

ASSOCIATED UNIVERSITIES, INC.

10 Columbus Circle  
New York 19, New York

MINUTES

AUI - NSF Staff Conference  
January 27, 1958

1. Messrs. Eckhardt, Keller, Leigh, Luton and Sheppard represented the NSF for all or part of the discussions and Messrs. Burchill Callender, and Emberson represented AUI. The purpose of the meeting was to discuss the AUI January 3, 1958 budget submittal in the light of the National Science Board Meeting of January 20, 1958.
2. The above mentioned January 3, 1958 submittal was the point of departure for all the discussions: Reference the summary tabulation, item A-1 "Site Acquisition", a supplementary table was submitted on January 27, 1958 (although the supplementary table carries the January 3, 1958 date), which is attached hereto as Appendix A.

Action  
Required

3. Concerning item A-2 "On-site secondary roads", the IBA map D-33 was submitted. This map shows the central portion of the site and includes the new road, and the locations for the 85- and 140-foot telescopes, and the proposed new buildings. Mr. Luton requested two sets of maps: the D-33, plus a map of the entire site showing the D-33 location. He further requested that we mark with colored crayon the locations of telescopes, buildings, etc.

4. The electric power and water supply items were discussed but remained unchanged.

Action  
Required

5. Concerning B-2 "Control Building", there was a thorough discussion of the factors believed to be responsible for the cost of about \$30/square foot. Mr. Luton asked that we supply him 2 sets of the architects' drawings.

Action  
Required

6. Concerning B-3 "Maintenance Building", the fact that E. W. Bliss would do machining at the 140-foot site and not in this proposed building was reviewed as well as requirements for the electric power substation, site maintenance, and related matters. In view of the commitment to the National Science Board, the consensus of the NSF staff was that \$150,000 was about the maximum that could be supported. AUI agreed to look into cheaper construction for this building, and to report back prior to February 6 on how we might proceed and what the general floor plan would be.

7. Concerning B-4 "Laboratory", we reported that the central section was now estimated to cost \$466,000, because of a 5% per year increase in materials and labor since the original \$441,000 estimate was made 2 1/2 years ago. It was further explained that the escalation in Item B-7 provided only for the trend from January 1958 until such time as the work could be completed. The NSF could not support more than the central section of the Laboratory at this time and a figure of \$466,000 was adopted.
8. Concerning B-5 "Temporary Housing", a summary sheet was submitted which is attached hereto as Appendix B. There was a great deal of discussion on the estimated rate of growth and on the provision of renovated space as opposed to the new construction in item B-6. The consensus was that all of the temporary housing was thoroughly justified and should stay in at the \$83,000 level.
9. Concerning B-6 "Residence Hall & Dormitory", the pros and cons were reviewed. There was great sympathy for the AUI position, but there was also an argument that this item would be difficult to defend before Congress as part of the supplemental and that a better case could be made at a later date when we had experience. No decision was made, pending internal NSF discussions with Dr. Waterman.
10. The items under C were reviewed but left unchanged, except that C-5 "West Virginia Taxes" was deleted pending a firm opinion on whether or not it would have to be paid.
11. Action Completed The NSF requested more details concerning item C-6 "RF components and electronic equipment", to assist them in their presentations to the Bureau of the Budget and Congress. Dr. Findlay has subsequently prepared a statement, which is attached hereto as Appendix C.
12. The items under D provide furniture and equipment for the buildings listed in the earlier sections. It was agreed that AUI should review these items and adjust them for the revised building program. The NSF would tentatively assume that D-2,4, and 5 would be so changed; with respect to D-5, the cafeteria equipment would be required, at least in part, to equip the feeding arrangements the NSF suggested for the basement of the Laboratory. The escalation and contingency, item D-6, was to be reduced from \$39,000 to \$20,000.
13. Action Required Concerning Item E "Architect & Engineering Services", it was pointed out that the original estimates for building costs, as well as those contained in the summary table, did not include the A-E costs. Approximately \$66,000 has been spent and an estimated \$84,000 will be required to complete the building program in the January 3 submittal. Mr. Luton asked that we give him a statement on the above.
14. Mr. Callender had prepared detailed estimates on the various equipment and furnishing items. Copies of these tabulations were left with the NSF. For the record, they are Attachment D to these minutes.

NATIONAL RADIO ASTRONOMY OBSERVATORY

Estimated Costs of Land Acquisition

Paid - Land	\$124,060
Optioned - Not Paid	45,525
Condemned	187,301
To be Condemned	100,652
Acquisition Costs, 11/30/57	<u>66,137</u>
Sub Total	\$523,675
Estimated Costs of Easements	80,000
Additional Administrative Costs	17,000
Reserve for Court Judgments (1)	<u>29,325</u>
Total	\$650,000

(1) In excess of condemnation price

Note: Total land to be acquired was estimated at 2,100 acres;  
Actual acreage acquired totals 2,650 acres.

NATIONAL RADIO ASTRONOMY OBSERVATORY  
Initial Renovation Program Estimate (1)

APPENDIX "B"  
to 1/27/58 Minutes

January 3, 1958

Name of Former Owner	Number of Rooms	Intended Use	Est. Cost of Renovation	Est. Cost of Furnishing	Total
Kessler	Six Rooms, including initial lab space	Office Only	\$ 8,000	\$ ----	\$ 8,000
Beard (Moro)	Six Rooms	Laboratory & Office only	10,000	----	10,000
Riley	Six Rooms - three bedrooms	Residence for visiting scientists	5,500	3,000	8,500
Tracy (C)	Five Rooms - Two bedrooms	Temporary Residence for Staff Astronomers	6,000	----	6,000
Tracy (D)	Six Rooms - Three bedrooms	Temporary Residence for Construction Manager	8,000	----	8,000
Hill	Eight Rooms - Four bedrooms	Two Apts. for Visiting Astronomers	10,000	6,000	16,000
Hannah	Eight Rooms - Four bedrooms	Guest House for Single Visiting Astronomers and Others	8,000	6,000	14,000
Beard (Mary)	Seven Rooms	Temporary Lab and Shop Quarters Only	5,000	----	5,000
SUB TOTAL			\$60,500	\$15,000	\$75,500
Renovate Barn for Automotive Equipment, Maintenance Shop, Storage, etc.			2,500	----	2,500
Contingencies			5,000	----	5,000
Renovation costs include: installing central heating, new plumbing, bathrooms, kitchens, well-drilling, septic tanks, jacking and replacing foundations, leveling floors and reinforcing floor joists, new interior walls, refinish or replace floors, electrical wiring, painting, new gutters, etc.....			\$68,000	\$15,000	\$83,000

Receiver Program at the NRAO

by J.W. Findlay - January 29, 1958

Further details are given of the receivers outlined on page 25 of the "Estimated Costs of Construction" of January 3, 1958.

Receiver for 1170 - 1430 Mc

Budget Cost \$35,000

This receiver is already ordered from Airborne Instruments Laboratory. It is both a total power and a DC comparison receiver, especially intended for use on a program of research on the red-shifted hydrogen radiation from extra-galactic objects. The receiver will have high gain stability (0.1%) and good frequency stability.

X-Band Receiver

Budget Cost \$80,000

This receiver is already ordered from the Ewen Knight Corporation. It operates on a frequency around 8500 Mc using travelling wave tubes, with a bandwidth of 1000 Mc. This wide bandwidth, combined with the use of a switching system at the receiver input, and long integration times, makes the receiver capable of detecting antenna temperature changes of 0.01°K. This is at least one and nearer two orders of magnitude better than has previously been achieved. A very extensive program of research awaits this receiver and the 85-foot dish.

Galactic Hydrogen Receiver (Multichannel)

Budget Cost \$80,000

To study the hydrogen within our galaxy, a receiver capable of detecting radiation separately in a number of adjacent narrow frequency bands around 1420 Mc is needed. Such a multi-channel receiver sets a very high standard in electronic engineering. Two attempts to make such a receiver (by the Ewen Knight Corporation and by DTM in Washington) have been made. How and where to procure this receiver is not yet decided.

S-Band Receiver

Budget Cost \$90,000

This will be a receiver of a similar type to the X-band receiver already described, with some additional features included in it. It will operate around 3000 Mc with a band-width of about 400 Mc. Work with it, when combined with the X-band receiver, will give very important positional and spectral data on sources. No supplier is yet chosen.

Galactic Hydrogen Receiver

Budget Cost \$35,000

A simpler receiver, of fairly conventional design which will probably follow the principles of local oscillator switching and scanning established by the Dutch, will be procured for use before the end of 1958. It fills two functions, to allow H-line work to start on the 85-foot dish before the complex multichannel receiver is ready, and to allow eventually of simultaneous H-line work on the 85-foot and the 140-foot dishes, when the multichannel receiver is ready. This receiver will either be bought or made in the Observatory electronic laboratory. In the latter event, a more sophisticated receiver will be obtained for the same budget figure.

A Wide-Range H-Line Receiver

Budget figure \$120,000

The technical details of this receiver are not yet certain. The intent is to incorporate as many features as possible into the design. A "Maser" at the front end is hoped for, and sufficient flexibility in bandwidth, switching and video circuits to achieve a real step towards a good multi-purpose receiver. Work on planning and technical investigation remains to be done before this receiver can be ordered, but it is hoped that funds could be committed by July, 1959.

Interferometer Receivers (2)

Budget figure \$35,000

In addition to the 140-foot and 85-foot dishes, at least two experiments involving large arrays, either simple interferometers, Mills crosses or aperture synthesizers must be planned for. Each such array will need a phase switched receiver, on frequencies somewhere between 30 Mc and a few hundreds of Mc.

Special Feeds

Budget figure \$50,000

Each frequency band used on the telescope calls for a specially designed feed-horn. The design of these to achieve best coverage of the dish, minimum VSWR and maximum frequency range calls for very special engineering. For example, a combined feed to allow the 85-foot to carry out experiments on 21-cm and 4-cm without changing feeds will cost about \$10,000.

Data Extraction and Processing

Budget figure \$35,000

A first start has to be made on extracting automatically positional data of the telescope axes, accurate time and a measure of the received signal. This information will be coded into a digital code and made available in a form which can operate as electrical printer, or punch tape or IBM cards. Eventually it must be capable of being used on a digital computer. A system has been developed and designed and a firm to make it will soon be chosen.

Total Budget figure \$595,000