Record of Meeting at the National Science Foundation
March 13, 1958

Present: National Science Foundation:

Roger Adams*
E. A. Eckhardt
T. Keith Glennan*
Geoffrey Keller
J. B. Luton
Edward J. McShane*
James M. Mitchell
C. B. Ruttenberg
Raymond T. Seeger
Frank C. Sheppard
Warren Weaver*

Associated Universities, Inc.:

C. C. Chambers **
C. F. Dunbar
R. M. Emberson
P. S. Macaulay**
Edward Reynolds**
Otto Struve**

* National Science Board ** AUI Trustee

Mitchell presided.

1. Supplemental Budget Request

Luton called attention to NSF's "Justification of Supplemental Estimates Fiscal Year 1958," copies of which were distributed. This request is now with the Bureau of the Budget. On page 6 appears a comparison between the estimate for the NRAO originally used for the FY 1958 budget and the revised estimate for FY 1958. For "Site Development and Other Observatory Equipment," there is a small net decrease. For "Buildings and Housing" there is an increase of $743,000, and for "Radio Telescopes," $3,970,000. The total net increase is $4,582,000 (later reduced to $4,442,000).

2. Electronics

Weaver called attention to Item C-3, "RF Components and Electronic Components," and asked to what extent the increase of $395,000 represented advances in the art.

Emberson said the travelling wave receiver on order from Ewen & Knight was not available when the original estimate was prepared. The remaining items are receivers required for specific uses. The original sum of $200,000 would have permitted use of the telescopes for research but only on a very restricted basis.

3. Housing, etc.

Similarly, Item B-5, "Residence Hall and Cafeteria," has been, in AUI's opinion, essential for effective use of the site, although, when faced with the fixed FY 1957-8 ceiling, AUI gave this item a lower priority than some others more di-

rectly connected with the observing program. AUI's request takes into account the needs of visitors and also of members of the staff who will require temporary housing while they get settled permanently.

Mitchell and Luton emphasized the remote location of the Observatory and the importance of not ending up with a costly facility for which a satisfactory staff could not be recruited. Struve spoke of the parallel to Lick Observatory, where it has been found necessary to provide housing. He emphasized that the problem at Palomar is completely different, because of its proximity to the City of Pasadena and California Institute of Technology and the main buildings of the Carnegie Institution of Washington.

Weaver offered two criticisms. First, Item B-5 ($602,000) is too high for what is being acquired. The cost per square foot is about $30. Second, it is a new item, not in the original budget.

4. Contract Financing

Emberson replied that the estimated cost was furnished by AUI's architect-engineers. Obviously competitive bidding may produce some reduction. As to Weaver's second point, it must be remembered that the original FY 1957-1958 budget was prepared to meet NSF's requirement that an "operating observatory" be produced for $4,000,000. AUI's original request was for $6,200,000, with a second phase of $2,300,000 to be provided in FY 1959.

Sheppard said that NSF's original request to the Bureau of the Budget had been prepared by the NSF staff without any consultation with AUI. The latter has never departed from its original position on what the initial capital expenditures should be.

Emberson said the new total of $9,712,000 should provide adequate capital funds to permit effective use of the 85' and 140' telescopes. AUI will not expect to make further substantial capital expenditures (except for electronic equipment) until it has had a substantial period of actual operating experience.

5. Telescope Costs

Weaver asked why the need for additional funds for the 140' telescope because of rising costs and improvements in the design had not become apparent much sooner.

Emberson said the process of education had been a gradual one and was still going on. He cited the very recent developments in servo-mechanisms as an example of an improvement in an allied art which may be of the highest importance in the drive and control mechanism. He also emphasized that the original $2,000,000 figure was first used in an almost casual conversation in 1954, and the $2,200,000 was intended to provide a smaller less precise instrument. As time went on, it became apparent that $2,200,000 would cover materials and shop costs, but not erection. Moreover, insufficient weight was given to the overall risk factor which a contractor would be obliged to attach to a large first time job of this sort.

Emberson said confirmation of Bliss's price for the 140' instrument had been obtained through competitive proposals and also from informal estimates. For example, N. W. Kellogg Co. estimated cost of transportation and erection alone at about $2,000,000.

Luton said the original estimate for FY 1958 was indisputably a poor one. However, he called attention to the greater precision of the instrument as now designed, and the fact that it must be "custom built" at a remote location. Chambers reminded the meeting that the Green Bank location was not selected until after the facility estimate had been made. Furthermore, Luton pointed out that despite the state of the economy, the applicable price indices are still riging.

6. Future Development

Mitchell asked about advance planning for NRAO.

Emberson said that the next major research instrument should be a very large antenna (perhaps the equivalent of a paraboloid) with a diameter well in excess of 1,000 feet, and limited steerability. For such a project, plans must be made a long way ahead. AUI proposes to embark in the near future on some basic studies to gain information on which a preliminary design might be based. Thus, if flat panels are to be used, their optimum size and arrangement must be determined. If the instrument is to be paraboloidal with a more complicated r-f feed, there are numerous problems connected with the spherical surface and the supporting structure which must be considered. Air support analogous to an air supported radome should be studied.

At Mitchell's request, Struve discussed the importance of a very large antenna. The immediate increment would be a much deeper penetration of the universe than is possible with any telescope, optical or radio, now in existence. To solve basic cosmological problems, penetration to three or four times four billion light years (the present limit) should be achieved, and an instrument such as the one now under consideration should be built as soon as possible.

Struve described astronomy as being in an exploding state. The frontiers of knowledgeare expanding rapidly, and the United States should make every effort to equip scientists with research tools which will keep them abreast of the latest developments and enable them to push further into the unknown. Planning of the very large antenna should go forward as rapidly as possible, and, indeed, the 140' telescope should be regarded as merely a stopgap.

In response to questions, Struve expressed the opinion that the West Virginia site is about as good a one as can be found for the 140' telescope, and also for the very large antenna under discussion. He pointed out the obvious advantages of steerability, but recognized the difficulty of achieving it with so large an instrument.

Emberson considers that the cost of these studies (which he estimates at about $30,000) can be met from operating funds provided the amount $450,000) proposed for FY 1959 is received.

Emberson also summarized the progress which has been made in other countries, notably Great Britain, Holland, Australia, and Russia. Information about the last named is very scanty.

The possible availability of the Navy installation at Sugar Grove was discussed. Emberson said any observing time on this telescope, when it is completed, of course, will be most welcome. Furthermore, the proximity of such a large

establishment is certain to be helpful to the more modestly equipped NRAO. However, he emphasized that the Navy equipment as planned would not be a satisfactory substitute from the scientific point of view for the very large antenna AUI has under consideration.

Accepted on behalf of
National Science Foundation ,

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Date:

Prepared and submitted on behalf of
Associated Universities, Inc.

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Charles F. Dunbar, Secretary

Date: April 15, 1958