National Radio Astronomy Observatory
Green Bank, West Virginia

Quarterly Report

October 1 - December 31, 1963

RESEARCH PROGRAMS

85-foot telescope

	Hours
Scheduled	1537.25
Equipment installation	59.50
Time lost due to equipment failure, interference and weather	216.00
Scheduled maintenance	229.75

During this quarter the 85-foot telescope was used with (a) the 5000 Mc maser; (b) another look for the West Ford dipole belt at 4 cm; and (c) polarization measurements at 40 cm.

(a) The 5000 Mc maser. 87.75 hours were used in calibrating and testing the maser on the telescope. About 30.00 hours of atmospheric extinction were observed. Due to continuing rapid helium boil-off, ice plugs, and electronic problems, the maser was returned to the laboratory for further tests.

(b) Attempt to measure needles. (Project West Ford) J. Findlay again tried to detect the West Ford belt at 4 cm with a more highly stabilized local oscillator resulting in about a 30 kc bandwidth. Results were negative.

(c) Polarization measurements at 40 cm. A 750 Mc rotating polarization feed was installed on the telescope. D. Hogg and I. Pauliny-Toth observed background polarization. M. DeJong looked for polarization on some 3C sources, and F. Bash measured Jupiter polarization.

300-foot telescope

	Hours
Scheduled	1408.25
Equipment installation, replacement of bad telescope members, touch-up painting and general maintenance	347.75
Time lost due to equipment failure, interference and weather	89.75

During this quarter the 300-foot telescope was used to complete the 3C program, and to continue the NGC program and the sky survey under the direction of I. Pauliny-Toth, C. Wade, M. DeJong, T. K. Menon, and B. Höglund, respectively. Observations were taken with a 1410 Mc parametric amplifier and a low noise 750 Mc front end simultaneously. In addition, P. Mezger measured the dish efficiency and other parameters of the telescope and associated feeds at 21 cm and 10 cm. At 21 cm dish efficiency was measured to be 44% -- the same as measured last year at about the same time. Preliminary results indicate a 10 cm efficiency of about 14% with a half-power beam width of 4.5 minutes of arc. The 10 cm measurements indicate the telescope to be better than predicted at this frequency.

The telescope was shutdown for about 13 eight hour daytime periods to replace damaged members, mount a standby encoder, and do touch-up painting.

It is well to note that about 16% of the observing time lost was due to local interference, aggrevated by construction on the 85-foot interferometer.

The Millimeter Wave program

Observations at 8 to 14 microns were begun using the 36" telescope at Green Bank.

Although Jupiter was detected at 1.2 mm, uncertainties in the beam parameters of the 5-foot telescope prevented a brightness temperature determination. Observations of the moon, using the sun as a calibration source, give 221 $\pm$ 20°K for the mean brightness temperature and 286 $\pm$ 20°K and 157 $\pm$ 15°K for the maximum and minimum temperature during a lunation. These results indicate larger thermal gradients near the surface than were expected.

The new 12-foot telescope is essentially complete and is undergoing preliminary observational tests.

EQUIPMENT DEVELOPMENT

The three parametric amplifiers for the occultation experiment have been tested. Two were accepted; one required minor adjustments, and will be delivered during the first week of January. All components and units, except the feed, are built and ready for assembly. The system will initially be used with analog recorders only.

Two 1410 MHz radiometer systems with parametric amplifiers have been built and installed on the 300-foot telescope in addition to the 1410 MHz and 750 MHz systems already in operation.

During laboratory tests of the maser, the dewar developed a strong leak between the vacuum and nitrogen chambers. The dewar was returned to the factory for evaluation.

A 10 cm radiometer was built, tested, and installed on the 300-foot telescope for antenna measurements.

Wiring of the autocorrelation receiver is approximately 50% complete. Several of the units that were contracted out have been delivered. One of the filter units did not meet our specifications and was returned to the factory for adjustment. The delivery of the local oscillator frequency multiplier has been delayed, and is now scheduled for delivery about January 10. With these exceptions, the autocorrelation receiver is on schedule, and it is hoped that the first system tests can be made during the second half of January.

A master digital clock, clock slave and time comparator have been built and installed on the 300-foot telescope.

A position indicator for the 12-foot telescope has been built and installed.

A digital data output system, capable of handling the output from up to 8 receivers simultaneously, has been designed, built and installed at the 300-foot telescope.

A new position indicator for the 300-foot telescope has been built and installed.

The position indicator for the new 85-foot telescope has been designed and partly built.

The 20-channel hydrogen line receiver is being modified in the laboratory according to experience gained during the observing period in September 1963.

The design of the 85-foot interferometer system has been completed, and equipment for operation at the shortest (1200 m) baselength has been ordered. Additional equipment (cables, etc.) will be decided after initial tests at the close spacing.

During the report period, the following Electronics Division Internal Reports have been issued:

No.	Title	Author	Date (1963)
21	Design of a Two Element Interferometer Local Oscillator System	J. Bringe	October
22	Electrical Path Fluctuations in the Atmosphere: A Preliminary Report on the Measurement of Differential Overground Path Fluctuations at 5.6 kMc	N. Keen	October
23	Underground Temperature Variations	V. Venugopal	October
24	Not yet completed		
25	Microwave Physics Corporation Parametric Amplifier	B. Hansson and D. Ross	December

26	750 Mc - 1400 Mc Receivers at the 300-foot Telescope	D. Ross	November

CONSTRUCTION

Interferometer

Blaw-Knox has essentially completed erection of the structure for the new 85-foot telescope. The reflector backup clips were checked on December 21, and the reflector surface plates can now be installed. Power wiring from the transformer to the drive motors should be complete the first week in January.

High voltage wiring has been completed from the underground electric duct to the new transformer that rides with the telescope, and on December 13 it was tested and energized.

The control building that will ride with the telescope is now being fabricated. Erection should start about January 15.

Future planning provides for operating the telescope the latter part of January, and moving it to station No. 2 in early February.

Warehouse building

The new warehouse building was completed on October 25 and is now occupied. Construction time was 4 months and 1 week.

ANTENNA DESIGN STUDIES

General

Two important meetings have taken place to discuss future antennas for radio astronomy, both of which have a direct bearing on the antenna development program at the Observatory. The first meeting, held at Green Bank on October 28 and 29, was intended to discuss the immediate needs for another large parabolic antenna at NRAO. This meeting was attended by visiting astronomers who had used the 300-foot extensively, by some others who had specific future programs in mind, by Dr. Keller and Dr. Hurlburt of NSF, and by several of the NRAO staff. The main conclusions of the meeting for the immediate program of NRAO were:

1) Attempt to obtain funds in FY 65 for a 300-foot transit telescope. The telescope should operate to 10 cm wavelength and have sufficient sky coverage to reach the galactic center. It was estimated that the cost would be about $1.5 million, and that it could be in operation by the late fall of 1965.

2) Continue design work on a 300-foot (or 100 meter) steerable telescope. It was agreed that the NRAO should work with Dr. Weaver's group to extend the design work they have already begun.

3) If it should prove impossible to fund the 300-foot transit telescope in FY 65, the situation should be reexamined with a view to obtaining a steerable instrument as early as possible.

4) Design work on a larger ($\geq$ 450 ft.) steerable telescope should be commenced as soon as possible.

The second meeting took place in Washington on November 1 and 2, and was called by Professor A. E. Whitford as an ad hoc meeting of radio astronomers to advise him in his capacity as Chairman of the Panel on Astronomical Facilities of the Committee on Science and Public Policy. The meeting was well attended and led to intensive discussion on possible needs of radio astronomers for facilities over the next decade. The final results will be incorporated in the report of the Panel to the Committee, but it is fair to say that the general discussion lent support to the NRAO plans for developing both a very large antenna system and further large parabolic antennas.

Parabolic antenna design.

As a direct outcome of the discussions on parabolic dishes, design work has been started on a second 300-foot transit telescope, to give good performance at 10 cm wavelength, and to cover the sky down to 72° from the zenith. Mr. E. R. Faelten is carrying out the first design study, the results of which should be available in mid-February 1964.

The report of the study by Lear Siegler, Inc. Astro Structures Division of the design and cost of parabolic dishes for the very large antenna has just been received. The report describes outline designs of dishes of 85 feet, 120 feet, and 150 feet in diameter on both Az-El and X-Y mounts, working at frequencies up to 3000 Mc/s. The study covers the best design of a reflector of a given size; that is, one which for a specified deflection under gravity has a minimum weight and minimum moment of inertia. It also considers the dynamic behaviour of the various antennas and the performance of either an electrical or hydraulic drive system for the reflectors.

PERSONNEL

Mr. John Hungerbuhler, of Westwood, New Jersey, joined the engineering division staff as electrical/mechanical engineer on October 15.

Mr. Yervant Terzian, graduate student from the Indiana State University, came to the Observatory on December 4 to do his thesis work on interstellar ionized hydrogen plazma.

Dr. Hugh M. Johnson, Associate Scientist, left the Observatory on November 30 to become associated with Lockheed Electronics in Palo Alto, California.

Mr. Bert Hansson, Electronic Engineer, on leave from Chalmers Institute of Technology, Gothenburg, Sweden, has returned there after spending 18 months at NRAO. When he was here he headed the low noise group in the electronics division.