NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

Quarterly Report

October 1 - December 31, 1968

RESEARCH PROGRAMS

Interferometer (three 85-foot telescopes)

		Hours
Scheduled observing		2034.25
Scheduled maintenance and equipment changes		125.75
Time lost due to:	equipment failure	45.50
	power	0
	weather	60.26
	interference	1.50

During this quarter a number of new programs at 11 cm were begun.

Observer	Program
J. Basart, D. Buhl, and A. Sinclair (Bellcomm Inc.)	The lunar occultation of Jupiter.
K. Kellermann and I. Pauliny-Toth	Measurement of positions of sources found in high-frequency surveys.
S. Weinreb	An instrumental test program in which an attempt was made to observe the H134α hydrogen recombination line.
G. Miley	Measurement of structure of quasi-stellar sources.
E. Fomalont (Calif. Inst. Tech.)	Synthesis of the polarization brightness distribution of about 50 sources from the 3C catalogue.

The following programs were continued:

D. Cudaback (Berkeley), C. Heiles (Berkeley) and B. Turner	Observations of H II regions.
C. Wade	Measurement of source positions.
J. Basart, B. Clark, and G. Miley	Observations with a phase-stable interferometer of 200,000 wavelengths baseline, using the 42-foot portable telescope.

Observer	Program
H. C. Ko (Ohio State)	Polarization synthesis.
B. Clark and D. Hogg	Fan-beam synthesis.

300-foot Telescope

		Hours
Scheduled observing		2013.00
Scheduled maintenance and equipment changes		171.00
Time lost due to:	equipment failure	8.50
	power	4.00
	weather	18.75
	interference	34.00

During this quarter, M. Davis continued 4 feed survey observations, and M. Felli (Arcetri, Italy) and E. Churchwell (Indiana) mapped Sharpless H II regions at 1400 MHz.

The following pulsar observations were conducted in the frequency range 100-120 MHz.

Observer	Program
G. R. Huguenin (Massachusetts) and J. Taylor (Harvard)	Measurements of known pulsars and search for new ones.
D. Staelin (M.I.T.) and E. Reifenstein	Pulsar search with emphasis on the galactic plane and a detailed study of time, frequency and polarization structure of known pulsars, particularly NP0532 and NP0527.
S. Goldstein (Virginia)	Measurement of the frequency dependence of polarization of pulsar CP0328.
D. Downes (Harvard)	Search for pulsar-like radiation from supernova remnants.

140-foot Telescope

		Hours
Scheduled observing		1935.25
Scheduled maintenance and equipment changes		221.00
Time lost due to:	equipment failure	112.50
	power	0
	weather	53.75
	interference	1.25

During this quarter there were two very long baseline (VLB) programs involving the use of the 140-foot telescope and the M.I.T. 120-foot telescope. The first investigation was done by B. Burke (M.I.T.), I. Shapiro (M.I.T.), H. Hinteregger (M.I.T.), and A. Whitney (M.I.T.) and involved accurate position measurements of two radio sources 3C 273 and 3C 279 near the sun, looking for the combined effect of the relativistic bending of radio waves by the gravitational field of the sun and of refraction effects in the sun's corona. The second VLB program was conducted by A. Barrett (M.I.T.) and W. Wilson (M.I.T.) and consisted of a measurement of one infrared star in order to determine its angular size.

G. R. Huguenin (Harvard) and J. Taylor (Harvard) observed pulsars at 234, 256, and 405 MHz to support and extend data collected at the 300-foot telescope.

The lunar occultation of Jupiter was observed by S. Gulkis (Cornell), J. Sutton (Cornell), T. Carr (Florida), D. Buhl, and J. Basart at 234, 256, 405, 1420, and 1720 MHz simultaneously.

The following line programs and searches were undertaken:

Observer	Program
A. Barrett (M.I.T.) and W. Wilson (M.I.T.)	OH line survey of infrared stars.
A. Barrett (M.I.T.) and B. Turner	Search for 3.8 cm excited OH lines.
B. Turner	Differential polarization measurements in two sources that show variation in circular polarization across the emission lines at 1720 MHz. A search for OH at all ground-state frequencies in a previously unobserved sample of galactic sources (H II regions, non-thermal continuum sources and stellar clusters and associations with large reddening or obscuration).
M. Roberts	Search for H I emission from a number of dwarf galaxies and a study of recombination lines in Sag A.
J. Simpson (Berkeley)	Observations of hydrogen and helium recombination lines at near H and OH frequencies.
F. Kerr (Maryland) and W. Sullivan (Maryland)	Search for neutral hydrogen correlation with the rings of stars found by Schmidt-Kaler and Isserstedt.

Observer	Program
F. Kerr (Maryland) and A. Sandqvist (Maryland)	H and OH line lunar occultation of galactic center.
G. Walters (Rice), H. Goldwire (Rice), L. Blackwell (Rice), C. Predmore (Rice), and J. Halpain (Rice)	Search for 3.46 cm hyperfine emission from singly charged He^3 in H II regions.
W. Dent (Massachusetts)	Measurements to detect redshifted H I line in absorption in the vicinity of selected quasi-stellar objects.
C. Gordon and K. Gordon (Michigan)	Search for H I absorption in the vicinity of known pulsars, using 234, 256, and 405 MHz equipment to assist in identifying and studying amplitude and pulse shapes.
G. Verschuur	Continuation of measurements of the Zeeman splitting of 21 cm spectral lines.

The following continuum observations were conducted during this quarter:

D. Heeschen	15.375 GHz observations of elliptical galaxies.
D. Buhl	High-resolution mapping of the moon at 4.995 and 15.375 GHz.
R. Rubin and B. Turner	Mapping and flux determinations at 15.375 GHz for continuum sources associated with bright planetary nebulae and with Wolf-Rayet stars.
J. Dickel (Illinois)	Mapping of Tycho's supernova and collection of polarization data at 15.375 and 4.995 GHz.
P. Mezger, M. Felli (Arcetri, Italy) and E. Churchwell (Indiana)	15.375 GHz survey of the Rosette Nebula and other selected H II regions.
I. Pauliny-Toth and K. Kellermann	Survey of 5C1 and 5C2 zones at 15.375 GHz and flux densities of variable sources at 15.375 and 4.995 GHz.

36-foot Telescope

		Hours
Scheduled tests and observing		860.50
Scheduled maintenance and equipment changes		32.00
Time lost due to:	equipment failure	166.00
	power	12.00
	weather	294.50
	interference	0

Most of the time this quarter was spent on telescope pointing, calibration, and other tests. Sixty-five hours were spent on the following scientific programs at 31.4 GHz.

Observer	Program
J. Schraml	Mapping H II regions.
J. Schraml and S. Maran (Kitt Peak)	Pulsar detection at high frequency.
D. Heeschen	Observations of elliptical galaxies.
K. Kellermann	Flux density measurements of variable sources.

ELECTRONICS DIVISION--EQUIPMENT DEVELOPMENT

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

VLA Electronics Development	14%
Interference Protection	9%
Millimeter Receiver Development	8%
413-Channel Autocorrelation Receiver	3%
Very-Long Baseline Interferometer	10%
OH-Line Receiver Construction	10%
Water Vapor Receiver	3%
6 cm Radiometer Rebuilding	7%
Pulsar Receiver Construction	4%
Visitor Support and Routine Maintenance	32%

Approximately 80% of the equipment for a new interference van is now complete. Some of the equipment has been put in use for detection of interference that is currently disturbing pulsar experiments.

Completion of a new OH-line receiver is expected by May 1969. The receiver utilizes cryogenically cooled parametric amplifiers (constructed by NRAO) and should provide a factor of three increase in sensitivity compared with the present receiver.

The development of new equipment for very-long baseline interferometer observations has been delayed due to the death of the engineer in charge of the project. The project is presently being evaluated for rescheduling.

Construction work is continuing on 1.25 cm water vapor receivers and on RF and IF equipment for observations of pulsars.

The 6 cm parametric amplifier that has been on loan to CSIRO in Australia has been returned and is now being prepared for installation on the 140-foot telescope in January.

ANTENNA DESIGN STUDIES

The Very Large Array (VLA)

The current phase of the VLA development project was completed in December 1968, and a report covering the work during the two years since the publication of the VLA proposal in January 1967 has been drafted. The report contains the following chapters: (1) Introduction, (2) NRAO Interferometer Observations, (3) The Array Configuration, (4) The Array Site, (5) The Antenna Element, (6) The Electronic System, (7) The Computer System, (8) The VLA Operation and Maintenance, and (9) Project Schedules and Cost.

The next logical steps in the VLA project cover the detailed design of system components, acquisition of the VLA site, and construction of an antenna prototype on this site. Funds for this phase of the project are not included in the current fiscal year and will almost certainly not be available in FY 1970. Pending authorization and funding to continue the project, no further design or study work is planned. Limited observations of the environment (e.g., water vapor content in the atmosphere and radio interference) of potential VLA sites will, however, continue at least until July 1, 1969.

Members of the NRAO staff and the CalTech radio astronomy group met in early November in an effort to increase the cooperation between the two groups, and to discuss the individual features of the VLA and the CalTech proposals.

The Homology Telescope

The theoretical investigations of the homology principle for the design and construction of large paraboloids have developed to a point where a conceptual design of a specific telescope can be made. Accordingly, a design of a 100 m diameter fully steerable homologous telescope was started in October 1968. The work is mainly an in-house effort by the NRAO Engineering Division with assistance of the Systems Development Laboratory in Los Angeles. The goal of the present design work is: (1) To prove the feasibility of the homology principle in a practical design, and (2) To arrive at an engineering cost estimate ($\pm$ 10%) of a 100 m fully steerable telescope useful to 5 cm wavelength or better.

KARL G. JANSKY LECTURE

The third annual Karl G. Jansky Lecture was delivered on December 10, 1968 by Professor Joseph S. Shklovsky, head of the Radio Astronomy Department of the Sternberg Astronomical Institute, Moscow, USSR, on the topic, "On the Variability of Cosmic Radio Source Emission." Dr. Shklovsky's contributions to radio astronomy include the prediction, later confirmed observationally, that the supernova remnant Cassiopeia A would decrease in intensity by a few percent per year; the theory of supernova remnants, including their origin and evolution; the first recognition that the synchrotron radiation mechanism is responsible for the radio radiation received from extragalactic sources; and the theory of cosmic rays and X-ray sources. Professor Shklovsky spent a week at the NRAO and visited other U.S. institutions during a three-week stay in the United States.

PERSONNEL

Appointments

Edward B. Fomalont	Visiting Assistant Scientist	Oct. 1, 1968
Geoffrey H. Macdonald	Research Associate	Oct. 3, 1968
George K. Miley	Research Associate	Oct. 7, 1968
John R. Hallman, Jr.	Electronic Engineer III	Nov. 4, 1968

Terminations

Magne B. Hagstrom	Electronic Engineer II	Oct. 11, 1968
* Claude C. Bare	Electronic Engineer I	Dec. 3, 1968
Naresh C. Mathur	Research Associate	Dec. 31, 1968

* Deceased