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Memorandum re California Institute of Technology, Pasadena, California

June 11, 1928

Monday morning, June 11, Doctor Rose and I arrived at Pasadena, California. We were met at Palo Alto by Doctors Millikan and Noyes of California Institute of Technology, and driven to Pasadena and to Doctor George E. Hale's private laboratory. Here we met: Doctor Hale, Doctor Adams, Director of Mount Wilson, Doctor Merriam, President of Carnegie Institution, and Mr. H. M. Robinson of the Board of Trustees of California Institute of Technology.

We discussed informally the proposed 200-inch telescope. Doctor Rose indicated the status of the action of the International Education Board and stated that the first point to be cleared up was the question of funds necessary to maintain the proposed observatory. Doctor Hale and Doctor Adams agreed that the annual cost based on the present costs of operating Mount Wilson Observatory (\$250,000) would be between \$100,000 and \$150,000. Mr. Robinson stated that, while he would not officially speak for the Trustees, he was sure they would agree to provide these funds up to \$150,000 a year. He also stated that he would personally agree to undertake raising the funds necessary for this purpose. We learned later that in this statement given in such a modest way he himself plans to give an annual income of \$100,000 for this purpose and later capitalize it. He also agrees to raise this to \$150,000 annually if desired.

Doctor Rose then presented the following statement which we had prepared on the train:

200-Inch Reflecting Telescope for California Institute of Technology -
Points to be included in Formal Request from the Trustees of
California Institute of Technology

I. The International Education Board is to provide funds as needed for:

- a) A 200-inch reflecting telescope
- b) Site including land and land improvements
- c) Observatory and other necessary buildings
- d) Auxiliary apparatus
- e) Other expenses in connection with making the observatory available for use.

The total funds so provided are not to exceed in the aggregate \$6,000,000 and the International Education Board is not expected to provide funds for any other purposes than those here indicated.

II. The California Institute of Technology is to assume full responsibility for building the proposed Observatory and is to provide the necessary funds for operating it after its completion.

III. It is understood that if experience should show at any stage of development that the undertaking cannot be carried to successful completion, no further expenses will be incurred by the California Institute of Technology and no further funds will be provided by the International Education Board.

IV. In transmitting a formal request from the Trustees of California Institute of Technology to the International Education Board for funds to carry out this proposal, it is suggested that the request include:

- a) Evidence of cooperation from the Carnegie Institution and the staff of Mount Wilson Observatory.

b) Personnel of:

1. Committee of representative astronomers to consider site
2. Committee on construction of reflectors
3. Committee on design of telescope, buildings, equipment, etc.

c) A budget of estimated expenditures including:

1. Expenses of committees
2. Expenses of experimentation and manufacture of reflectors
3. Expenses of land and land improvements
4. Expenses of buildings and telescope mounting
5. Expenses of other equipment
6. Contingent

Supplemental Information

The formal request from the Trustees of California Institute of Technology will form the basis of the formal pledge of the International Education Board.

After the pledge has been approved, formally executed and accepted the following procedure is suggested:

Upon request from the California Institute of Technology accompanied by full report as to the status of development, the Executive Committee of the International Education Board will consider and appropriate from time to time such funds as may be needed to meet the respective budget items included in the formal request.

After such appropriations are authorized, payments will be made by the International Education Board to the California Institute of Technology upon duly authorized requisition and statement of account.

The intention of this suggested procedure is to provide funds only as expenses are incurred and to enable plans and construction to develop without delay and without expense to the Institute. A full accounting of all expenditures is expected, but approval and payment of bills is the function of the Institute. Advances will be provided as needed.

This was discussed and seemed entirely satisfactory to all present as a basis for a formal letter of application. The principle of furnishing funds as and when needed is also satisfactory. Doctor Hale is prepared to initiate some studies very promptly. He raised the question of securing prompt action from the International Education Board, but we suggested that the Institute advance any funds needed immediately and that the Executive Committee of the International Education Board take appropriate action in the fall.

Doctor Hale then presented the following statement of a proposed scheme of organization:

Astrophysical Observatory of the California Institute of
Technology

Proposed Scheme of Organization, Construction, and Operation
Observatory Council

Four members of the Executive Council of the Institute, Messrs. Hale, Millikan, Noyes, and Robinson, to be charged by the Trustees with the expenditure of the Observatory Fund; the selection of building sites; the provision of all necessary roads, water-supply, power-lines, and other requirements; the design, construction, transportation, and erection of instruments, machinery, and buildings; the selection of a scientific and operating staff; and the general policy of research.

The Observatory Council shall appoint an experienced astronomer or physicist as the executive officer of the Observatory, to take direct charge of its design, construction, and operation.

Advisory Committee

Comprising the Director of the Mount Wilson Observatory and other leading astronomers and physicists, to cooperate with the Observatory Council in the solution of its problems.

Instruments and Buildings

(a) A preliminary study, by a group of the ablest experts, to be made of all promising methods of making telescope mirror discs of large diameter.

(b) If, as now seems probable, such a study should point to the use of fused quartz, the next step would be an experimental test of its possibilities, and the manufacture as soon as feasible of a 200-inch mirror disc.

(c) A simultaneous study, by a group of experienced astronomers, physicists, opticians, instrument makers, and engineers, of the various optical and mechanical questions involved in the design of the telescope and all buildings, instruments, apparatus, and accessories for the observation, registration, and measurement of celestial images, the measurement of photographs, and the laboratory interpretation of results. The preparation of working drawings and the work of construction to follow as soon as circumstances permit.

(d) A simultaneous comparative study, by astronomers, physicists, and meteorologists familiar with the performance of the largest existing instruments, of possible sites for the 200-inch telescope, taking into account not only the clearness and steadiness of the atmosphere at various seasons throughout several years, but with due regard to the special requirements of the telescope, the nature of the problems in view, the efficiency of the observers, and the intimate cooperation of the Mount

Wilson Observatory of the Carnegie Institution of Washington and the Bridge and Gates Laboratories of the California Institute.

(e) The grinding, polishing, and figuring of the large and small mirror discs when ready. Most of this work, like the casting of the 200-inch disc, must be done at the site selected, because of the difficulty of transporting the large disc.

(f) The construction and erection of the telescope mounting, buildings, and accessory apparatus.

Procedure

The design and construction of a 200-inch telescope is a large enterprise, calling for an intimate and effective union of the highest scientific and engineering knowledge and experience. I recommend that the J. G. White Engineering Corporation, of which Mr. Gano Dunn is President, be employed to take general supervision of the work of construction, part of which (including buildings, road, water-supply, etc.) would be done by their own engineers, while the mounting might be built by Warner & Swasey. In the design of the mounting and dome the combined knowledge of Mr. Francis G. Pease and other members of the Mount Wilson staff and that of Messrs. Gano Dunn, Ambrose Swasey, and other leading authorities should be utilized. If a fused quartz disc is decided upon, Doctor Elihu Thomson of the General Electric Company is prepared to undertake this work. The grinding, polishing, and figuring of the disc should be done by the Mount Wilson opticians, in a building to be erected at the site selected for the telescope.

The simultaneous study of the accessory instruments and apparatus would involve in many cases the cooperation of other agencies. Some of the apparatus could be obtained from dealers in scientific instruments but much of it must be made in the instrument shop of the Astrophysical Laboratory, which should be erected on the campus of the California Institute.

Observing Staff

Toward the end of the construction period, which will necessarily occupy several years, the observing staff should be organized. This should include a director; several observers, assistants, and computers; and research associates, assistants, and fellows appointed for various periods from the staffs of the Mount Wilson Observatory, the California Institute, and other institutions. Provision should also be made for graduate study and research.

It goes without saying that the 200-inch telescope should be employed for investigations beyond the range of other instruments. The prime purpose in view is therefore to supplement the instrumental equipment of the Mount Wilson Observatory and the California Institute in such a way as to provide for the extension of their astronomical and physical researches into fields now inaccessible.

Plan of Cooperation

The chief objects of a plan of cooperation between the Carnegie Institution of Washington and the California Institute should be:

(1) To assure the effective utilization of the knowledge and experience of both institutions in the design, construction, and operation of the proposed Astrophysical Observatory.

(2) To conduct the preparatory studies, as well as the ultimate scheme of research, so that the result will be to aid from outset the current work of both institutions.

The procedure suggested in the preceding pages has been prepared with these objects in mind. It is designed to secure the best possible results without involving the Carnegie Institution of Washington in any expense, or calling for much of the time of its research men, or even of existing shop facilities during the construction period. The study of accessory instruments and methods, which should begin at once, would quickly yield results immediately applicable in current research, and highly advantageous to both institutions. After the completion of the telescope, it goes without saying that the opportunities to be offered to members of both staffs would be invaluable.

Doctor Hale stated that it would take from 18 months to two years to reach a definite conclusion as to site and mentioned two possible sites, one 12 miles and the other 100 miles from Pasadena. We also discussed the question of earthquake, It was the unanimous conclusion of Hale, Merriam, and Adams that this could be ignored. Doctor Hale even went so far as to state he doubted whether the greatest California earthquake on record could damage an instrument of the proposed dimensions and design.

In his discussion he suggested Doctor Anderson as the executive officer of the proposed observatory during its period of construction, such men as Day of Washington Geo-Physical Laboratory and Elihu Thompson on the committee to consider the problem of reflector construction and design.

The next day we visited the Seismological Laboratory recently built by the Carnegie Institution and saw the equipment and data being compiled. This makes it clear that the Special Committee on Site will have at its disposal a wealth of material on the earth's structure and earth movements never before assembled.

Doctor Rose and I, after completing our conferences, prepared the following letter which was sent to the members of the Board:

June 18, 1928

To the Members of the International Education Board:

At the May 1928 meeting of the International Education Board, resolutions were adopted approving a proposal by the California Institute of Technology for the construction of an observatory, including a 200-inch telescope and authorizing the Executive Committee to provide funds as needed for this purpose.

At that meeting it was agreed, as the result of discussion, that the resolutions proposed in the docket should be modified in certain details and particularly that they should embody a definite undertaking by the California Institute to provide the necessary funds for the operation of the observatory after its completion.

Officers of the Board visited Pasadena recently for a conference covering all the points discussed at the meeting. Members of the Board of Trustees of the Institute and its executive staff, the President of the Carnegie Institution and the Director of Mt. Wilson Observatory were present. The following is a brief summary of the results of this conference:

1. California Institute is prepared to finance the operation of the observatory after its completion. One of the trustees promptly offered to provide two million dollars endowment for this purpose and assumed the responsibility for an additional million should this be found necessary.

2. California Institute is prepared to assume full responsibility for building the proposed observatory. It is understood that the International Education Board is to make no commitment beyond providing the necessary funds as needed up to a total not to exceed six million dollars. It is also understood that, if experience should show at any stage of development that the undertaking can not be carried to successful completion, no further expenses will be incurred by the Institute and no further funds provided by the International Education Board.
3. California Institute proposes to create a special committee, to be known as the Observatory Council, to have supervision of the undertaking. The Council will appoint a competent scientist as its executive officer.
4. The Council will create a Committee on Site; this committee to be made up of competent scientists and to be reinforced by a group of astronomers - American and foreign - who will serve as consultants. This committee will undertake a study of possible locations, make the necessary tests of atmospheric and other conditions, and will have at its disposal similar studies made in locating the Mt. Wilson observatory, together with accumulated information of this and other observatories and the material now being gathered by the Seismological laboratory at Pasadena, California. It is expected that these studies will require two years for completion after which a recommendation will be made which will combine as far as possible the desirable characteristics of an ideal site.
5. A group similarly constituted and composed of the most competent authorities in the field is to be charged with maturing plans, carrying out experiments and finally producing the necessary disks, including the 200-inch reflector. Here again it is proposed to bring to bear upon this most important feature of the undertaking the best scientific and technical ability to be found in this country and abroad.
6. Still another group will undertake to design the mounting of the great mirror. This is an extremely complex problem and will call for the intimate co-operation of scientists and technicians representing a great variety of ability. This group will have as a starting point the preliminary designs on which Dr. Pease and a group of experts have been working for the past four or five years.

7. In due course the California Institute will make a formal application. This to cover in greater detail than here attempted the important items of the agreement, and to be accompanied by a budget of estimated expenditures. This will be presented to the Executive Committee for consideration, presumably in the early fall.

In the meantime the Institute will give attention to the important question of personnel with a view to starting activities without undue delay. It will also consider plans of organization, of research, of construction and the designing of all necessary accessory equipment, such as interferometers, spectrographs, thermo-couples, etc. In this equipment, as well as in the large instrument, effort will be made to improve upon the best now available.

The discussions at Pasadena emphasized more than ever the international character of the proposed observatory. It is to be a contribution not so much to an institution as to science. In maturing the designs, in all matters of construction and in the use of the completed instrument the undertaking is to call into play the best ability regardless of institutional or national boundary lines.

Very truly,

WICKLIFFE ROSE

Unless objections are made or suggestions received the following resolutions will be incorporated in the minutes of the May meeting:

WHEREAS, The California Institute of Technology, Pasadena, California, presents a proposal to the International Education Board for an appropriation of the funds needed to erect an observatory including a 200-inch reflecting telescope involving the expenditure of approximately \$6,000,000; and

WHEREAS, The Trustees of the California Institute of Technology are to assume full responsibility for providing the necessary funds for the upkeep and maintenance of the observatory including the telescope, if constructed; and

WHEREAS, The Carnegie Institution of Washington, D.C., acting in cooperation with the California Institute of Technology approves the proposal and indicates its willingness to assist and cooperate in the undertaking; and

WHEREAS, The staff of the Mount Wilson Observatory, Pasadena, California, under the control of the Carnegie Institution of Washington, is in hearty accord with the proposal and promises cooperation in the program outlined;

THEREFORE, BE IT

RESOLVED, That the International Education Board hereby approves in principle the proposal submitted by the California Institute of Technology, Pasadena, California, to construct, if this should prove feasible, an observatory including a 200-inch reflecting telescope to be situated at such place as may be determined by the Trustees of the California Institute of Technology on the advice of a committee of representative astronomers; and be it further

RESOLVED, That the Executive Committee of the International Education Board be, and it hereby is, empowered in its discretion to commit the Board from time to time to appropriations to the California Institute of Technology, Pasadena, California, of sums not to exceed in the aggregate Six million Dollars (\$6,000,000) for the purchase of a site and the construction of an observatory including a 200-inch reflecting telescope with accessories and any and all other expenses incurred in making the observatory available for use, it being understood that the Trustees of the California Institute of Technology will provide the funds required for the operation of the completed observatory; and it being stipulated that commitments by the Executive Committee under this authorization shall not be made more rapidly than developments justify; and be it further

RESOLVED, That a sum not to exceed Six million Dollars (\$6,000,000) be, and it hereby is, appropriated to make this action effective, the appropriation to be charged to the principal funds of the Board.