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CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA

ASTROPHYSICAL OBSERVATORY

25 November 1935

Dr. Max Mason, President
Rockefeller Foundation
49 West 49th Street
New York City, N. Y.

Dear Max:

I am enclosing a sort of historical report of the steps we have gone through in the development of the design of the telescope tube and mounting, and certain related matters. I hope that this gives you the picture you want to present to the Directors. If not, I will go into it in more detail. Dr. Hale has seen this and approved it.

I had a nice trip out and have been quite busy since my arrival. Spent the weekend on Palomar Mt. and enjoyed it immensely.

Hope you can send me your brother's address, so that I may look him up.

With best regards.

Very sincerely,

Sandy

CSMcD:hb

DEVELOPMENT OF TELESCOPE DESIGN

At the end of 1934, there were available at the California Institute of Technology, studies and tentative designs on two types of mountings for the 200-inch telescope. For purposes of identification, these may be designated as the Fork type and the Yoke type, the fork type consisting of a cone supported so as to rotate on bearings and with two projecting arms which carried the trunnions for the telescope tube: the yoke type consisting of a mounting with bearings at both ends, the north being a horseshoe type so that the tube could be lowered down into the horseshoe when pointing north; the south end being solid, and the two ends connected together by a structure and carrying trunnions for the telescope tube approximately midway between the two ends of the mounting.

To obtain the greatest possible assistance in selecting the type of mounting, and to get information and data from which to develop the mounting into a design stage suitable for manufacturing purposes, a large number of engineers and manufacturing firms were consulted. The problem naturally was a combined structural and mechanical one, and the probabilities were that welding would be greatly involved. In the past, the Union Iron Works in San Francisco, a shipbuilding plant, now a subsidiary of the Bethlehem Shipbuilding Company, had built the mounting and the tube for the 60-inch, and the Bethlehem Shipbuilding Company at Quincy, Mass., had done similar work in connection with the 100-inch at Mount Wilson. The class of work required is, in general, along the lines used in large shipbuilding, except that greater precision and accuracy is necessary, and the equipment available at the large shipyards makes them somewhat a natural source of manufacture of such structures. Their engineers and consultants should have information and data that would be of considerable interest in the particular problem. Therefore, plans of the two types of mounting were sent to Mr. Wylie Wakeman, Vice-Pres. and General Manager of the Bethlehem Shipbuilding Company, and Mr. Burkhardt, Chief Engr. of that Company; also, to Mr. Homer Ferguson, President of the Newport News Shipbuilding and Dry Dock Company; Mr. J. F. Metten, President of the New York Shipbuilding Company. All of the above named men were personally contacted and the problems gone over with them in detail, as well as with Mr. W. W. Smith of the Federal Shipbuilding Company, a subsidiary of the U. S. Steel Company. All of the above companies made exhaustive studies of our plans and submitted detailed reports, giving their comments.

Plans of the different types of mountings were also shown to and discussed with Messrs. Pawley, Beekman and Stevens of the General Electric Company, and their comments and recommendations were gladly given, based on their experience in welding and machining heavy structures for the electrical development work in Russia; with Mr. Mildon, Vice-President and General Manager of the Westinghouse Plant in Philadelphia, Mr. Hodgkinson, Chief Consulting Mechanical Engineer of Westinghouse, with Mr. H. F. Schmidt, Consulting Engineer, and Mr. J. Ormondroyd, of the Mechanical Research Dept. of Westinghouse. Later, with Mr. Merrick, President of the Westinghouse Electric & Mfg. Company, and with Mr. W. H. Harmon,

Vice-President of the Baldwin-Southwark Corp. at Eddystone, Pennsylvania, also with Mr. Kruse of that company: with Mr. M. B. Butler, Jr., Vice-President of the Budd Mfg. Company of Philadelphia in connection with the possible use of stainless steel or other alloyed steels in this construction, also with Mr. Llewellyn, consulting engineer of the U.S. Steel Company, particularly in connection with alloyed steels. With Dr. John Johnston, Director of Research of the U. S. Steel Company, and Dr. Bain, Chief Metallurgist of that Company. With Isaac Harter, Vice-President of Babcock & Wilcox Company, Mr. Trainer, General Manager of Special Production, of that Company who had charge of their work on Boulder Dam. Also, with Mr. Bliss and Mr. Burrell of Warner-Swasey Company. With Mr. Otis Hovey of the American Bridge Company. With Mr. Wilfred Sykes, Ass't to the President and General Manager of the Inland Steel Company, and with quite a number of representative, unattached engineers, the following of whom gave particular study and comment on our proposed designs.

Dr. W. F. Durand, Prof. Emeritus of Stanford University
Prof. S. F. Timoshenko, of the University of Michigan

Also, Mr. John Bessells and Prof. Geo. B. Karelitz of Lessells & Karelitz, in their special study and report made under authorization of the Observatory Council, in collaboration with Prof. Timoshenko.

Besides the studies and reports obtained from outside sources, the types of design were carefully studied by the immediate engineering staff on this project, assisted materially by the regular staff of the California Institute of Technology, especially by the studies made by Prof. R. R. Martel, W. H. Klapp, Dr. Th. vonKarmon, and the other members of the technical advisory committee of the Observatory Council.

The result of all these contacts and studies was the practically unanimous opinion that the yoke type of mounting was the one preferred, and the development and refinement of design has proceeded with this type of mounting.

Since determining the general type of mounting, continued discussion and study has been made by a number of those mentioned above, on the preferred details of construction. This has crystallized the interest of manufacturing of the tube and mounting between two companies, or groups, namely the Westinghouse Electric & Mfg. Company and a combination of the Babcock & Wilcox Company and the Baldwin-Southwark Corporation. Mr. Isaac Harter, Vice-President of B&W and Mr. W. H. Harmon Vice-President of Baldwin-Southwark, with Prof. Hollister of Cornell who is consultant for Babcock & Wilcox, and Prof. Beggs, consultant of the Baldwin-Southwark, who have spent some time here in Pasadena going over details and giving suggestions and comments. Similarly Mr. Merrick, President of the Westinghouse Electric & Mfg. Company, Mr. Hodgkinson, Chief Consulting Engineer, and Mr. Ormondroyd, of their company, have spent quite some time here with our staff, in the development of details.

Dr. W. F. Durand has spent some time going over our plans here in Pasadena, and, similarly Dr. S. F. Timoshenko and Prof. Geo. B. Karelitz.

In addition to the above, our plans have been studied and comments given on them, by design divisions of the Bureau of Construction and Repair and Bureau of Engineering of the Navy Department, and by the Design Department of the Mare Island Navy Yard.

The present status of the tube and mounting is: a one-tenth scale model of the tube has been completed and tested for deflections and found satisfactory. The details of the rest of the mounting are completed to the extent of manufacturing a one-tenth scale model, which manufacture is under way, and this model will be tested for determination of final design.

In addition to the tube and mounting, considerable study has been made on the method of control and precise drive. In addition to those individuals mentioned heretofore, there have been others who have been consulted on this part of the problem principally. These include Mr. H. C. Ford, President of the Ford Instrument Company, who has spent some time here going over studies in detail and who is at the present time, preparing his recommendations. Mr. Robert McMath, who developed the control and drive for the McMath Telescope and whose design has been used to a great extent on the McDonald Telescope. Dr. V. Busch, Vice-President of the Massachusetts Institute of Technology, with Prof. Buckingham of that institute. Also, Dr. V. K. Zworykin of the RCA Research Laboratory.

The foregoing gives a general picture of the procedure in developing the main features of the design. We have had the finest type of cooperation from all parties and assistance from many on special parts of this problem who have not been mentioned, for instance, Dr. F. B. Jewett has given his comments and recommendations onvarious things, particularly in connection with communication. Dr. Coolidge of the General Electric Company has given his assistance on certain details. Dr. Styri and his associates, of the SKF Industries, have made extensive studies of our bearing problems. Also, the Timken Bearing Company and the Messinger Bearing Company, have made similar studies.

Sincerely yours,