III. RADIO ASTRONOMY*

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RESEARCH OBJECTIVES AND SUMMARY OF RESEARCH

The research objectives of the radio astronomy group may be broadly described as follows:

1. The development of radiometric techniques at millimeter wavelengths with particular attention directed toward low-noise parametric amplifiers and solid-state devices. Low-noise preamplifiers are of prime importance to radio astronomical investigations and have been developed and applied to observational programs for wavelengths longer than approximately 1 cm, and it is our objective to extend this study to millimeter wavelengths. Solid-state devices, chiefly local oscillators at millimeter wavelengths, are required for many satellite applications of radiometry.

2. The observation of extraterrestrial radio sources at centimeter and millimeter wavelengths and a study of the radio spectrum of the interstellar medium. The 28-ft and 120-ft parabolic antennas at Lincoln Laboratory, M. I. T., are being used for the study of lunar, planetary, galactic, and extragalactic radio emission at wavelengths less than 10 cm, and the H and OH spectral lines at 21 cm and 18 cm, respectively, are also being studied. During the past year the K-band observations of Venus made during the 1964 conjunction have been completely analyzed and the results have been submitted for publication.[1] These observations are being extended to cover the 1965-66 inferior conjunction. Observations of radio sources at 2-cm and 3.75-cm wavelengths have been performed and will continue.[2] The observations include determinations of the radio brightness distributions of the strong sources, determinations of the percentage of polarized radiation, and determination of the absolute flux. The last measurements have been made with the aid of a large Cornucopia-type horn antenna of known power gain. During 1965 the discovery of linearly polarized OH emission was accomplished in conjunction with personnel of Lincoln Laboratory.[3] This work was extended at the National Radio Astronomy Observatory on the recently completed 140-ft radio telescope. These observations showed the OH emission to be strongly circularly polarized and revealed several emission lines less than 1 kc/sec in width.[4]

3. The study of microwave emission and absorption by the terrestrial atmosphere and surface, with particular emphasis on the meteorological satellite application of microwave sensors. This work has included ground-based observations in conjunction with, and in support of, measurements of planetary microwave emission, and theoretical studies of satellite measurements of atmospheric water vapor and oxygen. An extensive program of balloon observations has been carried out to determine the microwave properties of the upper atmosphere as governed by the resonance lines of molecular oxygen

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at 5-mm wavelength.[5] These results indicate departures from the Van Vleck-Weisskopf theory of microwave absorption and emission, and further observations are being conducted to confirm this conclusion.

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References

1. D. H. Staelin and A. H. Barrett, Astrophys. J. (to appear in the April 1966 issue).
2. R. J. Allen, A. H. Barrett, A. E. E. Rogers, and S. H. Zisk, Quarterly Progress Report, No. 78, Research Laboratory of Electronics, M. I. T., July 15, 1965, pp. 27-35.
3. S. Weinreb, M. L. Meeks, J. Carter, A. H. Barrett, and A. E. E. Rogers, Nature 208, 440 (October 30, 1965).
4. A. H. Barrett and A. E. E. Rogers (to be published in Nature).
5. W. B. Lenoir, Quarterly Progress Report No. 77, Research Laboratory of Electronics, M. I. T., pp. 20-23.