US/QR BK

NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

Quarterly Report

October 1 - December 31, 1967

RESEARCH PROGRAMS

Interferometer (three 85-foot telescopes)

		Hours
Scheduled observing		1983.25
Scheduled maintenance and equipment changes		145.25
Time lost due to:	equipment failure	96.75
	power	0.00
	weather	62.00
	interference	1.75

The synthesis program which was begun in the preceding quarter has been completed. Observations were made at all of the nine possible antenna configurations. The three-element interferometer is now being used by R. Colomb (Argentine Institute of Radio Astronomy) to measure the positions of about 50 sources below the celestial equator. It is expected that the positional accuracy achieved will be about 1" arc. In addition, observations of HII regions are being made by C. Heiles (University of California, Berkeley), D. Cudaback (University of California, Berkeley), and B. Turner in order to estimate the extent of fine structure in ionized hydrogen regions.

Preliminary tests of the 42-foot telescope system used as an interferometer with one of the 85-foot telescopes were made at Green Bank in October. In November the 42-foot telescope was moved to a site seven miles northeast of Green Bank. Observations have begun for testing the stability of the fringe phase over this long baseline.

Several experiments have been conducted with the infrared hygrometers to determine to what degree the atmospheric water vapor disturbs the phase of the interferometer fringes. Six hygrometers, which will be used to compare the atmospheric water vapor content at Green Bank with that of the prospective VLA sites, have been completed and tested.

300-foot Telescope

		Hours
Scheduled observing		1856.25
Scheduled maintenance and equipment changes		171.75
Time lost due to:	equipment failure	31.50
	power	5.25
	weather	4.75
	interference	0.00

Flux densities of 3C sources were measured by K. Kellermann and I. Pauliny-Toth at 405 MHz.

M. Davis conducted a four feed survey at 1414 MHz.

The remaining observations were 1420 MHz hydrogen line, using the auto-correlation receiver, and are as follows:

Observers	Observations
G. Verschuur	Observations of region near ring of low radio continuum polarization at R.A. $03^h\ 15^m$. (750 MHz continuum data also collected.)
G. Verschuur	Mapping of a small cloud of neutral hydrogen to determine its extent and structure, and observed structure within a standard HI emission region.
G. Westerhout (University of Maryland)	Mapping of galactic plane
C. Sturch (University of Rochester)	Observations of neutral hydrogen in the direction of RR Lyrae stars and globular clusters in order to correlate interstellar reddening with hydrogen density in those directions.
C. Heiles (University of California, Berkeley)	Study of small scale structure of neutral hydrogen in many places throughout the Milky Way, of motion of hydrogen within two or three interstellar gas clouds, of association of hydrogen with reflection nebulae, dust clouds and associations, and of motions within a few high velocity hydrogen clouds.
J. Mast (University of Virginia)	Observations of interstellar hydrogen in the direction of stars of intermediate latitudes that have measured optical interstellar line velocities.

140-foot Telescope

		Hours
Scheduled observing		1702.50
Scheduled maintenance and equipment changes		422.25
Time lost due to:	equipment failure	132.75
	power	6.25
	weather	17.25
	interference	6.25

One VLB (Very Long Baseline) observation at 610 MHz was conducted by D. Jauncey (Cornell), B. Clark, and K. Kellermann, using the 140-foot telescope in conjunction with the 1000-foot Arecibo telescope.

Lunar occultations of radio sources were conducted in separate observations by J. Taylor (Harvard) and D. Gulkis (Cornell) at 234, 256, and 405 MHz.

The following continuum observations were conducted at 15.375 GHz:

Observers	Observations
K. Kellermann, I. Pauliny-Toth	Flux density of variable sources
M. Cohen, W. Coles (University of California, San Diego)	Scintillation measurements of the occultation of 3C 279 and 3C 273 by the sun's corona.
J. Schraml	Mapped and measured precise positions of 13 radio sources
C. Sagan, D. Morrison (Harvard)	Observations of Venus and Mercury

The following continuum observations were conducted at 4995 MHz:

B. Burke, T. Wilson, T. Reifenstein (all M.I.T.), P. Mezger	Measurement of positions and mapping of sources for hydrogen recombination line measurement program.
K. Kellermann, I. Pauliny-Toth	Flux densities of sources

The following line observations were conducted using the newly built NRAO 50-channel filter receiver and the autocorrelation receiver:

Observers	Observations
M. Roberts	Search for line from H_2^+ at 1399 MHz
B. Burke, T. Wilson, T. Reifenstein (all M.I.T.), P. Mezger	H109α and H137β observations
C. Heiles (University of California, Berkeley)	Observations of OH emitting dust clouds to determine spatial extent and kinematics of the OH molecules in these objects.
A. Cunningham	OH absorption observations at 1665 MHz and 1667 MHz to obtain values of kinetic temperature and the RMS

Observer	Observations
A. Cunningham, cont.	turbulent velocity in the interstellar medium.
T. Menon	Time variations of OH emission from the radio source W3.
T. Menon	Line search from 1-2 GHz for a few selected sources.

A small amount of observing time was assigned to the NRAO Computer Division to test data acquisition and recording programs on the Honeywell DDP-116 computer.

ELECTRONICS DIVISION -- EQUIPMENT DEVELOPMENT

During the past quarter the manpower assignments within the Electronics Division have been divided among the following programs:

New 416-channel Autocorrelation Receiver	12%
Interference Protection	4%
New Standard Receivers	8%
Millimeter Receiver Development	7%
Very Long Baseline Interferometer	10%
Construction of 50-channel Radiometer	6%
On-Line Computer Installation	3%
3-Element Interferometer Completion	3%
42-foot Antenna Electronics	6%
VLA Electronics Development	6%
4-Feed 21-cm Radiometer	8%
1-4 GHz Front End	6%
Visitor Support and Routine Maintenance	21%

The 416-channel receiver has been completed and is now in a debugging stage. The analog portion of the receiver and high-speed digital sections are operating properly; the low-speed digital portions have not yet been checked.

The third terminal of the very-long baseline interferometer has been completed. One terminal has been shipped to Sweden for observations in January.

The four-feed 21-cm receiver has been completed and has been used on the 300-foot telescope. This system provides four simultaneous antenna beams with low-noise parametric amplifiers on each beam.

A 1-4 GHz front-end has been completed. This unit is now being used for line searches on the 140-foot telescope.

Forty channel receivers with 1 MHz and 5 MHz bandwidth channels are now in construction. These receivers will use computer synchronous detection as on the 50-channel, 100 kc bandwidth receiver.

A low-noise devices group has been started and work has begun on a cooled paramp for the OH line frequencies.

A degenerate parametric amplifier operating at a frequency of 31.4 GHz has been delivered by Advanced Technology, Inc. This unit has 3 dB noise figure, 15 dB gain, and 500 MHz bandwidth, and is one of the most sensitive (if not the most sensitive) front-ends ever developed at this frequency.

THE NRAO 36-FOOT MILLIMETER WAVE ANTENNA, KITT PEAK, ARIZONA

Final acceptance tests were made during the report period, and the installation was accepted. A 3.5 mm receiver was installed and used for calibration measurements. The aperture efficiency is approximately 40% at this wavelength. An attempt to observe at 1.2 mm wavelength in the middle of December was interrupted by a severe snowstorm that caused a major power failure in the area. At the end of the reporting period, power was still not restored.

ANTENNA DESIGN STUDIES

The Very Large Array (VLA) Project

The array configuration studies are continuing. A computer program designed to optimize the distribution of a given number of antenna elements along the arms of the wye is being used. The deterioration of the array performance for a total number of antenna elements lower than 36 is being studied.

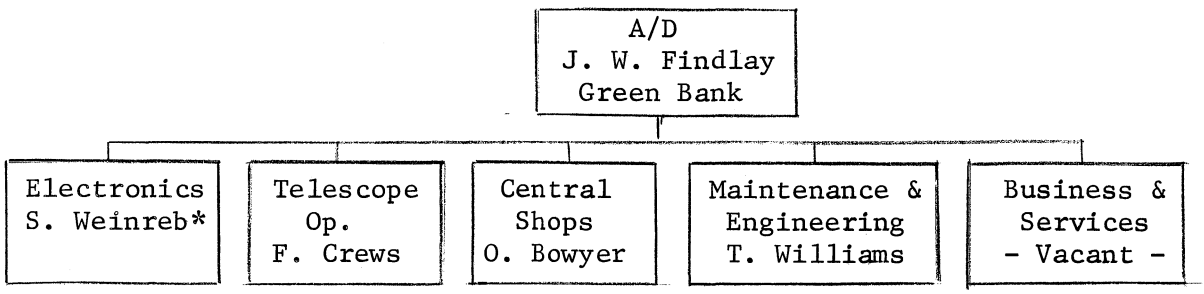
Water vapor observations using two infrared spectral hygrometers spaced 1.8 km apart at Green Bank have been made. The correlation between the two hygrometers is high.

The 42-foot telescope has been used with the Green Bank three-element interferometer. Successful observations have been made at 11.4 km spacings.

THE ORGANIZATION OF GREEN BANK

Changes have been made in the way Green Bank is being run, and the present status of these is described in what follows.

1. Organization Chart



* see notes below

2. Definition of Responsibilities

(a) Assistant Director - (Green Bank)

Responsible to the Director for staffing, planning, and general management of the Green Bank facility. Coordinates and supervises the work of the electronics division, telescope operations, shops, maintenance, and general business and supporting activities at Green Bank. Provides space, housekeeping services, and transportation for other NRAO staff and visitors not under his specific direction. Responsible for the public education program, public and community relations, employee programs, site development and site protection at Green Bank. In consultation with the Director may initiate, alter or modify observing programs as the situation indicates. Works closely with the Assistant Director - Technical Services and the Assistant Director-Administration in the overall development and management affairs of the NRAO. Responsible for the creation and execution of the budget for the Green Bank operation. Is assisted by an electronic lab manager, head of telescope operations, head of central shops, head of maintenance, and head of business and services.

(b) Electronics

The electronics division, under Dr. S. Weinreb, is at present physically divided between Green Bank and Charlottesville. It functions for the whole of NRAO as the group doing research, development, procurement, installation and maintenance of electronics equipment. The group has the specific task of providing at Green Bank all the electronics needs to carry out the observing programs, and also the installation, maintenance, test and report of this electronics.

It is intended that a separation should grow within electronics so that a group can be identified which is primarily devoted to these latter tasks at Green Bank. Such a group will remain at Green Bank.

Until this state is reached, Dr. Weinreb accepts a dual responsibility. He is responsible to Assistant Director - Technical Services for providing electronics equipment and services to NRAO. He is responsible to the Assistant Director - Green Bank for providing, installing, maintaining, and testing all electronics at Green Bank.

Eventually the electronics division head can be expected to move to Charlottesville and to leave at Green Bank an adequate electronics group with a chief engineer, who in turn is responsible to Assistant Director - Green Bank.

(c) Telescope Operations

The head of telescope operations is responsible to Assistant Director - Green Bank for the operation and maintenance of all telescopes at Green Bank.

(d) Central Shops

The head of central shops is responsible to Assistant Director - Green Bank for providing services to the Green Bank site.

(e) Engineering and Maintenance

The head of engineering and maintenance is responsible to Assistant Director - Green Bank for providing engineering services needed on the Green Bank site and for overall site, vehicle and building maintenance.

(f) Business and Services

The head of business and services is responsible to Assistant Director - Green Bank for personnel services, food and housing, site security and public education. He will also do budget and financial plans needed for Green Bank operations. Within business and services is the group under W. Powell responsible for purchasing, property control, and warehousing.

The purchasing and property control functions in the NRAO as a whole are the responsibility of Assistant Director - Administration. Mr. Powell is therefore responsible to Assistant Director - Administration for these functions. He has responsibilities to Assistant Director - Green Bank for providing the purchasing, property, and warehouse services necessary for the satisfactory operation of the Green Bank site.

3. Green Bank Services to NRAO

Some Green Bank personnel will continue to serve the Observatory as a whole; for example, central shops, engineering and maintenance, and business will all work from time to time on tasks for the rest of NRAO.

HII REGION SYMPOSIUM

On December 8-11, 1967 the National Radio Astronomy Observatory, jointly with the Arecibo Ionospheric Observatory, sponsored a Symposium on HII Regions in Charlottesville, Virginia. The symposium consisted of three, full day sessions during which 28 invited papers were read, together with approximately an equal number of shorter contributions. Over 130 participants attended the seven sessions that were concerned with 1) Observations Related to Regions of Star Formation, 2) Evolution of Stars and HII Regions, 3) Optical and Radio Observations of HII Regions, 4) Radio Recombination Lines, 5) Electron Temperatures in HII Regions, 6) Large Scale Distribution of HII Regions, and 7) OH Emission. On Sunday, December 10 about 60 of the participants visited Green Bank, where they listened to informal presentations of some of the NRAO research programs and toured the facilities. The symposium appeared to stimulate the efforts of the theoreticians and the radio and optical observers and served to present for general discussion current problems in many different areas of HII region research.

JANSKY LECTURE

The second annual Karl G. Jansky Lecture was delivered on November 29, 1967, during a one week visit to the NRAO by Professor Jan H. Oort, Director of the Leiden Observatory in The Netherlands, on the topic "Large-scale Distribution and Motion of Hydrogen in the Galaxy." Professor Oort summarized

the current problems in 21-cm radio astronomy research, paying particular attention to recent observations of high velocity clouds observed at high latitudes and new unpublished data concerning the galactic center.

PERSONNEL

Appointments

Jochen Edrich	Electronics Engineer I	October 9, 1967
Francis F. Gardner	Visiting Scientist	October 11, 1967

Terminations

Francis F. Gardner	Visiting Scientist	December 15, 1967