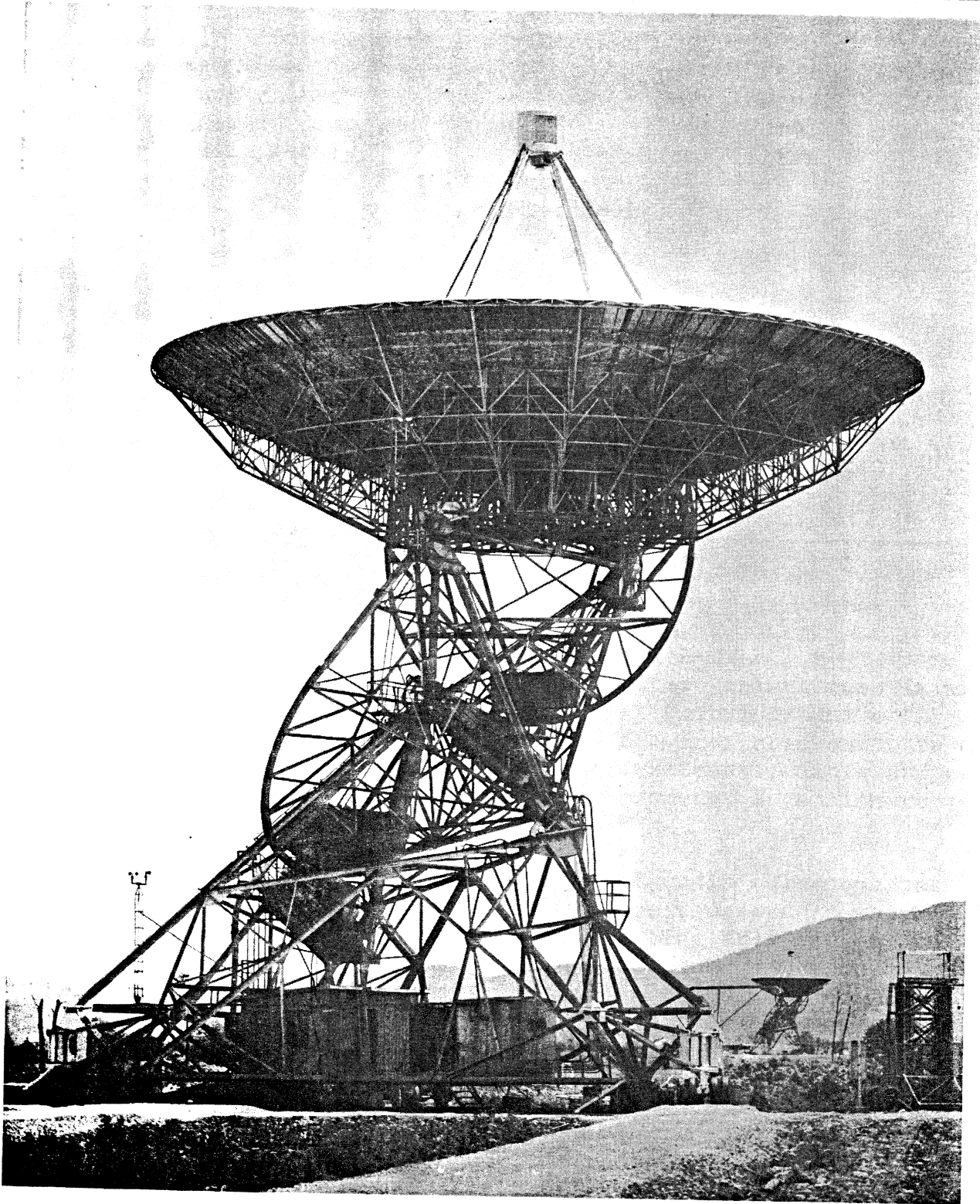


# *The* O B S E R V E R

Vol. 3, No. 9

July 31, 1964



85' INTERFEROMETER

Observer Editor  
Peter B. Good

Cub Reporters for Month of July:

Ray Walker	Harry Wooddell
Howard Lambert	Basil Gumm
Neil Albaugh	Tom Williams

Articles Submitted By:

John Gallagher  
Nigel Keen  
Wally Oref

Typist: J. Galford

Photography and Printing:  
Graphic Arts Dept.

---

THE NRAO INTERFEROMETER  
by  
Niegl J. Keen

In an attempt to overcome the size limitation on antennas in radio astronomy, Professor Ryle and his colleagues at Cambridge University, England, devised a scheme whereby an antenna of very large aperture could be built synthetically, using only a few small antennas: this approach is known as "aperture synthesis". The interferometer is an inherent part of this synthetic antenna.

The two reasons for increasing the size of radio telescopes are (a) to provide more energy from radio sources, since the rate at which energy is collected increases directly with the collecting area and (b) to decrease the diameter of the "beam" within which energy may be collected from a source and so to resolve finer detail in radio sources: the angular width of an antenna "beam" varies inversely with the antenna diameter (for example, the NRAO 300-foot telescope would have twice the beam diameter, and hence half of the resolving power, of a 600-foot telescope operating at the same frequency).

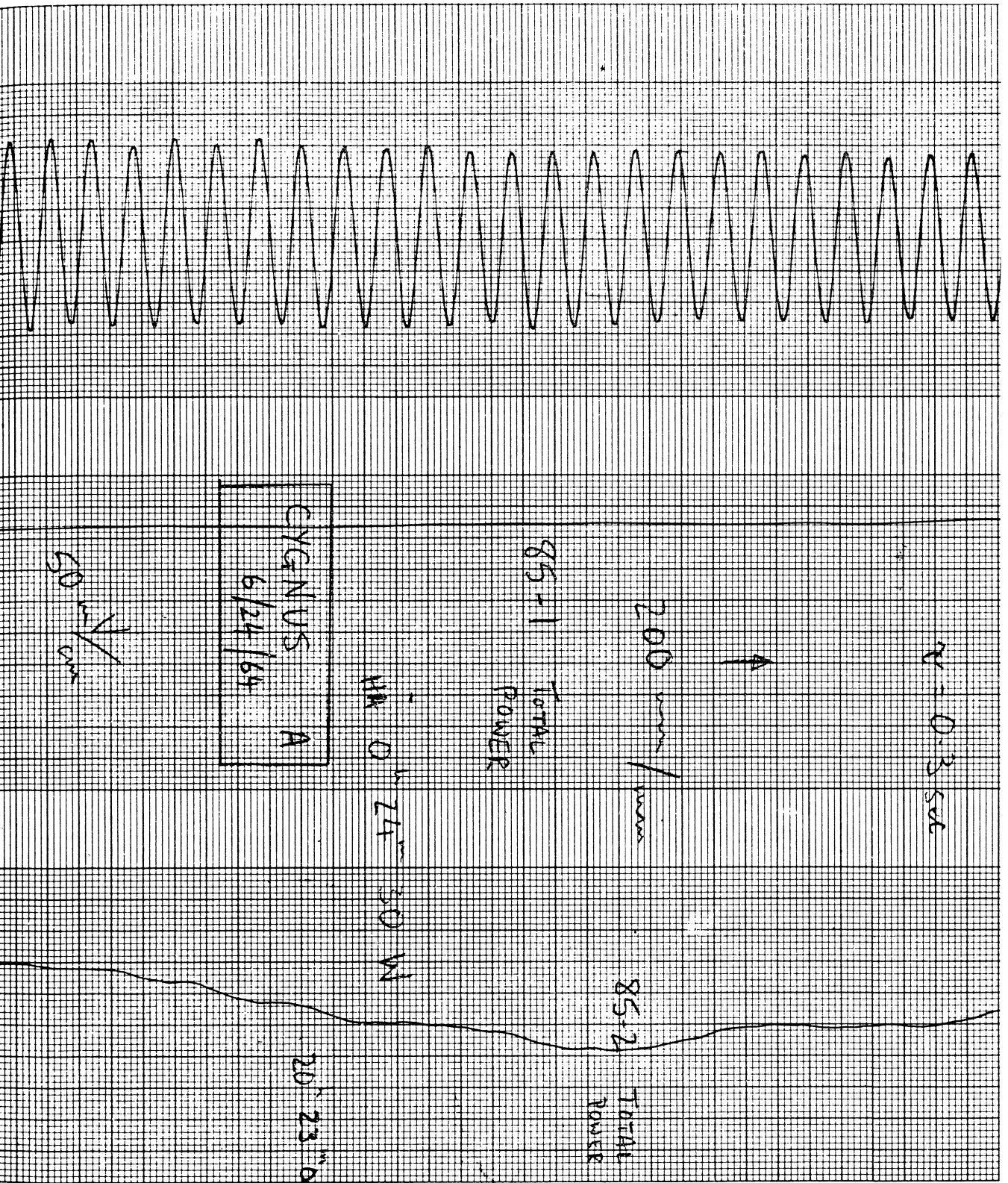
Let us assume that we wish to build a radio telescope of diameter 2700 meters (larger than one and a half miles in diameter!). This is impossible with the surface accuracy required for the high frequencies which we wish to study. The diagram shows a large circular antenna, and an arrangement of smaller antennas which will give an identical "beam" artificially.

.....continued on next page.....

## INTERFEROMETER - cont'd

We sacrifice collecting area in this arrangement, but we will assume that we only require high resolution information on relatively strong sources. Since the small circles represent 85-ft. (26 meter) antennas, and the large circle represents a 2700-meter antenna, we see that we would need more than 300 85-foot antennas if such a system were to operate in real time. Apart from the fantastic capital cost and the necessity for an electronics division of gigantic proportions, such an array of antennas would present a gargantuan problem in system reliability. At NRAO, as at Cambridge, England and California Institute of Technology, the approach is to use two antennas (although more will eventually be used in all three places), and to build up the large array by the method of aperture synthesis: by this we mean that every small antenna shown on the diagram forms a two-antenna interferometer with every other antenna on the diagram, and all the records are added together to produce a final picture of the source as it would be seen by the 300 antennas observing simultaneously. In most cases the number of interferometer pairs may be considerably reduced with a subsequent saving in time, and without excessively impairing the final picture.

A typical two-antenna interferometer record is shown for a strong radio source, Cygnus A. A weaker source, 3C 48, gives a record which varies appreciably from the theoretical sine wave due to system "noise". Apart from the system noise, the outstanding problem of the interferometer is the day-to-day stability of the system. Even frequent calibrations on certain well studied radio sources leave us with uncertainties which can severely blur the final picture. The next few months will decide how good our aperture synthesis picture can be.



$r = 0.35 \mu$

200 v/m / wave

85-1  
TOTAL  
POWER

85-2  
TOTAL  
POWER

20 21 22 23 24 25 26 27 28 29 30 W

CYGNUS A  
6/24/64

50 v/m / wave

20-23-00

3C 118  
6/24/64

$$r = 0.35 \mu$$

85-1  
TOTAL POWER

85-2  
TOTAL POWER

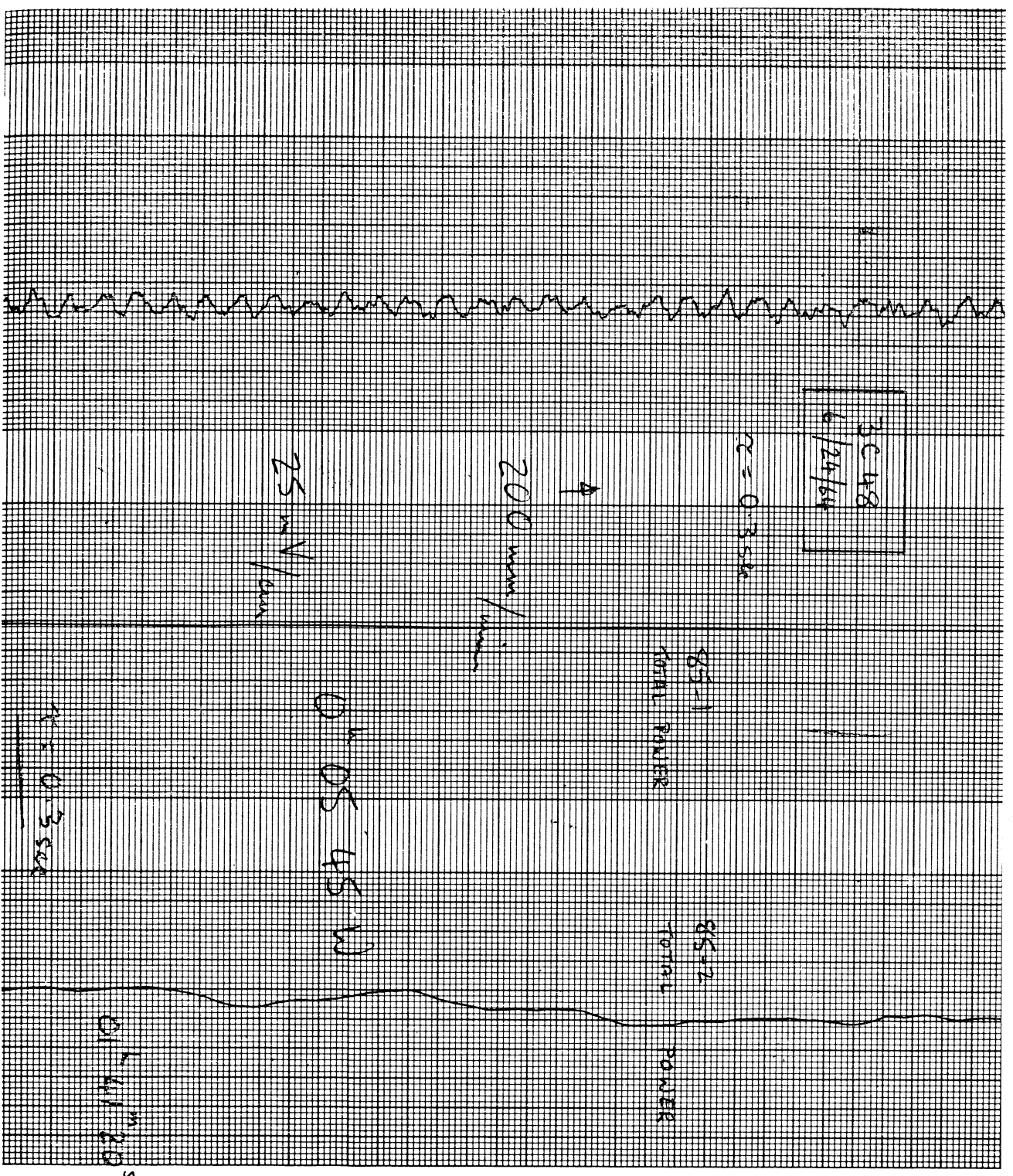
200 mm/mm

25 mV/mm

0.05 cps

$$r = 0.35 \mu$$

01-11-28





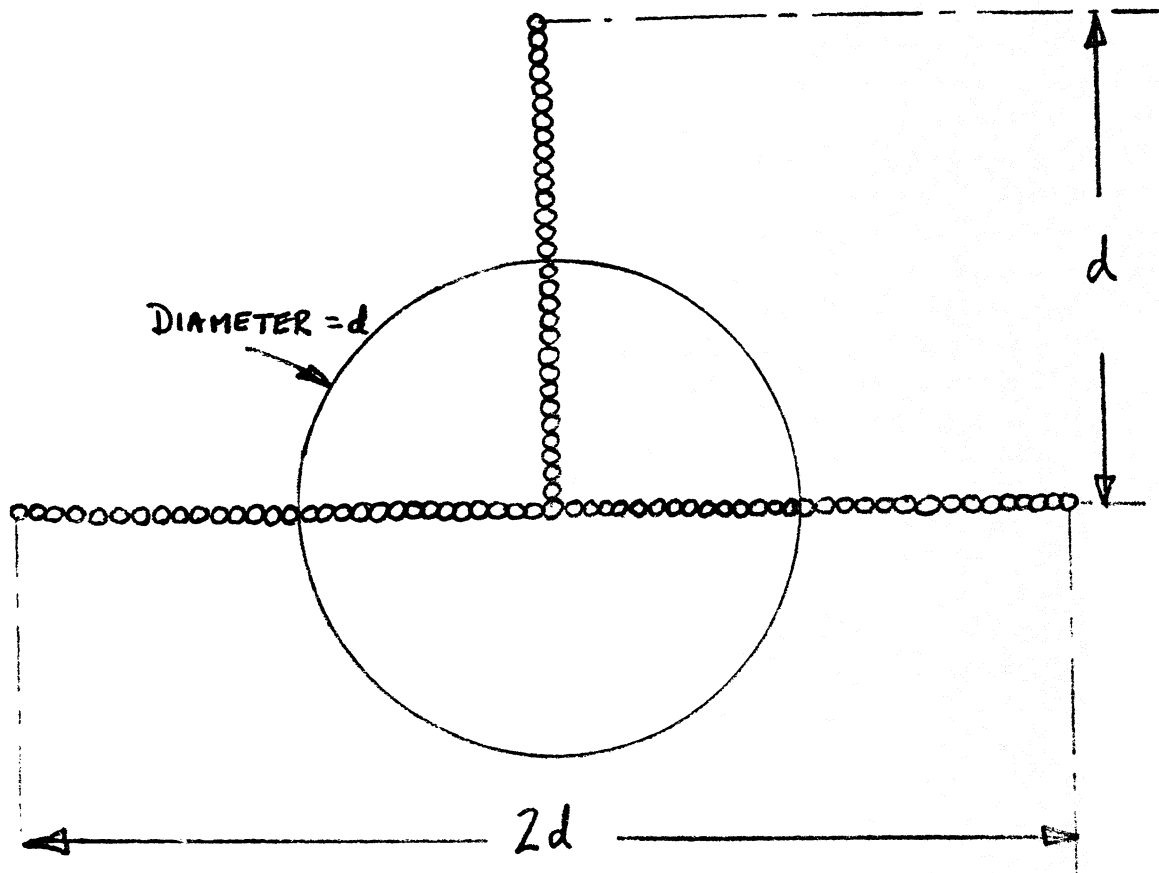


Diagram of a large circular antenna with an array of smaller antennas which gives an equivalent beam

THE SNODGRASS COLUMN

One of the most encouraging developments of the past year has been the success of the interferometer in receiving the local radio stations loud and clear. We are convinced that this is a great step forward in the development of receivers and antennas for the exploration of inner space. It also gives us the cosy feeling that there is something very special about our interferometer records.....

Our society columnist has been pleased to notice an increase (of one!) in the number of people wearing ties. He did want to know, however, why they were holding up such a dirty pair of trousers.

For anyone interested in gastronomic treats, Len Howell has discovered a delicious chicken broth which he will be pleased to supply (at the very reasonable price of 10¢ per serving). He tells me that people who have had his chicken broth pine away and die, rather than eat or drink anything else.

It is reported that one of our Senior Scientists has light-heartedly suggested that children should not attend the Monday night movies, since many of the actors have been consuming alcoholic beverages. We envy the actors their privilege.

IT'S THE WORKS

The new smiling face at the Guard House is that of Neil Horner recently transferred to the Guard Force.

Another of the Guard Force, Jimmy Hevener, had an unfortunate motorcycle accident earlier in the month. We hope to see him back soon.

Henry Taylor and his wife recently celebrated the birth of a baby girl, Tina Marie.

We are glad to see Bob Elliott and Bob Aldridge back at Maintenance after their recent illnesses.

Gail Geiger says that with all the new babies being born and all the weddings going on, he sure is saving a lot on his cigar bill.

Two fine young draftsmen of the Engineering Dept. stood the strain well during the absence of their seniors.

Basil Gum is growing taller. Says that boy is getting louder every day.

140-FOOT TELESCOPE

What's newsworthy at the 140' this month? We feel anything which goes on at this important project is newsworthy. This has been a long hot summer and one week of this summer was climaxed on Saturday July 25th, by a tremendous rain and loud thunder and lightning. Water poured into the basement by way of the area-way entrance and the sump pump worked double time to keep as much of the water out as possible. PC & R laborers helped out by mopping up water and John Ralston and Howard Lambert waded the water and mud outside the pedestal while diverting water from the area-way entrance.

One tremendous blast of lightning appeared to have struck somewhere between the inverted superstructure

.... continued next page

140-FOOT TELESCOPE cont'd

and the pedestal building. John King quickly alighted from the North derrick shed when the blast came. No one actually knows where it struck, but John Echter-nach said that cross hairs were broken on the optical target which he and John Ralston were using on the superstructure.

All of the permanent steel structure of the 140' has been placed on the pedestal and it is expected that work will soon commence on placing of the polar gear sectors.

Cecil B. Good during one of the mammoth steel lifts (on a very hot day) had to have water carried to him during his filming operation although he was at no time more than 75 to 100 yards from it. Do you get the Cecil B. bit? Remember Mr. DeMille?

All 140' project personnel offer their condolences to Mrs. Chuck James and her son. Mr. James, General Superintendent for PC & R at the 140' over the past several months, succumbed to a heart attack on Sunday, July 26, 1964.

300-FOOT NEWS

Dr. Roberts is presently observing at the 300' with the 20-channel hydrogen line receiver. He is studying hydrogen in other galaxies, a project continued from last summer when he was a visitor. The 20-channel receiver has each channel at a different frequency spaced 100 kc between channels for a total bandwidth of 2 Mc. Each frequency corresponds to one velocity. This gives a picture of the motion of hydrogen

in a galaxy. From this motion the total mass of a galaxy can be derived. Measuring the total amount of hydrogen in a galaxy is of special interest, because hydrogen is the most abundant element in the universe and the basic building material for stars.

This research has been carried on for several years by Dr. Roberts. It is described in an article in June 1963 issue of Scientific American.

The carpenter shop has been busy building an oil storage shed. They are now in the process of building an additional roof to provide cooler temperature in the control building.

It seems that the digital lab has had their share of work here lately. First the scanner not scanning ... or recorder not recording ... analog-to-digital not counting ... having a baby ... what?..... by the way, congratulations John.

Bill Terrell says "THANKS" to Len Howell & Bob Vance who didn't forget that the operators must go on, even when everyone was having a jolly good time at the picnic. He says it was a real fight to choose between a butter and jelly sandwich and the chicken dinner you boys brought in.

The painters have gone, the scope looks better, the operators are happy with their cars all nicely waxed. Dick Spurlock says they should have patched up the pit marks in his Chevy while they were removing the paint, and Paul Devlin still doesn't believe there are that many people working at the 300'.



NRAORA PICNIC

The second annual NRAORA picnic for its members and their families was held on Saturday, July 18th, at the recreation area. A count made by Bob Vance indicated approximately 350 persons attended. Plans were for a maximum of 400 people and the food was of sufficient quantity. No one went away hungry, or least they should not have. The food was obtained from Phil's Restaurant in Elkins, and it was most delicious. Comments overheard during the festivities indicate that the gala affair was well received and enjoyed. From the start of the numerous contests held for both the children and adults alike, to the main feature of the day, the chow line, the affair was well planned and conducted. It is indeed proper at this time to offer on behalf of all NRAORA members and their families, their sincere thanks for a most enjoyable day to those persons primarily responsible for the planning and work which went into this project. These include Lenny Howell and Bob Vance who headed up the entire program; Mike Waslo, Omar Bowyer, and Sidney Smith who ably assisted where needed. Our thanks go also to the ladies who devoted their time and energies to serving the food, and to all others who assisted in any capacity to make the picnic a success. The writer restrains from naming these many persons lest he be remiss in overlooking someone.

FISCALLY YOURS

Auditors, auditors, auditors,  
and more auditors!!!!!!!

LAB GAB

The autocorrelation receiver has been returned to the Digital Lab for modification to operate with magnetic tape scanners.

Claude Bare has donated a ground-plane antenna to the Forest Service people on Bald Knob for radio communications between fire towers. Their budget will not cover the expense of a new antenna. Smokey the Bear says, "Remember, only Bare can prevent forest fires!"

Millimeter Lab has prepared two back ends for the 11 and 21 cm receivers. A 6 cm switched line receiver is also being prepared.

Jim Ware has recently starred in the feature film saga of the NRAO. Roland von Hoerner and Andy Rogers also appeared in a supporting role. Plans for attending the Cannes Film Festival are not definite. Autographs will be signed from 4:00 to 4:30 daily.

The multi-filter has been on the 300-foot telescope and has reportedly been satisfactory. It will be taken off on July 27th when it will be replaced by the 11 and 21 cm receiver.

The Green Bank Rifle and Pistol Club held a rifle shooting match on the July 22nd. The new M1's were tried out by the club members. The highest score was 203 out of 210 shot by Neil Albaugh: Jim Dolan scoring second with a score of 200.

The new audio system from the receiver section has some bugs in it. With a voltage gain of 180,000 and high input impedance, it triggers  
.... continued next page

LAB GAB cont'd

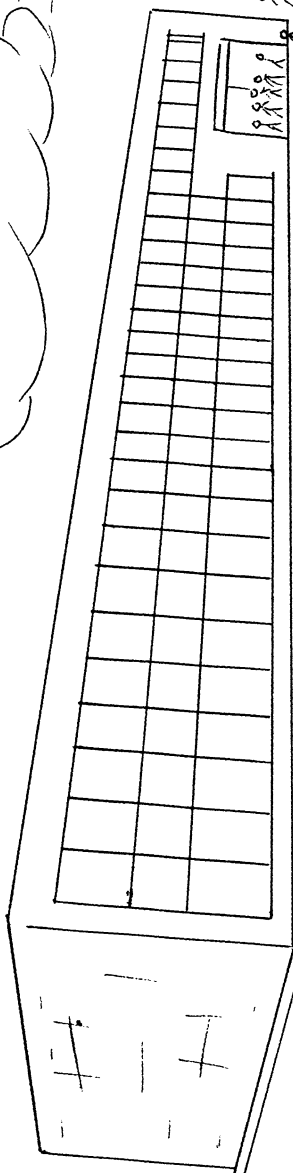
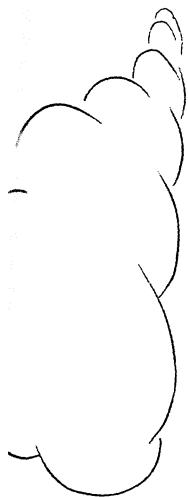
on unwanted noise.

Flash: Dewey Ross joins the Astrology staff. On July 23rd, a demonstration of water witching with coat hangers was given by Dewey. He "found" a water pipe which some people claimed wasn't a water pipe at all, but an electrical conduit. The controversy rages between the occultists and the "I gotta see it before I'll believe" people.

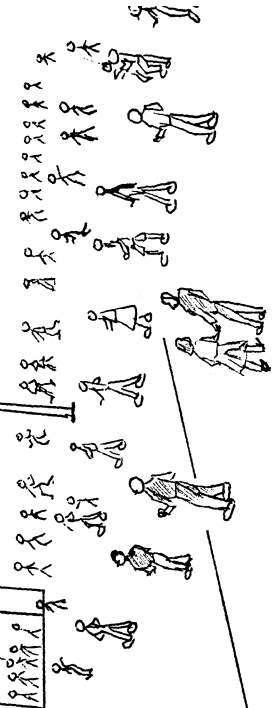
Well, on the "Outer Limits" last week .....

Attention Photographers:

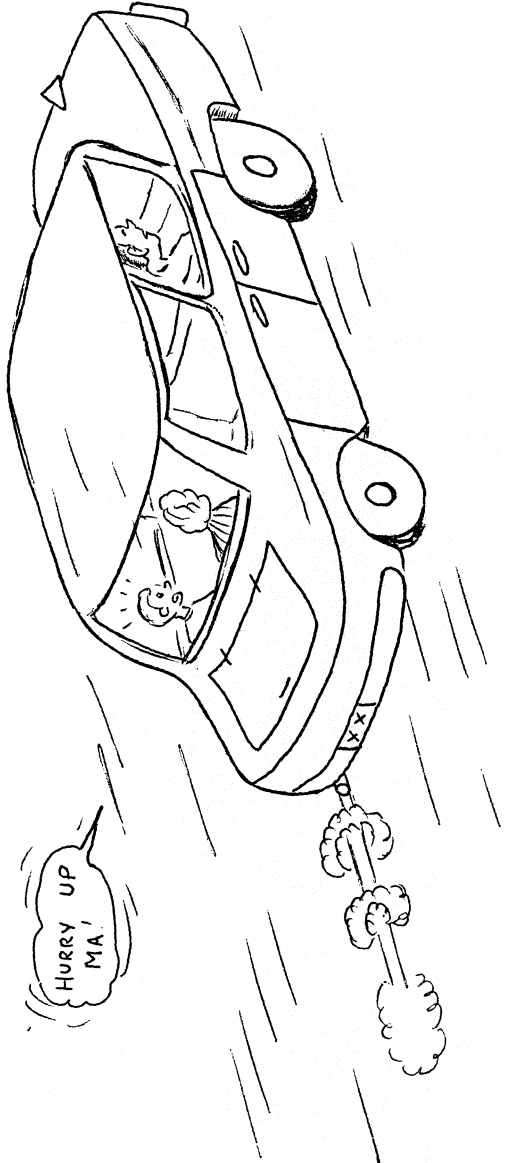
Do you have any exceptional 35 mm color slides of NRAO telescopes, buildings, construction, electronic equipment, etc., that you are justly proud of? If you do, the Public Education Office is interested in making duplicates of your best for a master set of Observatory color slides. Unfortunately, the P.E.O. is so very poor that it can't offer a super duper prize, but we can offer our sincerest thanks and appreciation. How about looking through your slide collection and picking out a few top notch shots and showing them to ole color-blind Wally.



GOOD GRIEF



FRANKLY, I DON'T CARE IF "SHANE" IS BEING SHOWN TONIGHT.



HURRY UP MA

Peter B Good