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**STUDY OF THE PROPOSAL TO ESTABLISH AN NRAO OFFICE
IN CHARLOTTESVILLE**

**Prepared by the NRAO Staff
October, 1963**

**Distribution: AUI Trustees and Officers
E. R. Piore**

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INTRODUCTION

I recommend that the NRAO establish an office in Charlottesville, Virginia. The purpose of the proposed move is to strengthen the scientific and professional staff, and thereby increase the scientific effectiveness of Green Bank and the NRAO.

A number of scientists and engineers have in the past declined positions at the NRAO because of its location. At least one staff scientist has resigned, in part because of the location of the Observatory. Two scientists now considering positions at the NRAO have indicated that they will probably accept the offers if an office is established in Charlottesville, but will decline if the Observatory keeps its scientific offices at Green Bank.

This recommendation is made reluctantly. Splitting the Observatory staff and activities between two locations will have disadvantages. Research, equipment development, the operation and continual modification of existing equipment, and services to visiting scientists are intimately intermingled at the NRAO. There is necessarily a close working relationship between staff scientists, visitors, telescope operators and technicians, equipment development groups, and the telescopes. This is best achieved by daily physical proximity. Closeness to the equipment one uses and to the people who operate and develop that equipment is an advantage that can outweigh many disadvantages. I believe these considerations were behind the original AUI-NSF decision to establish the entire staff at Green Bank, along with the telescopes.

As headquarters for the Observatory, Green Bank has one major limitation, namely, the fact that it is an isolated, low population area. Indeed, these very features were important factors in the original site selection. This general characteristic carries with it a number of specific disadvantages, e.g., limited housing market and transportation, rural schools with their inevitable limitations, limited shopping, services, and medical facilities.

To effect any substantial change would require an increase of people and activities not directly associated with the Observatory. Furthermore, such an increase in the foreseeable future is not only unlikely, but the prospect of it would pose a dilemma, since the increase would be undesirable from the standpoint of the observing activities of the Observatory.

The net effect of Green Bank's general and specific limitations is to make it extremely difficult to acquire and retain the high quality scientific and professional staff the Observatory needs. I have come to the conclusion that this vital difficulty would outweigh the advantages of having the scientific staff based at Green Bank, if a suitable location could be found near enough geographically to permit the maintenance of

close contact with Green Bank. In my opinion, Charlottesville is such a location.

Several locations have been discussed as alternates to Charlottesville, including Washington, College Park, Maryland, New York, Princeton, and Cambridge. However, I believe Charlottesville is a better choice for the needs of the NRAO, because of its relative closeness to Green Bank. This is the overriding consideration.

The major instruments -- those now operating and under construction, and those planned for the future -- will be at Green Bank, with the probable exceptions of the large array and the millimeter wave telescope. Most experimental work, and final development and testing of new equipment will remain at Green Bank. A major portion of the NRAO staff will be based at Green Bank. It is very desirable that the scientific staff have ready access to Green Bank, and that visitors have easy access to one location when they are at the other. Charlottesville meets this requirement much better than does any other suggested location. It is 2-1/2 hours by car from Green Bank to Charlottesville, and less than one hour by air. From Charlottesville it is relatively easy to go to Green Bank, spend a working day there, and return the same evening, without much advance planning or arrangement. The effort required to get from Green Bank to Charlottesville is much less than that required to go from Green Bank to any other reasonable place.

I give considerable weight to the need for the scientific offices to be as close as possible to Green Bank, because of what I believe to be the purpose and nature of the NRAO. The primary purpose of a national research facility of the NRAO type is to design, construct, and operate research equipments which are more complex or expensive than a single academic institution is able or willing to handle, and to make the equipment available to any qualified scientist. In the case of radio astronomy, this does not mean just large expensive structures. It also means electronic receiving equipment, data output systems, complex antenna arrays, data processing systems, etc.

I believe there is a need for the NRAO. Radio astronomy research requires large, expensive structures and complex electronic and antenna systems. The design, construction and operation of such systems in turn requires a permanent staff with a wide variety of talents. To keep even an 85-foot telescope adequately instrumented and maintained requires the services of a considerable number of people. It is hardly feasible for a university to provide a large, skilled supporting staff for two or three astronomers. It is feasible for the NRAO to provide such a staff, and to make the equipment available to any astronomer with a good idea.

Thus there are, in my view, two almost unique features of the National Observatory -- visitors, and the supporting staff. If the Observatory could fulfill its primary purpose without a permanent scientific staff then there

would be little reason for having one. But the permanent scientific staff is essential to the purpose of the Observatory. The national function of the Observatory is accomplished almost entirely as a result of staff research. The staff scientists, through their research activities, provide the need for, and means of development of, the supporting staff -- telescope operators, engineers, technicians, etc. -- without whom the Observatory could not function. They provide most of the ideas for and development of new research equipment. They give advice and assistance in many ways to visitors with observing programs. Without a research staff actively engaged in their own research, the special obligations of a national observatory cannot be adequately met. The fulfillment of these obligations, through staff research, is largely dependent on the close relationship of the scientists with the supporting staff, the visitors, and the telescopes. Too great a physical separation between the scientists and Green Bank would not be good.

During the coming years, I believe NRAO will be engaged in at least four major developments:

(1) The construction of large parabolas. The trend will probably be away from fully steerable instruments, towards greater utilization of partial steerability through multiple feed and receiver systems, movable feeds and/or Cassegrain systems, and radiometer improvements. Green Bank is now, and should remain, the focal point of these developments.

(2) The development of a very large array. This instrument probably cannot be at Green Bank because of space limitations. It is likely that the site will be less accessible than Green Bank, and less habitable. The nature of operations at the array site will be very different from those at Green Bank because of the different nature of the instruments. The array will be a very complex system, not as flexible of use as a single parabola. It will not be feasible, for example, for visitors to use their own radiometers, since the electronics are an integral part of the system. Individual staff and visiting scientists will have much less direct contact with the instrument than they do with a single parabola. It is probable that the array output will not be combined in real time. Instead, all the individual outputs may go on tape, in which case the real scientific work of an observing program will be done at the NRAO offices in processing and analyzing the data. Development work leading to the array, and future modifications will all be done, and the equipment tested, at the scientific offices and Green Bank.

(3) The development of millimeter wave astronomy. The development work will be done at the scientific offices and at Green Bank. Ultimately a small mountain top site will be needed for observing.

(4) A greatly increased development of data acquisition and processing systems.

Thus the NRAO will probably have at least three observing stations -- Green Bank, the array station, and the millimeter wave station. The activities at Green Bank will be much more varied than at the other sites, the bulk of the staff will be at Green Bank, and visitor activity will be greater at Green Bank than at other sites. The scientific staff and visitors will divide their time primarily between Green Bank and the scientific offices. From the standpoint of future developments, as well as from the standpoint of present activities, it seems desirable to locate the scientific offices as close to Green Bank as is reasonably possible.

Establishment of a Charlottesville office falls naturally into two phases. In the first phase -- the initial move -- only the scientific staff and a small number of supporting personnel will move. By keeping the initial move small it is easier to accomplish and administer, avoids a major disruption of the present NRAO organization, minimizes the impact on the staff and the Green Bank community, and avoids establishing too set a pattern of operation prior to actual experience in this type of split operation. In the second phase, which will occur gradually over a period of time, the Charlottesville office will be expanded and more administrative functions concentrated there until finally Charlottesville becomes both the scientific and the administrative headquarters of the NRAO. This development is tied to the general growth of the NRAO.

This report discusses various aspects of the initial move in some detail, and attempts to give a general picture of how the NRAO and the Charlottesville-Green Bank sites may develop in the future. It would be difficult and probably unwise to establish in a definitive way now the future detailed organization of the NRAO and the way in which various activities and functions can best be split between Green Bank and Charlottesville. The report is necessarily somewhat vague in regard to some of these areas; in other cases the report describes only preliminary ideas, many of which will undoubtedly be modified as we gain experience in a two-site operation.

1. ORGANIZATION OF GREEN BANK - CHARLOTTESVILLE

Initially, the Charlottesville office will comprise the smallest number of people, consistent with the primary purpose of the move, that will make a reasonably self-contained group. The scientific research and development staffs will form the nucleus of the Charlottesville office. With them must be certain supporting personnel and facilities. All observing activities, and most administrative and business functions, will remain at Green Bank.

The specific breakdown of activities between Green Bank and Charlottesville will be as follows:

Charlottesville: Director's office, scientific staff headquarters, scientific services (library, computer, photographic and drafting facilities), design and development of new systems and equipment.

Green Bank: Telescope operations, electronic equipment construction and maintenance, scientific services, plant maintenance and engineering, business, fiscal.

Scientific services have to be provided both in Green Bank and Charlottesville, and some duplication of activity will occur. Computing facilities will be needed at both locations -- at Green Bank because scientists will spend considerable time there during observing and development programs, and a computer is needed for preliminary data processing, etc. -- and at Charlottesville because the bulk of the reduction and analysis work will be carried out there. The computing facilities now at Green Bank will probably be adequate for a long time. A large computing facility will have to be built up in Charlottesville. Preliminary discussions with the University indicate that their computing facility will probably not be adequate for our needs.

A library will be needed both at Green Bank and at Charlottesville, but both libraries can be restricted to the books and periodicals regularly needed. Ready access to the University libraries obviates the need for development of a very large, comprehensive library.

A small darkroom and drafting facility will be needed in Charlottesville, in addition to that at Green Bank.

Electronics laboratory facilities and equipment will be needed at both locations. Initially, the Charlottesville laboratory will be kept minimal, with the principal electronics laboratory remaining at Green Bank. With time the laboratory at Charlottesville will be further expanded. Its function will be primarily design and development of new antenna and radiometer systems and components. Construction, testing and maintenance of equipment will be primarily at Green Bank.

To carry out the above concept, the following people will move to Charlottesville initially:

Director's Office

J. W. Findlay
D. S. Heeschen

Howard

Scientific Staff

F. N. Bash
D. E. Hogg
B. Hoglund
H. Hvatum
*H. M. Johnson
N. J. Keen
F. J. Low
T. K. Menon
P. Mezger
I. Pauliny-Toth
*P. Stumpff
S. von Hoerner
C. M. Wade

Robert

Scientific Services

L. Ness
~~V. G. Scott~~
~~R. L. Uphoff~~
One draftsman

↑
Weller ??
v

BIRD
KAISER

ROSE + 1 OTHER OPERATOR
FRIEL ?

Electronics

J. Bringe
~~B. Hansson~~
A. Shalloway

Thus 22 of the present NRAO staff of 150 would be involved in the initial move. In addition, 3 secretaries, 2 computer programmers, 2 research assistants, 2 electronics technicians, and an assistant to the Director will be recruited in Charlottesville, bringing the initial Charlottesville staff to a total of about 32. Any new scientific staff members recruited prior to the move would also move to the Charlottesville office.

2. SCIENTIFIC AND DEVELOPMENT ACTIVITIES IN THE SPLIT OPERATION

The scientific staff will be headquartered at Charlottesville. In general, it will be the rule that a scientist with an observing program must be at Green Bank during the period his program is being carried out on the telescope. Observing "in absentia" by either staff or visiting scientists will be discouraged. Various arrangements are possible. A scientist may move to Green Bank with his family for a period of weeks or months while he is observing. In this case he would undoubtedly return to Charlottesville periodically for short periods for consultations with his colleagues, colloquia, etc. In other cases the scientist may wish to spend 3 or 4 days a week in Green Bank while observing and the remainder of his time in Charlottesville. A person engaged in experimental work or the testing of new equipment may follow a similar schedule. We estimate that a staff member primarily interested in observational work will spend, on the average, 25% of his time in Green Bank.

A visitor to the NRAO for a relatively short period of a few weeks to a few months will probably spend most of his time in Green Bank, if observing is the purpose of his visit. Some short term observing visitors may prefer to make Charlottesville their base, and spend 3 or 4 days a week in Green Bank. Longer term visitors will probably follow the pattern described above for the staff. In any event, most observing visitors will spend some time in Charlottesville, prior to beginning their observing program, in order to plan the program, discuss equipment, calibrations, observing techniques, etc., with the staff. Visitors whose primary interest is other than observing would be based in Charlottesville, and in some cases would make short visits to Green Bank.

Computer facilities for preliminary data reductions, a library, offices, housing, the cafeteria, and technical assistance will be available in Green Bank for visitors and staff.

Lengthy data reductions, analysis, program preparation and all general scientific work other than observing will be concentrated in Charlottesville. The design and development of new systems will also be in Charlottesville. Most construction, testing, and modifying of new equipment will be in Green Bank. There will be no observing equipment in Charlottesville, and no extensive shop or laboratory facilities.

Research and development work on new observing systems and components, particularly that which requires close cooperation between the scientific and technical staffs, will be done primarily in Charlottesville. In general, a project will be carried through its initial phases in Charlottesville -- idea, study of feasibility, planning, design, prototype breadboarding and testing. The Green Bank laboratory will be responsible for maintenance of electronic systems, repair and calibration of test equipment, and final construction and test of equipment and systems. Basically, Charlottesville will

be the design and development lab and Green Bank the operating and maintenance lab, although there will, of course, be a great deal of overlap and interaction between the two groups. The primary emphasis in Charlottesville will be on systems development -- the large array and its complex problems, radiometer systems for parabolas, data processing systems. The group in Charlottesville will consist principally of scientific specialists in various fields, with a relatively small supporting staff of technicians. Routine electronic work and electronic services to the scientific programs of the Observatory will remain concentrated in Green Bank.

Taking into account both observing and experimental work, we estimate that there will be, on the average, 5 to 7 scientists at Green Bank at any time shortly after the move to Charlottesville. As the staff grows and visitor activity increases, this number should more than double within a few years time.

The necessity for spending part time in Green Bank and part time in Charlottesville may impose some hardships on the scientific staff. They may spend more time traveling and more time away from their families. However, the disadvantages should be more than compensated by the advantages -- better living conditions, better contacts with other scientists, greater intellectual stimulation, fewer distractions from their scientific work while at Green Bank, a generally better climate for creative thought and work.

An observing scientist may spend, on the average, one week in four observing at Green Bank. In addition, he may make one or two shorter trips, of one or two day's duration, to Green Bank each month for consultations, etc. These trips would require 5 to 15 hours of travel time per month. This can be compared with the time now spent traveling by the staff which would not be required if they lived in Charlottesville. A poll of the staff showed that they now spend, on the average, 10 hours per month traveling to such places as Elkins (3 hours round trip), Staunton (4 hours), or Charlottesville (5 hours) for shopping, medical care, etc. Virtually none of this travel would be required of a person living in Charlottesville. Thus, while some people may spend somewhat greater time traveling, for many the time spent will be no greater, or even less, than now.

The very important relationships between the scientific staff and the supporting staff of telescope operators and technicians should not be impaired by the move to Charlottesville. Close contacts will be maintained through the observing and development work carried out at Green Bank, and the permanent scientific staff will continue to provide the necessary continuity of contacts. Further, if the move accomplishes its main purpose -- to increase the general scientific productivity of the NRAO -- the contacts between scientist and technical staff will increase.

The net effect of the move on the visitor program of the Observatory should be to considerably strengthen it. There should be an increase in

the number of long-term (6 months to one year) visitors to the Observatory who will spend only a part of their time observing, or do no observing at all. A number of astronomers have at various times expressed interest in spending a semester or a year at the NRAO, but have been reluctant to do so because of the isolation of Green Bank. It will be possible to attract some of these people to Charlottesville.

Visitors who spend most of their time observing at Green Bank will find their situation relatively unchanged by the move. They will have essentially the same contacts with our staff members that they now have -- one type of contact based on the assistance with equipment, program planning, observing and calibration procedures we give visitors -- a second based on common interests in the work. The move, by making it easier to strengthen our staff should in fact strengthen our ties with visitors and increase the variety of visitor associations, both in Green Bank and in Charlottesville.

3. MANAGEMENT OF THE SPLIT OPERATION.

Initially, all management and administrative functions, other than direct scientific planning, will remain in Green Bank, although some of the people involved will move to Charlottesville. The present senior administrative staff of the Observatory is:

- D. S. Heeschen, Director
- J. W. Findlay, Deputy Director
- F. J. Callender, Head of Business Office
- J. F. Crews, Head of Telescope Operations Division
- H. Hvatum, Head of Electronics Division
- W. W. Pleasants, Head of Engineering and Plant
Maintenance Division
- T. R. Riffe, Head of Fiscal Division

Of these, Heeschen, Findlay, and Hvatum will move to Charlottesville initially. The others remain in Green Bank. These three move because they must lead the scientific and instrumental development program of the NRAO, and must therefore be in close contact with the scientific staff. At the same time, to maintain their necessarily close contacts with the other administrative officers and with activities at Green Bank, they will have to spend considerable time at Green Bank. The regular weekly staff meetings of this administrative group will continue to be held in Green Bank.

The business matters of the Charlottesville office will be handled initially by the Assistant to the Director, who will act as Charlottesville office manager.

Administrative functions at Green Bank can be roughly divided into three areas: 1) those which pertain directly to the scientific work of the Observatory, namely, scientific services, electronics, and telescope operations; 2) those which pertain to the operation of the Green Bank facility, plant maintenance and engineering, administrative services, business operations, etc., and 3) those which pertain to the management of the NRAO as a whole, fiscal, budgets, contracts, etc. Broadly speaking, the first and third areas will be administered by division heads in Green Bank who will report directly to the Director's office. In the cases of scientific services and electronics, the persons in charge at Green Bank will be responsible to the heads of the corresponding divisions in Charlottesville. The fiscal and budget officers in Green Bank will report to the Director, and eventually these functions will be consolidated in Charlottesville. The second area of management activities will be headed by a resident Green Bank Facility Manager who will report to the Director. In addition to direct responsibility for the activities outlined in area 2, the Facility Manager will be the senior administrator in residence at Green Bank and will have authority over all activities, in all areas, that relate directly to the non-technical operation of Green Bank.

4. PROBABLE FUTURE DEVELOPMENT OF THE NRAO

The future development of the NRAO, and how it relates to the Charlottesville office, cannot be stated definitely because there are so many unknowns. In particular, it appears desirable to gain experience in operating from two locations before deciding how various activities will ultimately be split between Green Bank and Charlottesville. Nevertheless, a probable general development is suggested below. This development is based on the following premises.

1) Instrumental development at NRAO in coming years will be primarily in the areas of:

- a. A very large array - the VLA - of antennas to give resolution of the order of seconds of arc.
- b. Larger parabolas, the greater utilization of transit instruments through moving feeds, multiple feeds, etc.
- c. Millimeter wave instrumentation.
- d. Data handling, reduction and analysis equipment and techniques. This is a necessary adjunct to the VLA development and to the greater utilization of large parabolas.
- e. Development of radiometer systems, and low noise devices including antenna feeds.

2) Because of its nature, the VLA will probably be in a remote western site.

3) The millimeter wave observing site will be a mountain-top, probably in the west.

4) Parabolas, and experimental development and test work, will be concentrated at Green Bank.

5) The scientific, engineering and technical staff needed for the VLA and data handling development is now essentially non-existent, and must be recruited to Charlottesville.

The scientific motives for these developments are primarily:

1) Studies of extragalactic radio sources, from the standpoint of their physical characteristics, class characteristics, and evolution.

2) Studies of galactic discrete sources - same reasons.

3) Galactic and extragalactic H I studies.

With time, the Charlottesville office will be enlarged. The research staff will be increased. An applied math and computer operations group will be built up. A development group, consisting of scientists, engineers and technicians, will be built up to develop new antenna systems, radiometers, and other equipment. This expansion of the research and development staff in Charlottesville will be achieved primarily from new recruitment rather than from the transfer of additional people from Green Bank to Charlottesville. The first move to Charlottesville leaves the present electronics and engineering activities and staff at Green Bank almost unchanged. Whether many of the existing staff in these areas will move eventually to Charlottesville is not clear, and we plan to let this be decided through experience and need.

As the Charlottesville office grows and as the $MM\lambda$ and VLA sites are developed, it will probably be desirable to consolidate the top administrative and management staffs in Charlottesville. Thus, eventually, the chief fiscal and business officers, and some of their staff, will move to Charlottesville. How business and accounting activities will be split between Green Bank and Charlottesville is left undecided for the present. Again, some experience should aid in a proper solution.

This all leads to the following general pattern by perhaps 1970. The Observatory will probably have four sites -- Green Bank, Charlottesville, and the $mm\lambda$ site and the VLA site. Administrative and management headquarters will be in Charlottesville. The research staff will be headquartered in Charlottesville. Development of new antenna systems and equipment, up to the building and experiment stage, will be in Charlottesville. Green Bank will be the principal observing and experimental location. The observing instruments at Green Bank will consist mainly of versatile large parabolas, and the 2-element, variable baseline, interferometer. Experimental work,

building and testing of prototype equipment, modifications and improvements to existing equipment will be concentrated largely at Green Bank, but some will also be done in Charlottesville. The exact division between Green Bank and Charlottesville of these types of activities is as yet undefined. The mm λ and VLA sites will be only observing stations, as opposed to Green Bank and Charlottesville, where there are many other activities as well. The staffs at these two sites will consist primarily of telescope operators and maintenance people. Business operations will be divided between Green Bank and Charlottesville in an as yet undefined way. Probably the bulk of these activities will remain in Green Bank, where there will always be the largest staff and the most diversified business and experimental activities of any of the locations. Top management will, however, be in Charlottesville.

These ideas about the development of the NRAO are summarized in Table 1 and Figure 1.

TABLE 1

NRAO Staff
(full time)

<u>A. Charlottesville</u>	<u>Now</u>	<u>1965</u>	<u>1970</u>
Director's Office	--	5	8
Research Group	--	13	20
Development Group	--	6	20
Scientific Services	--	8	20
Business	--	0	5
Fiscal	--	0	5
Total Charlottesville	<u>0</u>	<u>32</u>	<u>78</u>
<u>B. Green Bank</u>			
Director's Office	4	0	0
Scientific Services	16	8	8
Telescope Operators	18	25	40
Electronics	33	30	30
Engineering	9	12	12
Business	23	23	20
Fiscal	9	9	10
Plant Maintenance	27	35	35
Research Group	<u>12</u>	<u>0</u>	<u>0</u>
Total Green Bank	151	142	155
<u>C. Millimeter Wave Site</u>			
Telescope Operators, Maintenance, service	0	0	5
<u>D. VLA Site</u>			
Telescope Operators, Maintenance, service	<u>0</u>	<u>0</u>	<u>20</u>
Grand Total	151	174	258

Figure 1a

Present NRAO Organization

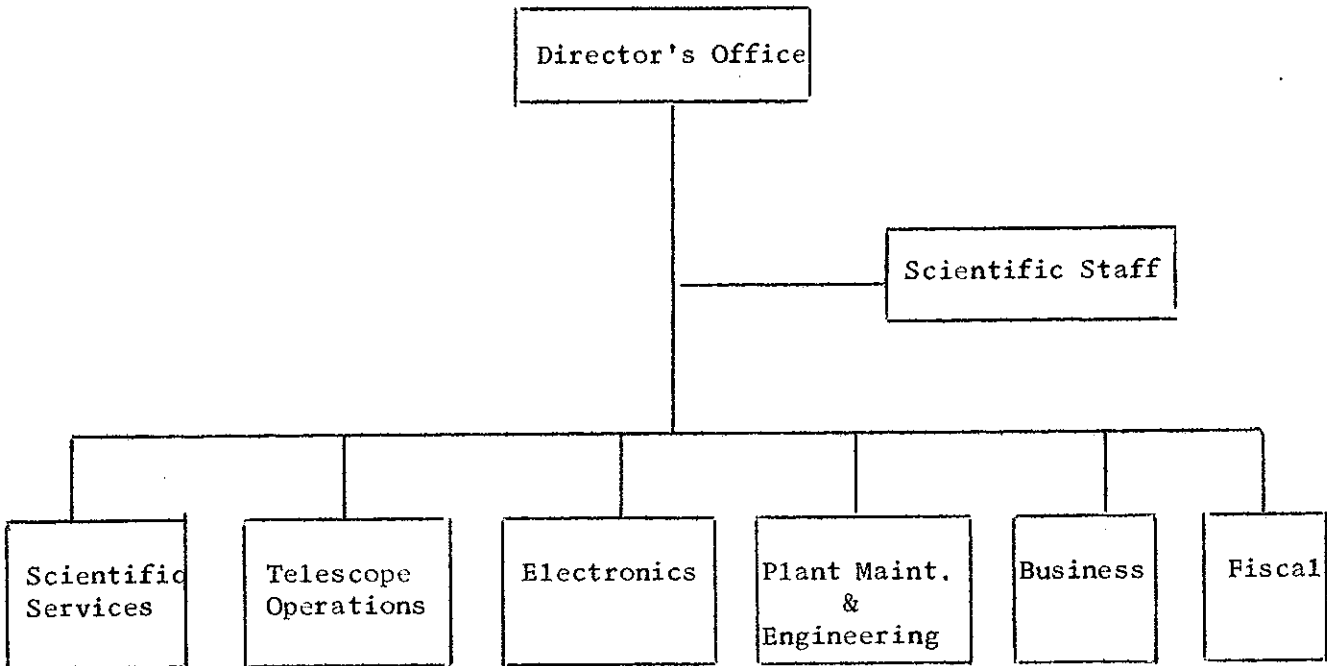


Figure 1b

Probable Organization after Charlottesville Move

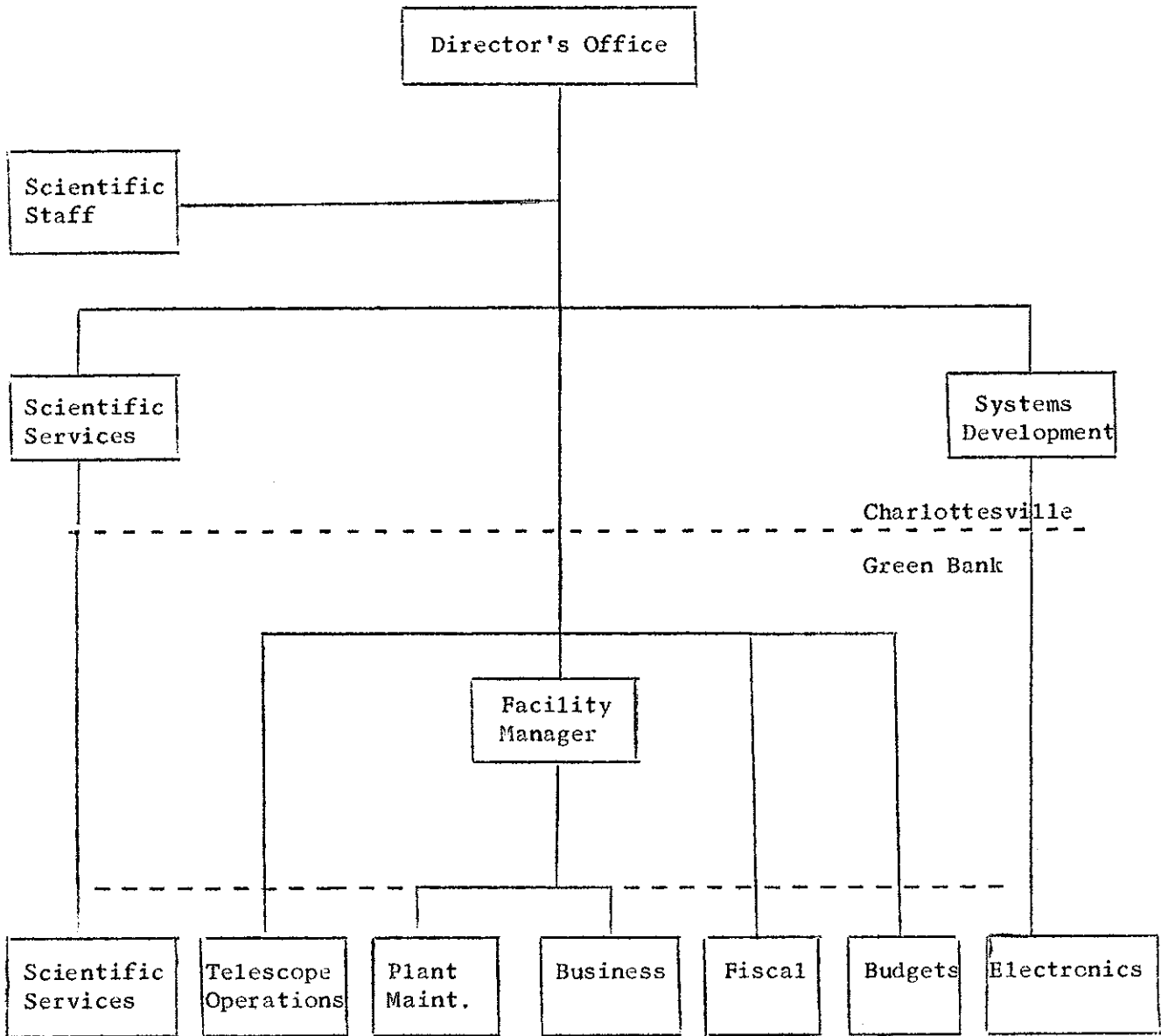
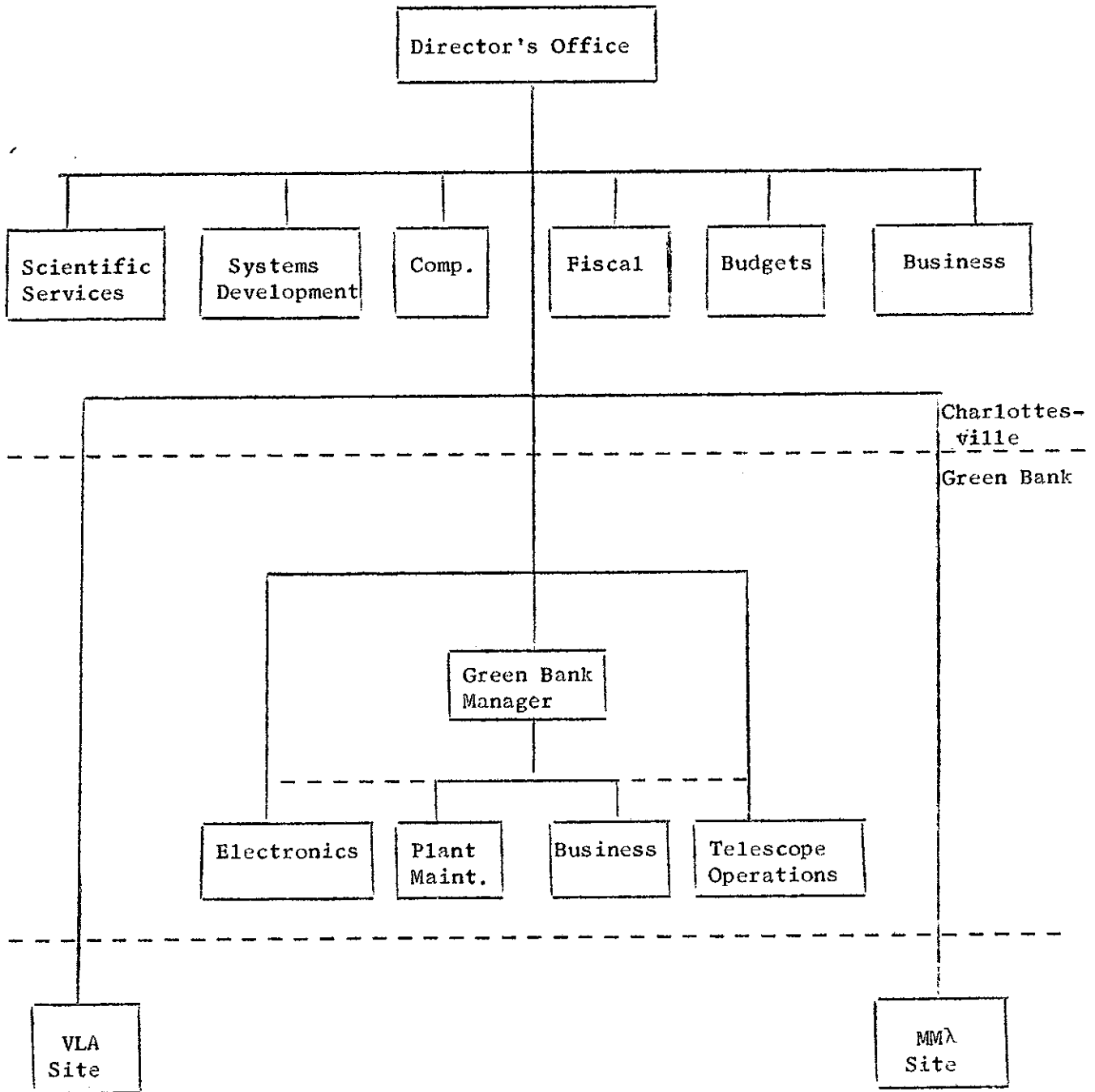


Figure 1c

Possible Future Organization of the NRAO



5. TRANSPORTATION AND COMMUNICATIONS

There will be a regularly scheduled automobile service between Green Bank and Charlottesville. The frequency of service will have to be determined by need -- a minimum of three round trips per week will probably be required initially. In addition, one government car, one AUI car and one pickup or panel truck should be provided in Charlottesville. Driving time between Green Bank and Charlottesville is about 2-1/2 hours in all but the very worst winter weather.

The Observatory should also provide airplane service between Green Bank and Charlottesville. At first this may best be on a irregular "on call" basis, but ultimately it should be feasible to have regular round-trip service two or three times a week, or even daily. This can be done on a lease basis such as that currently being used by AUI at Brookhaven. A 3000 foot landing strip now exists on the Observatory grounds at Green Bank, capable of accommodating a twin-engine, five place aircraft. Flying time between Charlottesville and Green Bank is less than one hour. Reliable air service is possible about 9 or 10 months of the year. Based on the current experience of AUI at Brookhaven and quotations from local air services, the cost of this service runs approximately \$20,000 annually, assuming the order of 700 hours flying time per year.

Truck transportation of equipment, materials and supplies between Green Bank and Charlottesville generally will be handled by the Observatory.

It may be desirable to have a direct telephone line and/or TWX service between Green Bank and Charlottesville. The cost of a direct telephone line is \$247 per month. Green Bank already has TWX equipment. Similar equipment installed in Charlottesville would cost about \$50 per month. The rapid transmission of written information, instructions, etc., between the two sites would be an invaluable aid to efficient operations.

Commercial transportation facilities between Charlottesville and major cities in the east are adequate. The Chesapeake & Ohio and Southern Railways both serve Charlottesville. The C&O operates two passenger trains daily, each way, between New York, Washington, Charlottesville, and Chicago. The Southern Railway has four passenger trains daily, each way, between the south, Charlottesville, Washington, and New York.

The Trailway Bus Lines service the area with frequent daily schedules, and charter, freight and express package service.

The Charlottesville-Albemarle Municipal Airport is located approximately eight miles from the city. It is served by Piedmont Airlines, which maintains 15 scheduled daily flights to various cities in the east and south. In particular, there are seven flights daily from Washington, D. C. to Charlottesville, and five from Charlottesville to Washington.

2964
247
12
494
247

6. PERSONNEL POLICIES - TRAVEL AND HOUSING

A. Travel expenses for people who come to Green Bank from Charlottesville will be as follows:

1) Transportation by NRAO vehicle, preferably with a driver supplied by NRAO.

2) Transportation by private automobile in each case must be approved by Director's office in advance of trip. Mileage will be allowed at 8 cents per mile for the roundtrip only (Charlottesville to Green Bank and return). This mileage will be computed in advance and no other mileage -- for incidental travel at Green Bank -- will be reimbursed.

3) Lodging while at Green Bank. All persons from Charlottesville will be housed in Observatory quarters while at Green Bank. There will be no charge to the individual during his stay, nor will he be required to file a travel claim. However, it will be necessary that he sign for a room when he comes on site and also when he departs. This requirement will satisfy the accounting needs as to where the charge for the lodging is to be recorded. Also, the need for adequate tax records (State -- Virginia and West Virginia) will be satisfied as there will be a permanent record of the number of days a person is in each State (unless income tax reciprocity can be agreed to by West Virginia and Virginia, it may be necessary that individuals with dual duty stations file tax returns in both States).

4) Meals while at Green Bank. Persons on detached duty from Charlottesville to Green Bank may take all their meals in the Observatory cafeteria. There will be no charge for these meals, nor will the person be required to file a travel claim. Instead, each person will be required to sign a "meal-chit" for each meal taken. (This would not include coffee, donuts, or in-between snacks for which the employee will be expected to pay, but does include sandwiches, etc., for night observing)

B. Persons who travel from Green Bank to Charlottesville.

Since there will be no Observatory owned facilities (dining and lodging) at Charlottesville, the regular NRAO travel regulations will apply to persons stationed at Green Bank who will be required to travel to Charlottesville.

C. Housing Policy at Green Bank.

The recently established housing policy must be reviewed. Some changes may be desirable, but it will still be necessary to retain a housing policy which encourages people to establish their own residences in the Green Bank community, rather than stay indefinitely in Observatory housing.

7. IMPACT OF MOVE ON NRAO MORALE, RESEARCH PROGRAMS, DEVELOPMENT WORK

The effects of the move on the scientific research and development work will be good in the long run. There may be a period both before, during and after the move where work will be slowed down. During this period uncertainties may lead to a temporary loss of good morale. There are a number of fairly simple things which can be done to minimize ill effects, but the main preventative of difficulty will be the fact that as the scientific staff in its new location becomes more active, the quality and quantity of good scientific work will grow. This will have a good and strong reaction on the whole staff.

The following things will be done to reduce any temporary disadvantages before and after the move.

a) Before the move, but when the plans are announced, supervisors will talk informally with their staff to make sure that the purpose of the move is understood, and to clear up any questions about possible effects on the employees individually.

b) For the period following the move the staff at Charlottesville will spend perhaps rather more time than is strictly necessary at Green Bank. In addition to the weekly senior staff meetings, other meetings, colloquia, etc., will be held -- some at Green Bank and some at Charlottesville.

Problems needing discussion between personnel at Green Bank and Charlottesville will, as far as possible, be worked out by meetings at Green Bank.

c) The Director and Deputy Director will spend a lot of time at Green Bank, and will watch with care to see that the correct and productive way of work and thinking is followed. This will be very much a matter of watching that small details of disagreement do not grow into large differences of opinion.

If these matters are watched with care for the first six months to a year after the move, the eventual gain in better staff and better research will result in a good relationship between Charlottesville, Green Bank, and any other more distant sites which may come into use.

8. POLITICAL AND COMMUNITY RELATIONS ASPECTS OF THE MOVE

The establishment of an office in Charlottesville will have effects at various levels throughout the government as well as in the scientific and the local community. From evidence already available it can be assumed that the reaction of most scientists will be very favorable. Local businessmen will lose some business, and the local community as a whole may fear that the move will result in a lessening of support of the

schools, public library, etc., by the Observatory and Observatory people. The move may also be interpreted in local and state circles as a first step in moving out of Green Bank. Therefore, the state and local political reaction may be decidedly unfavorable.

It is desirable that we maintain good relations with state and local leaders. We should emphasize to them that the anticipated effect of this move is a strengthening of Green Bank, and increased activity and instrumentation in Green Bank. The move in no way lessens our commitment to Green Bank, nor does it decrease our need for assistance from state and local leaders to protect Green Bank from interference, and improve local conditions to make them amenable to the staff and the community.

The best counter to a possible unfavorable reaction lies probably in early discussions of the plans with various key people, and in a full description of the reasons for the move, our expected effects of the move, and our general plans for the further development of Green Bank as soon as the news is released. We should emphasize the following points:

- a) The move will involve only 22 people -- a small fraction of the Observatory staff.
- b) There will be no decrease in the Observatory's interest in community affairs -- the school, library, medical facilities, emergency ambulance and fire service.
- c) The move is designed to strengthen the Observatory, and should lead to increased activity at Green Bank, and therefore to an increased impact of the Observatory on the community.
- d) There is no change in the long range plans for additional instruments at Green Bank. The move does not involve a new observing site at the expense of Green Bank.
- e) The move is being made because of the need for academic ties, rather than because of any imagined fundamental deficiencies in the Green Bank area.

If we take adequate care in warning and informing various interested people, the over-all political and local reaction should not be serious. The following course of action might be considered, to achieve the best understanding of our reasons for a move and our plans.

a) Early warning: An early warning phase could be valuable, and it might be desirable to start it soon. In this phase we should tell the following people of our ideas. We should say we are in the discussion stage, the move may affect only 22 people, and that NRAO remains in strength at Green Bank. We should be prepared to give an approximate date by which NSF/AUI would probably make an announcement, and we should say that premature release would be unhelpful. The people to be informed are:

The W. Va. Congressional Delegation
Governor Barron
The State Legislators from this region

b) Release of Information: We should have a press release from NSF/AUI as soon as possible after a decision is reached. It should be brief and not sounding too important, and again should emphasize that the main functions and size of the NRAO at Green Bank will hardly alter. This release could go to the above list a short time before the press release date.

c) Local Information: It might be well to inform the NRAO staff (and thus through them the local community) immediately after AUI/NSF approval. A copy of the press release, perhaps amplified by a note from the Director, would do.

9. WHY NOT THE UNIVERSITY OF WEST VIRGINIA OR SOME OTHER COLLEGE OR UNIVERSITY?

West Virginia University, at Morgantown, is about the same distance from Green Bank as is Charlottesville. There are two main considerations which led to the selection of Charlottesville rather than Morgantown.

- a) West Virginia University has no astronomy department. The University of Virginia has an active astronomy department (3 faculty members, 2 vacancies), an excellent astronomical library, and an optical observatory.
- b) Morgantown is difficult to reach from any major city except Pittsburgh. It is served by Lake Central Airlines and has one flight per day to Washington and three to Pittsburgh. Charlottesville is much easier to reach, by road, rail or air.

Other universities and colleges in the Virginia-West Virginia area are either much smaller than the University of Virginia, or much more difficult to reach from Green Bank, or both.

10. INITIAL BUILDING AND FACILITIES NEEDED IN CHARLOTTESVILLE

A new building will be built in Charlottesville for the offices there. It will cover about 20,000 square feet and will contain offices, laboratories and a small shop, a computer center, library, colloquium room, and small conference room. The building will be designed in such a way that it can later be expanded.

There have been strong indications that the University would make some of its land available to AUI. The site is highly desirable, in that it is within easy walking distance of other university buildings housing the Physics and Engineering Departments.

Apparently, outright purchase is not practical. However, a long-term lease appears to be entirely feasible, and there is ample precedent for the expenditure of Federal funds for the erection of buildings on privately-owned property under a variety of arrangements. In most cases, the building or other structures is erected for the use of the owner of the land, whereas AUI would only be a tenant. The University would be the owner. However, in one case, a university has leased land to the Government for use under a contract between the Government and the university with provision for use by other contractors with the Government, if the contract were terminated before the expiration of the lease. There is also a precedent at the University of Virginia itself. One of the buildings used for certain types of engineering research was erected by the Federal Government on university-owned land under an agreement which provides that title to the building remains in the Government, which also specifies the type of research for which it can be used.

Therefore, it would appear practical for AUI to rent the land, with its own funds, if necessary, and for a building owned by the National Science Foundation to be erected thereon.

If for any reason a lease proves impractical, other land, at a distance of about a mile from the University, is available for purchase. The entire tract is about 50 acres, but it would probably be possible to buy a smaller amount -- say five acres -- at a price of about \$4,000 per acre.

It is estimated that a building will cost about \$30 a square foot. (The University is just completing a Life Sciences building at a cost of \$25 a square foot, and is in the final design phase of a new Chemistry building which they estimate at \$30 a square foot. These buildings are roughly similar in quality and complexity to that we will build.)

The Observatory has already budgeted \$700,000 (subject to Congressional action on the FY 1964 budget) for a new building, since one would have been needed even without the move to Charlottesville.

Janitor and maintenance service have been offered, on a contract basis, by the University if we build on their land.

11. COST OF MOVE

i. Cost of building.

Estimated at \$700,000, which also includes cost of A/E services, utilities, parking areas, walkways, and roads.

ii. Relocation costs.

There are 22 persons who will be required to move immediately. Not all of these have families, nor do they all own their furniture. However,

relocation costs for the group is estimated on the average cost to move a family (possessions) a distance equal to Green Bank and Charlottesville. The cost to move 8500 lbs. of household possessions for 95 miles is \$393. Therefore, we should allow $\$400 \times 22 = \$8,800$ to move our employees.

In addition to moving the employees, we will need to move a certain amount of files, stored documents, etc. However, no "extra" charges to the NRAO budget will be incurred since the items will be moved in NRAO vehicles.

iii. Reimbursement for real estate losses.

Only two people who will move initially own their homes in Green Bank (Heeschen and Wade), and the established "housing guarantee" should apply to any loss incurred. In all probability it will not be possible to sell these houses as soon as an announcement of a move of part of the NRAO staff is made, and AUI may wish to underwrite the total amount and hold them until the initial impact of the move has subsided and the market returns to normal. In the meantime, AUI could hold the houses as rental property.

The estimated value of these two houses is about \$38,000.

iv. Cost of facilities.

a) Library. The present cost of the Green Bank library is about \$65,000, exclusive of periodicals and general operating costs. About \$10,000 of the \$65,000 has been for capital equipment (chairs, tables, lamps, shelving, etc.) and the remainder for books. To duplicate the present library we should allow at least \$65,000.

b) Computers. Since computers will be rented and this will be a recurring (annual) cost, and money is provided in the forthcoming budget for an additional computer, this cost has not been considered as a cost of the move. However, certain auxiliary equipment will be required which will need to be purchased (card racks, plug boards, 6 Freiden calculators, etc.). The cost of which should be about \$8,000.

c) Office furnishings and equipment. The cost to furnish offices at Green Bank is about \$500-\$600 per office. Since about 30 people will initially move in to Charlottesville, we should allow \$18,000 ($30 \times \600) for office furnishings and \$12,000 for miscellaneous furniture, i.e., lounge furnishings, water coolers, dark room furnishings and equipment, typewriters, etc., or a total of \$30,000.

d) Laboratory equipment. To equip a minimal laboratory at Charlottesville with research and test equipment will require about \$50,000. However, much of this equipment is already on hand and would merely be transferred to Charlottesville. The remainder could easily be purchased with current funds already available.

The bulk of this cost would be incurred even without a move since a building and increased equipment for computers, library, offices, and laboratory would in that event be needed in Green Bank. The items have all already been planned and budgeted. The only real costs resulting directly from the move are the relocation expenses and real estate losses. The latter should in time be at least partially recovered.

SUMMARY

Item	Operating	Capital	AUI	Total
Building		\$700,000		\$700,000
Relocation of employees	\$ 8,800			8,800
Real estate losses			\$38,000	
Library	55,000	10,000		65,000
Computers		8,000		8,000
Office furnishings		30,000		30,000
Laboratory		50,000		50,000
Total	\$63,800	\$798,000	\$38,000	\$899,800

There will be a small, continuing, added operating cost as a result of the split operation. There will be a small increase in staff, to handle transportation between the two sites, and because of a little duplication of personnel in some support activities. In addition, there will be increased travel costs. In general, however, operating expenses will not be effected -- the growth of the Observatory and of its operating staff and facilities, such as computers and library, are simply split between two locations.

There will be no decrease in utilization of the capital assets such as buildings and housing at Green Bank. The present main building is overcrowded now, and the removal of 22 people will hardly be noticed from the standpoint of availability of space. The housing situation will be relieved somewhat by the move, but the relief will be temporary and all Observatory houses will continue to be almost fully occupied.

12. EFFECT ON FY 1965 BUDGET

A preliminary examination of the FY 1965 budget indicates that it is adequate to cover the small additional costs incurred by the move, provided the budget is not cut significantly by the NSF or the Congress, and provided the FY 1964 budget is not seriously cut by the Congress.

13. RELATIONS WITH THE UNIVERSITY OF VIRGINIA

A number of discussions have been held with various University officials. Heeschen has talked with Jesse Beams, Physics Department, F. L. Hereford, Dean of the Graduate School of Arts and Sciences, L. R. Quarles, Dean of the Engineering School, and L. W. Frederick, Chairman of the Astronomy Department and Director of the Leander McCormick Observatory. Reynolds, Dunbar and Heeschen met with Dr. E. F. Shannon, President of the University. Dunbar and Heeschen met with the University Comptroller, Mr. Vincent Shea. The reaction of all of these people was highly encouraging. They appear to welcome the possibility of the NRAO establishing offices in Charlottesville, and all were helpful in offering assistance and information about the University and the town.

As mentioned earlier, the University has offered the use of land, and of janitor and maintenance service. The scientific people -- Hereford, Beams, Quarles and Frederick -- all expressed a desire for close scientific relations. The University libraries will of course be available to our staff, as will the opportunity to participate in colloquia, and other activities. Shea indicated that the NRAO would be considered part of the "University family", that our scientific staff would be invited to join the faculty club, and that the University facilities at the Old Ivy Inn (guest rooms, rooms and services for small conferences, etc.) would be available to the NRAO.

No detailed arrangements have been discussed yet, of course, and except for the land and certain services there is probably no need for any formal arrangement with the University. However, all discussions thus far indicate that our relations with the University will be very satisfactory and mutually beneficial.

14. DESCRIPTION OF UNIVERSITY OF VIRGINIA *

A. History

Chartered by the General Assembly in 1819 under the sponsorship of Thomas Jefferson, the University of Virginia officially opened for instruction on March 7, 1825. The policy-making body of the University, then as now, was a Board of Visitors, with an elected Rector or chairman.

* This section is obtained principally from a copy of a University proposal to NASA, supplied to us by Dean Hereford.

James Madison and James Monroe were among prominent members of the University's first Board of Visitors, and Jefferson himself was the first Rector.

Instruction originally was to be given on the graduate level in eight schools: ancient and modern languages, mathematics, natural philosophy (physics and astronomy), in natural history (chemistry and botany), moral philosophy (ethics and psychology), anatomy and medicine, law, and engineering. Of the original schools, Medicine, Law, and Engineering became toward the end of the century independent divisions of the University. In 1904, the School of Graduate Studies, now entitled the Graduate School of Arts and Sciences, was formally distinguished from the College of Arts and Sciences. Each of the Schools are independent, set their own standard, and recommend their own candidates to the General Faculty.

While the original organization of the Academic Schools of the University by Jefferson contemplated instruction of graduate grade in each School, the first post graduate department in the modern sense was instituted in the School of Greek in 1859. Following the Civil War a "post-graduate department" was announced for the School of Latin. The degree of Doctor of Philosophy was first awarded in 1885, but no formal departmental organization for graduate study existed until 1904. In that year the Graduate School was established to meet the requirement of the Association of American Universities, in which Association the University of Virginia was the first Southern university to hold membership.

B. Schools and Degrees

At the present time, the University of Virginia has the following colleges and schools and offers the following degrees:

COLLEGE OF ARTS AND SCIENCES
Bachelor of Arts
Bachelor of Science in Chemistry, Physics

GRADUATE SCHOOL OF ARTS AND SCIENCES
Master of Arts
Master of Science
Master of Arts in Teaching
Doctor of Philosophy

SCHOOL OF ENGINEERING AND APPLIED SCIENCE
Bachelor, Master and Doctor of Science
in
Aeronautical, Chemical, Civil, Mechanical and Electrical Engineering
Master and Doctor of Science
in
Nuclear Engineering, Engineering-Physics

SCHOOL OF ARCHITECTURE
Bachelor of Architecture, City Planning, Architectural History

SCHOOL OF COMMERCE
Bachelor of Science in Commerce

GRADUATE SCHOOL OF BUSINESS ADMINISTRATION
Master of Business Administration

SCHOOL OF EDUCATION
Bachelor of Science in Education
Master of Education
Doctor of Education

SCHOOL OF LAW
Bachelor of Laws
Master of Laws
Doctor of Juridicial Science

SCHOOL OF MEDICINE
Doctor of Medicine

SCHOOL OF NURSING
Bachelor of Science in Nursing
Diploma in Nursing

Note -- The University of Virginia confers no honorary degree.

C. Enrollment.

Detailed statistics on enrollment at the University are not available at this time. Total enrollment in 1962 was approximately 5,000, 500 of whom were in the Graduate School of Arts and Sciences. Undergraduate enrollment in the College of Arts and Sciences totaled approximately 2,100, with students coming from 39 different states. Approximately one-half of the students in the College of Arts and Sciences come from Virginia.

During the 1961-1962 academic session and summer school, 120 master degrees and 57 doctorates were conferred, of which 64 master degrees and 32 doctorates were in the pure and applied sciences.

It is anticipated and planned that the total enrollment will increase to approximately 10,000 in the next ten years. The greatest rate of growth is planned in the Graduate School of Arts and Sciences where it is anticipated that the student body will increase from the present number of about 500 to 1500. This does not include graduate students who will be in residence at the Virginia Associated Research Center. This Center will be a joint operation of the University of Virginia, Virginia Polytechnic Institute, and the College of William and Mary. It is expected that several hundred graduate students in the Sciences and Engineering will be enrolled there within five or six years.

D. Current Research Interests of Selected Scientific and Engineering Departments.

1. Physics. Nuclear physics for the study of the interaction of high energy radiations with nuclei, utilizing a 1-MEV Van de Graaf generator and a 70-MEV electron synchrotron. Solid state physics on the general subjects of the role of imperfections in the properties of crystals and the electric and magnetic transport properties of metals. Applications of ultra-high centrifugal fields to the study of basic properties of materials and low pressure interactions between molecules and rapidly moving surfaces.

2. Chemistry. Organic compounds and their reactions with ozone, analytical determination of trace elements, chemical structure of compounds with potential biological activity. The detection and determination and decay characteristics of radio isotopes, kinetics, quantum mechanical calculations and experimentation, reaction rates of organic molecules.

3. Applied Mathematics. This is a new department which will bridge the gap between pure mathematics and its application to engineering disciplines.

4. Civil Engineering and Applied Mechanics. Theoretical and experimental studies of rigid body dynamics and vibrations of short and long columns and beams; experimental bearing studies; the plasticity, delayed fracture and creep behavior of rotating metal discs; the deformation and stress analysis of rotating conical sections.

5. Electrical Engineering. Applications of the free electromagnetic suspension system, thin film junctions, nonlinear circuitry, ionization produced by heavy low energy ions in various gases, non-radio fuzing, electrostatic properties and change effects on moving bodies, auger transitions, stellar scintillations, superconducting electric motors.

6. Mechanical Engineering. Thermal transfer in low density fields, high rotational speed devices, vibrations of beams and structures, and theoretical work in adaptive controls and linear systems.

7. Nuclear Engineering. Utilizing a 1-megawatt swimming pool type of nuclear reactor with an average thermal neutron flux of about 10^{13}

neutrons per square centimeter per second -- plasma thermocouple design, direct power conversion, analog computer simulation of reactor kinetics, study of slant shielding requirements, nuclear absorption techniques, neutron activation analysis, development of solid state particle detectors and studies of their uses in neutron spectroscopy.

8. Astronomy. The Leander McCormick Observatory played an important role in astronomy around the turn of the century and for many years ranked well in the field of positional astronomy. During the past few decades, the department has not kept pace with the developments in the field. The University is taking steps to remedy this situation and has established the following goals:

- a) Construction of a new observatory to house a new 30" reflector and an existing 10" astrograph;
- b) Equipping the 30" reflector with a photoelectric photometer and a spectrograph for use with image intensifier instrumentation;
- c) Repair and modernization of the existing 26" refractor;
- d) Close collaboration with the National Radio Astronomy Observatory.

The research program, which has concentrated in astrometry, will be broadened and it is anticipated that the department will regain a significant position in astronomy.

9. Aeronautical Engineering. Low density gas dynamics, dynamic stability, magnetogas dynamics and plasma physics.

E. Major Research Facilities.

To summarize, the research interests indicated in D above are carried out in well equipped laboratories and include the following major facilities:

1. A one-megawatt nuclear reactor
2. Two medium energy nuclear particle accelerators
3. The John Lee Pratt Trace Analysis Laboratory
4. The Leander McCormick Observatory
5. A solid state laboratory including electron microscopes, X-ray equipment, etc.

In addition, in recent years the University has completed a new physics building, a computer center, and an aerospace-mechanical engineering building.

In the near future it is expected that the following additional facilities will become available:

1. The NASA 600-MEV Synchrocyclotron at the Space Radiation Effects Laboratory near Langley Field.
2. A new Nuclear Physics Laboratory which will have a new 5.5 MEV Van de Graaff Accelerator.
3. A new Chemistry Building now in the drawing stage (funds totaling \$5.1 million are in hand for this building).
4. A new observatory for the Department of Astronomy.
5. A new Life Sciences Building for biology and psychology to be occupied in the fall, 1963.

Finally, it should be mentioned that the University is developing plans for a Science-Engineering Library, a new Computer Center, an Earth Sciences Building, and an Engineering Research Building.

F. Other.

A copy of a letter from Dean Hereford is attached at the end of this report. He also supplied the following faculty salary information:

Assistant Professor	\$ 7,300 - \$ 8,600
Associate Professor	\$ 8,600 - \$11,000
Professor	\$11,000 - \$16,000

These are base salaries, for 9 months. The faculty may accept up to 3/9 of their base salary for summer contract work. In addition, there are a number of endowed positions (3 in Physics, 1 in Astronomy) with 9 month salaries up to \$21,000. These figures apply to Arts and Sciences, Engineering, and Law. The Medical School has a different system.

Science and Engineering Faculty

Department	Professor	Associate Professor	Assistant Professor
Astronomy	0	2	1
Biology	6	2	4
Microbiology	2	3	1
Biochemistry	2	1	2
Chemistry	7	4	3
Geology	1	2	2
Mathematics	4	5	3
Physics	6	5	6
Aeronautical Engineering	3	2	
Chemical Engineering	2	2	
Civil Engineering	2	3	
Electrical Engineering	4	3	
Mechanical Engineering	1	3	
Nuclear Engineering	1	1	

15. STATE FINANCIAL SUPPORT AND OTHER FINANCIAL INFORMATION
CONCERNING THE UNIVERSITY OF VIRGINIA

Although the University of Virginia is state supported, it has a considerable amount of autonomy in its financial operation. Unlike some state supported universities, all fees (tuition, sales, services, athletic receipts, etc.) are retained by the university for the operation of those revenue producing functions. (West Virginia University deposits most collections to the state general fund and it is reappropriated for the specific function to which the revenue applies).

Since the University of Virginia retains its receipts as an internal function, and these amounts do not appear as an appropriation from general funds, it would be unfair to compare the state appropriation with other state universities, (W. V. U. for example) inasmuch as the state appropriation would appear less than other states that deposit all fees into the general fund.

There is, however, a correlation between the amounts expended by the University for Instruction and Departmental Research and the annual state appropriation to the University.

In the academic year 1961-62 the amount expended for Instruction and Departmental Research was \$5.5 million and the state appropriation was \$5.0 million. This same relationship (appropriation to instruction) seems to prevail in prior years also.

State appropriations over the past ten years have held steady at about twenty percent of all funds available to the University; (See Table 2) with eighty percent contributed by university functional activities or research contracts. (The university hospital accounts for about 1/3 of the total funds (revenues) of the university and a like percentage of the expenditures).

During the ten year period 1953-1962, the university more than doubled its income and expenditures (see Table 3 and 4). The total percentage increase in income during the period was 122.7% (\$11.0 million to \$24.5 million), while the state appropriation increase was 127.3% (\$2.2 million to \$5.0 million). Although the greatest dollar increase (\$5.0 million) came from auxiliary enterprises (primarily the hospital), the percentage increase was but 90.0%. The greatest percentage increase was in research contracts at 485.7% or a dollar increase of \$3.4 million.

Expenditures during the ten year period increased by 137.3%. (The reason for the larger rate of increase in expenditure over the ten year period -- exp. 137%; income 123% -- results from an excess of about one million dollars of receipts over expenditures during the first year of this comparison). While the total increase in expenditures for the university was 137.3%, the increase in Instruction and Departmental Research and Organized Research increased 190.3%. The next largest increase was recorded in the extension program at 175.0% or from \$.4 million to \$1.1 million.

Total State

The total state of Virginia appropriation from general revenue (taxes) was \$123,265,000 in 1952-53. The general revenue appropriation in 1961-62 was \$235,453,000 for an increase in the ten year period of \$107,188,000 or a percentage increase of 83.6%.

In 1952-53 the amount of general revenue funds specifically ear-marked for educational functions (all classes) in Virginia was \$58,954,000 or 46.0% of the total funds available.

In 1961-62 the amount of general revenue funds specifically ear-marked for educational functions was \$149,664,000 or 63.6% of the total funds available.

The increase in total funds available during the ten year period for education was \$90,700,000 or 153.8%.

The increase in appropriation to the University over the ten year period was \$2,800,000 or 127.3%.

In 1952-53 the University received \$2,200,000 from general revenue or 3.7% of the total available for educational functions (\$58,954,000).

In 1961-62 the University received \$5,000,000 from general revenue or 3.3% of the total available for educational functions (\$149,664,000)

Mr. Dunbar and Mr. Reynolds have talked with several individuals in Charlottesville to try and get some idea of the degree to which the State Legislature may support the development of the University in the future. From their discussions they believe the political climate is distinctly favorable to the University, and that it is the policy of the State to develop it into a distinguished State University.

TABLE 2

Total University Funds Available, State Appropriations
and Percentage of State Appropriation to Total Funds for
the Years 1953 - 1962

<u>Fiscal Year</u>	<u>Total Funds Available</u>	<u>State Funds Only</u>	<u>Percent State Funds to Total</u>
1953	\$11.0	\$2.2	20.0%
1954	11.5	2.4	20.9
1955	12.5	2.9	23.2
1956	13.5	3.0	22.2
1957	15.0	3.5	23.3
1958	17.0	3.5	20.6
1959	19.0	4.5	23.7
1960	20.5	4.4	21.5
1961	22.5	5.0	22.2
1962	24.5	5.0	20.4

Total funds increased at a steady annual rate over the ten year period. State funds increased at a steady rate but on a two year basis. (Appropriation on a biennium rather than an annual basis in Virginia). State participation remained at about 20% over the ten year period.

TABLE 3

Comparison of Income of the University of Virginia over the Ten Year Period 1953-1962 by Source. (In Millions)

<u>Source</u>	<u>1952-3</u>	<u>1961-2</u>	<u>Inc.</u> <u>\$</u>	<u>Inc.</u> <u>%</u>
Gifts, Grants, Contracts	\$.7	\$ 4.1	\$ 3.4	485.7%
Auxiliary Enterprises	5.5	10.5	5.0	90.9
State Appropriation	2.2	5.0	2.8	127.3
Student Fees	2.0	3.4	1.4	70.0
Endowments	.5	.8	.3	60.0
Other	.1	.7	.6	600.0
Totals	11.0	24.5	13.5	122.7

TABLE 4

Comparison of Expenditures of the University of Virginia over the Ten Year Period 1953-1962 by Major Source (In Millions)

<u>Source</u>	<u>1952-3</u>	<u>1961-2</u>	<u>Inc.</u> <u>\$</u>	<u>Inc.</u> <u>%</u>
Instruction and Research*	\$ 3.1	\$ 9.0	\$ 5.9	190.3%
Auxiliary Enterprises	5.5	10.2	4.7	85.4
Plant Maintenance	.6	1.2	.6	100.0
Extension Program	.4	1.1	.7	175.0
Libraries	.3	.6	.3	100.0
Other	.3	2.1	1.8	138.5
Totals	10.2	24.2	14.0	137.5

* See Also Table Number 5.

TABLE 5

Distribution of Funds Expended by the University of Virginia during the Year 1961-62 for Instruction and Research (In Millions)

<u>Source</u>	<u>Instruction and Dept. Research</u>	<u>Organized Research</u>	<u>Total</u>	<u>% of Grand Total</u>
Medicine	\$1.3	1.7	\$ 3.0	33.3%
Arts and Sciences	2.1	.3	2.4	26.7
Engineering, Physics, etc.	.7	1.1	1.8	20.0
Business and Commerce	.4	-	.4	4.4
Law	.4	-	.4	4.4
Education	.3		.3	3.3
Other	<u>.3</u>	<u>.4</u>	<u>.7</u>	<u>7.9</u>
TOTAL	5.5	3.5	9.0	100.0

16. CHARLOTTESVILLE AS A PLACE TO LIVE AND WORK*

A. Location and history.

The Charlottesville-Albemarle County area is located near the central part of Virginia, and lies within the Blue Ridge and Piedmont physiological provinces. Slightly more than 100 miles southwest of Washington, D. C. and approximately 70 miles east of Richmond, the area is bound on the south by the James River, and on the northwest by the crest of the Blue Ridge Mountains. Major market areas within a 500 mile radius include the major ports of the Eastern Seaboard, the eastern section of the Great Lakes area, the Nation's Capitol, and numerous other commercial, industrial, and cultural centers.

The town of Charlottesville, named for Queen Charlotte, wife of George III, was formed as a planned community in 1762. It has been involved in many notable military incidents, including the French and Indian War, the Revolutionary War, and the Civil War. In 1779, approximately 4000 of the British and Hessian prisoners taken when Burgoyne surrendered at Saratoga were confined at "The Barracks" near Charlottesville. Many of the Hessians escaped into the mountains where even today their names survive among the mountain people. During the Civil War, the University buildings were used as hospitals for the Confederate wounded.

James Monroe, George Rogers Clark, Meriwether Lewis, and William Clark are numbered among the areas famous citizens of the past. However, Thomas Jefferson was Charlottesville's most distinguished son. In addition to being President of the United States, Vice President, Ambassador to France, Governor of Virginia, father of the University of Virginia, he authored the Declaration of Independence and the Statutes of Virginia Religious Freedom. Exerting a widespread influence on American architecture, he designed, among others, the Capitol at Richmond, the University of Virginia, the original White House in Washington, Monticello, and Ash Lawn, the plantation home of James Monroe.

B. Physiography and Climate.

Most of the County lies within the Piedmont Plateau province, with only a part of the western section in the Blue Ridge province. Elevations in the rolling Piedmont Plateau area (in which Charlottesville is located) range from 300 to 800 feet above sea level. Elevations in the Blue Ridge area range from 2500 to 3250 feet above sea level. The area is drained by the James River.

Charlottesville enjoys a temperate climate with cold, but not severe, winters and relatively cool summers. The frost-free growing season averages

* This section is primarily from a report prepared by the Virginia Electric Power Company.

210 days, from April 6 to November 2 (as compared with approximately 120 days for Green Bank). Snowfall averages 19.4 inches annually (as compared with more than 100 inches in Green Bank).

Average seasonal temperatures and average precipitation for selected seasons and months, compiled from weather bureau records covering a period of 30 years (1931-60), follow:

	<u>Winter</u>	<u>Spring</u>	<u>Summer</u>	<u>Fall</u>	<u>Annual</u>
Average Temp.(°F)	40.6°	65.5°	74.4°	48.8°	57.3°
Average Precip.(inches)	3.48	3.71	5.55	3.29	46.49

C. Population and Labor Force.

The population of the Charlottesville-Albemarle County area increased 14.8 percent during the 1950-1960 decade. The total population in the area in 1960 was 60,396. Of this 29,427 were residents of Charlottesville. In Charlottesville, 13,023 persons (44.3%) were in the 20 to 49 year age groups. Of the 19,022 persons in Charlottesville 39 years of age and under, 49.4 percent (9,404 persons) were in the 20 through 39 year age group. These few statistics indicate that the community has a large young and correspondingly vigorous population group.

Certain statistics as to average wages per worker (covered by unemployment compensation) in Charlottesville follow.

<u>Classification</u>	<u>Average Annual Wage</u>
Construction	\$ 3,800
Manufacturing	3,800
Trade	3,320
Services	2,520
Total	<u>\$ 3,600</u>

In addition, weekly wage ranges for selected occupations are:

<u>General Office</u>	<u>Typists</u>	<u>Stenographers</u>	<u>Bookkeepers</u>
<u>Clerks</u>	<u>Clerk-Typists</u>		
\$40-\$60	\$45-\$65	\$55-\$75	\$50-\$75

Also, hourly ranges for production workers in manufacturing in the area in-

dicate that established wage ranges at the NRAO will not have to be adjusted as a result of the move.

There are certain limitations imposed on both labor and management in Virginia that usually achieve peaceful settlements of labor disputes. Virginia does have a "right-to-work" law which preserves the rights of minorities and protects individuals against all forms of coercion. This law prohibits the use of force, violence, or intimidation that attempts to induce any employee to quit employment; nor can any person engage in picketing by force or violence, singly or with others, in such a way as to obstruct free passage to or from an employer's premises. Furthermore, picketing is limited to employees of the concern on strike. Over the past five years the average percent of estimated working time lost due to labor disputes in Virginia has been .06 percent compared with the U.S. average of .26 percent. Only nine other states can demonstrate a slightly better record.

D. Retail Commerce and Banking Facilities.

Charlottesville is a busy retail center, offering fine department stores, and modern suburban shopping centers side by side with charming specialty and antique shops. The City is the only large commercial and marketing center within a large retail trade area which includes parts of eight neighboring counties, and has a population of approximately 126,000. Consequently, it is about completely self sufficient in satisfying the retail trade needs of its residents. Practically every type of commercial establishment is located in Charlottesville and the area immediately surrounding the City.

Legal consultation may be obtained from any of the approximately 25 law firms, or from the large number of individual-practicing attorneys in the area.

There are three banks -- two national and one state -- with seven branches in the City. These banks are as follows:

<u>Name</u>	<u>Total Assets</u>
Citizens Bank and Trust Company	\$ 14,803,154
National Bank and Trust Company	42,831,215
Peoples National Bank of Central Virginia	118,855,066

E. Real Estate

Approximately 200 houses are currently available in the area for lease and/or purchase. Rental rates range from \$55 to \$200 per month and selling prices range from \$6,500 to \$42,500. Additional living facilities are offered through approximately 200 apartment and duplex units in the area. Subsequent to World War II and up until about 5 years ago, housing was extremely

tight. However, the Comptroller of the University of Virginia advises us that the building boom has now caught up with the demand and adequate housing is available.

In some respects, real estate prices in Charlottesville are high, when compared with the rest of Virginia. This is due to the fact that there are no large housing developments in the area, and most of the homes have been or must be custom built. Approximately 65 general contractors are available to satisfy the desires of those who might decide to build a new home. This comment about the cost of real estate being relatively high is derived from the opinion of University faculty members who have moved to Charlottesville from other campuses.

F. Cost of Living - Taxes.

The cost of living is higher than in some other parts of Virginia, but lower than in the large metropolitan areas of the Eastern Seaboard. This is due largely to the impact of the University faculty on the local economy as well as the fact that there are a significant number of well-to-do families and estate owners in the area. This portion of the population demands higher quality goods, as well as greater variety, and can afford to pay for them. While this inevitably drives the cost-of-living index higher, it also insures that the so-called "better things in life" are available.

Taxes include real estate, personal property, and state income tax. Real estate and personal property taxes are low. The state income tax is based on 2 percent for the first \$3,000 of taxable income, 3 percent for the next \$2,000, and 5 percent for anything over \$5,000. A flat \$1,000 exemption per person is allowed. From this information it would appear that taxes range from low to moderate. At present there is no sales tax.

G. Overnight and Banquet Accommodations.

Because of the constant stream of transient visitors who will be visiting NRAO Charlottesville, the question of local overnight accommodations is important. In the Charlottesville area there are 27 motels and hotels offering a total of 936 rooms. Air conditioning, parking, and dining facilities are offered by most of these establishments, and many have swimming pools.

Facilities for dinner meetings and banquets are available at three locations, having a capacity for serving 100, 250, and 300 persons, respectively. Catering services are offered by two establishments in Charlottesville, and in addition, meals may be had at any of the areas 75 restaurants.

H. Community Facilities.

1. Local government. The cities of Virginia are autonomous political units entirely independent of any county. Residents of a Virginia city are therefore affected by the ordinances and regulations of but one local government, their city government, and pay taxes to this government. The City of

Charlottesville is governed under the Council-Manager form of government. Under this form of government, the legislative powers of city government are vested in the Council and the administrative and executive powers are vested in the City Manager.

Charlottesville's five-member Council is elected at large by popular vote to serve four-year terms of office, giving a representation of approximately one councilman per 6,000 population. The Council elects a Mayor and Vice-Mayor from its membership and appoints the City Manager.

The city effectively enforces its zoning ordinances and subdivision regulations. It has a building inspector, engineer, electrical inspector, and a planning commission.

In general, whatever is taxed at the local level is exempt from taxation at the state level. Only local governments can levy taxes on real estate and personal property. The local tax rate per \$100 true value of real estate in 1962 was \$0.92. The total per capita tax in 1961 for the State of Virginia and its local governments was \$145.

2. Education. There are six elementary schools and two high schools in Charlottesville. One of the high schools is non-white and the other predominantly white. The public schools of Charlottesville are now in the early stages of desegregation and have had no serious racial incidents.

The average pupil/teacher ratio in the elementary schools is 23.9, in the high schools 18.9. The school enrollment in the predominantly white high school is between 1200 and 1300. Approximately 3,000 pupils are enrolled in the six elementary schools.

Virginia's requirements for its high school graduates compare favorably with those of most advanced states. Qualified eighth graders are encouraged to take subjects such as foreign languages, algebra, and science. More units in english, mathematics, laboratory science and world history are required as a result of new standards which became effective in September 1959.

The average annual salary for teachers (excluding principals and supervisors) during the 1961-1962 school year was \$5,067 in Charlottesville. This compares with the state average of \$4,640. The per capita cost of operation was \$345.48 as compared with \$273.80 for the state. This per capita cost is at least 50 percent higher than West Virginia.

The curriculum in the Charlottesville public schools, as well as the quality of instruction, benefit directly from the presence of the University for three reasons: (1) As parents, the faculty demand and expect their children to be properly prepared for higher education; (2) the University's school of education has an inevitable effect on the local school systems; (3) wives of younger faculty members, with excellent training, form a significant part of the local public school faculty.

The physical facilities are at least good if not excellent. The Charlottesville High School was built just prior to World War II, and has since added a new wing. The County High School is less than ten years old. Several of the elementary schools are new and plans are now being drawn to build two new schools, starting next year.

Graduates of Charlottesville High Schools have been admitted to many of the Nation's leading colleges and universities.

In addition to the public school facilities, the area has private accredited primary and secondary schools for boys and girls. Nurseries and kindergartens are conducted by private interests and church groups.

3. Library. In addition to the University library facilities, the McIntire Public Library, located in Charlottesville, is a regional library serving a population in excess of 60,000. The library operates a bookmobile throughout the county. Its monthly circulation approximates 16,000-17,000 books from its total of 51,000 books.

4. Medical facilities. The Charlottesville area is served by two modern hospitals furnishing the best in medical and nursing care. The University of Virginia Hospital has 485 beds and 55 bassinets. The hospital offers complete medical and nursing courses through the University. The Martha Jefferson Hospital, also located in Charlottesville, is a private hospital and has 121 beds and 20 bassinets.

In addition, Charlottesville and the county have a joint Health Department with a doctor and eight nurses. This department holds regular clinics twice monthly in each of seven locations. Two dental clinics are in operation five days a week.

The number of doctors, interns, and dentists practicing in the area are as follows: 9 general practitioners; 9 obstetricians; 25 dentists; 2 optometrists; 42 surgeons; and 244 specialists in various other fields.

Ambulance service is available from private "for-hire" sources having a total of nine ambulances, and from the 62 member Charlottesville-Albemarle Volunteer Rescue Squad located in Charlottesville. Prescriptions can be filled at any of the 14 pharmacies in the area.

5. Fire and police protection. The police department of Charlottesville makes use of 10 radio equipped vehicles in performing general patrol, traffic control, detective and vice investigations, and juvenile services. There is one police officer for every 535 inhabitants. Charlottesville's crime rate per 10,000 population was 70.68 during 1960, as compared with the national rate of 103.79.

The City of Charlottesville maintains a fire department staffed by 20 full time paid firemen, and 80 volunteers. In addition to its standard hose and pumper trucks, the department has hook and ladder trucks among its eight

pieces of equipment. The city is given a Class 2 fire insurance rating by the National Board of Fire Underwriters.

6. Civic and Church facilities. Churches of all major denominations are located in the area. Among a total of 44 churches are included 3 Catholic churches, a Jewish temple, a Salvation Army chapel, a Greek Orthodox church, a Quaker Society of Friends, and 37 Protestant churches, representing 17 denominations.

A listing of the civic, fraternal and cultural organizations in the area follow: American Legion, B'nai B'rith, D.A.R., DAV, Eastern Star, Elks, Knights of Columbus, Masons, Moose, Odd Fellows, Music Club, Garden Club, Dramatic Club, Business and Professional Woman's Club, VFW, Woodmen of the World, Rotary, Kiwanis, Exchange, Lions, Y's Men, Junior Chamber of Commerce, Art Club, Girl Scouts, Civitans, and Boy Scouts.

7. Recreation. The public and private recreation facilities in the Charlottesville area offer a wide variety of entertainment. Golfing, tennis, dancing, swimming, hiking, boating, fishing, hunting, bowling, picnicking, basketball, baseball, football, and track facilities are available to those desiring to participate in physical activities.

To the spectator, the University offers its athletic events, visiting artists and orchestras, concerts, and plays. The museums connected with the University have excellent permanent and visiting exhibits.

Charlottesville operates seven parks and playgrounds, which include wading pools, a golf course, tennis courts, picnic grounds, and softball fields. Supervised recreation programs are offered during the summer.

The city also operates a Recreation Center, with facilities for dancing, roller skating, basketball, plays, and arts and crafts.

In the winter, skiing is also available during occasional winter snows. Bowling enthusiasts may avail themselves of the facilities offered by two establishments in Charlottesville.

Three indoor theatres within Charlottesville and a drive-in theatre just beyond the city limits are available to movie-goers.

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UNIVERSITY OF VIRGINIA
Charlottesville

The Graduate School of Arts and Sciences
Office of the Dean

August 20, 1963

Mr. David S. Heeschen
National Radioastronomy Observatory
Green Bank, West Virginia

Dear Dr. Heeschen:

It was very nice to meet with you last week and to learn that part of the scientific activities of the Observatory may be shifted to Charlottesville. I am writing in response to your request for information concerning the long range plans of the University of Virginia regarding the growth of its efforts in the Sciences and in Engineering.

The University fully recognizes the educational needs of the nation in these fields. It is anticipated that during the next ten years the University will experience its greatest rate of growth in research and graduate studies in the Sciences and Engineering. The clearest evidence of our intent to do the job can probably be gained from recent and currently planned additions to the physical plant. In recent years the University has completed a Physics Building, a Nuclear Reactor and associated laboratories, a Computer Center, and an Aerospace-Mechanical Engineering Building. A Life Science Building for Biology and Psychology is being occupied this fall. A Nuclear Physics Laboratory housing two nuclear particle accelerators will be completed in the fall of 1964. University and NSF funds are to be available shortly for a new observatory for the Department of Astronomy, and funds in excess of five million dollars are in hand for a new Chemistry Building. Finally I should mention plans for a Science-Engineering Library, a new Computer Center, an Earth Science Building, and an Engineering Research Building.

With regard to the student body the University expects to grow from the current total enrollment of approximately 5500 to approximately 10,000 by 1975. The greatest rate of growth is planned in the Graduate School of Arts and Sciences where it is anticipated that the student body will increase from the present number of about 500 to 1500. This does not include graduate students who will be in residence at the Virginia Associated Research Center, which will operate the NASA Space Radiation Effects Laboratory, and, also, provide graduate study in the Sciences and Engineering. This center will be a joint operation of the University of Virginia, Virginia Polytechnic Institute, and the College of William and Mary. It is expected that several hundred graduate students will be enrolled there within five or six years. The Center will be located near the Langley Research Center.

I hope that this information will be helpful to you. Please let me know if I can do anything further.

I shall be away from Charlottesville for the period August 21 - September 4. In the event that you wish to discuss possibilities regarding land or any other details, please call Mr. Vincent Shea, who is the Comptroller. He knows of your plans and will be happy to help you in any way.

Sincerely yours,

(Signed) Frank L. Hereford

Frank L. Hereford
Dean

FLH:ss