A REVIEW OF RADIO ASTRONOMY IN THE USA

I. INTRODUCTION

It has been suggested that the present time would be opportune for a review to be made of the whole field of radio astronomy in the country. In this paper we will suggest some of the reasons why such a review would be valuable, outline the questions which should be studied and answered, and finally give some possible ways in which the review should be carried out.

II. THE NEED FOR A REVIEW

1. The Present Time is Opportune

Although radio astronomy has been a research subject since shortly after World War II, it went through its fastest expansion, measured by the number of universities and observatories involved, in the period of the middle and late 1950's. By 1960 not only was the National Radio Astronomy Observatory established but so also were almost all the presently active research groups in universities. For example, by 1960 there were active, productive research efforts at Cal Tech, Berkeley, Stanford, Ohio State, Illinois, Michigan, Harvard (Agassiz and Fort Davis), Cornell, MIT, NRL, DTM, Florida, Florida State, NBS-Boulder, and Yale.

We thus can review almost ten years of work which has gone on in universities and research institutes. Also, since 1960, there have been rather few newcomers to the list of radio astronomy research groups. Texas has grown, but at the expense of Yale. La Jolla is starting, but has no instruments of its own. DTM has dropped in interest, and MIT has grown.

The time is opportune also because at the NRAO the plans and ideas generated twelve years ago have, in a broad way, been carried out. NRAO is entering its second phase. It is most desirable to see it, and national observatories in general, as a part of the overall scientific pattern.

2. The Future is Uncertain and Requires Work and Thought

The future of any area of research in the physical sciences is uncertain. It may well be true that the last 40 years (since atomic, quantum and nuclear physics) have seen the most rapid advances in physical sciences that will be seen for a long time. There may well be a slower growth period ahead, and

other less well-developed sciences will be, for some time, growing faster. There may well be an emphasis on the need to develop the technology which physics has made possible. And yet the small but active science of radio astronomy is obviously still in a quite rapid state of expansion; new discoveries still happen quite often. Its place in the next ten years of science needs to be defined; to do this will require that its value and its cost to the country will need to be assessed. If there is to be a further national commitment to radio astronomy, it must be weighed carefully against possible investments in other sciences. Only in this way will the various parts of the decision making chain be able to come to valid conclusions in radio astronomy and its future.

III. THE SCOPE OF THE REVIEW

1. Broad Scope

Broadly, the review should try to show the value of radio astronomy to the country in the past and to predict its future potential and growth. The review should not be directed to the instrumental needs of the science; these have been studied in some detail. It should concentrate more on the way in which the science should develop in the country. We will now try to identify some of the major questions which should be answered.

2. The Scientific Results So Far

The review should summarize the main scientific advances made in radio astronomy. The groups or people responsible for the main advances should be stated and any practical results of the advances should be explained. This survey should not be confined to the USA, but should be world-wide.

3. Radio Astronomy as an Academic Discipline

The value of radio astronomy as an academic discipline in the physical sciences should be assessed. It is an excellent multi-discipline science and has been very productive of new results in astronomy.

(i) Has it been a good training-ground for undergraduate and graduate students?

(ii) Has it resulted in a measurable improvement in the academic standards or curricula at universities?

(iii) Has it enhanced our position in the world of science?

(iv) Will it be a major factor in our future pursuit of academic excellence?

4. Radio Astronomy and the Universities

The history of radio astronomy in the universities needs to be studied. The following questions come to mind:

(i) Has radio astronomy become a truly acceptable part of astronomy in the universities?

(ii) How have universities supported radio astronomy? Have they put a proper proportion of their own resources (men and money and tenure appointments) into the support of radio astronomy?

(iii) Do the universities consider radio astronomy to be a scientific discipline with a long-term future on or associated with the campus?

(iv) Will they be prepared to devote in the future a proportion of their own funds to the operational support of radio astronomy instruments associated with the university?

(v) What has been the level of Government support to university radio astronomy in the past?

(vi) To whom has it gone, how has it been spent, and who supplied it?

(vii) What are the probable needs of radio astronomy support in the universities in the future?

(viii) How many universities should be supported and by whom?

(ix) Is there any way of measuring the "cost-effectiveness" of the universities' research in radio astronomy?

5. Radio Astronomy at the NRAO

The NRAO, as the only truly national observatory in the world, should be examined in a broad way and also to answer some specific questions:

(i) Was the original concept of a national observatory correct?

(ii) To what extent has the NRAO fulfilled the original concept, and where has it departed from it?

(iii) Should the NRAO have a new set of goals for the future?

(iv) If so, can such goals be defined -- if only in general terms?

(v) Are more "national" observatories required in radio astronomy?

(vi) Can NRAO keep up with the growing number of demands from a growing number of users who represent a proportion of the growing number of radio astronomers?

(vii) Is the management pattern of AUI in running NRAO satisfactory?

(viii) Should a broader-based group (URA, for example) run NRAO?

(ix) Are the NSF-AUI-NRAO relationships correct?

(x) Is there any way of measuring the "cost-effectiveness" of radio astronomy research at the NRAO?

6. The Universities and NRAO

The relationship between NRAO and the radio astronomers in universities and other centers should be examined critically and carefully. Some of the questions under 4 and 5 bear on this subject. Specifically it would be good to know:

(i) The facts as to the division of support given to radio astronomy in the universities and at the NRAO in the past should be brought out.

(ii) Has there been a satisfactory growth of radio astronomy support in total over the past years?

(iii) How has the division of radio astronomy support between universities and NRAO changed over the past years?

(iv) What should be the pattern of the division of support in the future?

(v) What is the relation between universities and NRAO in fulfilling the task of bringing good students into the science and in training them effectively?

(vi) What improvements could be suggested in this relationship?

(vii) Is a new relation between universities and NRAO needed to develop, build and operate large new radio telescopes?

7. Radio Astronomy and the National Interest

Although radio astronomy is basically a subject of pure research, it may be worth a brief enquiry into its relation with other activities.

(i) Is there a danger that the results of radio astronomy will not be used by other mission-oriented agencies (NASA, Department of Defense)?

(ii) Should any mechanism exist for bringing radio astronomy and the other agencies' interests together?

(iii) Is there a need for a group or place where the progress and value of radio astronomy is measured against other scientific disciplines? (A PSAC sub-group, for example.)

(iv) Are radio astronomers sufficiently well-represented in the national council of decision-makers or advisors (e.g., National Academy of Sciences)?

IV. HOW TO CARRY OUT THE REVIEW

Perhaps, after reading the foregoing list of questions and comments, the first reaction will be not to carry out such a review. However, if it were to be done, it would require the following sort of group:

1. A Study Group with a Chairman

The members of the study group (about 15) and its chairman should be men with a more broad competence than just radio astronomy, although a majority should be quite familiar with the aims and methods of astronomy or radio astronomy. The group should include some experienced university administrators. It would need a supporting staff of two scientists or engineers familiar with staff work of this kind. Secretarial and office help would be needed in addition.

2. Time Scale and Cost

The work would occupy nine months to a year. The cost would be $40-50K (assuming Government rates for honoraria, travel, etc.).

3. Who Could Do It?

(i) AUI could finance and run it. This would be satisfactory provided the Study Group were suitably chosen so as not to be biased for or against AUI/NRAO.

(ii) The National Academy of Sciences. The Committee on Science and Public Policy (COSPUP) could set up the group. Funding might have to be supplied. Or the Academy might agree to do it as a special task.

(iii) PSAC. The Study could be undertaken under the direction of PSAC.

J. W. Findlay

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