

ASSOCIATED UNIVERSITIES, INC.

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April 11, 1956

Memorandum to: L. V. Berkner
From: C. F. Dunbar
Subject: Radio Astronomy Project

I attach hereto some rather hastily prepared minutes of our meeting on April 2, 1956. As you will learn in more detail when you get back, we followed up this meeting with another one on April 10, and I think we are making satisfactory progress in meeting Sunderlin's requirements with respect to the figures.

CFD:cs

cc: R. M. Emberson
L. R. Burchill ✓

RADIO ASTRONOMY PROJECT

Record of Meeting at The National Science Foundation April 2, 1956

On April 2, 1956, representatives of the NSF and AUI conferred at the office of the NSF in Washington. The following persons were present:

NSF: Dr. Alan T. Waterman, Director
Dr. G. E. Sunderlin, Deputy Director
Dr. Raymond J. Seeger, Acting Assistant Director for Mathematical,
Physical and Engineering Sciences
Dr. Helen Hogg
William J. Hoff, General Counsel
Dr. Paul M. Gross, Vice Chairman of NSF Board

AUI: L. V. Berkner, President
Carl C. Chambers, Trustee from University of Pennsylvania
Charles F. Dunbar, Secretary

Waterman opened the discussion by describing the Congressional action on NSF's budget. The appropriation bill passed by the House provides \$3,500,000 for facilities. In its report, the Appropriations Committee called particular attention to the fact that it was leaving to the Foundation the task of determining what specific projects should be supported, and expressed the strong opinion that NSF could not undertake to start construction of the facility, unless funds for its completion had been appropriated. NSF hopes that it will obtain more favorable treatment from the Senate, and there is some chance that ultimately the full amount requested, namely \$7,000,000, will be provided.

Berkner described the status of AUI's work under the following headings:

1. DISHES

AUI has obtained three designs for a 140' dish. Husband's design follows in many respects the design worked out by Grote Reber many years ago. Feld's design calls for a stiff dish with an adjustable surface, held in place by a pre-stressed ring on the outer edge and pre-stressed bracing. Kennedy's design is an expansion of its design for an 84' dish. The use of aluminum as the principal material gives quite a different moment of inertia from the other two designs, both of which call for steel.

At the Advisory Committee meeting on March 26-27, the desirability of relaxing the specifications to effect a cost reduction was discussed in detail. The general engineering opinion is that there would have to be a considerable relaxation to effect any important saving in cost. The Committee recommended that there be no change in the specifications at this time, but did recommend that a design for an equatorial mount based on the same specifications be obtained, together with a cost estimate. When this design is completed, it should be possible to determine the relationship between relaxation of specifications and cost.

The cost estimates for the three designs do not vary very much, and it is reasonable to hope that the dish and foundation can be obtained for \$2,200,000. Each design is being reviewed by a panel of three engineers (structural, electrical and r-f), who will give AUI their opinions in the course of the next two or three weeks.

As to drive mechanism, the report from Servo-Mechanisms Laboratory has not yet been completed, but a satisfactory drive mechanism can certainly be obtained. It seems clear that 10 seconds of arc is about the limit, and it may be necessary to relax to 15 seconds.

In response to questions, Berkner said that an increase to 150 feet would result in a material increase in cost, since weight and cost vary with the cube of the radius. The Feld design has the advantage of providing more help for the design of future larger dishes. The Kennedy design is probably about the largest dish that can be built on the design principles embodied in it.

2. SITE

Everyone concerned likes the Green Bank site and it seems reasonable to suppose that no better one is available within the 300 mile radius of Washington specified by NSF. It also seems clear, after elaborate investigation, that no public land meeting the requirements is available.

The noise level at Green Bank is the best that has been found, and the following tabulation of index numbers shows the comparison between Green Bank and other locations which have been considered:

Green Bank	24
Deerfield	100
Massanutten	4000
NRL (Washington)	10 ⁶

Steps are being taken to obtain as much noise protection as possible. Zoning regulation has been drafted and is under consideration by the Attorney General of West Virginia. Steps have also been taken to see what help can be obtained from FCC and IRAC. Originally, it was hoped to have particular frequencies allocated to radio astronomy and obtain protection for everyone. However, it has become apparent that many installations are located in places that make protection practically impossible. The best method now appears to be creation of zones of avoidance, or "radio parks." It seems likely that the hydrogen line frequency and its subharmonics can be cleared. In response to questions, Berkner said that the Advisory Committee thought the noise measurements that had been made to date were sufficient.

Berkner said that AUI has acquired purchase options on 6,002 acres for a total price of \$502,000. In his judgment, some 2,000 additional acres should be purchased or restricted as to use by agreement with the owners. The earthquake history of the area is good, and AUI has been assured by

geologists that good locations for the heavy equipment can be found on the land which is under option. It seems useless to try to get a location in a national park, and the Forest Service land is, in general, on hills, leaving valleys in private hands. Emberson has checked every location that has been suggested, and can provide complete documentation. In response to a question, Berkner said the only possible objection to the Green Bank site was its remoteness. This objection was not considered serious.

3. ORGANIZATION

Berkner then described AUI's ideas for an operating organization for the radio astronomy facility. NSF should enter into a contract with a competent operator, experienced in the management of research institutions. Its contract would provide for an annual budget to cover operating and capital expenditures. The contractor's organization should provide for an advisory or visiting committee, fully representative of the radio astronomers throughout the country. This committee would be consulted on scientific programs and methods of operation designed to make the facility a truly national one. Actual operation would be under the control of a Director, who should be a scientist of recognized stature and who would be responsible for operating the institution in conformity with the policies established by the Trustees with the help of the Visiting Committee. NSF, in turn, should appoint a broadly representative advisory body to assist it in reviewing the operations of its contractor to make sure that the programs were adapted to the scientific needs of the country and that the institution was serving the needs of the radio astronomy community as a whole.

At the conclusion of his presentation, Berkner distributed copies of a letter dated March 30, 1956 (copy of which is attached) addressed by him to Dr. Waterman. He expressed the opinion that NSF should now consider whether the time had come to take the following steps:

- (a) Select a Director
- (b) Acquire a site
- (c) Obtain bids for construction of a radio telescope

Berkner's presentation was the subject of detailed discussion. Waterman pointed out that the big unknown element was Congressional action on the appropriation bill which must still be considered by the Senate and then by a conference committee. He asked whether any part of the program could be postponed.

Berkner said it would be possible to postpone the 140' dish and to build instead two 60' dishes at the outset. This would result in about a six months' delay, if funds could be made available in FY 1957 to complete the detailed design of the 140' dish. Berkner proposed a contract providing for performance in two stages, first a detailed design to be paid for out of FY 1957 funds, and then fabrication and erection to be paid for from FY 1958 funds, if and when they became available. The contract would have to provide for termination if funds for the second phase were not forthcoming. If the 140' dish were postponed in this way, a 10 per cent increase in cost estimate would be wise.

Hoff expressed the opinion that a facility without the 140' dish could probably be regarded as "complete" within the meaning of the House Appropriations' Committee's report. It certainly would be necessary to make full disclosure of the change in plans to the House and also to the Senate.

Berkner said \$3,043,000 in FY 1957 would cover the cost of two 60' dishes and detailed design for the 140' dish.

Sunderlin asked for an explanation of the increase from the original figure of \$4,500,000 to the \$6,000,000 figure contained in Berkner's letter. Berkner said the bulk of the increase was explained by the increases in the cost of the land and electric power. Sunderlin expressed concern at the widening gap between the figure submitted to the Bureau of the Budget and the amount AUI now appears to consider necessary. He asked whether it would not be possible to effect some savings in the most recent budget (see attached letter). Berkner agreed to provide a detailed explanation of the new figures. Waterman expressed the opinion that it would probably be easier to satisfy Congress if the 140' dish were undertaken in FY 1957 and the other observing equipment postponed until FY 1958, when it would be quite appropriate to ask for some supplementary equipment. Seeger asked whether a saving could not be effected by reducing the amount of land to be acquired. It was the consensus that this would be undesirable.

The question of organization was discussed at length. Waterman said NSF could hold title to the facility, but as a matter of law could not operate it. NSF's concern is that radio astronomy be served on a national basis, and any plan of organization must be adapted to this purpose. NSF should also retain sufficient control to make sure that satisfactory research programs are being formulated and carried on. Chambers and Berkner expressed complete agreement with Waterman, but both doubted the desirability of having any corporate body introduced between NSF and the operating contractor. In their opinion, this would serve only to cloud responsibility, and NSF's purposes could be better served by having a strong advisory body representative of radio astronomy throughout the country.

Waterman explained that in the view of some people, AUI is a provincial organization, controlled and operated primarily in the interests of the northeastern section of the country. Hoff pointed out that NSF did not wish to assume the administrative responsibility of an operating contract. Gross emphasized the importance of focussing responsibility, but obtaining adequate representation for radio astronomy on the governing body of any operating contractor.

Sunderlin said there was a feeling that in operating Brookhaven AUI is working for the Government. The radio astronomy facility, on the other hand, should be operated primarily for radio astronomy as a science. Since NSF is inclined to assume that Green Bank will be the national facility, it wishes to make sure that its operation meets the wishes and needs of the radio astronomers as a body. Berkner emphasized that of all the AEC laboratories, Brookhaven bears the least resemblance to a laboratory operated for the Government. It developed out of demand from the univer-

sities, and, unlike the other AEC national laboratories, did not come into being until the close of the war. He also pointed out the degree of independence Brookhaven has in its budgeting and general operations.

If AUI were selected to operate the radio astronomy facility, it would be prepared to add two radio astronomers to the Board of Trustees. NSF would gain by having a going concern take over the operation of the new facility. Creation of a brand new organization would inevitably result in delay.

Gross expressed himself as not much concerned with the problem of representation, which he considers can be easily solved. The real crux of the matter is the selection of the Director, and the success of the new institution will depend in great measure on him. He asked whether AUI's sponsoring universities would participate in a new organization, if it were felt that AUI as now organized does not have the necessary national flavor.

Berkner said that AUI would certainly help in organizing an operating body, but that he did not think the universities would enlarge the number of sponsors. AUI admittedly does not have a national flavor, and the only basis for selecting it as the operator would be its ability to administer research in an academic atmosphere. The national character of the facility would be determined by the operating policies adopted by the contractor.

Hoff suggested that if title to the facility were in the operating contractor, it might be more interested in keeping the establishment going, if it became difficult for NSF to do so. Dunbar pointed out that if title were in a private organization, it would be much more difficult to obtain the necessary protection against radio noise.

Seeger suggested the possibility of one corporate body to take charge of both the national optical astronomy facility and the national radio astronomy facility. Gross said this might be a good idea eventually but probably the two should go ahead separately for a while.

Waterman said that there seemed to be two theories with respect to operating mechanism. Under one, NSF would make a grant to some organization which would follow its own plan of operation. The other would be a direct contract between the operator and NSF. Hoff pointed out that a grant could be as detailed as seemed necessary and was a mechanism through which operating policies could be laid down in some detail.

Berkner said the three following questions must be answered in the near future:

- 1) What is to be done about the site;
- 2) What is to be done about the 140' dish;
- 3) What is to be done about a contractor.

Seeger asked when AUI would send in a final report. Berkner said he hoped to have it ready by the first of the year. He described the arrangements he had made for editorial assistance.

Berkner's proposal that the name Carl G. Jansky Radio Astronomy Observatory be adopted met with general approval.