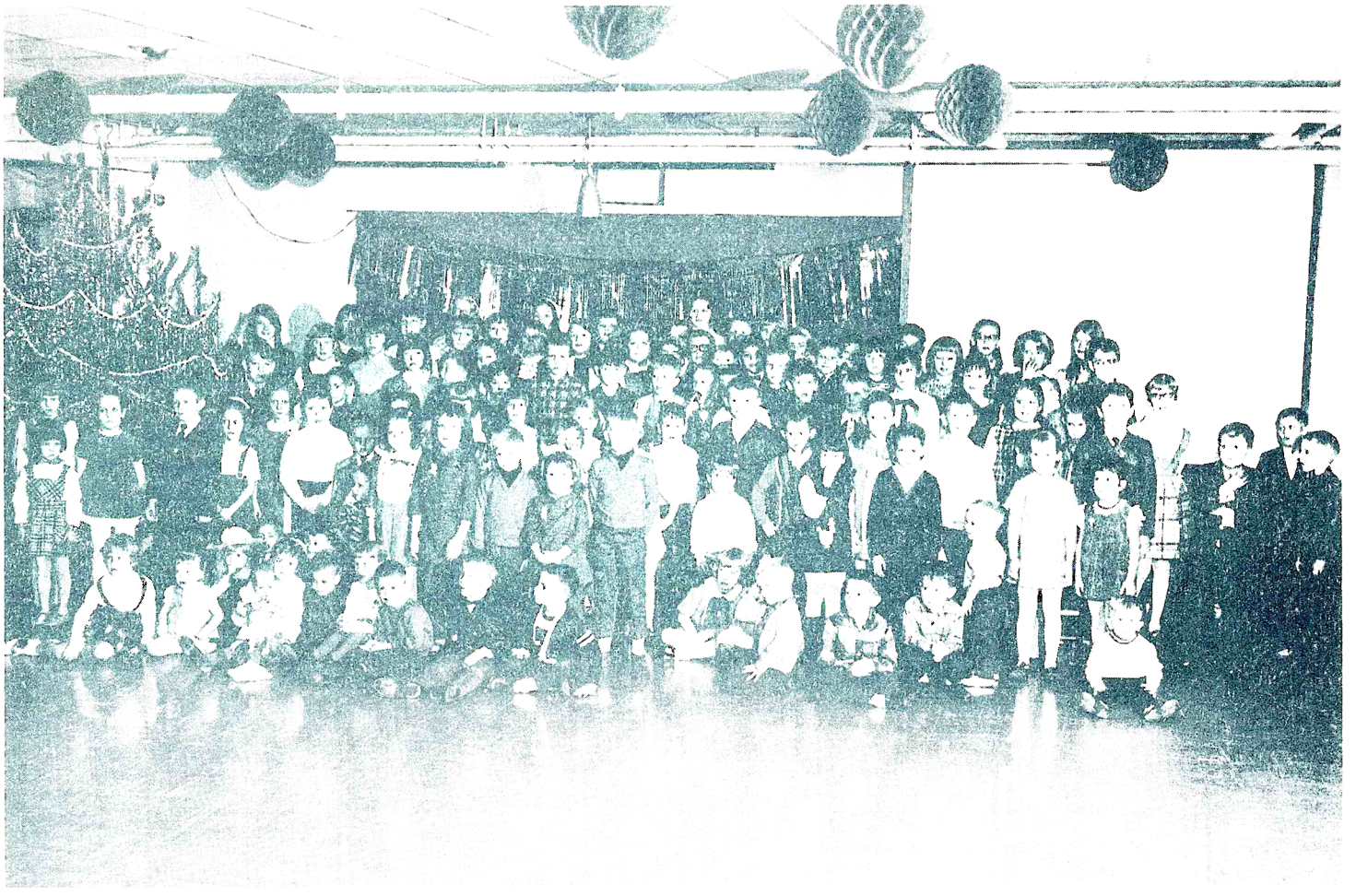
the OBSERVER

Vol. 10, No. 1 January 1970 Page 1

'TIS THE SEASON TO BE JOLLY



The Children's Christmas Party — Green Bank

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This issue of the Observer was to have been prepared in advance of the due date (December 12) because (1) some people had vacation leave to take or lose before January 1, (2) others were planning their holiday trips, and (3) others were tied up with various organizations for Christmas parties, etc. However, material was still being received as late as December 23. So, a rather hurried editing, typing, assemblying job was done.

This is the time of year when the sportsman is in his glory — from hunting squirrels, turkeys, bear and deer to indoor activities such as bowling and basketball. We hope you enjoy our special Sports Section.

Our New Year's resolution is to make the Observer better. In order to do so, we need your constant contributions and ideas. And we would like to thank all those who have contributed, and hope that they continue.

* * * *

GOODBYE 1969!

The Observer is a bimonthly publication of the National Radio Astronomy Observatory.

FROM THE DIRECTOR'S OFFICE

In the November 1969 Observer, I promised this time to discuss the Dicke Committee report and the steps we are taking to insure that the NRAO will remain in the forefront of radio astronomy in the future. The current difficult situation that exists for the funding of large radio astronomical facilities can best be understood in an historical context. The story really begins in late 1962 when the National Academy of Sciences' Committee on Science and Public Policy formed the first panel to study the need of major, new astronomical facilities in the U.S. during the period 1962 to 1972. The Panel, chaired by A. E. Whitford, produced the famous Whitford Report in 1964 which proposed a $224 million program for ground-based facilities that included a very large, high-resolution pencil beam array, an 8-element high-resolution array for Owens Valley Observatory, two fully steerable 300-foot paraboloids, an engineering study for the largest possible steerable paraboloid, and support for small instruments and special, unique problems in existing radio astronomy departments.

Between 1964 and 1967 the optical recommendations were implemented fairly satisfactorily, but progress toward the recommended radio astronomical facilities went slowly. It was during that time that the NRAO began development of plans for the Very Large Array (VLA), and a group led by John Findlay began an engineering study of the largest feasible steerable telescope (LFST). CalTech continued to press for their 8-element array and one 330-foot paraboloid was proposed by a West Coast group. The Northeast Radio Observatory Committee (NEROC) undertook the design of a fully steerable 440-foot antenna that would be useful for radar as well as for passive radio astronomy. On still another front, Cornell University completed the Arecibo Observatory, a 1000-foot fixed antenna useful for radar astronomy, ionospheric studies, and radio astronomy, located in Puerto Rico.

By summer 1967, the National Science Foundation had proposals on hand for the capital funding of the VLA, the CalTech 8-dish array, upgrading the surface of the Arecibo telescope for use at 10-cm wavelength, the 440-foot telescope, the 330-foot conventional dish mentioned above, and a 330-foot dish for aeronomy. To help sort out the proposals, NSF convened a panel chaired by R. H. Dicke (Princeton). There were seven other members of the panel, who together with Dicke, spent five days in July 1967 hearing presentations by representatives of each institution proposing these major new instruments and deliberating their relative merits. In August 1967, the first Dicke Committee Report was made public. It recommended the immediate acceptance and funding of the CalTech 8-dish array, acceptance and funding as early as possible for the Cornell proposal to up-grade the surface of the Arecibo antenna. The Panel did not endorse the West Coast proposal for a conventional 330-dish and recommended instead that definitive studies of large, fixed, spherical dishes with multiple feeds (like Arecibo) be made since that approach might be the best way to achieve instruments of the largest collecting area. At the same time it recommended that the NEROC 440-foot proposal be deferred until studies of Arecibo-type spherical dishes had been made and recommended that the VLA design studies be continued and that NRAO should concentrate on phase coherent radio astronomical research at a one second arc resolution in order to demonstrate the feasibility of the VLA.

Thus the Dicke Committee effectively updated the radio astronomical section of the Whitford Report and gave the NSF a plan of action, produced and deliberated upon by the scientists, themselves, that could be taken to the Bureau of the Budget and then to Congress for funding. Moreover, the Dicke Committee proposed that adequate operating budgets be made available to CalTech and to Arecibo, with the provision that at least 50% of the observing time on any such new, very large facilities should be made nationally available to qualified visitors.

Two years elapsed and during that time no funds were forthcoming for the construction of any of the instruments recommended by the Panel. Design studies were continued, however, and by the spring of 1969 the VLA (now 27 dishes) and 440-foot designs were more firm, the characteristics of Arecibo-type antennas were better understood, von Hoerner had a preliminary 300 foot design based upon the prin-

ciple of homologous deformations. Arecibo was beginning to be funded by the NSF rather than by the Air Force, and NRAO had proved the feasibility of 1" arc VLA operation through experiments conducted near Green Bank with the 42-foot portable telescope.

Partly because of these developments and partly because NSF wanted a clearer, updated mandate from radio astronomers, the Dicke Committee was reconvened with its same membership in June 1969 and spent three days reviewing the proposals before it. In their report in August 1969, they pointed out that dramatic and startling discoveries had been made since the Panel met in 1967, the most notable of which were pulsars, molecular lines, organic molecules, measurements of the galactic magnetic fields, and a new test of relativity. They contrasted these remarkable achievements with the "tragic standstill in the funding of new facilities", noting that radio astronomy facilities in the U.S. are essentially the same now as they were five years ago. In giving its recommendations, the Second Dicke Panel noted that while our country has stood still, Great Britain has plans for a fully steerable 450-foot dish, the Netherlands is constructing a 12-dish array that will be operating in 1970, Germany is constructing a fully steerable 330-foot antenna that will be operating by the end of 1970, and India is building a new large facility that will soon be in operation. The Panel recommended the following, with equal priority:

(a) That the Arecibo dish be resurfaced.

(b) That the Owens Valley Array be accepted and funded.

(c) That the final design and construction of the 440-foot dish now proposed by the Smithsonian Astrophysical Observatory be started and that as large a portion of the dish as is feasible be useful at 1.2 cm wavelength.

(d) That an immediate start be made on the VLA construction, proceeding in stages from a sub-VLA to the full 27-dish array.

(e) That homology design studies be continued and oriented toward the design of a large antenna usable down to 3 to 6 millimeter wavelengths.

(f) That support of radio astronomy research and facilities in the universities be substantially improved.

(g) That these major, unique new facilities make at least 50% of the observing time available to visitors, with sufficient operating funds to assure their use by all the nation's scientists.

The NRAO has placed major emphasis on the VLA and the homology antenna. Construction funds for the VLA have been included in our budget requests to the NSF and we are also seeking funds to continue design of the homology antenna, now to be a 210-foot dish usable to 3-6 millimeters. The new director of the NSF, William McElroy, is convinced that the radio astronomy facilities recommended by the Dicke Panel should be given highest priority and the NSF has put together a funding plan that phases all the facilities funding in such a way that all the new instruments could be built and operating by 1980. The total expense will be over $150 million and the success of NSF's plans will depend upon how unanimously the nation's radio astronomers push the plan and back whatever priorities the NSF may have to put on the projects in future budgets, the ability of NSF to pursuade the administration and Congress that the facilities should be built, and the national climate in the House and Senate toward such major new scientific facilities.

The situation has been further complicated recently when the National Academy of Sciences has convened a new committee chaired by Jesse Greenstein that has been charged to make another overall review of the needs of astronomy. The Greenstein Committee will cover space as well as ground-based astronomy, radio and optical, IR and X-ray astronomy as well. The study will be far more complete than the Whitford Committee study and will require at least two years to finish. Dave Heeschen is chairing a subcommittee on the needs of radio astronomy. The subcommittee, in response to requests from the NSF, has already done a quick study of the major facility requirements for radio astronomy. The subcommittee has already strongly endorsed recommendations of the second Dicke Committee meeting and urged their implementation at the earliest possible time.

The NRAO is continuing to push for the VLA and the homology telescope. We recognize, however, that the federal budget is very tight and that the climate in the administration and in Congress may not now be very favorable

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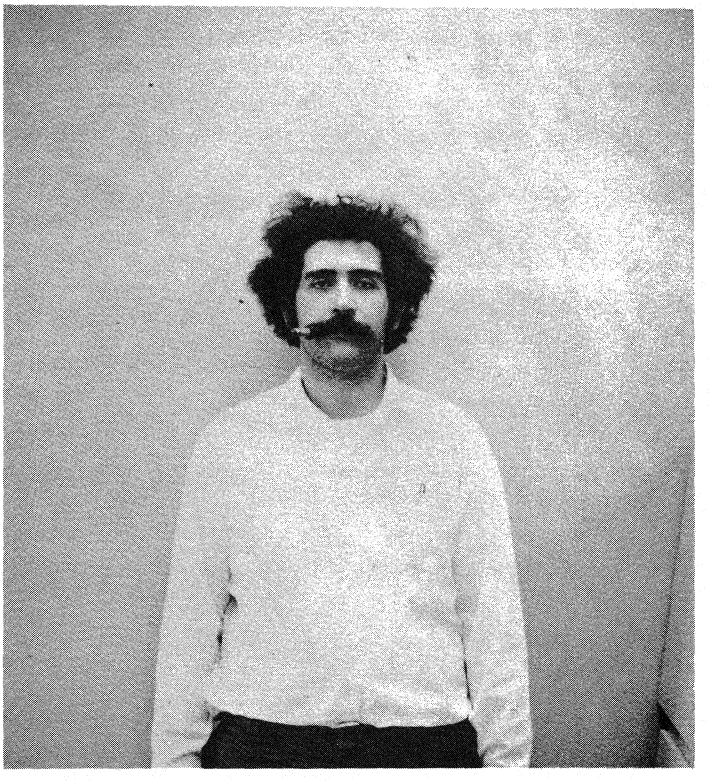
VLB INTERFEROMETRY

John Broderick



Early in 1967 a significant advancement was achieved in radio astronomy which promises to become an important tool not only for radio astronomers but also for positional astronomers, geographers, geophysicists, general relativitists, and chronometricists — to say nothing of the boon it is to radio astronomers who like to travel. This new technique is called very long baseline interferometry (VLB, LBI or sometimes VLBI) and the telescopes and staff of NRAO have played an important role in its development.

VLB interferometry is in principle the same as conventional interferometry (the important thing to remember about interferometry is that no double letters appear in its spelling) which was described in last month's Observer by Dave Hogg. The thing that determines fineness of the detail one can measure with electromagnetic radiation (radio or light waves) is the separation of the collecting elements of the receiver in relation to the wavelength of the signal being received. This quantity D/λ is called the resolving power. D is the maximum separation of the receiving elements (e.g., the diameter of a single radio dish, the diameter of the pupil of an eye, or the separation of two radio dishes coupled as one; alas, the eyes are not coupled in the necessary way to perform as an interferometer). λ is the wavelength of the radiation being received (e.g., 21 cm, or about 8 inches for some radio telescopes; for the human eye 5000 Å, about 20 millionths of an inch). The bigger the resolving power the finer the details one can discern. Thus a 300 foot (2600 inch) telescope operating at 21 cm (8 inches) has a resolving power of 450 while the eye (about 1/10 inch in daylight) operating in green light (20 millionths of an inch) has a theoretical resolving power of 5,000 (in practice, eyes are only about half that good).

If instead of putting all the collecting area in the shape of a parabolic dish, the area is, say, divided between two dishes and these are separated, the resolving power increases as the elements are separated. When the signals from these elements are brought together, they will produce an interference pattern. (To explain an interference pattern, consider two parallel picket lines. One, manned by the Youth International Party (Yippies, corresponding to the signal from telescope 1) has pickets rigidly stationed 20 feet apart. The other, manned by the Young Americans for Freedom (YAF, corresponding to the signal from telescope 2) has pickets rigidly stationed 21 feet apart. Where the picket lines are in phase, and the YAF's fall about halfway between the Yippies, there is a double density picket line. Where the lines are out of phase, on the other hand, these are areas of destructive interference, which could be readily determined from, say, an aerial photograph.) If the angular size of a source is large, however, the interference pattern is smeared out until it cannot be seen.

One of the difficulties in interferometry has been in bringing the signals together to be correlated. It is not feasible to amplify the signal received at each element of the interferometer and transmit them at the operating frequency (the RF)

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to a common place to perform the interference correlation. Instead the signal had to be transformed to a lower, more managable intermediate frequency (the IF). This requires a device called a local oscillator which must be precisely the same at both receiving elements. The simplest way to achieve this is to generate one local oscillator frequency (LO) which is shared by both receivers. Now the problem is how to get the LO to both receivers. For distances of up to a few kilometers this can be sent through cables. For greater distances the cost of the cables is too great. Transmission of the IF signal through the air can be used at distances greater than this but they are limited to straight line paths at the frequencies used. By putting in relay stations to circumvent obstacles like mountains and things, the separation achieved by this method has been extended to about 80 miles. Beyond this, cost again becomes prohibitive.

The development of atomic clocks — sources of very stable frequencies — enabled the interferometer elements to become severed from each other and thus move as far apart as was wished — limited only by the existence of radio telescopes in far flung corners of the world. It turns out that when certain atoms change their electron configurations, some of these transitions are accompanied by the emission of electromagnetic radiation of a very precise frequency. This radiation can be harnessed to regulate clocks to fantastically stable rates. For rubidium clocks the stability is good to 3 parts in a trillion (1 second per 100,000 years; for a Bulova Acutron the stability of 1 sec/day guaranteed is only 1 part in 43,000 at best) for hydrogen maser clocks the stability reaches one part in a hundred trillion. This stability enables one to adjust two of these clocks to the same rate to within this tolerance and use them as separate local oscillators at each of the telescopes in the interferometer.

Now comes the question of getting the signals together to do the correlation. With conventional interferometry one uses the same means for this as for distributing the local oscillator signal, i.e., the signals are sent back via cables or microwave links. For VLB work some other scheme must be found; it has been, and it is magnetic tape recordings. The signals are recorded on the tapes, the tapes are brought together (not without occasional shipping delays, unfortunately) and processed. (Note that a jet airplane carrying 200 reels of tape from California to Washington has an effective bandwidth of about 1 1/2 MHz.) Two methods are currently in use: the Canadian group of very long baseline interferometry experimenters who independently of and almost simultaneously with the NRAO group developed LBI, as they call it, feed the IF signal directly onto video tape — the same kind of units responsible for Instant Replay, reruns and other repetitious goodies on TV. This signal, which varies continuously from one value to the next, is called an analog signal. The tapes are brought together, played back; the signals are multiplied; and the output is fed into a chart recorder which draws a wavy trace (fringes) — if the source was not resolved (i.e., the angular size was less than (λ/D) 60 degrees). The processing scheme used at NRAO uses digital techniques. Before the signal is recorded, it is converted into a series of ones and zeros, depending on whether the signal was positive or negative at the time it was sampled. This series of 0's and 1's are recorded on tape, the rate at which the signals are laid on the tape in both methods, by the way, is controlled by the atomic clock — tape recorders don't run at an accurate enough rate as is needed. The tapes used for this are 2400 foot reels of computer tape. The tapes are fed into the IBM 360/50 computer at Charlottesville which carries out the multiplication of the signals and the search for the fringes. One of these tapes gets filled at the telescope in three minutes and it takes the computer about 40 minutes to process a pair. The rate at which the data is read onto the tape is 720,000 bits per second. Next year a new system will be put into operation at NRAO using video tapes which handle 4 million bits a second and a special purpose multiplying computer will be used to perform the tape-to-tape bit multiplication which now consumes the most time on the IBM 360/50. One reel of this tape will record for 90 minutes with much greater sensitivity because of the increased sampling rate. In both the Canadian and American systems the tapes need to be aligned during playback to within one millionth of a second.

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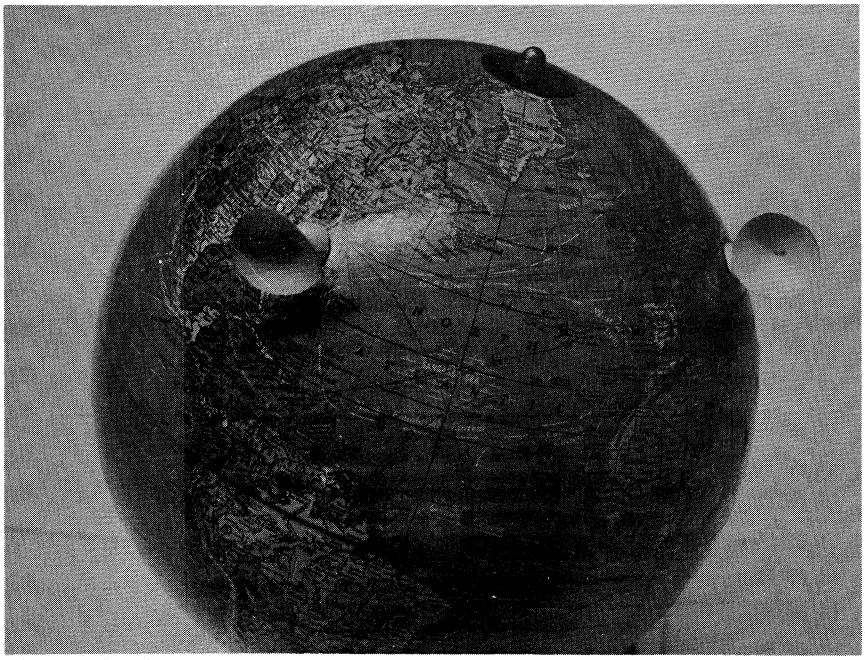

Figure 1: Model of a VLB Telescope

At this point of the operation the difference in the time at which both stations receive a signal from the source must be taken into account. The maximum amount this could be is 0.021 second (the time it takes light to travel a distance equal to the radius of the earth). This would occur for the situation envisioned in Figure 2.

This alignment is achieved by knowing what time it was at both stations to within a few millionths of a second and searching over a small range of delays to find the correct delay. This time keeping operation is also carried out by the atomic clocks and as a backup system one uses the network of LORAN (Long Range Aid to Navigation) stations which broadcast accurate timing signals from which a clock can be set to within 10 microseconds (10 millionths of a second) of UTC (Universal Time Coordinated). Another effect which must be accounted for in a VLB telescope (a model of the recent VLB telescope with stations in Green Bank, USA and the Crimea, USSR is illustrated in Figure 1) is the frequency of the fringes. This rate is determined by the separation of the two stations and the rotation of the earth. For widely separated stations this can be as high as 20,000 cycles per second, which is much too fast to be detected by either the VLB or LBI setup. This fringe rate can be slowed down by changing the frequency of the local oscillator at one of the stations so that it is operating at a frequency different from the other by an amount nearly equal to the fringe rate — then the apparent fringe rate is shifted to nearly zero cycles per second. The method used by the VLB group is to slow the fringes down in the computer by multiplying one of the tapes by a signal determined by the expected fringe rate. This second method eliminates the possibility of mistakes in making the change in the LO during the observations — which has happened occasionally.

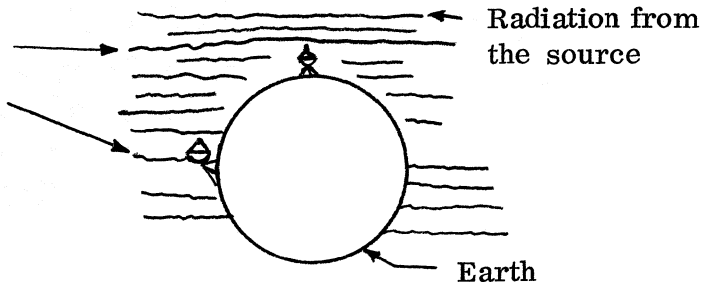

Figure 2

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Thus far the NRAO group has participated in observations between here and Maryland, Massachusetts, California, Australia, Puerto Rico, Sweden, and most recently Russia (described by Ken Kellermann in this issue). The observations have been on quasars and their smaller brothers, Seyfert galaxies. Next month we plan to make low frequency observation on pulsars using the 140-foot here and the 1000-foot dish at Arecibo, Puerto Rico. Another group at MIT has been concerned mostly with observations of small knots of emission from the OH radical within the Milky Way. A group at MIT is also interested in geophysical applications of the VLB. Last October they collaborated with Tom Clark of NASA-GSFC on a test of Einstein's general theory of relativity using VLB techniques to measure the deflection of the Sun's gravity of radio waves from quasars passing behind the Sun. The 140-foot telescope was used in this observation. They hope to measure the distance between the two VLB terminals to an accuracy of a wavelength and consequently measure whether the stations were drifting apart to get evidence of continental drift. Yet another group is studying bursts of radiation from the planet Jupiter with VLB techniques. In the future, if a network of VLB stations were set up throughout the world, the time at these stations could be synchronized to within billionths of a second. Presently the accuracy is only a few microseconds.

So with VLB one finds a radio astronomy technique which has application not only to understanding the world outside our solar system, but has application to the study of the Earth itself.

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toward the construction of major new scientific instruments. We are confident that the VLA and homology telescope will eventually be authorized because of the great scientific support in their favor, but it may take a few more years before they receive funding.

In the meantime the NRAO is developing plans for a further expansion of the present interferometer at Green Bank to help bridge the gap until the VLA becomes available as a national instrument.

William E. Howard III

OLD FRIENDS - NEW FACES

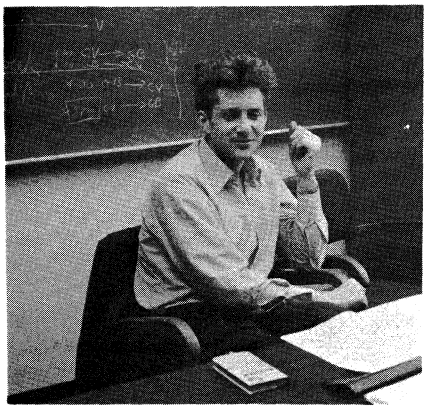
Frances Copper

Colloquium speakers for the coming months include: Dr. Joseph Silk, Princeton U. Observatory, January 22; Dr. Robert Bless, U. Wisconsin, February 26; and Dr. Glenn M. Frye, Jr., Case Western Reserve U., March 12.

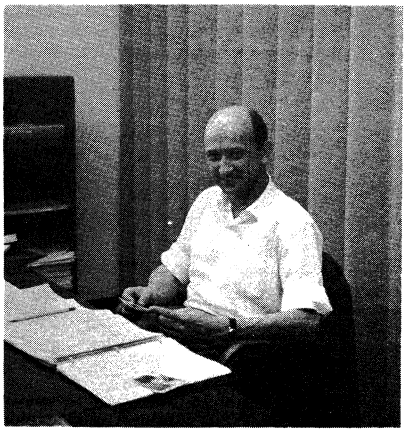
In January, Dr. I. G. Moiseev and Dr. V. V. Vitkevich from the Lebedev Physical Institute, Moscow, will be visiting us in connection with the VLB experiment, although Dr. Vitkevich may delay his trip until April in order to participate in the VLB Symposium.

Presently visiting from Moscow are Drs. Kardashev and Matveyenko who participated in the October VLB experiment with the Crimea. While here they have been making observations of pulsars with the 300-ft. telescope and the Crab Nebula with the 140-ft. telescope.

WELCOME TO NRAO



Dr. Kardashev



Dr. Matveyenko

Correction to this column last issue: Photo was Dr. James Roberts during his colloquium.

* * * *

HOW NOT TO DO A VLB EXPERIMENT*

Ken Kellermann

Following the successful completion of the Green Bank-Sweden 6 cm VLB experiment in February 1968, the VLB group began to look for new, exotic places to visit. A U.S.-Australia baseline appeared attractive as being the longest reasonable physical baseline where on the earth a radio source could be simultaneously seen from both ends. However, it was clear that to obtain really high resolution it was necessary to go to short centimeter wavelengths. But, the only radio telescopes of sufficient collecting area capable of operation at short centimeter wavelengths located far from Green Bank are in the USSR.

So in February 1968 we wrote a letter to Professor Victor Vitkevich, director of the radio astronomy department of the Lebedev Physical Institute, proposing a VLB experiment between the 140-foot and the 22-meter precision reflector located at Serpekhof near Moscow. Although we were aware that there might be some political and practical problems in doing a VLB experiment in the USSR, I don't think any of us anticipated just how difficult it would actually be.

At first it looked as though we would get no response from the USSR, but five months after our original letter we received a telegram from Moscow followed by a letter from Dr. Leonid Matveyenko saying that Vitkevich did not answer because he was on vacation! And somewhat to our surprise he replied that the USSR Academy of Science had given tentative approval to the proprosed experiment, except that they recommended we use the new 22-meter telescope in Crimea rather than the one in Serpekhof because (a) it was a better telescope, (b) it is a better baseline, and (c) the weather is better in Crimea than Moscow. Also, he proposed an exchange of personnel to discuss plans for the experiment.

Somewhat encouraged, we invited Matveyenko and Dr. Ivan Moiseyev, director of the radio astronomy station in Crimea, to visit us at NRAO. At the same time Dr. Heeschen wrote to the NSF asking permission to bring our VLB experiment to the USSR. A few weeks later Russia invaded Czechoslovakia and the NSF told us to hold off. In January of this year Matveyenko and Moiseev arrived in Green Bank. We tentatively agreed on doing two experiments — one at 6 cm and one at 3 cm. Because the weather in Crimea is said to be poor in late autumn we decided to do the experiment in October of 1969.

By this time Russia was behaving itself politically, so we moved ahead with making firm plans. We immediately ran into difficulty with the U.S. Commerce Department trying to get an export license to allow us to ship the VLB equipment to the USSR. The main cause of concern was that one of the by-products of a VLB experiment is that the distance between the two antennas may be determined to an accuracy of about 100 feet, and it is expected that future improvements will reduce this uncertainty to a few inches. And the experts at the Defense Department were afraid that a 100 megaton bomb which landed a few inches from the 140-foot telescope could do more damage than one which landed a few hundred feet away. We later learned that the Soviet government was similarly concerned. But as a result of frequent prodding by Bill Howard, Ted Riffe, and Bill Powell, the Commerce Department finally granted us an export license in August, only a few days before I was scheduled to leave NRAO.

On September 10 I arrived in Moscow with my wife and was met at Moscow's Sheremetevo Airport by Leonid Matveyenko. After retrieving our luggage, Matveyenko told the Customs man "AkademyNauk" (Academy of Science) and we passed through Customs without any inspection or formality. We later found much use for the phrase "Akademy Nauk" which indicated that we were guests of the Academy of Science and would open any and all doors from the Crown Jewels to last minute reservations on a Russian airplane.

We spent the next few days discussing plans (about 1 hour); seeing Moscow; and trying to learn a bit of Russian since it became immediately

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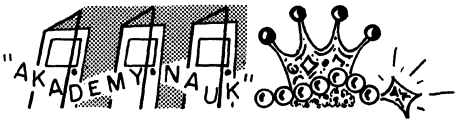
* Part 1 — to be continued in March 1 issue.



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apparent that except for the scientists no one in Moscow speaks English, in particular waitresses in restaurants. So if you want to eat you must speak Russian.

Our equipment was scheduled to arrive September 15 and Matveyenko was dispatched to the airport to collect it. He returned that evening and reported that he needed the "baggage ticket". I tried to explain that you don't get a baggage ticket with freight and that in any case I was already in Moscow when the shipment left the United States, and I would not possibly have any of the papers prepared when the shipment left. This appeared to cause some concern amongst the Russians.

The following day we obtained a letter from the Academy of Science to the cargo and customs people saying that it was o.k. for me to collect our equipment, and Matveyenko and I drove to the airport in a car and were supposedly followed by a truck which was to carry everything back to Moscow. Following about an hour of being sent from one office to another and several heated discussions, we were led to a shed that contained the equipment (or as all Russians insisted on calling it, the "aperture"). Matveyenko appeared to be a little surprised at the size and weight of our "aperture" which consisted of three, large wooden crates plus 25 boxes of magnetic tapes weighing a total of 3,000 pounds.

For some unknown reason we had to wait about two hours for the truck to arrive. But this was good practice as we were to spend a good part of the next few months waiting for someone or something, and, of course, when the truck arrived, it turned out to be about the size of a VW bus (in fact, it was exactly identical to a VW bus except for the letters "VW") and it barely could hold the smallest of our three crates. It took 6 or 8 guys with a lot of pushing and groaning to get this one crate loaded onto the truck. I drove back to Moscow in the car, being assured that they would handle the rest and get it to Moscow.

Much to my surprise, all the "aperture" somehow appeared the following morning in the basement of the Sternberg Institute. I never even tried to ask how it got there. By this time John Payne had arrived in Moscow and we decided to open things up to see if it worked. We knew that Bill Vrable had been kind enough to include a few screwdrivers in one box but it took a while to locate a local screwdriver so we could open the box to get at our own. And when one was found it was so worn it had more of a point than a blade.

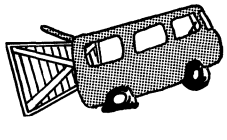
As John and I set about opening the various boxes we gathered an audience of 6 or 8 people who stood around talking and watching us try to open the boxes with this rather primitive tool. We later noted that groups of men standing around and talking seemed to be a national habit, from the farmers to street repair crews. In fact, we rarely saw anyone working for more than ten minutes at a time without stopping for a discussion or "small rest" — any man, that is. The women work very hard at such tasks ranging from carrying pails of water from the well to the house to running steamrollers and pneumatic drills, but more about this later.

A few of our audience did try to pry out a screw or turn a nail but in spite of their help we managed to get the boxes open, and much to our surprise everything seemed to be intact.

It had been pointed out to us that the boxes were too big to fit in the cargo door of an Aeroflot airplane (Aeroflot is the Soviet airline and is the largest airline in the world) to be flown to Crimea. I argued that since they had come from London by Aeroflot they must fit. But my reasoning proved incorrect since the planes flying from Moscow to Crimea have smaller doors than those flying from Moscow to London.

There then followed a big discussion (Russians seem to like big discussions) as to whether the "aperture" should be shipped by truck or railroad. To complicate the situation, it was necessary to send the rubidium clock and VLB control unit first to Lenningrad to synchronize the clock with the German Loran station, while the tape recorder, front ends, and 25 cartons of magnetic tape were to go directly to Crimea. It was finally decided to send the shipment to Crimea by train and the one to Lenningrad by truck.

A minor difficulty was that the maximum weight per item allowed on the Russian railroad is 100 kgms, and our tape recorder together with



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crate weighed about 500 kgms. But after obtaining a letter from the "Academy" the rule was changed, and our tape recorder departed for Crimea.

The VLB control unit was scheduled to leave by truck on the morning of September 18 for Lenningrad. By noon the driver had not yet appeared at the Sternberg Institute and a subsequent investigation revealed that he had gone to the airport instead. He was quickly recalled and dispatched to Lenningrad with strict instructions to proceed directly to Lenningrad and not to stop for rest until he arrived (Moscow to Lenningrad is about 400 miles).

That evening the whole VLB party — John Payne, Matveyenko, Leonid Kogan (a going engineer assigned to the project), my wife, and myself flew to Lenningrad aboard an Aeroflot TU104 jet. We also carried in the airplane our atomic clock which we hoped to set in Lenningrad with the aid of Loran which we were told was easy to receive in Lenningrad. Arriving in Lenningrad we were met by a delegation from the Pulkova Observatory where we planned to set up our Loran equipment.

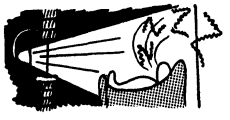
Following a sleepless night in an unheated hotel room with the temperature near freezing, we set out for Pulkova. (The night was sleepless because one of the banks of floodlights that was used to illuminate the side of the building was located just under our window. John had a similar choice location.)

Arriving at Pulkova I was not too surprised to find that our equipment had not yet arrived. It showed up about noon and again we opened up the crate before a large audience — but this time with our own screwdriver which I had carried in my pocket to Lenningrad.

The 230 V AC line turned out to be more like 200 volts, so we had to find a transformer. To insure continuous operation of the atomic clock we also had a 28 V DC battery supply with an advertized capacity to last about 75 hours.

Lacking a proper Loran antenna we strung a wire across the floor and promptly received what appeared to be the Loran transmission from Sylt, Germany. Only the Sylt station was supposed to transmit with a 79.6 millisecond period and the signal we were receiving had an apparent period of 80.0 milliseconds. There seemed little doubt that this was an actual Loran signal since it clearly had the characteristic 8 sub-pulses per main pulse, with each sub-pulse separated by the usual 1 millisecond. We therefore decided that something must be wrong with the VLB counting circuitry and spent the next two days trying to isolate the trouble. In the course of checking the VLB unit we used a variety of Russian test equipment which often turned out to be identical (except for the lettering on controls) to some piece of American (usually Hewlett Packard) equipment. After wasting two days and convincing ourselves that everything was working properly, and rejecting the unlikely possibility that Loran had changed its period without announcement, the light finally dawned — we were not receiving Loran at all, but an unadvertized Russian copy. The real Loran appeared to be buried in interference from the most powerful transmitter in the USSR located only a few miles away broadcasting entertainment to the Soviet ships all over the world. John considered building a filter but it was clear that it would take a week to dig up the necessary parts. We did manage to find a very ancient receiver which had fair selectivity which we tried to use unsuccessfully as an RF preamplifier. Another few days were wasted trying a variety of antennas in various locations and orientations trying to dig the Loran signal out of the background. Most of the time, however, was spent in repairing the Pulkova receiver we were using as a preamplifier, which kept breaking down in one way or another. It was rumored that at various odd hours of the night on certain days of the week the interfering station would temporarily stop broadcasting, but this never materialized, and it was becoming clear that we were getting no where fast.

We had previously explored the possibility of flying a running clock into the USSR but our Russian colleagues in Moscow indicated that this would be "impossible". But, in Lenningrad Pariskii was more optimistic and thought that it might be arranged. On Saturday, September 21, I telephoned Bert Hansson in Sweden, one of our collaborators on previous VLB experiments, to see if he could arrange to synchronize their clock



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in Stockholm and send it to Lenningrad. But I was told that (1) they had no batteries, (2) it was a weekend and there was no one around to prepare a proper box nor was it possible to buy batteries on the weekend, and (3) Sweden had just experienced a major storm which blew down an antenna at their observatory and had damaged the director's yacht. Nevertheless, Bert promised to "see-what-he-could-do".

Meanwhile, the first observations were only about a week away and we hadn't even been to the Crimea site yet. So John decided to go alone to Crimea to set up the VLB equipment, install the front ends and check out the TWX machine that was supposed to be installed. I stayed behind in Lenningrad to struggle with the Loran receiver and await the clock from Sweden.

The VLB control unit was scheduled to be shipped by train to Crimea at midnight on September 23. I planned to spend all that day in a last minute attempt to receive the Loran signals. Kogan told me that the railway people required that the box be at the station not later than 10 p.m. in order to make the 12 p.m. train, and then he went off to make the final arrangements for the train shipment. About 3 o'clock he burst in while I was still unsuccessfully struggling to receive Loran and announced we had to be at the RR station by 5 p.m. There then followed an unprecedented flourish of activity and in the record time of 15 minutes the 6-foot high, 300 pound rack was nailed shut into its crate, placed in the truck, and off we sped to the Lenningrad RR station. And speed, we did, because we were immediately stopped by the police for speeding (this was the second time out of a total of five that I was in a car in the USSR that was stopped for speeding). But Kogan explained that we had a visiting American delegation and we were let off with a warning. Of course, then we got lost trying to find the station for cargo and drove all around Lenningrad. We finally arrived a few minutes before the deadline.

It took a crew of about 8 rugged looking Russians to move the crate from the truck to the RR car. They struggled, moving it in short spurts singing a "heave-ho-tovarishch" before each shove. To make things a bit miserable for all, it was cold and raining.

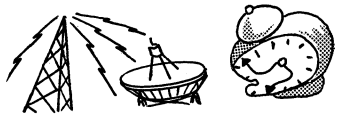
Finally getting the crate in the RR car, they broke out in a big happy smile and someone produced a little, square bottle (we would become very used to this bottle in the coming weeks) and everyone took a quick drink. I asked Kogan what it was they were drinking and he replied "alcohol". I said I know but what kind of alcohol? And he repeated "alcohol". And it turned out that is exactly what it was — pure alcohol. Well, not quite pure, but 90% pure.

Having no success with the Loran receiver and not hearing from Sweden, things looked a bit grim, but on the night of September 24 we went anyway to the Lenningrad airport to meet the Aeroflot flight from Stockholm. To our pleasant surprise there was a heavy wooden box addressed to me, strapped in a first class seat with a safety belt. Of course, the Customs man (customer, as Kogan called him) wanted to see what was inside. We handed him some official looking papers of explanation, and opened the box. He took a quick look, saw a few glowing lights, looked with astonishment at the clock ticking loudly, and said o.k. We quickly left before he could change his mind.

At Pulkova, we synchronized the NRAO clock to the Sweden clock, attached the Russian batteries in case of power failture, and left it to run at Pulkova. We had the batteries supplied with the Swedish clock recharged, and set off for the airport to fly to Crimea. In order to preserve the nickel-cadmium batteries supplied with the Swedish clock, we also carried two 6-volt car batteries and an inverter to supply 230 V AC. This combination gave us a battery capacity which was good for about 25 hours, more than enough (we thought) for a two and half hour plane trip.

The whole load weighed about 200 pounds and it took some explaining to get it on the airplane.

The flight was uneventful and upon arriving in Simferopol, the capital of Crimea, we were met by Moiseyev and set off on a two and half hour winding drive through the mountains to Yalta (this was the first of 10 such trips I made between Simferopol and Yalta). In Yalta we were greeted by John with the news that:



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1) The TWX machine could not be connected because the lines were not good enough.

2) The 50 ohm, 10 dB loss LO cable they promised us was 72 ohms and had 20 dB loss so we could not get enough LO signal from the control building to the antenna.

3) He could not receive the Loran timing signals from Turkey.

But the real blow came when the box was opened: the clock had stopped on the airplane half way between Lenningrad and Crimea. The batteries had lasted only about an hour.

This was by far the low point of the expedition. We had no time, no LO, and the first observations were only 5 days away. By this time I was so confused; I had lost track of the days and told everyone we had to observe in 4 days.

(To be continued next month.)

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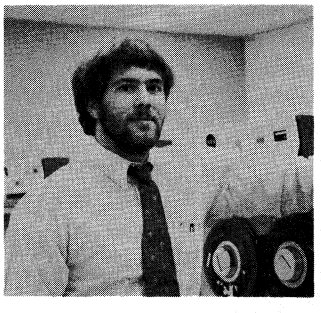
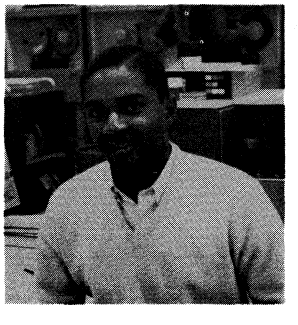
NEW EMPLOYEES

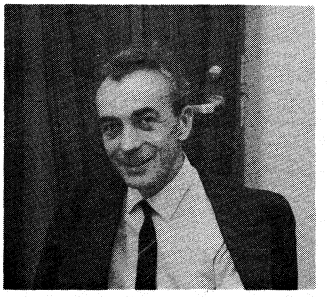
Mary Ann Starr



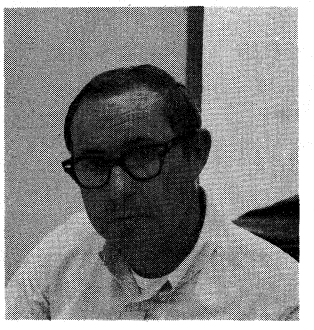
John M. Copper, Jr.
Computer Division - CV



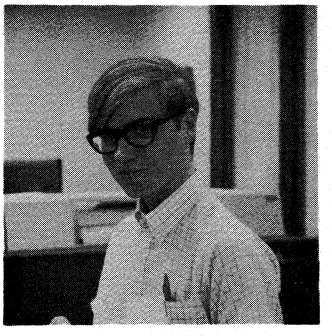
Lemuel T. Lewis
Computer Division



Jozef Maslowski
Basic Research - CV



Billy L. Meredith
Basic Research - CV
(Welcome back, Bill!)



Glenn E. Strickland
Computer Division - CV

Charles Udell
Computer Division - CV

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TERMINATIONS

Thomas L. Wilson, Basic Research, Adolphus T. Shears, Maintenance, Daniel Suggs, Computer, George T. Wren, Computer, and Janice Mullenax, Bus. and Services.

* * * *

PROMOTION

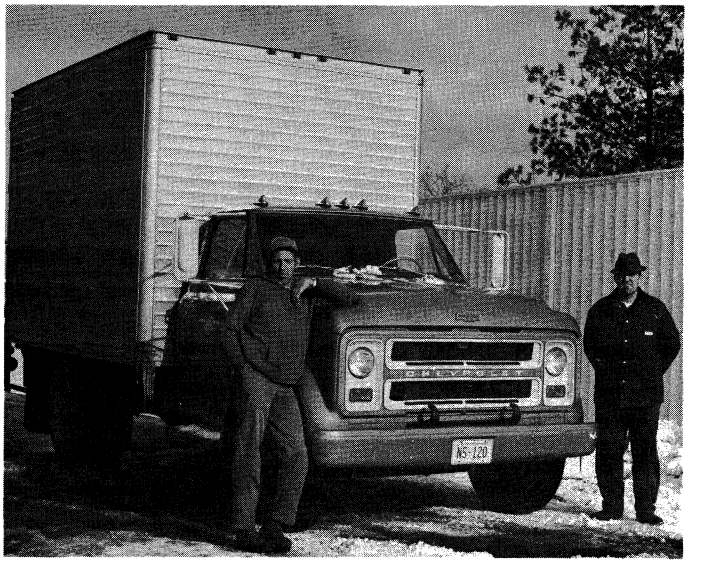
John Hawkins to Head, Green Bank Administrative Services — Congratulations!

* * * *

PLANT MAINTENANCE

Helen Carpenter

This issue the Plant Maintenance Division will feature its truck drivers, Henry Taylor and Merle Kerr, who have been keeping very busy lately. They have delivered and picked up tapes and electronic equipment to Goddard Space Center, NRL at Maryland Point, Buffalo, N. Y. (delivery and pickup of damaged transformer from the 140-foot), Charlottesville and trips to Kennedy International Airport (brought home the VLB equipment). Henry especially enjoyed a trip to Haystack and Cambridge last month during the student riots— he hurried on just as quickly as possible. Things like the truck breaking down (Patterson, N. J.) help break the routine; that time Merle and Henry got to fly home. Getting things through customs and the maneuvering necessary for this takes skill, too — of course, we want to keep "horse-trading" Henry in practice.



l. to r.: Merle Kerr and Henry Taylor

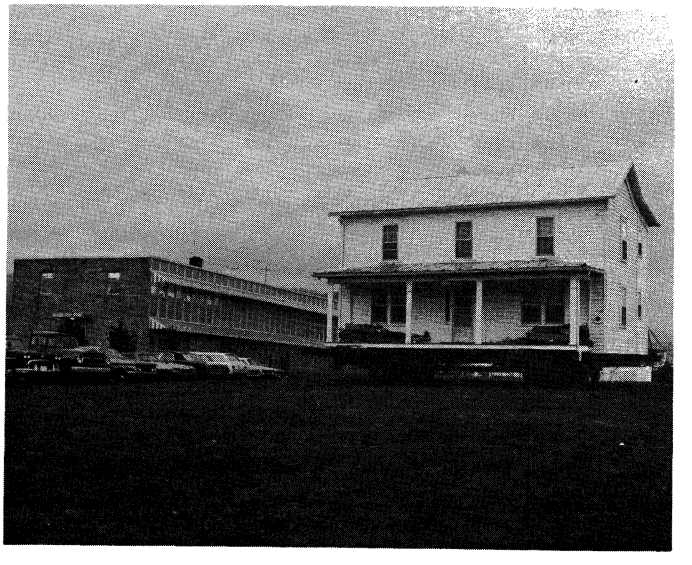
Getting the foundations ready for the house moving project has been the concern of the carpenters, heavy equipment operators, and laborers. Trying to keep ahead of "old man winter" in order to complete this work may take some extra effort —like cold hands and red noses.

Mr. Williams spent the week of October 27th attending the annual congress of the National Safety Council as NRAO's representative. The meetings were held in Chicago.

Our salaried personnel are trying to use their annual leave before the first of the year. Glen Grandon just returned from a trip to North Carolina, Paul Devlin from a trip to Pennsylvania and Ohio, and we'll be expecting Bob Elliott to take off for the sunshine of Florida shortly in his new trailer. Our weekly personnel took advantage of deer season to use their vacation leave.

Delbert Cassell of the janitor staff is presently on our sick list. Delbert is at home recovering from a broken ankle.

We wish our fellow employees and friends a very "Merry Christmas" and a "Happy New Year".



Now that's what I call a camper!

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CHRISTMAS NOSTALGIX

Ray Hallman

Let's play a game! Give yourself a free moment from your busy daily routine and play "Christmas Nostalgix". It's easy! All you do is sit back, relax, allow yourself a mood of yesteryear, and remember when you were a child. You can start your mood by thinking of things like Tinker Toys, finger puppets, and model trains, or by thinking of words like skate-key, doll-house, and kaleidoscope.

To aid in this little adventure, a quickie scratch-sheet was shipped around to various Observatory personnel. It contained the general idea of "Christmas Nostalgix" as well as the following question:

(If Santa could bring to you)
(anything, what would it be?)

Here are some ideas returned. Not all appear here as space doesn't permit. But all returns are gratefully appreciated by this writer.

Bob Eskanazy would like a Johnny Lightning race car set. G. Verschuur would like a model radio telescope. Elaine Litman wants a working model spaceship. Jim Garland is more serious wanting a real spaceship! Bill Beyers says he would be satisfied with a toy train that not only has has a light, bell, and smoke but also runs behind schedule. Peggy Weems always wanted a grocery store push-cart to play at home with. (She never got one.) David Ehnebuske wants a huge set of Tinker Toys. Susan Brown says trucks seem like a lot more fun than dolls so a large beach buggy would be fine. Santa could bring Mike Davis 12 months of summer students every year. Bill Webster really wants an autographed photograph of the astronauts on the moon. Jon Spargo says his mommy says he has been a good boy so Santa should bring him a twain. Bev Weatherholt wants a bicycle with a life-time guarantee. For George Behrens, ice skates and Jim Fullmer a paint-by-number set. Margaret Hurley says a doll house with furniture and dolls that fit inside or a great stack of books. Harry Wooddell wants a walking-talking doll. For Jim Finks a construction set that will make automated models. Archie Hughes says give me a one volume encyclopedia. Jim Pennington, a baseball glove and bat, and Herb Hanes, a mini-bike. Len Howell also wants a mini-bike. Bruce Balick imagines that 2 x 4's cut to different lengths and varnished would be nice. Frances Copper wants a magician's kit; and Mary Ann Starr, a pair of pink ballet shoes! Mark Gordon says a set of puzzles such as wire links, pyramids, etc., would be fine. For Ann Jackson a Tippie Toes doll with tricycle and hobby horse. Some Observatory men concurred in their wants as best expressed by Tony Miano:

"Ode to Santa"

Tony Miano

If I still were a little boy
The Xmas toy for my greatest joy
From Santa I would implore
Only one mini-Zsa Zsa Gabor!

It is the expressed purpose of "Christmas Nostalgix" to initiate a pleasant moment of thought. If this end is achieved in only one reader at no cost to any other, then the goal is realized.

HAPPY NEW YEAR!

* * * *

THE BEST GIFT OF ALL: "Somebody Down Here Loves Me"

We would like to welcome two new members to the NRAO family — ELLEN MOORE DAVIS and RONALD LEE HENDERSON. Ellen's new home is with the Mike Davis family and Ronald's new home is with the Troy Henderson family. Both adoptions were finalized December 8, 1969.

("What the world needs now is love, sweet love.")

NRAORA

Bev Weatherholt

Halloween Dance — November 1 was the night for the Halloween Dance but only three couples showed up in costume. The Charles Suttons, the Troy Hendersons, and the Mike Davises all received a prize. See the following photograph.

L. to r.: Mike and Jean Davis, Dorsalene and Troy Henderson, and Martha and "Shep" Sutton.

Purchased — A Sony model 540 tape recorder has been purchased for NRAORA use. It is to be used for activities such as the Pool Party where there is no live music, intermission at the dances, and other activities with the Board's approval.

Group Excursions — Out of 167 memo sent to Green Bank employees, only 46 replies were received (really shows how interested we are). Of the 46, there were suggestions ranging from football games to balloon jumping. (See next page for breakdown.)

Work Orders Submitted — (1) Tobogan slope (probably won't be anything done until next fall). (2) Winterize pool and prepare skating rink. (3) Rifle building for rifle range (money probably won't be available until after first of year. (4) Design for multi-purpose building for Rec. Area (includes proper-type toilets, etc.)

Hill House Plan — No results!!!!!!!!!!!!

Pool Room — The Pool Room has been badly misused again. By badly misused I mean foot prints on the tables, bent and broken cue sticks, and (would you believe?) foot prints on the walls and ceilings. Would the people with the "fly-away feet" and "over-powerful muscles" please exert your energies elsewhere?

Children's Christmas Parties — Santa Claus visited NRAO Green Bank and Charlottesville on Sunday afternoon, Dec. 21, and brought lots of presents for those between 0-12 years. The children also enjoyed a cartoon and refreshments.

Teenage Dance — "Bucky Clark and The Bad Habits" provided the entertainment for those between 13 and 20 on Dec. 26. Everyone seemed to enjoy themselves.

Adult Dance — The New Year's Dance was held early this year in order to have a favorite group of musicians, "The Esquires". As usual, this was the most successful dance of the year.

* * * *

Congratulations and thanks to the NRAORA Board of Directors and all others who have helped with the above-mentioned activities. Many of us do not realize the time needed to arrange parties, dances, etc. The selection of gifts, the decorations that go up—then down — then up again, plus getting everybody to cooperate require the muscles of Hercules and the diplomacy of an ambassador. A kind word to these people would brighten their day. So, the Observer staff would like to be one of the first to say THANKS; WE APPRECIATE YOUR EFFORTS!

—Observer Staff

* * * *

RESULTS OF NRAORA GROUP EXCURSION SURVEY

Jon Spargo

Approval was obtained by the NRAORA Board of Directors to use the tour buses for group excursions after the regular tour season had ended. A questionnaire was circulated to see (1) how many employees would be interested and (2) what type of activity would be most appealing. The results are as follows:

Total number of employees at Green Bank	167
Total number of survey replies received	46

Numerical breakdown of various events people wished to attend:

Football	36
Basketball	31
Bowling	16
Baseball	19
Ice Follies	28
Circus	16
Movies	20
Plays	17
Concerts	15
Other	9

Breakdown of the category "Other":

Roller Skating	1
Girl Chasing	1
Fox Hunting	1
Bear Hunting	1
Ice Hockey	2
Scenic Tours	1
Rodeo	1
Balloon Jumping	1

Specific suggestions which were included under the headings above are as follows:

1) Pocahontas High School Championship games, if any.
2) "I Am Curious (Yellow)" — Movie
3) Grand Old Opry) Concert
4) Herb Alpert)
5) Al Hirt)
6) Frank Sinatra)
7) Greenbrier Repertory Theater)
8) Hamlet)
9) Richard III) Plays
10) Puppet-Mobile of West Virginia)
Univ. Creative Arts Center)
11) Pittsburgh Pirates — Baseball
12) Tours of Penn. Dutch Country — Scenic Tours
13) Annual Meeting of the Society of Virginia Balloon Jumpers at Breakneck, Maryland) Balloon Jumping

We wish to thank those who took the time to answer our survey. We had hoped for a larger response; however, we feel we have enough information to begin work. Currently we are in the process of obtaining schedules and ticket information from as many places as we can, and hope that by the time you read this we already will have taken at least one excursion.

Please feel free to contact any member of the Rec. Association if you have any suggestions for the excursion program or if you can be of some assistance in setting up any particular outing.

—Group Excursion Committee

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NRAO HOLIDAYS

Day	1970	Holiday
Th	1/1	New Year's Day
F	1/2	* Holiday
M	2/23	For Washington's Birthday
F	5/29	For Memorial Day
F	7/3	For Independence Day
M	9/7	Labor Day
Th	11/26	Thanksgiving Day
F	11/27	* Holiday
Th	12/24	Christmas Eve (1/2 Holiday)
F	12/25	Christmas Day

* Additional holiday

(Clip out and tape to desk calendar)

LIBRARY

May Daw

Come take a world tour in one room — the library. We receive publications from observatories in countries from Algeria to Yugoslavia; you may find articles written in Chinese, Japanese, Armenian, Ukranian, Polish, Russian, as well as all the more common European languages.

Opening the mail used to be a stamp collector's delight, but now many countries have switched to dull postage metering. Still, the Konkoly Observatory in Budapest makes an effort to put a new colorful Hungarian stamp on each shipment of their variable star bulletins. Just last month we added a new country to our list when we the Instituto Geofisico del Peru began sending us solar activity bulletins. That makes 44 countries in all, and we sometimes have to run to the atlas to refresh our memories on their locations.

We try not to wince when Moscow ships us their "Biulleten' stantsii opticheskogo nabliudeniia iskusstvennykh sputnikov zemli". (If you recognize the hidden word "sputnik", you'll soon find out they publish papers concerned with observations of artificial satellites.)

Communist China no longer sends reprints from the Peking Astronomical Observatory, though we did receive some as late as 1965.

Any day now we may get another package from Lembang, Indonesia, or Johannesburg, South Africa. We invite you to come exploring with us.

A very merry Christmas and thanks to whoever returned The Peter Principle!

* * * *

THROUGH THE MILL WITH INFLUENZA

Bunny Vance

Throat sore
Have chill
Head aches
Feel ill.
Medicine cabinet
Fill bill
Search confuses
Choose pill.
Read label
Doubtful still
Shake head
Cure or kill?
Question good
Answer nil.
Back to bed
Write will .....

The Message — Mama Germ to Papa Germ at height of the flu season: "If you can't call, virus."

From Witchita (Kan.) Beacon

Nothing New Under the Sun — Mouth-to-mouth breathing, that modern advance in medical science, is described in the Bible — II Kings, Chapter 4, Verses 32-34.

Am. J. of Nursing (April 1969)

Ode to Bureaucracy — Automation hasn't cut out red tape...It merely perforated it.

Am. J. of Nursing (April 1969)

* * * *

FOR WOMEN ONLY

A most cordial invitation to join the garden club is extended to all women employees and wives of employees of NRAO. We are looking forward to having a very interesting winter program. The first meeting of the New Year is January 13th. Meetings begin at 10:30 a.m., with luncheon at noon in the Residence Hall lobby at Green Bank. Luncheon reservations were to have been made by December 30. Since you will not be receiving this invitation until January 1, please call Joan Hovatter (456-4293), Jean Davis (456-4812), Jane Peery (456-4628) or Kay Williams (456-4764), hostesses. Also, they will be glad to answer any other questions you may have.

Hope to see you there!

BEARDS AT NRAO

This month the Observer staff has assembled a handsome set of photographs of the various bearded ones found scattered about the facilities of NRAO. We thought, however, that you also might like to know how a psychologist views people's reaction to bearded men. The case in point is an article entitled "The Survival Value of the Beard" — subtitled "There's status in it—and sexual magnetism" — by Daniel G. Freedman. This article appeared in the October 1969 issue of Psychology Today.

A group of undergraduates at the University of Chicago were asked how they felt about beards. According to Mr. Freedman, the majority of men and women (56%) used adjectives of youthfulness to describe unbearded men. Of the men, 22% described the personalities of bearded men as independent; 20% described them as extroverted. Fifty-five percent of the women used adjectives such as masculine, sophisticated and mature in describing men.* A detailed survey of several women revealed that a beard makes a man seem more masculine to a woman and she feels more feminine toward him.

Now before all you shaven males are tempted to throw away your razors, please read on.

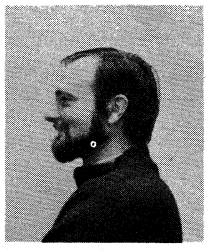
Mr. Freedman also discovered that in social situations most people seemed closer to beardless men. In fact, he found that bearded men themselves often admit that they are less tense with unbearded, shaven strangers than with other bearded men.

It appears, then, that beards make men more appealing to women and perhaps help make love blossom. They also give men more status in the eyes of other men and may increase the social distance between two men.

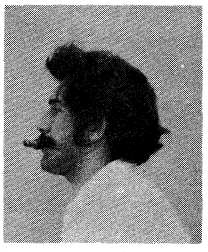
In the terms of Mr. Freedman's survey, we present to you NRAO's very own unyouthful, independent, extroverted, masculine, sophisticated, mature, lonely, bearded men.

(There were several who almost qualified, e.g., David Ehnebuske, but their moustaches were small and trimmed. Sorry about that!)

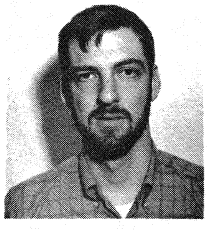
* bearded, of course.



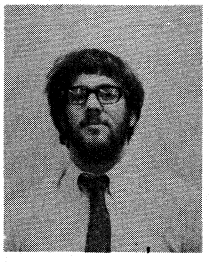
Bill Beyers
CV - Computer



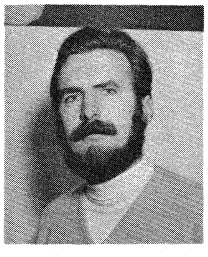
John Broderick
CV - Basic Res.



Bill Brundage
GB - Electronics



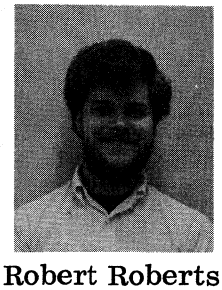
John Copper, Jr.
CV - Computer



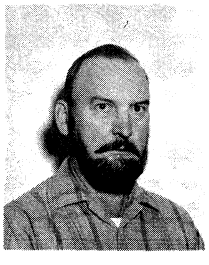
Mike Davis
GB - Basic Res.

John McCormack
GB - Electronics

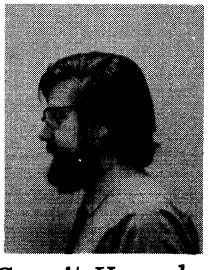
Ivan Pauliny-Toth
GB - Basic Res.



Robert Roberts
CV - Emp. by UVA



"Shep" Sutton
GB - Telescope Op.



Gerrit Verschuur
CV - Basic Res.

APPLE JUICE AND APPLE CIDER

By Bung

This article was originally scheduled for the last Observer but for one reason or another it was not included in the last issue. Therefore, this article is not as timely as it could have been. Still, it may be of interest to those people who in future years find themselves with or have access to a lot of surplus apples. This year, for example, there was an over supply of apples everywhere, and it was a good time to have made apple juice and apple cider. The purpose of this article is to ready you for the next year's big apple crop — by telling you how to turn those extra apples into apple juice and apple cider.

The process of converting apples into juice is rather a simple one if you have access to one piece of equipment, the cider mill. At one time you could find a cider mill on about every farm but now there are only a few left. Yet, without too much difficulty, one can usually get his hands on a mill to use.

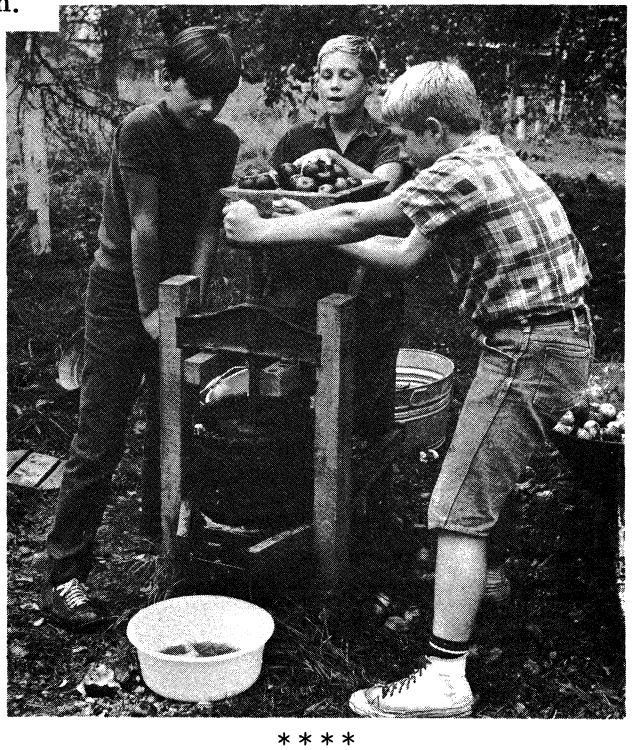
Basically, a cider mill consists of a hopper, apple grinder, one or more hardwood creels, and a screw press. Apples are fed to the grinder from a hopper located above the grinder. The grinder shreds apples into small pieces and drops them into a creel under the grinder. The creel is an open-ended, cylinder shaped container made out of slats of hardwood with spaces between each slat. The creel holds the ground-up apples and permits apple juice to flow between the slats when the apples are pressed. The creel sets on a circular piece of 3/4 inch hardwood. The screw press squeezes out the juice by exerting pressure on another circular piece of hardwood placed on top of the filled creel.

In addition to a cider mill, you will need a supply of jugs, bucket, funnel, straining cloth, juice-catch pan, a variety of apples (for blending) and a couple of stout monks to operate the grinder and press.

Apples should be sweet, juicy, and washed. Old-timers will argue that it is not necessary to sort or wash apples before grinding, that unwashed, slightly over-ripe and wormy apples add body and taste to apple cider.

Once cider mill, apples and equipment are ready, it only takes time and work to make apple juice. In quick order apples are fed to the hopper, ground up until the creel is full and pressed until the apple juice stops flowing. (A bushel of juicy apples makes about a gallon and a half of juice.) The juice is strained and funneled into jugs. Left as is for about a week, the apple juice will ferment into sweet cider. If left longer, it will turn to hard cider and eventually if it sits for a long time will change into cider vinegar.

Some people prefer to keep the juice as apple juice. To keep it this way, it must be processed within a day or two to stop fermentation. This can be done if the juice is heated to a temperature of 160 degrees and held at this heat for 10 minutes. During heating, the top of the juice should be skimmed continuously. After a 10-minute heat, the juice is placed into sterilized Mason jars and sealed. The sealed jars should be laid on their sides for 10 minutes and then cooled in a lukewarm water bath for another 10 minutes. Those who do not want to go to all this trouble will just have to drink fast to get rid of all their cider before it turns hard. Unprocessed apple juice waits for no man.



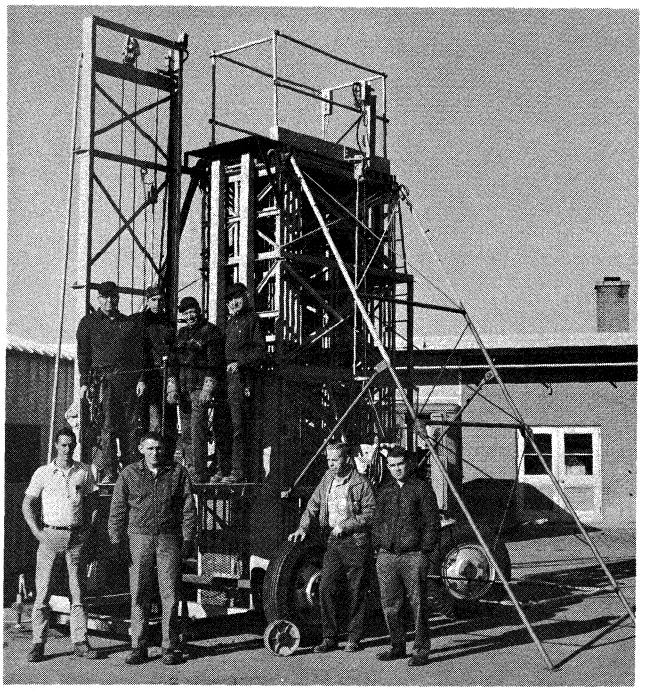
* * * *

CENTRAL MACHINE SHOPS

Sheet Metal Shop

Dorman Williams

Pictured is the elevator from the 85-1 telescope that was brought to the shop for up dating.



This elevator originally was mounted on steel wheels and had smaller out-riggers. The small elevator was separated from the large one. In the past years the telescope mechanics had changed the out-riggers and hooked the small unit to the large one.

At this time the steel wheels were replaced by rubber tires for a complete, new towing arrangement. The small unit is made piggy-back, and the out-riggers are hinged, which makes this elevator usable on the baseline.

For those who don't remember the small, steel wheels, see the center bottom of the picture. Also pictures are the Sheet Metal Shop employees: Basil Gum, Bedford Taylor, Wendell Monk, Boyd Wright and Dorman Williams; also, Everett Arbogast (Central Shops Tool Room Clerk), Bearyl McLaughlin and Troy Moore (Plant Maintenance), who replaced most of the wiring and controls on the elevator.

While John Payne was in Russia, we were building feed horns and mounts for his Distance Measuring Instrument. They are now installed in the back of the lab.

We are presently building two more rotating tables for front-end boxes, speaker mounts for the new tour buses, and hand rails for the 140-foot service tower platforms.

We wish everyone a Happy and Most Prosperous New Year.

* * * *

SAFETY IN THE MACHINE SHOPS

Omar Bowyer

The need for a safety program in our Machine Shops was established, outlined, and put into effect early in 1968. Since then our safety record has been very good. This article is written for you that are new or those who have forgotten.

All employees visiting in the NRAO Machine Shops are asked to wear approved safety glasses. This includes the Sheet Metal Shop, Machine Shop, Do-It-Yourself Shop, CV Machine Shop, and Welding Shop.

The personnel assigned to the shops will wear safety glasses when their work involves hand or machine cutting, shearing, rolling, bending, grinding, sand blasting, chromating, and plating. Those performing, or helping, in any form of welding, soldering, or cutting with a torch must wear approved welding hoods or goggles for that purpose.

We encourage you not to talk with the machinist while he is operating a machine. If it is important enough, ask him to shut the machine off — but don't endanger the operator or yourself.

While safety is the responsibility of each and every employee, others are assigned various safety enforcement tasks. So if you fail to observe our safety rules, someone will remind you.

Read your NRAO Safety Manual. Talk safety, observe safe and unsafe conditions, make suggestions — you may be next year's safety winner.

* * * *

INTERFEROMETER

Duane Sizemore

It seems that in this day and age every record is being broken or threatened. This also includes the marvelous field of radio astronomy. It's not every day, for instance, that you can observe a source with a -05° declination, at +02° declination, and at a latitude of +38° 13', and expect to get meaningful data. Basically there are two ways to accomplish this: 1. Move the source. 2. Play musical telescope. (The definition of musical telescope being: adjusting the polar shaft to fit the occasion.) Since NASA has been unable to move the moon as of yet, we thought it easier to move the polar shaft of the telescope, it being the 42' at Huntersville. In that lonesome place anything can happen!

So, recently during a run of Webster, Wink, Hjellming, Altenhoff, and Mezger, from now on known to us as W²HAM, the fun and games began. W²HAM were primarily interested in four H-II region sources, W3, DR21, W49, and Orion A. They had previously added supplemental data to their regular interferometer data via the long baseline available with the 42' in Huntersville for three of these sources. However, Orion A remained a problem because of its minus declination which was beyond the south limit of the 42'. The Orion data was wanted because it is an especially interesting source due to its complexity, which gave hints of extremely fine structure from the regular interferometer data. For this reason Orion A also turns out to be one of the most intensely studied of all radio sources. Due to the fact that W²HAM wanted to observe Orion A, which is at -05° 25' declination, and the 42' antenna's south limit was +00° 50', our task had just begun. The 42' was built with an adjustment screw on the south end of the polar shaft, and this was adjusted (south end dropped) by 7° in declination. This now gave us a console readout of 45° 13' for the declination shaft at stow. So by going south 43° 25' we still came up with Orion at approximately +02° declination. It's not changing the polar shaft that's hard--it's getting up at 3:00 A. M. and driving to Huntersville that gets you. You can see anything along the road at that time of the morning. Anyway by standing the 42' trailer on end we can now observe the south pole! Anyone interested?

Anyhow, I'm happy to report that our hard work paid off with a successful observation of Orion A for W²HAM.

Before I go I would like to pass on that the hunters among us at the interferometer were mildly successful this year. Leroy Webb bagged a six point buck that, after field dressing, weighed in at 135 lbs. George Liptak, not to be outdone, brought down an eight pointer although it was a little lighter at 115 lbs. field dressed. Nice shooting, guys! Yours truly managed to get an eight lb. hen turkey but drew a blank in the deer department. Oh well, as the saying goes, better luck next year. "MERRY CHRISTMAS EVERYONE!"

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Just as soon as our scientists solve the problems of space exploration, I wish they would try to discover a more inviting way to start the day than getting out of bed in the morning.

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FACTS FROM FISCAL*

"Every Alien Must Report"

John Hawkins

Requirements: Every alien who is within the United States on January 1 shall, within 30 days following such date, report his address to any United States Post Office or Immigration and Naturalization Office. Any alien who is temporarily absent from the United States during the reporting period shall report his address within 10 days after his return to the U. S.

How to Report: Go to any U. S. Post Office or Immigration and Naturalization Office. Ask for the alien address report card. Complete all items on this card. Hand the card to a clerk in the post office or immigration office.

Penalties: Any alien who willfully fails to report as required is liable to be taken into custody and deported. In addition, imprisonment or fines may be levied before deportation.

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36-FOOT TELESCOPE

George Grove

The October-November period at the 36' began with an extended search for the water vapor units sent off to Caltech and Haystack. A full day of phone calls uncovered one unit at Caltech and proved the other one had left Tucson, apparently for a scenic tour of the eastern United States.

Continued--

*Information supplied by the NRAO Fiscal Division.

We hastily packed the third unit and fired it off to the Haystack group, after some modest confusion concerning the address.

Our computer took a couple days vacation, and we had to call Dwayne (Schiebel) again to bring it back to work. If Dwayne ever gets an unlisted telephone number, we'll be in real trouble out here.

The dome provided us with our next exercise when one of the polypropylene lacing cords on the outside, near the top, parted and let the fabric slide down a few inches. We dug out our spangled tights and did our version of a highwire act splicing things back up. From the appearance of the lacing in that area, we can look forward to several encores of this thrill-packed routine.

The next couple weeks were pretty bland, peppered only with a few computer and Servo system lapses. The arrival of the 9 mm multichannel spiced things up. We were pleasantly surprised to find that the extra racks could be wedged into our control room without causing the walls to bulge out, and the additional cables were hardly noticeable. Neil and Dave (Buhl) abstained from the local taco palaces long enough to get the whole pile going before Palmer and Zuckerman blew in. Dave, Pat, Ben, and Lew (Snyder) then spent the next few weeks trying to strain spectral lines out of the received stew. Their ability to take data when the weather conditions were slightly worse than abysmal gave them considerably more time on the air than we had anticipated.

During this period we celebrated another windy day--minimum velocities over 30 miles per hour, average peaks over 60, and a couple of gusts over 70.

The dome seems to be fairly accurate wind gauge. Over 55 miles per hour, the collapsible section of the door starts flopping up and down in the guide channels, and over 70 the windward side of the dome starts lifting off the azimuth track. These breezes always seem to come during cold or wet weather, when the dome fabric is very slack; the lacings and fabric take a pretty severe beating. We haven't had any tears yet, but some of the inside lacing is beginning to show signs of wear.

Ron Weimer came through Tucson just as the line-searchers were preparing to finish, and cured an old problem of ours, that of keeping the dome and telescope pointed in the same direction during daylight hours. His changes to the photocell tracking system cured the problem giving us fewer ruined observations and also cutting the daytime observer's physical exercise in half.

Ned is well settled in by now, and Jerry (Middleton) has become such a native that he decided to take a few days of "valley fever" treatment, just as Jack Gore did some time ago.

The K.P.N.O. Holiday Party was the final event of this period, quite dull when compared with some of the Green Bank shindigs of years gone by. We think the plush surroundings favored by the optical types don't seem to turn a party into a real blast the way the cramped smoke-filled basemen does.

* * * *

Some scientists claim that "intelligent beings" from outer space may be trying to contact the earth by radio. If so, Jim Dolan is inclined to believe they are broadcasting on the rock-and-roll frequency that his daughter listens to much of the time.

* * * *

This hitherto unknown fragment was found buried in an obscure corner of the CV library. The 6 feet of sediment, consisting of unopened, dusty volumes of the Astrophysical Journal, below which it lay, bespeak its great antiquity.

The Assistant Director's Tale

Geoffrey Chaucer (1340?-1400)

In days gone by, when al the warld was greene
Astronomicks poluted not the sceene,
When men wer men and wommen dyd rejoys,
Was herd in alle land the Kynges voys
That a brave man fare in the barren hils
To guyde his garyson with myghtie skils.
John Cantab highte he and great his fame:
From Poad to Antypoad folkes rede [1] his name.
Thus rood he weary up the pilgrym roade
From tropick Virgin toun to froz'n aboad:
Ful three houres journey [2]. Havying rechd the spot
In Dere Creke Vale that Godde and Man forgotte
He dallyd not, but in less than one yere
Bilded the Kyng a myghtie metal Ere
Three hundert paces wyde to serche the skyes
And put him in lyne for a Noble pryse.
Yet not content, with gigant Metalle Horne
At Cassiopeia aym'd for many a morne
He tryed hir strength and found it ebbing fast.
Thus wyslie did he act from fyrst to last.
His starv'd Astronomicks gave he thir fyll
Of fatted Beeves and Buttes of Ale at wyll
Amyd the Splendour of his Reddewode Halle.
Yet tyme passed by: agayn the Kyng dyd calle
Him to new dutis. Subjeckts bad farewel
As he dyd wend his waye to Tropick Hel,
And wish'd him Lucke, in a warld not so greene
Where Astronomicke Horde polutes ye Sceene.

Notes: 1. "Speak" not "read". Uncultured please note.

2. Chaucer's acquaintance American continent is uncanny. Was he aware of Erickson's voyage, or was this a Swiftian vision?

* * * *

ANNUAL SAFETY PRIZE AWARD

The Safety Committee has judged the safety suggestions turned in to the Committee via the suggestion boxes and through the plant mail, over approximately the last year. At about that time an announcement was made that an annual $25 cash prize would be awarded.

Copies of all suggestions received were distributed to all members of the Committee with the name of the contributor deleted in order that an unbiased judgment would be made.

It was decided by the Committee that a suggestion made by STEVE MAYOR was the most meritorious and he has been awarded our 1969 safety prize.

One employee turned in a total of some 17 suggestions, several of which were considered to have considerable merit. It was decided to make a special award of $15 to this employee, BOB VIERS. This is the sort of interest which the Committee is attempting to generate among our employees. "Go thou and do likewise."

Many other suggestions were received, including one anonymous entry which proposed that we "Fire everyone, therefore no personnel to receive accidents." An attempt was made to determine the originator of this contribution, with the idea of obliging at least him.

The Committee again wishes to thank all contributors and to urge all employees to make their safety suggestions to be considered for our second annual prize. All employees except members of the Committee are eligible, including Charlottesville personnel, this year's contributors, and this year's award winners.

CONGRATULATIONS

TO

STEVE MAYOR

AND

BOB VIERS

****

"We are honored to have as our guest speaker, an expert on safety."

ELECTRONICS — CV

Jack Cochran

The design and building of millimeter paramps by the Low Noise Lab has brought about a closer relationship with the Millimeter Lab. In fact, effective November 1 the two labs did merge and are under the direction of Dr. Jochen Edrich.

We wish everyone

A

HAPPY

NEW

YEAR !

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STRANGE HOBBIES OF NRAO EMPLOYEES

"Unorganized Stargazing, in which a Non-Astronomer Fakes It"

Jon Spargo

Why would anyone who works for NRAO take up astronomy for a hobby? This is a question that must be running through your mind. So, I'll give you some answers and let you take your pick. (1) I plead the Fifth Amendment, (2) I'm a nut; (3) it's interesting; (4) it's better than bear hunting; or (5) it gives me something to do while waiting for spring.

Anyway, on a cold evening you are likely to find me and my sub-millimeter wave telescope (see photo 1) out in my back yard cursing street lights, car headlights or any other minor disturbance (clouds) that hinders viewing. Ah, ha! you say, if he puts up with all of that, then there must be something worth looking at. To this I will agree and add also that there are a surprising number of celestial objects that can be seen with relatively inexpensive equipment such as an average pair of binoculars. For instance, the moon, of course, is an excellent subject, as is the planet Jupiter and its many moons. Saturn with its rings is one of the most beautiful objects in the sky. Or, the giant star cluster M13 in the constellation Hercules as well as the large gaseous nebula found in the constellation Orion are beautiful.

Well, if observing isn't your bag, then perhaps I can interest you in working with some very precise machinery in the form of a mount and controls for a telescope. Or perhaps you're a photographer and like to experiment with optics. As with any hobby you can, if you're inclined to, unload a sizeable chunk of cash in pursuing astronomy as a hobby. However, I've found that with moderate expense I've derived many hours of pleasure. My equipment consists of an 8 inch Newtonian reflector with a focal length of F/6, and compliment of lenses that allow magnification up to about 500X. A reflecting telescope makes use of a primary mirror which collects light from the object you are looking at and focuses it with the aid of a secondary mirror to a point where it

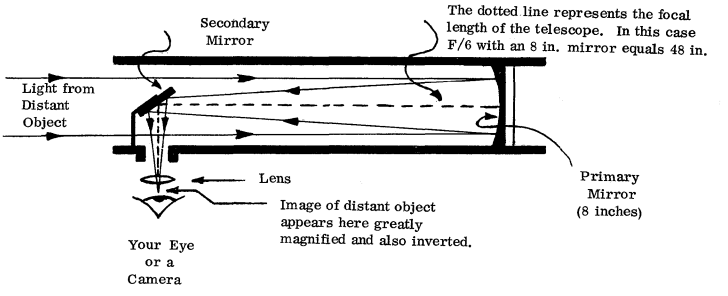


FIGURE 1

can be magnified by a lens. Although there are many variations to this scheme, Figure 1 will give you an idea of how it works.

For a telescope like this to be useful requires a steady mount, a problem which I am currently engaged in solving. At present my mounting system is rather a jury-rigged affair consisting of a concrete pier in the ground with a steel pipe attached as a pedestal. This is a recent addition which is intended to support my future mount. On top of the pipe is an old equatorial mount meant for a 6 inch scope and consequently leaves much to be desired for my 8 inch (see photo 2). The platform around the steel pipe in this picture is for convenience in looking through the telescope.

In addition to direct viewing, photography through the telescope offers much enjoyment. Referring again to Figure 1, if you remove the lens and your eye and replace them with a good, single lens reflex camera, the telescope then becomes in effect a large telephoto lens. On bright objects such as the moon, normal shutter speeds

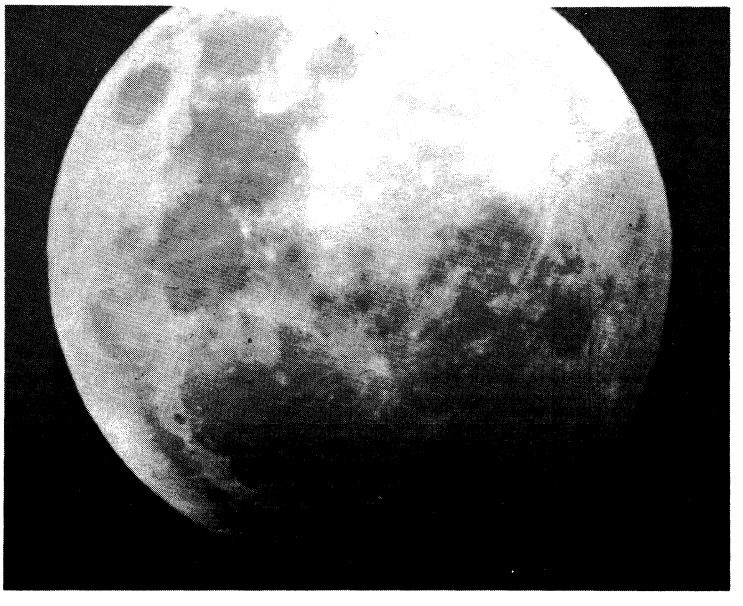
Continued, next page --

can be used, e.g., 1/250 sec. When photographing weak objects such as stars and planets, time exposure is necessary. It is also necessary for the telescope to track the object precisely so that in effect the object doesn't move with relation to the camera. Slight movement would cause a blurred image on the film. Unfortunately, my jury-rigged mount so far has prohibited me from photographing any dim objects. However, photo 3 is an example of photography done when the telescope is not required to track. This is a photo of the lunar eclipse of April 12, 1968.

Another plus for pursuing amateur astronomy is that there is an abundance of literature on hand in the NRAO library to aid in various aspects of the hobby, as well as many members of the staff who, from time to time, have been very helpful.

As with any hobby nut, only the flimsiest of excuses is needed to persuade me to get out my equipment and show it off. So, if you have a flimsy excuse and would like to look through a telescope, please feel free to call. My wife informs me that we have plenty of coffee on hand for warmth after observing on a cold evening.

I would also like to take this opportunity to invite anyone interested in amateur astronomy to make your presence known for the purpose of perhaps starting a small club, or pooling equipment, or having a star party and so on. I will be very happy to assist you in any way possible so that I won't feel alone when asked why would anyone who works at NRAO take up astronomy for a hobby!



* * * *

A bachelor friend reports that when someone starts telling an "adult story" these days, about the only thing you can be certain of is that "it is at least 21 years old."

* * * *

SPORTS SECTION

DEER HUNTING

Sportsmen begin preparing for deer season long before the actual operning day of the season. Often days are spent scouting the countryside to check on "signs". Guns must be sighted-in, oiled, and checked from top to bottom. Next the hunters get together to tell last year's stories and map out the final strategy.

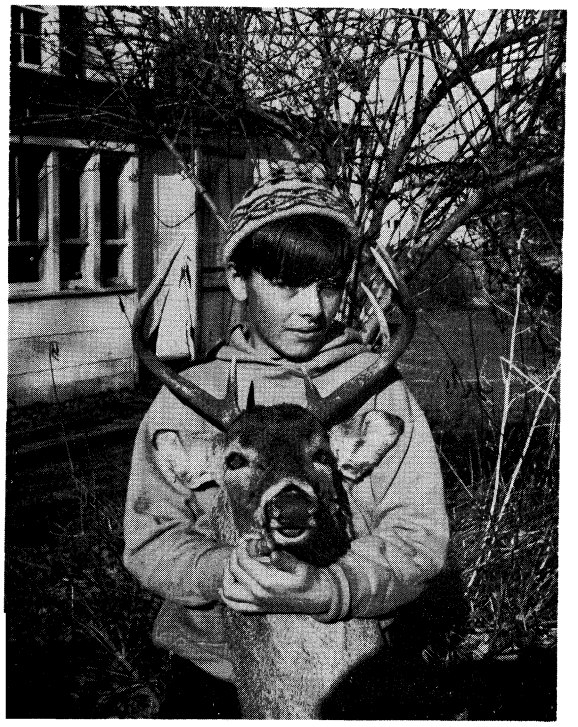
Some hunters go all the way — by this I mean their bodies and clothing must be scrubbed to remove human scent (B.O.) and then they rub on a potent (and stinking) deer scent oil. Others do not see the need for this and go "as is". This advance preparation is called "deer fever" and many a good hunter goofs up because he is too anxious to shoot, while others "freeze" when they come face to face with the deer. But then there are those who do it just right (at least right enough to get the deer).

A survey revealed the following deer kill by NRAO employees:

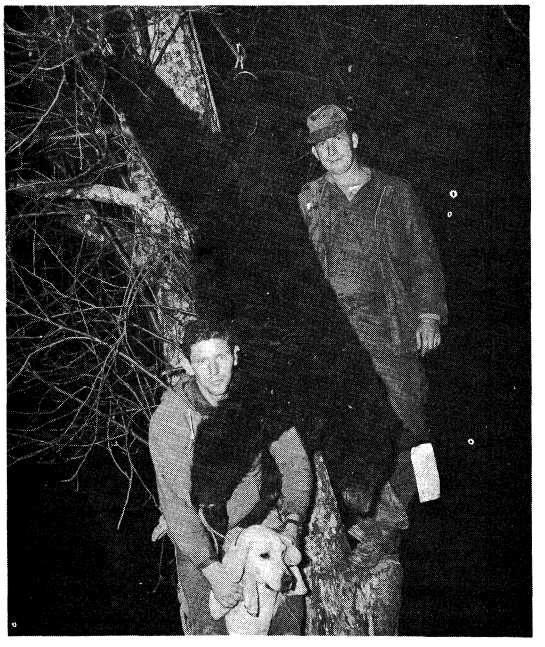
Pts.	Weight	Sportsman
0 1/	140 lb.	Lake Sipe
4	?	Ronald Gordon
4	145	Merle Kerr
5	100	Gene Crist
5	100	Steve Hamed (Tony's son)*
5	150	Pat Hall
6	130	Omar Bowyer
6	130	Herman Coleman
6	135	Leroy Webb
8	?	Bob Vance
8	115	Carl Davis
8	115	George Liptak
8	100	Tom Carpenter
8	170	Coonie Wright
8	125	Allen Crist, 13 (Gene's son)*

* Both fathers admit it was more of a thrill to see their sons get a deer than for themselves.

1/ Doe killed in Virginia.



Allen Crist with Deer



Odell Johnston and Chester Cassell with Bear. Sorry, no story about this thrilling bear chase. Chester says he wrote it but his wife "misplaced" it.

* * * *

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"Bowling" - N.R.A.O. Style!?

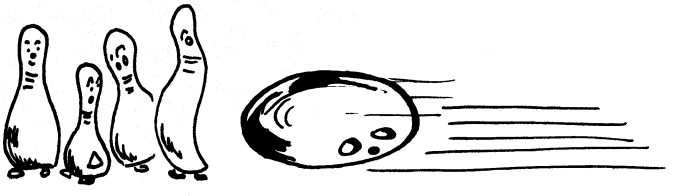
Organized bowling at NRAO Charlottesville first got underway just over a year ago. Much of the credit for getting the ball rolling at first must go to Mary Ann Starr and Peggy Weems (both avid bowlers with previous league experience), who stirred up interest among the rest of us and helped with advice on the intricacies of setting up a league. We started tentatively with only four 3-man teams, but the enthusiasm generated throughout the successive weeks soon led to doubling the size of the league, six 4-man teams.

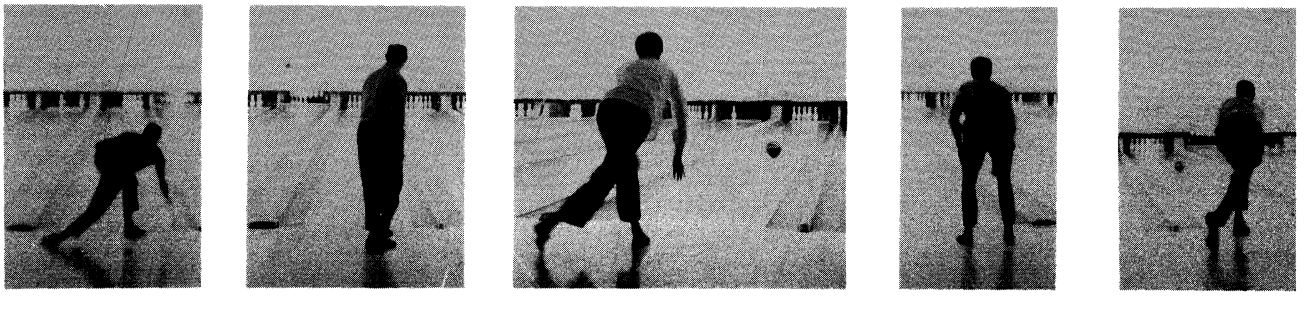
The psychologists would probably say that bowling forms an excellent outlet for expressing our aggressions--clobbering defenseless pieces of wood with a heavy hard-rubber ball. (Even if you aren't allowed to paint a picture of your boss on the head pin.)

At the end of the season, all the bowlers celebrated the completion of a season of fellowship with a delicious dinner at the Angus Barn.

This autumn the league reformed on a basis of six 3-man teams. Dr. Howard was elected president (succeeding Marvin Winer, who did such a good job last year that he was hired away by Green Bank), Phyllis Jackson became vice-president, and Kurt Gordon secretary/treasurer. In a fine display of equal opportunity, the six team captains number three men and three women. The spirit of informality, which is one of the positive features of the league, is demonstrated by the large number of "substitute" bowlers and the almost total lack of distinction between "regulars" and "substitutes".

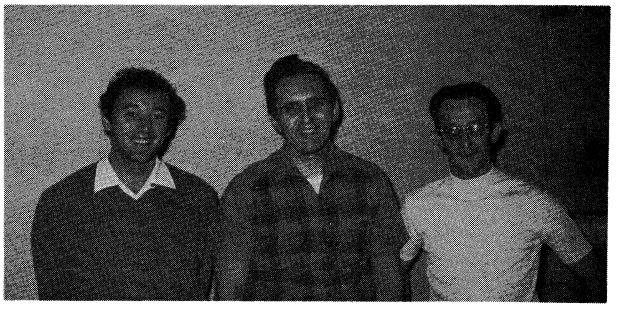
Come, join us!



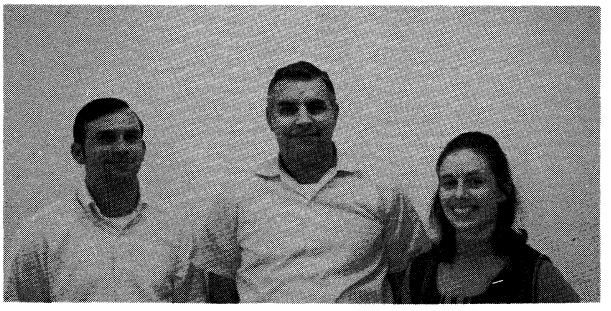


NRAO BOWLING LEAGUE - TEAMS

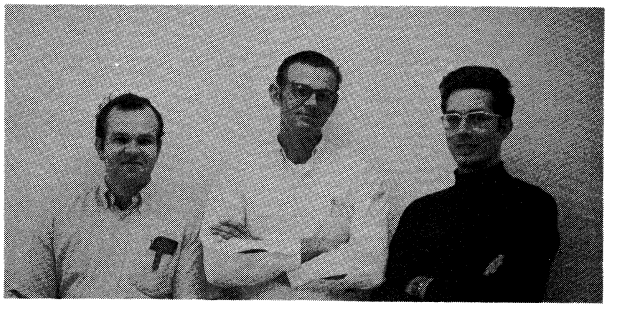
"AQUARIUS, LTD."
KURT GORDON, PHYLLIS JACKSON,*
HEIN HVATUM



"ARGONAUTS"
JOHN SUTTON,* BURTON LITMAN,
CARY YOUNG



"BORN LOSERS"
JACKIE COCHRAN, BERNARD PASTERNAK,
ELAINE LITMAN*



"MESCALEROS"
SHELTON REID, NEIL ALBAUGH,*
JORN WINK

"TID-BITS"
BILL HOWARD, ART SHALLOWAY,*
MARY ANN STARR

"UNKNOWNS"
GLORIA ESKANAZY,* LOUISE ASHWORTH,
MARY JANE YOUNG

* Team Captain

Bowling Scores

THE DAILY PROGRESS, Charlottesville, Virginia

NRAO League — Born Losers (35-9); Unknowns (26½-17½). High Individual Game: Bernard Pasternak, 205; High Team Game: Unknowns, 605; High Individual Series: Louise Ashworth, 540; High Team Series: Unknowns, 1762.

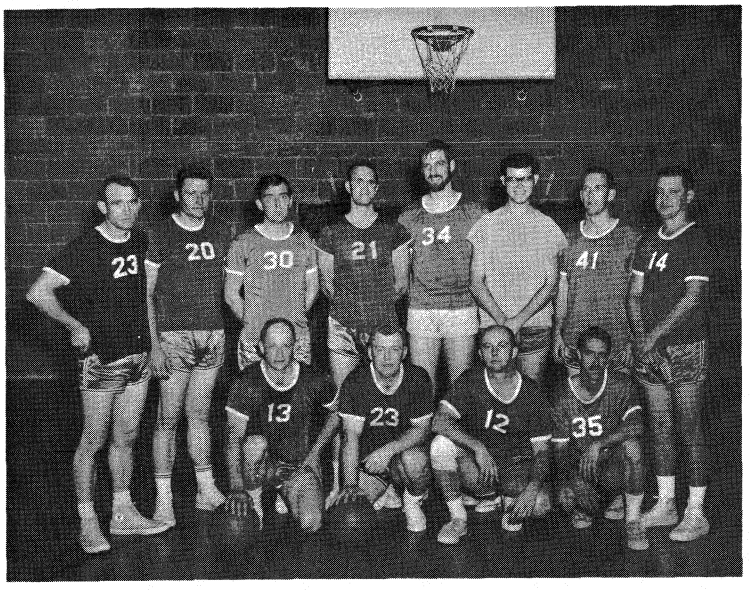
NRAORA BASKETBALL

Dave Williams

Basketball season is underway again with weekly games each Thursday night at the Cass gym. Twenty players have signed up to play this year. This was not considered enough players to pick permanent teams, so teams are chosen each night out of those present. We desperately need more players so teams can be picked for the remainder of the year.

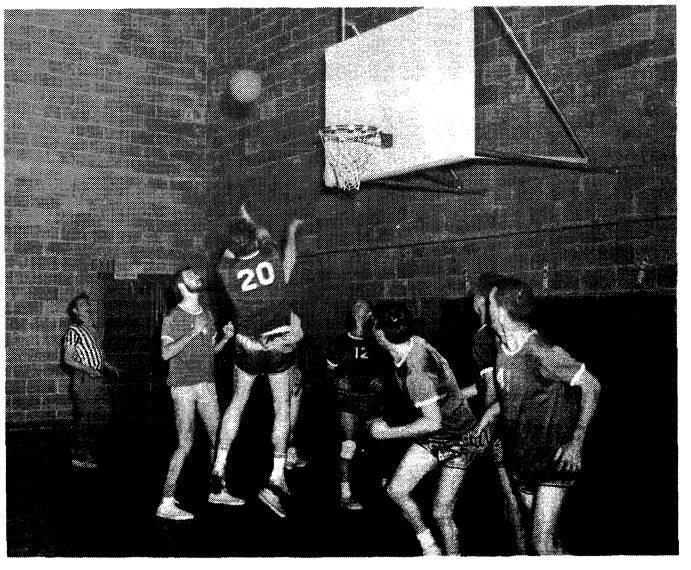
It has been customary in the past to have a party for those who have participated in any way with the basketball program. So if you would like to do a little partying, please contact Dave Williams or Ronnie Monk and sign up to play.

Lonnie (To-Jo) Ratliff is the referee on the floor and Dave Williams is the referee off the floor. We are all looking forward to another good year of round balling on the old Cass hardwood. If you don't care to play, come over and watch — it only costs 10 cents and you will get at least $5.00 worth of enjoyment plus quality basketball.



Standing, l. to r.: Maxie Gum, Ronald Gordon, Benny White, Ron Monk, Bill Brundage, Bob Nichols, Len Howell and Bill Vrable.

Seated, l. to r.: Russell Poling, Tom Carpenter, Jerry Shears, and Wendell Monk.



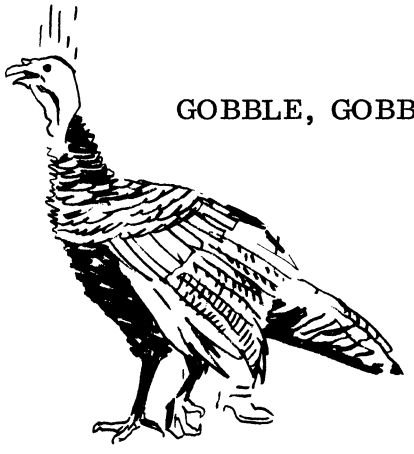
A - C - T - I - O - N

TURKEY KILL

Some sportsman enjoy turkey hunting more than anything else. Turkeys move from place to place in flocks and are hard to find. A flock in flight can "darken" the sky, and it is a sight to behold.

Many of the fellows hunted and hunted but only two reported a kill. (Guess you know what they had for Christmas dinner.)

Jim Dolan and Pat Hall chased a flock of turkeys all day. Some say they fired enough shots to kill all of them — but they came back empty-handed. Oh, well, better luck next year.



GOBBLE, GOBBLE

Bill McLaughlin	Hen	6-7 pounds
Duane Sizemore	Hen	8 pounds

* * * *

A fellow was dragged from his wrecked car and taken to a nearby house.

"I can't help you," said the householder, "I'm not an M.D., but a veterinarian."

"You're just the fellow for me," said the injured man, "because I was a jackass to think I could do 50 with those thin tires."

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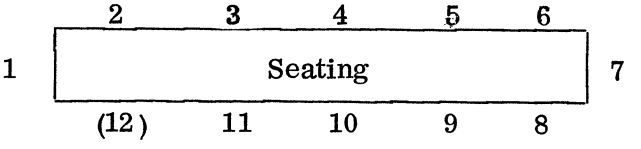
GB GALS' PARTY

Each Christmas the girls get together for a luncheon or dinner and exchange gifts. We thought perhaps the gals in CV would enjoy "seeing" all of us so Gene obliged by taking the following photo. Naomi Daniels was not present because she was on the sick list.



1	Beaty Sheets	7	Harry Wooddell
2	Jane Gordon	8	Pearl Clarkson
3	Sis Michael	9	Carolyn Dunkle
4	Bev Weatherholt	10	Edith McCloud
5	Helen Carpenter	11	Toby Mann
6	Berdeen O'Brien	12	(Sorry, Naomi)

* * * *

Look fellas, I realize that the TV signal from the Rose Bowl Game will deteriorate as we move onto my source, but the Observing Schedule does show that my program starts at 4:00 PM !!!