

Copy of this
was sent by Gage to MM

1103.1

CORNING GLASS WORKS

CORNING, NEW YORK



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April 27, 1932.

T. A.	APR 28 1932	sch RDC 4/29/32	
Files		G.A.	
WWB		/	
		MM	

No further reply necessary
as MM wrote Anderson,
as requested by Hale,
that this met with
approval of MM + TA.

Mr. Trevor Arnett,
General Education Board,
61 Broadway,
New York, N. Y.

Dear Sir:

At Dr. Hale's request, we are sending you a
copy of a letter just sent him. This letter is our interpreta-
tion of the agreement between the California Institute of Tech-
nology and the Corning Glass Works for the construction of a
series of PYREX discs for telescope mirrors.

Very truly yours,

CORNING GLASS WORKS,
Aviation & Optical Division

By

O. A. Gage
O. A. Gage
In Charge

OAG:FMM

C O P Y

April 25, 1932.

Dr. George E. Hale,
University Club,
1 West 54th Street,
New York, N. Y.

My dear Dr. Hale:

This letter is our interpretation of the agreement covering the manufacture of glass disks for telescope mirrors. It is intended to summarize your letters of November 17th and February 5th and ours of October 24th, January 30th and March 22nd.

The Observatory Council of the California Institute of Technology wishes to secure:

One circular disk, 26" in diameter, 4 1/2" thick, approximately,
solid design

One circular disk, 30" in diameter, 5 1/2" thick, approximately,
ribbed design

One circular disk, 60" in diameter, 8" thick, approximately (it
is probable that two other 60" disks will be wanted immediately
after the completion of the 200" disk)

One circular disk, 120" in diameter, 18" thick, approximately

One circular disk, 200" in diameter, 30" thick, approximately

One elliptical disk, 60" by 80" by 8", approximately.

All of the figures given represent the finished minimum dimensions.

This list indicates the order of manufacture.

The design of each disk, whether solid, ribbed, or other, will be studied by you and your associates and finally determined by mutual agreement with our Laboratory.

April 23, 1932.

The material to be used is one of our PYREX brand glasses having an expansion of approximately 0.0000032. The glass may, of course, be changed by mutual agreement. We understand that near one surface the disks are to be as free from bubbles as we can produce them. The thickness of this region of minimum bubbles will depend upon the size and ultimate form of the mirror. Below this depth, many bubbles of moderate size, if not distributed too irregularly, will do no harm.

We are to use the best possible annealing practice known to us in order that strain may be reduced to the minimum. The annealing schedules for all the disks are being recalculated and will be sent you. Experiments to determine the possibility of crystallization during the long annealing periods are now under way in our Laboratory.

We are not expected to do any grinding or polishing unless this should prove necessary to determine whether a disk is apparently suitable for shipment to you. We shall attempt to shape roughly the concave surface in the 200" disk by sand-blasting.

The final tests will be made by you after the mirrors have been figured for optical use. We are to be notified promptly in writing of the results of your final tests and whether you accept or reject the disk.

We are confident that a 60" disk can be successfully produced. Disks larger than 100" in diameter have never been made as far as we know, and some unanticipated difficulties may arise which will prevent the making of even the 120" blank.

Our study of methods of manufacture leads us to believe such discs can be made at a cost between \$150,000 and \$300,000. These figures are not a quotation, but represent our best estimate based on experience in the manufacture of disks less than 30" in diameter. Unexpected and unforeseen difficulties may increase the cost over the figures mentioned, or it may be reduced, for example, by the use of less annealing equipment and fewer auxiliaries than contemplated. Apparatus now at West Lynn

will be used whenever possible. Further reduction in cost may be made by designing the disk to eliminate weight, as by casting the disk with a central hole or by using a ribbed design which will not sacrifice rigidity.

We estimate a minimum period of 19 months for the making of these disks if each first attempt is successful. We believe that thirty months should see the work completed unless serious difficulties are encountered. This time estimate applies after agreement has been reached upon design and may have to be modified by complications in the casting process introduced by ribbing.

Corning Glass Works is willing to undertake the manufacture of these disks at actual cost (direct expense plus usual overhead) plus 10 percent for disks successfully produced and at actual cost where acceptable disks are not produced.

By "direct expense" is meant that part of the cost devoted directly and exclusively to the article in question. Under this heading we include materials consumed, power used, labor employed, etc.

"Overhead" covers necessary outlay which is devoted partly to the disks and partly to other articles and which must be distributed on some proper basis. For detailed statement, see our letter of March 22, 1932. In accordance with our standard practice, overheads will be computed on a percentage basis. The figures used are our "standard" percentages of overhead which are employed in all cost computations of ware manufactured under the same conditions. These "standard" percentages are estimated as the average value over a business cycle and are less than the actual overheads under present conditions. Our estimates of cost given earlier in this letter include overhead.

Major equipment purchased for manufacture of the disks will be the property of the California Institute of Technology and will be billed at the price at which it is purchased. Its cost will not be included in computing 10 percent profit on accepted disks.

Itemized bills are to be presented to the California Institute of Technology monthly (in duplicate) and any information desired regarding the costs involved will be supplied. Opportunity will be given to make periodical inspection of the work and the methods

Dr. George E. Hale

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April 25, 1932.

employed. The usual Corning Glass Works' terms are to apply:- thirty days net from date of billing, package charges extra.

We understand that our responsibility ends when the disks are ready for delivery to the transportation company at Corning. Any further responsibility will be assumed by you. We are to investigate actively various possible means of transportation and will report results to you.

Our estimate does not include package charges but we will cooperate in packing these disks according to methods mutually worked out and in accordance with your instructions. Our charges for such service will be at actual cost and are not to be included in computing profit.

At the end of June and December of each year, we are to submit our estimated expenditures for the ensuing twelve months by six month periods.

Since there is some uncertainty regarding success in making these large disks, either party shall have the right to withdraw at any time, it being understood, however, that in such event we are to receive our actual cost on all work done to the date of withdrawal, plus 10% of the cost of any disks accepted.

Very truly yours,

CORNING GLASS WORKS,
Aviation & Optical Division

By

O A Gage
O. A. Gage
In Charge

OAG:FMM

CC: Dr. Max Mason
Dr. J. A. Anderson
Mr. Trevor Arnett