QUARTERLY STATUS REPORT No. 5

Period 23 September 1965 - 22 December 1965

DESIGN, DEVELOPMENT, FABRICATION AND INSTALLATION OF 105-INCH LUNAR AND PLANETARY TELESCOPE AT McDONALD OBSERVATORY

Contract NASr-242

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A. Review of Progress Prior to this Reporting Period

Contract NASr-242 supports the design, construction, and bringing into operation of a 105-inch reflector at the McDonald Observatory, especially suitable for solar system research. Previous report periods have reviewed the collecting of the necessary staff for this project, the selection of a design engineering firm, the choice of exact size and configuration of the telescope, the design parameters (focal lengths, tube structure, observing positions, and many other details), the choice of optical material and contractor for the primary mirror, and the initial planning for the dome.

B. Progress during the Period 23 September 1965 - 22 December 1965

A model of the telescope is shown in the appended photograph.

All important design factors were frozen by November, with complete general assembly layouts and many details, with their associated written specifications. During the summer and early autumn, conversations with and visits to potential telescope builders had narrowed the field of serious contenders to four: Boller & Chivens, Fecker, Warner & Swasey, and Westinghouse Sunnyvale. Each of these four firms was given a preliminary set of plans and specifications, in order that they might begin to prepare their bid for the telescope. The basic telescope being bid on by the manufacturers will consist of:

Cross-axis configuration

North and south pier oil pad bearings

Twin 6-foot declination ball bearings

Offset bi-conical polar axis with a centered telescope counterweight

Separate secondary cages for all but the most frequent secondary changes

However, back-to-back principal Cassegrain and coude systems and back-to-back high-speed coude system

Broken Cassegrain positions available as well as conventional Cassegrain

Cassegrains available at f/9 and f/18

Wide-field Newtonian at f/4, utilizing correcting lens

If practicable, a deep-penetration, relatively narrow-field Newtonian, also operating at f/4 (at the request of NASA, a prime focus cage is not included as a part of the NASA-supported telescope project)

Coude at f/33, with very large passages through telescope and bearings, permitting use of large beams with relatively little thermal interference from the telescope parts

Primary and secondary mirror support by simple and direct mechanical levers

Modern electronic control system, permitting rapid accurate setting initially to better than a minute of arc, and when a computer may become available (to handle aberration, refraction, telescope flexures, precession, proper motion when known, etc.) to within a few seconds of arc

Corning was able to complete fabrication of the primary mirror blank relatively near the original time schedule, having the mirror edged, contoured, and boxed for shipment just at the end of this report ng period. The mirror is undoubtedly the best large blank ever produced for astronomical purposes. Its internal strain is nowhere significantly greater than 3 millimicrons per centimeter, and over the vast majority of the blank is almost immeasurably small. The mirror is also free of significant internal bubbles, areas of devitrification, or other defects. In order to insure that contamination from the edge mold, used in the final sagging and annealing furnace, would not render the blank smaller than the minimum specification, the fabricating furnace was made several inches larger than the minimum specification. In this case, the furnace edging material held together very well, so that it was possible for Corning to deliver the blank with outer diameter 107 15/16 inches, with only a few chips in this edge which are irrelevant to the performance of the mirror. This size of blank can probably be finished to nearly 107-inch optical diameter, although it may be yet many months before it is clear precisely what full aperture should be figured into the blank. However, the basic 105-inch telescope design can accomodate this mirror and make effective use of two extra inches of aperture, without any change. The thickness of the blank (12 1/2 inches) likewise came out one inch greater than the minimum originally specified. While

not necessary, this will also be helpful in that it reduces by about 10% the requirement for quality of performance of the mirror support systems in order still to achieve the highest quality operating performance from the primary. The extra weight incurred by this additional mirror diameter and thickness is of no concern whatever, since the telescope requires very substantial additional counterweight near the position of the primary mirror in any event.

During the spring, summer and autumn of 1965, contacts with and visits to the principal possible optical finishing firms established that three were likely to have the competence to achieve the desired results with so large a mirror: Davidson Optronics, Fecker, and Perkin-Elmer Western. Prior to this, all really large telescope mirrors had been fabricated in observatory optical shops. In such cases, many years have been available to gradually attempt to achieve a nearly perfect figure with no penalty to the optician for failure to achieve the desired figure. Although we want with this telescope performance higher than has ever yet been achieved by a large telescope, to demand of opticians this performance level, with only eighteen months in which to achieve such a result, seemed a prohibitive contractual problem. Accordingly, specifications were drawn up which very clearly delineated the optical specifications of the instrument including the quality ultimately desired. However, the bid call specified that the optician should produce a minimally acceptable blank (presumably well within the range of his technology in the time available) for his basic bid price. Further work toward a truly superb mirror would be negotiated on the basis of the progress that was in fact being made toward improving the mirror when the minimum specification was achieved, and in terms of the time still available to improve the primary. Additional work at the telescope site would be expected of the optical figurer if, in his shop, he was not able to achieve the desired high quality of performance. At the end of the current reporting period, all of the finishers had cheerfully accepted these bidding specifications and were at work preparing their bids.

Final freezing of the mechanical design of the telescope in November made it possible to fix the exact positions and diameters of the various secondary mirrors of the system. Accordingly, specifications were prepared and submitted by the end of this reporting period to General Electric and Corning for the principal (f/9, f/18, and f/33) secondary mirrors which the optician should figure along with the primary. Additional secondaries and flats remain to be ordered in the relatively near future.

Wide field Cassegrain and Newtonian performance will require appropriate correcting lenses, the former probably a simple single-element quartz astigmatism corrector and field flattener, the latter a modified Ross corrector. A formal agreement with C. G. Wynne of Imperial College in London to design the necessary correcting lenses was signed during this period. Although this work has a somewhat lower priority than many other aspects of the telescope, we hope to have designs far enough along within six or eight months to be able to make firm the necessary mechanical details of these positions and to undertake work on the required correcting lenses.

Although not explicitly a part of this contract, it is of interest that as an integrated part of the design of the telescope, C. W. Jones Engineering worked with The University of Texas astronomers to execute the basic layout of the dome required to serve best this splendid new telescope. These initial ideas were then worked up with the Associate Architect of The University of Texas to prepare Preliminary Plans. In turn, these Preliminary Plans were approved by the Faculty Building Committee and the Board of Regents of The University of Texas, setting the stage for selection of an associate architect engineering firm to prepare bid drawings for the dome and building, as soon as final problems of funding are fully worked out.

C. Personnel Connected with the Contract

Specifically associated with the project during this reporting period at The University of Texas were:

Charles E. Jenkins - Administrative Supervisor

Charles L. Seeger - Electronics and Control Engineering

Marion L. Davis - Electronics and Control Engineering

Maynard L. Wilson - Engineering and Instrument Design

Charles D. Thompson - Engineering and Instrument Design

John F. Blanton - Engineering and Instrument Design

Jesse J. Sedwick - Engineering and Instrument Design

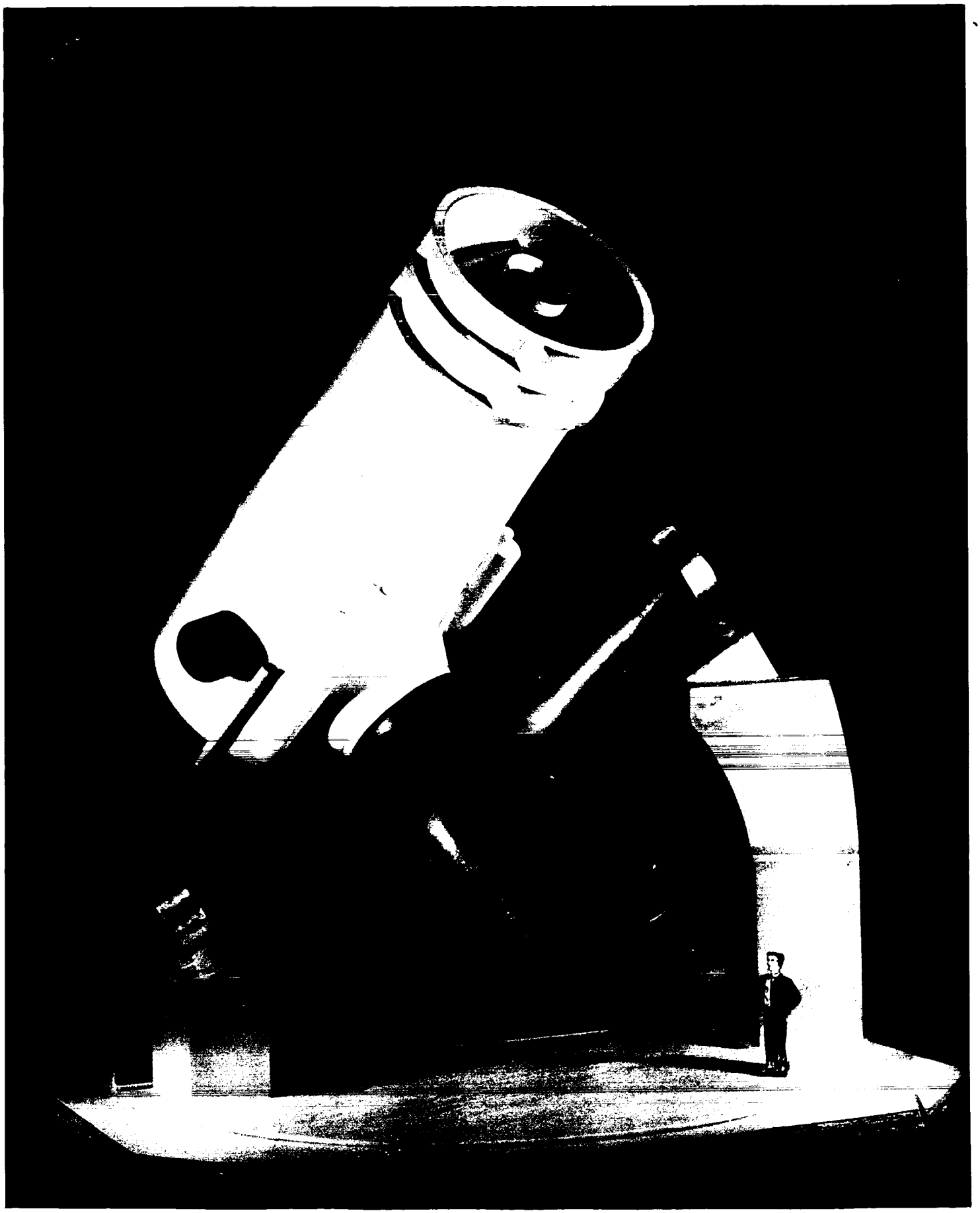
Kelly A. Wightman - Drafting

Howard G. Meyer - Reproduction

Phyllis F. Kirkpatrick - Secretarial and Administration

Ina B. Harrison - Secretarial

Various other members of The University of Texas Astronomy staff, though supported entirely or almost entirely under University budgets, have taken a substantial interest and spent considerable time on the telescope design work — among senior personnel, in addition to the Project Director, these were principally Drs. Neville J. Woolf, Andrew T. Young, Robert G. Tull, and Gerard de Vaucouleurs; and Research Engineer J. E. Floyd.

D. Financial Report

NASA Form 1030 (2-64) for this contract is submitted quarterly by the Auditor's Office of The University of Texas.