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September 10, 1928

My dear Doctor Hale:

I have just received copy of the letter from A. L. Ellis of the Thomson Research Laboratory sent to you under date of August 27. I am very glad to get this information regarding the status of the experimental work at the Lynn plant.

Can you give me some idea as to what the weight of the 200-inch mirror will come to?

Yours very truly,

H. J. THOMSON

Doctor George E. Hale
Mount Wilson Observatory
Pasadena, California

HJT MDB

C O P Y

General Electric Company

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River Works
West Lynn, Mass.
Aug. 27, 1928

Dr. George E. Hale,
Pasadena, California.

200" Quartz Mirror

Dear Sir:

Have just wired you as per the enclosed confirmation in response to your telegram to Elihu Thomson under date of August 23rd.

The estimate is made on the assumption that we will cut all red tape and move the program forward with all possible speed. Much of the work will have to be done on a twenty-four hour basis. Our tentative program is as follows:

We expect to be ready to spray the 22" blank by Sept. 5th, finish spraying by Sept. 7th and remove the blank from the furnace by Sept. 10th. The first blank may be a failure altho we do not anticipate any difficulty in doing this job. We feel that we can safely reason from our experience with an 11" blank to a 22" blank.

The next step in the manufacture of the large mirror, would be to construct a melting furnace for a 60" blank. We are expecting to so design the furnace that the melting furnace can also be used for the subsequent spraying operation and annealing cycle. We estimate that the material for this furnace will be ready by Oct. 1st and that the furnace will be ready for heat Oct. 14th. By Oct. 27th we expect to have burned out the furnace and coated the molds. We estimate that the melting cycle will require ten days. We expect to have difficulty with this large mass and are assuming that we will make four runs before we can get a good one. This will bring us to Dec. 15th.

The blank will have to be prepared for surfacing which we propose to grind flat. Any imperfections in the surfaces will have to be prepared for the spraying process which we estimate will bring us to Dec. 22nd. During this time, we will have the heater element changed from carbon which was necessary to melt the mass, to metallic resistor necessary for the glazing process and annealing cycle. The blank will then be raised to 990° C for spraying which brings us to Dec. 24th.

By spraying the surface at six points, simultaneously we expect to finish spraying by Jan. 7th.

The blank will then be raised to above the annealing point 1120° C, held at that temperature and reduced to room temperature by Jan. 28th.

Allowing for a possible failure a second run could be completed by March 27th.

This schedule, as you see, is practically the limit and is assuming that everything will go smoothly and that we will foresee difficulties in time to obviate unnecessary delays. We are therefore, adding thirty days to the estimate for such contingencies which brings us to May next year, at which time we hope to have passed the 60" stage and have data sufficient to be well under way with the 100" stage.

There is considerable work that will have to be carried on in parallel with the above program. To obtain data to obtain the design of the 200" mirror as well as the design of the furnaces for producing it. We must make sure that such a large mass can be brought back to room temperature, reheated for glazing and annealing processes and brought back to room temperature again without devitrifying. We are starting at once to determine the devitrification of the various kinds of quartz to be used. The determination will be made in the atmosphere of a carbon furnace. Also in the atmosphere of a metal resistance furnace which will be used in the glazing process. Simultaneously with these, determinations will be made in a small metallic resistance furnace having a nitrogen atmosphere against the possibility that we will be unable otherwise to sufficiently protect our carbon resistance heaters when melting the large masses.

We will determine the rate of heat transferred from the center to edge of a rather large mass of quartz under conditions similar to those of the melting or glazing processes to enable calculation of the cooling cycle for a large mirror of any design, having in mind that it will be possible on account of the characteristics of quartz to produce a light weight structure by resorting to ribbing.

The available data as to the thermal expansion of quartz, leaves much to be desired. We, therefore, propose to accurately determine the differential thermal ~~expansion~~ expansion of the types of quartz to be used in the construction of the mirror. We will also determine the difference, if any, in quartz from different localities.

In obtaining data on the properties of quartz, we will make use of Massachusetts Institute of Technology, Harvard University and the Bureau of Standards to the fullest extent and would undertake to do nothing at Lynn that can better be done at these points. We, of course, would want to direct such work from this end.

You will recognize that the foregoing is an ambitious program, in view of the fact that our experience is confined to surfacing a blank 11" diameter and the production of a sand backing blank 22" diameter. We would not consider making such an estimate except that we know you fully appreciate the state of the development to date and the possibilities of producing the large mirror. We are confident at this time of the ultimate successful production of the large mirror. The estimate of expenditures during the next eight months is consequently an educated guess. The \$75,000 figure is probably not far wrong and I am assuming that you will add a factor of safety to this figure, which in your opinion will best satisfy all conditions. In order to realize these dates, we should be working full force in two weeks and should have formal authorization to proceed with the work along these lines, at an early date, with an expenditure limitation rather than one of accomplishment. As we understand it, such authorization will

Dr. George E. Hale

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be given by Dr. John A. Anderson.

Your comments and criticisms of this program would be appreciated.

(Signed) A. L. Ellis

THOMSON RESEARCH LABORATORY

ALE:K

Cy: Prof. Elihu Thomson

Telegram from A. L. Ellis to George E. Hale

Lynn River Works Aug. 25, 1928

Dr. George E. Hale
Pasadena, California.

Estimate approximate expenditures for eight months including cost to date 75000 effectively employing as many men as possible Hope to have passed the 60" stage into the 100" stage by May next year Writing.

A. L. Ellis.