5/27/1960 A. Shaw

Copies Lee goes to DSH & FJC.
Corrections + comments to DSH please

The National Radio Astronomy Observatory and a Very Large Antenna

The Chairman of the Astronomy Department and the Research Equipment Development Department have both studied the draft interim report of the NSF Panel on Radio Telescopes which the Chairman, Dr. J. R. Pierce, has prepared. Comments on these meetings have also come from a member of the NSF Panel and these also have been considered. These comments reflected quite accurately the fact that staff members of NRAO who attended Panel meetings did not press too strongly their views about a very large antenna. This was done quite deliberately, because NRAO staff had been very active for several years in emphasising the need for a very large antenna in the USA and also had asked more than once for money to be appropriated to start the work. Thus the NRAO staff felt that the NSF Panel work would be most valuable if it were not too influenced or over-weighted by the strong views held by the NRAO staff.

However, the comment perhaps may have revealed the fact that there may be doubt in some minds as to whether the NRAO staff are personally and enthusiastically in favor of a very large antenna. In case this be so, it is certainly timely now to restate in the clearest way the opinions of the NRAO staff on the need for such an antenna and the way it should be built.

The staff of the NRAO desires strongly that a very large antenna should be designed and built at Green Bank by a group of workers on the staff of the Observatory.

The way this should be done is also clear to NRAO. A group of capable and enthusiastic scientists and engineers will grow at Green Bank over the next year to be ready to plan and carry out the VLA project. This

group already exists as a nucleus of men who are ready to spend the time necessary to complete a project of the size of the VLA. The group at present has started work on the design of an antenna system of 300-feet effective aperture good to 21-cms wavelength and of limited sky cover. This antenna is scheduled for completion within one year at a cost of $300,000. This is a challenging project. It will provide a very valuable research instrument very quickly for radio astronomy. The project will also demonstrate the ability of the NRAO group to carry out a difficult task in a short time at a low cost.

By the time the 300-foot is completed (July 1961) the NRAO will have a tested group of men capable of planning and building the VLA. This group will be led by a scientist of ability and enthusiasm will be directly responsible to the Director of NRAO. The group will, if financial support for the VLA is supplied in FY 1962 (i.e. by July 1961), be expanded during the first year of the VLA project to 10 to 15 scientists and engineers, with a suitable supporting staff of draftsmen and technicians.

The first task of the VLA group will be to decide what form the antenna will take. In this phase of the work several consultants will be asked to assist the project. Specific technical problems associated with two or three of the most promising design concepts of a VLA will be attacked and solved. The decision as to the type of VLA to build will be based on a real and careful evaluation of the cost, complexity, site needs and value to radio astronomy of the competing designs. The choice of the best design concept will be of vital importance and when made will be final. The group at NRAO regards the first phase of the work as extremely important.

With the design concept chosen, the group will turn to the preparation of a detailed design of the instrument. By this stage, the group will grow in size within NRAO to handle all the scientific and engineering problems and so will include structural, mechanical, civil, electrical and electronic engineers. The leadership will still be scientific and will remain so throughout the project.

When a detailed design is prepared and all critical parts of it have been tested, bid material will be put out to selected firms and contracts will be let for the fabrication and erection of the instrument.

The final phase is erection and testing. When this phase is complete and the VLA is built the group responsible for its construction will hand control of the instrument to the Astronomy Department of NRAO for research programs.

The radio astronomers at the NRAO -- Drake, Heeschen, Lynds, Wade-- believe that a very large antenna is urgently needed at the Observatory. This belief is based both on general considerations of the instrumental needs in radio astronomy and also, more specifically, on the needs which have arisen as a result of current research activities at the Observatory. These activities, in several broad areas of astronomical research, have already pushed the 85-foot telescope to the limit of its usefulness. When the 140-foot and 300-foot telescopes become available the problems can, in some cases, be taken one step further, but it is clear that here too the limits of instrumental capabilities will be reached short of satisfactory solutions of the problems.

Drake's study of the galactic center at 3.75 cm wavelength and the Leiden hydrogen line observations have shown the existence of very energetic phenomena which may provide much of the driving force for the dynamics of the galaxy and be an important feature of the evolution of the galaxy. To investigate these phenomens further, Drake wants to make hydrogen line and continuum observations of the nuclear regions of other, nearby, galaxies. To do this with resolution comparable to that used in the studies of our galaxy will require an antenna much larger than the 140-foot or 300-foot.

The investigations of the spectra of extragalactic radio sources that have been made with the 85-foot by Heeschen show that precision observations may yield much information about the nature of galaxies. The number of galaxies which can be studied with the 85-foot is very small. While the 140-foot and 300-foot telescopes will increase the number of galaxies that can be observed with precision, Heeschen believes that truly significant results will be firmly established only by further increasing both the number of galaxies observable and the precision of the observations. He would like to measure the relative intensity of several hundred sources, at several wavelengths, to an accuracy of better than 1%. To do this will require very large antenna of high angular resolution.

Two other problems in the general area of radio emission from galaxies are of particular interest to Lynds and Wade. Lynds is planning to try to measure, with the 140-foot, polarization of the emission from galaxies. This problem is at best marginal with the 140-foot, and so he would like to do it with a much larger antenna. Measurements of polarization in different regions

of nearby galaxies might be possible with a very large antenna, and if so would be of great value. Wade is concerned with the radio brightness distribution in galaxies and he too desires the resolution of an instrument considerably larger than the 140-foot or 300-foot.

All of these problems, concerning the characteristics of galaxies, will require the use of an antenna much larger than the 140-foot or 300-foot. Because of the personal interests that the radio astronomers at NRAO have in them they all feel that a very large antenna should be built as soon as possible. The entire scientific staff will put its efforts to obtaining such an antenna. Unless a very large antenna is obtained the opportunity to continue to study the problems of particular interest to the staff will be greatly diminished.

The Pierce committee has selected characteristics for a VLA on the basis of a single problem of major importance--the study of the distribution of hydrogen in M31. We agree that this is an extremely important problem and we heartily endorse the recommendations of the committee. The antenna needed to study the distribution of hydrogen in M31 is also the antenna needed for the problems described above, and the scientists at NRAO wish to build such an antenna at the Observatory as soon as possible.

The programs outlined above are those which the NRAO staff recognises now to be of direct personal interest to staff members. Many radio astronomers in the U.S.A. have equally pressing and important pieces of research to do on the very large antennas. Although we have here emphasised our personal desires

to build and use the antenna we recognise very naturally the responsibilities the NRAO will have in making sure that all visiting radio astronomers have the use of the antenna. The NRAO was set up and is operated to provide for all radio astronomers the very large instruments they need. We hope very strongly that the NRAO will be the location for a very large antenna, that the NRAO staff will build and operate it, and that all radio astronomers will use it and benefit by it.

John W. Findlay, Chairman
Research Equipment Development Dept.

David S. Heeschen, Chairman
Astronomy Department.

National Radio Astronomy Observatory

May 27, 1960

cc: OStruve
DSHeeschen
FJCallender