and with appropriate sighting equipment and ammunition, will place groups into 2" or less at 100 yards. Most, with a little tuning and by careful handloading of ammunition, can shrink the groups to less than 1" at that distance.

There is available to the serious shooter a host of good and amazingly uniform components with which to make ammunition equal to or better than factory ammunition. The latter usually being the case. Each rifle has its own peculiarities, and to achieve the utmost in accuracy one can make good use of the vast number of components available to the reloader. Several combinations of bullets, powders, and primers must necessarily be tried to find the load that performs best in that rifle. It is unusual that a best load in one rifle will be the best in another. Bore size even though stated as .22 caliber or .30 caliber, etc., may be plus or minus several ten thousandths of an inch in variation from rifle to rifle. This depends on manufacturer and his quality controls. Also, the smoothness of the bore finish, the dimensions of the chamber and the stiffness of the barrell are other areas where there is much variation from rifle to rifle.

At this point then we may begin to understand why factory ammunition can usually be bested by

good, carefully reloaded ammo. I don't imply that factory fodder is not good or should not be relied upon. However, it is made to give good results in all guns. Best results can only be found with carefully handloaded cartridges for one particular gun. I remember owning one rifle in which several makes of factory ammo were tried. The best produced only mediocre results with groups around 1 1/2" at 100 yards. Then by trying several different handloads, the rifle seemed to show a fondness for one particular load. This load gave me surprising five shot groups of .340", .420" and many others under 1/2" at 100 yards. These are still kept to remind me that targets such as these can be achieved with a little work. Incidentally, that rifle-load combination gave me that same efficiency for many years. Another rifle custom built by yours truly has given me the smallest group I have ever shot, a mere .125" at 100 yards (witnessed and also measured with dial calipers).

Guns, shooting, hunting — there is, I believe, much to recommend them as a rewarding hobby or pastime. Ask any hunter or shooter! I don't deny that it isn't a fraternity unlike that of fishermen. Swapping tales, information, and equipment seems to be part of the game. It is also a good way to make lasting friends — one of the best I know of — sort of a bonus while having fun.

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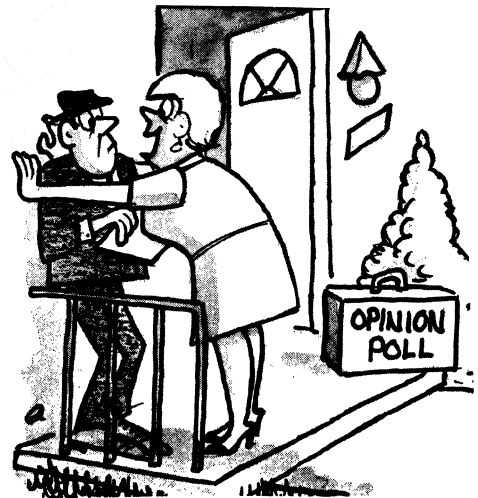
QUESTIONNAIRE

We would like to ascertain your views on the articles published in the Observer. Please take a moment to check your likes and dislikes. Return this page to Carolyn Dunkle, GB.

Articles	Like	Dislike
<u>From the Director's Office</u>		
<u>Letters to the Editor</u>		
<u>Scientific-Popular Articles</u>		
<u>New Employees</u>		
<u>Division News</u>		
<u>Letter to the Public Ed. Office</u>		
<u>Births - Marriages, etc.</u>		
<u>Old Friends - New Faces</u>		
<u>Sports Articles</u>		
<u>Fiscal Notes</u>		
<u>Cartoons</u>		

Your suggestions for future issues: \_\_\_\_\_  
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Would like to change the name of the Observer to "Parabola" or "Paraboloid" ? .....  (yes)  (no).



# N.R.A.O. SAFETY BULLETIN

I PROMISE TO  
READ MY SAEETY  
BOOK EVERY MONTH

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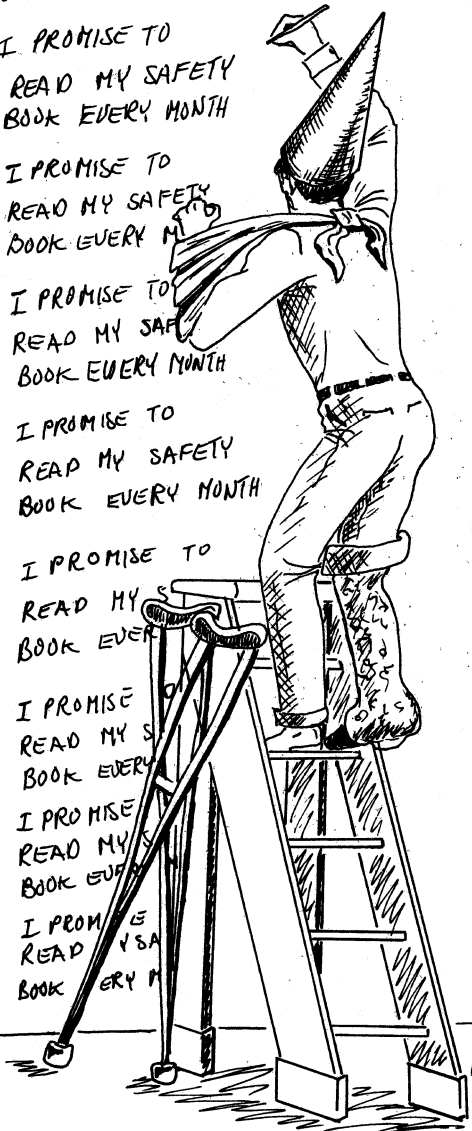
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BOOK EVER

I PROMISE  
READ MY S  
BOOK EVER

I PROMISE TO  
READ MY SAFETY  
BOOK EVERY MONTH



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