



# HARVARD COLLEGE OBSERVATORY

60 Garden Street, Cambridge, MA 02138

Sesquicentennial Year 1989

MAR 4 1991

To:

Chuck Whitney, John Huchra, Nate Hazen, Fred Seward, Nate Carleton, Martha Hazen, Ed Lilley, Peter Smith, Barbara Welther, Owen Gingerich

From:

Pamela Lodish, 5-2540 *PL*

Date:

March 1, 1991

Subject:

Sears Tower Committee

I am writing to invite you to a meeting regarding the proposed renovation of the exterior of the Sears Tower. I hope that you will be interested in working on this project with me. The organizational meeting will take place on Thursday morning, March 14, at 10 a.m. in Pratt.

By way of background, Irwin Shapiro asked me to convene a group of people who might be interested in or have opinions about the exterior renovation of the Sears Tower. My goal is to reach consensus about what work should be done to restore the dome. I believe that all of you have received Fred Seward's update of February 8, 1991, so I am only enclosing a copy of the Sears Tower condition survey prepared by Briggs. Please read both of these documents in preparation for our first meeting.

Please contact Judy Terry (5-9059) if you are not able to attend the first meeting, if you know of anyone who I have omitted from the proposed group, or if you need a copy of Fred Seward's February 8, 1991, report.

cc: Irwin Shapiro

Harvard University/Atmospheric Research Project



Engineering Sciences Laboratory

40 Oxford Street, Cambridge, MA 02138

617-495-5922

SEP 17 1991

September 11, 1991

William E. Knight  
7 Shornecliffe Road  
Newton, MA 02158

Dear Ed,

First I want to apologize for the delay in responding to your letter of July 7. I was on the west coast for several weeks at that time and after, back for only a few days, then back out for more weeks both in August and just after Labor day. There will be more starting the 15th and again October 1. So I'm afraid I let your letter slip as it didn't require an action response. I did note the Director's well-deserved letter to you of 8/14, and your reply.

Second, I'd like to bring you up to date on what is going on regarding the 15" telescope, at least as I see it. As you read in Dr. Shapiro's memo, Pam Lodish is moving ahead with the roof and building stabilization project. Harvard has assigned a Project Engineer - Dick Beckwith - to oversee the effort. A consultant has been engaged to define the work to be done; he did the site study work last month, and it should be out to bid before long.

With regard to the interior, the iron and brass gear pair that we removed together last spring from the aperture door drive were placed for restoration with the HCO model shop then, but recovered several months later when it became apparent that they were too busy. However the work was handed over to a long-time HCO employee who does precision machining on the side and is now very nearly done. The iron gear is being fixed in the manner of the original and the brass pinion pair are being replaced with identical new ones. These soon will be mounted again so as make the mechanism operational, although the doors are caulked shut for the time being. Your suggestion for the installation of a pair of brakes is noted and interesting. I would like to get the "winch" working first, and then assess the torques necessary to drive the doors (and to arrest them) before deciding on that course of action.

As far as the Observer's Chair is concerned, we are waiting on that for fund authorization. I personally feel that it should be done carefully by a reputable upholstery shop along with the restoration of the frame, and that it should not be remounted in finished form if work on the telescope proper is pending. For those reasons I have not been pushing it. The major work on the telescope awaits improved prospects on funding.

I'd like to add my thanks to those of others for your work, Ed, and that of the other ATM's. I had occasion to work directly only with you and Ed Dougherty, but certainly the work of all has been very much appreciated. Things always take more time than one would like, especially where money is required, but you all have brought a level of volunteer energy that has been very heartening.

Sincerely yours,

*Nate Hogen*

cc: Dr. Owen Gingerich  
Pam Lodish

William E. Knight  
7 Shornecliffe Road  
Newton, MA 02158  
(617) 969-6548

DEC 21 1990

December 19, 1990

Mr. Nathan Hazen  
Project Engineer  
Engineering Sciences Laboratory  
40 Oxford Street  
Cambridge, MA 02138

Dear Sir:

Harvard College Observatory  
15 in. Telescope

Since meeting with you and Dr. Owen Gingerich in his office at the Observatory on December 12, 1990, a small work party consisting of Ed. Dougherty, Greg Chase and myself examined the observing chair which serves the 15 in. telescope on Saturday, December 14, 1990. The chair was placed on blocks and the broken piece of wood which supports one end of the rope propelled drive wheel was removed. A rope was run through the sheaves as a means of measuring the required length of a new rope.

Based upon our inspection, we suggest our scope of work consist of the following tasks.

1. Either repair or replace the broken piece of wood mentioned above. Your advice will be appreciated.
2. Make a new sheave to replace the original which cannot be found. (A photograph would be helpful) A new rope will also be required. A long splice which will fit through the shives will be made. We require your advice as to whether Manilla or Dacron line should be used.
3. Make a new knob for the crank which elevates the chair. (A photograph showing the original would be helpful)
4. Thoroughly scrub the chair from top to bottom with a mild solution of Oakite or tri-sodium phosphate and Whisk or other laundry detergent.
5. Sand the wood structure smooth without removing existing paint. Touch up any bare wood with Benjamin Moore oil base gray primer. Apply one coat of Benjamin Moore oil base flat black house paint.

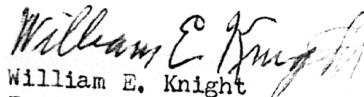
6. Remove the seat from its supporting hardware, repair by welding or replace the broken support bracket now being held by a temporary aluminum reinforcement.
7. Bring the chair to an upholsterer familiar with the type of work done on airplanes, buses or theatres.
8. Dismantle, inspect and clean all mechanisms. Reassemble and coat exposed surfaces of gears, wheels and shafting with clear lacquer or black paint to match the original finish in so far as possible.
9. Procure a polyurethane tarpaulin and cover the entire structure to protect it from overhead painting and/or other proposed work under the dome.

Hopefully, this scope of work, including suggestions you may have, can be completed in about six Saturdays. The time period could stretch out depending upon the weather, vacations, and availability of volunteers. With your approval we tentatively plan to clean and wash the structure on January 5, 1991.

We would be glad to discuss any of the proposed work at your convenience.

Best wishes for the holidays.

Yours very truly,

  
William E. Knight  
For Amateur Telescope Makers

WEK/mk

cc Mr. Owen Gingerich  
Mrs. Marion Hochuli

9  
November 1, 2003

Hi Owen....

Much as I would like to be with you the first time the synchronous motor drive is tried out on a star, I realize that this may not be possible. The purpose of this note is to review the characteristics of the drive that define operation limits.

We want to rotate the right ascension axis roughly one revolution in 24 hours, or one revolution in 1440 minutes, which is equivalent to  $1/1440 = .000694$  rpm. If we know the number of teeth in all the gears in the drive system we can calculate the needed synchronous motor speed to be 28.5 rpm, easily within the range of a synchronous motor designed for 30 rpm operating from a 60 Hz line frequency. We do know exactly all the number of teeth in all the gears *except* the large gear on the RA axis which we *think* has 571 teeth. This is not a problem because our guess is probably off by only a couple of teeth out of 571 teeth or probably less than 0.5%, easily accommodated with a slight change in the position of the black knob on the remote unit. (No need to mess with stuff in the brass box. If necessary, an adjustment can be made in the remote unit. The black knob frequency range is roughly 55 to 57 Hz.)

It is still necessary to acquire an object manually. Our Great Refractor does not have the usual differential gear and large motor needed to slew the telescope to a new object. When the desired object is in the field of view of the finder scope its fair to "trim" using the synchronous motor drive..... RA only, declination is still manual positioning.

The two main drive weights have been adjusted so that minimum torque is required from the synchronous motor, and there is no need to make changes in these weights. Changes in telescope balance or friction will require more/less torque from the synchronous motor to maintain tracking rate and the required torque change is readily provided by the synchronous motor. The range of torque available is approximately ten times that available from the previous weight driven clock drive. If the telescope is inadvertently driven to collide with the base, (or the large weight movement is intercepted by the floor), the synchronous motor will try to provide more torque until the torque exceeds the torque limits on the internal slip clutch, (located in the brass box), thereby protecting the telescope drive system from excessive overload. The synchronous motor will continue to run at synchronous speed but the output drive shaft will be stationary so the telescope will not move.

The large weight drops about 0.5 ft per minuet. Resetting the large weight is a hazardous operation because it is easy to pull the rope off the pulley which will cause the heavy weight to drop to the floor and this could easily injure personnel. If inexperienced operators are likely to be engaged, a metal bracket to keep the rope on the pulley is highly recommended.

There is no ON/OFF power switch on the brass box. The only way to turn the unit OFF is to pull the 115 volt power cord, and this is recommended. There is a two amp fuse on the lower right side of the brass box. There is an OFF/ON switch on the battery operated remote control unit. Use it!

Have fun!!

Hugo

781 - 275 - 5926  
hlogemann2@yahoo.com

George Field

15" 11  
November 26, 1980

Owen Gingerich

15-inch Committee

I am enthusiastic to see that Jim Crawford's work is pushing us ahead on this project and I hope that we can have an early meeting. However, I shall be in Europe for the next two weeks and hope that the meeting can be held off until the week of December 8.

I remind you of our discussion that Barbara Welther should be included on the Committee. She has, in fact, started doing some legwork on the historical background.

Last Friday I filmed six transition segments for a forthcoming Nova program "Beyond the Milky Way," and one of the historical segments was filmed in the 15-inch dome. I only wish that the surroundings had been restored to their 1850 splendor! Presumably Jim Cornell will give some publicity as to the precise date in February when you can see it on Channel 2.

OG/jj  
(Transcribed/signed in his absence)

12/20/89  
until  
1/10/90

Dear Nathan:

Like everyone else, we have a flood of things to do during this season. Gee, presents all the way unto the fourth generation! We're Headquarters for meetings and meals.

It seems to me that the old drawings are very good, but it might be that I was hoping it was so. You see the original three-dimention thing and probably think "Yes, but" ...? My reading (x 4) of the upper shaft center-line was .775" above the edge while you know it is ~~.75~~ 1.15". And the 60° Lat. 45° caused several changes from the drawing.

The Pulleys and weight cans are done. Not the lead slugs for them. The big ones will be separated into 1" tall pieces. CHANGED BY 1-5-90. SEE LAST PAGE [1]

A sheetmetal duplicate of your drawing is screwed onto my wooden triangle for an accurate work form.

Now, Clock details. It has run for several hundred hours mostly for curiosity and checking, apart from anything else. Except where stated, the shaft <sup>extention</sup> and <sup>WORM</sup> pinion are attached, and always the small pulley is used at the weight.

The pulley of course means that the pull on the drum is half the stated weight. 1/2 ft. worm pulley

One test is to see how well-done the clock system is, (no extention). It runs steadily on: one pulley of 1.8 oz. plus 3 steel washers, 12.7 oz. or 14.5 oz. ~~14.5~~ equals 7.2 oz. of pull. The drag is; Drum, 2 horizontal arbors and one vertical; 3 gears and 3 pinions, 8 pivot holes of friction, and inertia. Put on the extention shaft with its <sup>WORM</sup> pinion and friction almost doubles. Its a safe bet that Old M&M in 1840 had theirs running just as well.

Another check was Speed checks, within desired range.

Another was speed and output with various weights- shaft and <sup>WORM</sup> pinion attached, <sup>(+)</sup> Unwinding the drum always takes 2 hours; that's 13.5 feet of line. Tried were 4 Lbs, 9# and 14#.

$13\frac{1}{2}$  ft. in 2 hrs is a way of figuring what the wt. drop is at the 'scope.  $13\frac{1}{2}$  ' is  $6\frac{3}{4}$  ' in 2 hrs. or  $3\frac{3}{8}$  an hour, about. I FORGOT TO TYPE SOMETHING. SEE OTHER SIDE

formation from you, I believe, was that Upper  
it must turn 24 Revs & per hour to get 15° of TURNING.

So 24 R/H of Upper shaft means (Gear has 104T).

- 12 R/H of Middle or 2nd shaft (GEAR has 208T).

$12 \text{ R/H of Worm gear } \times 144 \text{ Teeth} = 144 \text{ T} \times \frac{12}{1728 \text{ T/H}}$  (Comparison to 208T is Worm gear 144 teeth)

1 Tooth of Worm gear = 1 Rev of Worm pinion which "translates" to

③ 1728 Revs of Pinion (clock output) per hour  $\div 60 = 29 \text{ R/M of Worm.}$

Call it 30 Turns of Clock Output shaft per minute.

② As the Fly weights are now set, it goes 22 R/M at  
fastest speed. To get 30-32 R.P.M. the easiest way is to:  
take off plastic disc lid; lower <sup>the</sup> vertical shaft and Fly ARM  
comes out. Bend 2 springs some  $15^\circ$  toward center. Put it  
together and speed goes up to 32 RPM. I put a  
masking tape flag onto output shaft stub and count RPM  
against a quartz clock. Some BUGS still remain as  
stated in "BAD NEWS".

These FLY WEIGHTS are the second size. The FIRST pair were about  
 $\frac{1}{3}$  heavier. With the bare Fly arm, it FLEW.

The new frame for Middle shaft is done. The gear unit turns easily in it.

The outer pulley is done-ratchet holds in one direction but releases when lifting the big weight. <sup>C.C.W.</sup> I had to rough-up its groove, like an old-time file-maker did, as contact area wasn't large enough.

BELT? Lucky so far. Locally a grey tube is used to hold screen in its frame. It is .230" dia. with a .075" hole thru it. Fairly tough. A #4-40 screw thread about 3/4" long makes a good connector, epoxied in. Loosen it with 2 pliers.

Upper shaft parts lie in wait. <sup>PARTS</sup> I hope the  $\frac{1}{8}$ " diam. shaft is too small and <sup>A</sup> need boring out. That gear turns true but has a small sideways wobble.

The U-joint assembly is nearly done, and the stuff above, labeled  $m, A, X$  - ALSO.

Now the Bad News.

The clock's output is tiny. A cockroach, with ~~put~~ steroids, could win a Push-Shove contest with it. But the Key is shaped handily to test 'More Input'. An adjustable thing like the front Fly lift was added near the Worm pinion for a bearing. The middle gear assembly will now turn all right. But do not add any weight at all to the largest weight's pulley or NO GO...??

Data on worm pulley. .915" long- 9 teeth, about .115" from tip to tip. Worm GEAR has same profile, same sized teeth and same angle of cut or slant. There is SO much area of contact, at least 5-7 teeth rubbing. Real slippery modern gook is a help. Local information is scarce. I've Marks <sup>M.E.</sup> Handbook and Kents also.

In a Music Box the Worm-Fly works with a real steep angle, small contact area, and work load is tiny. Power is taken at the second shaft and Fly is fifth.

The assembly so far looks very attractive and mechanically clever. Very impressive and reasonable. It served to introduce an idea that later was improved upon... I'm guessing.

RAY, LICENSED MECH. #70A MONTH.

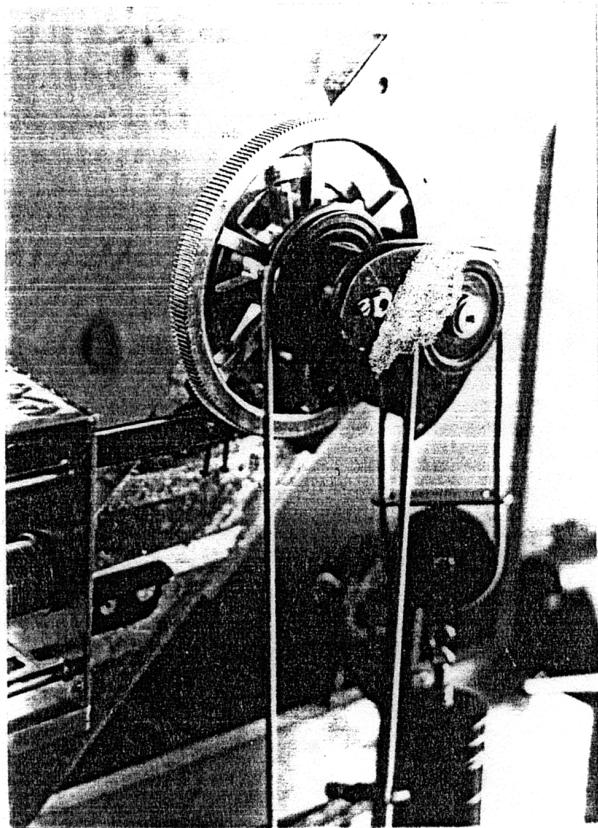
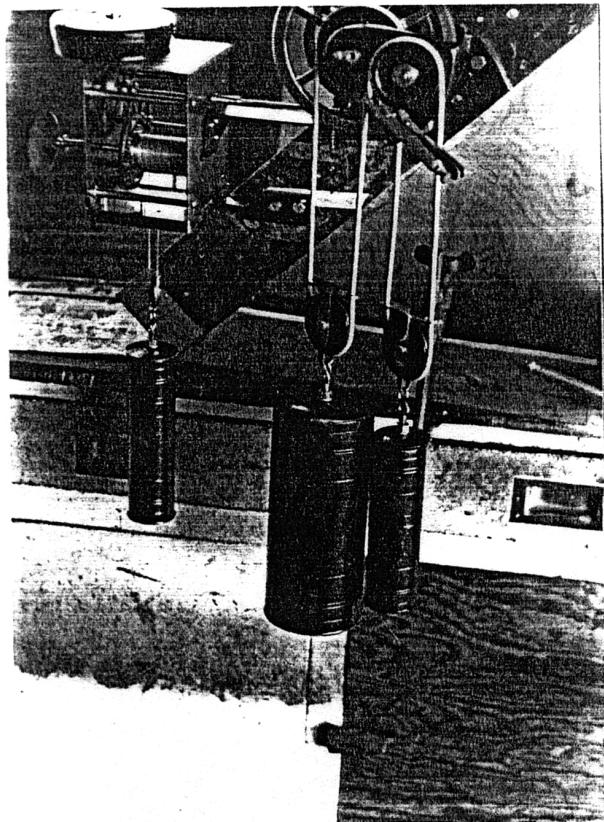
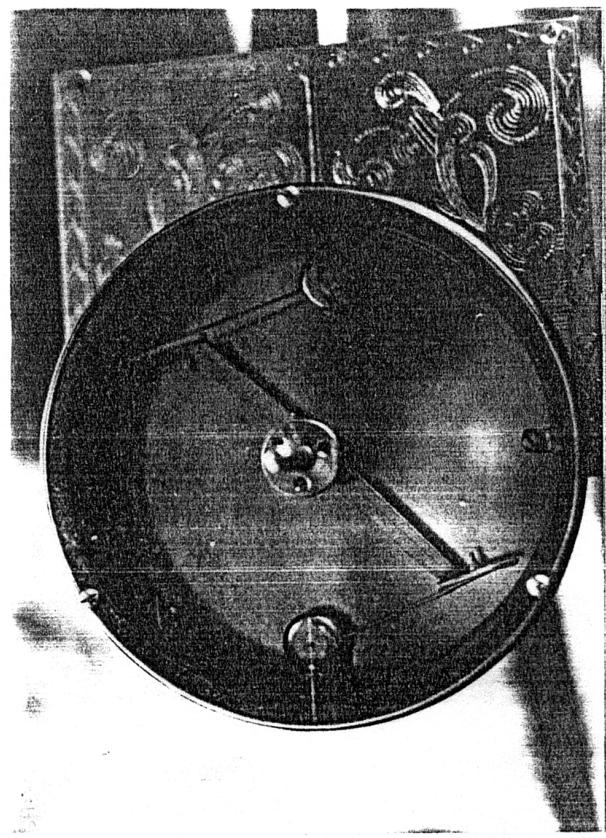
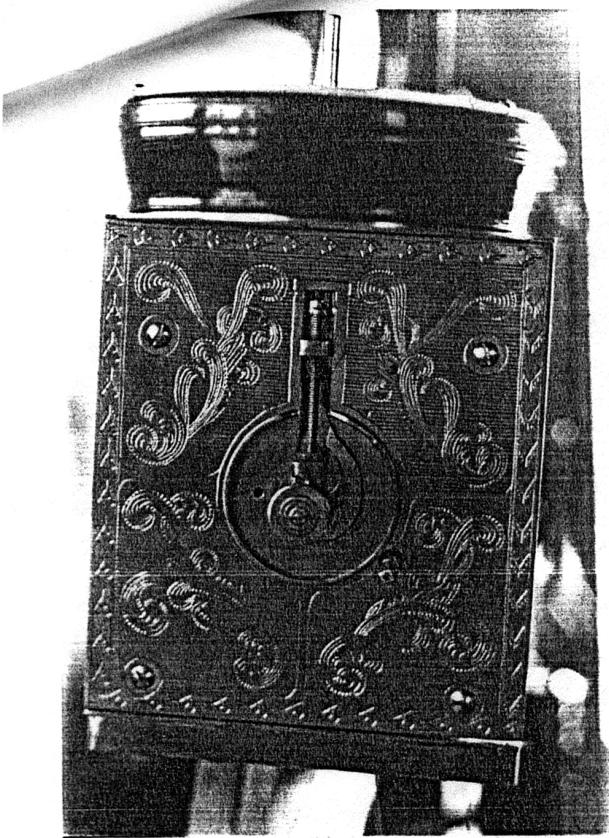
At Newark N.J. Airport, 1934,<sup>5</sup> I worked for TWA. DC2's were the new plane, the only one used for passengers and freight. Alongside the repair hanger was parked a similar one but its landing gear and other details were clearly sort of hand-made. I believe it was a DC1. Inside were cabinets and instruments. It was used for weather research, with its low ceiling I doubt if they learned much.

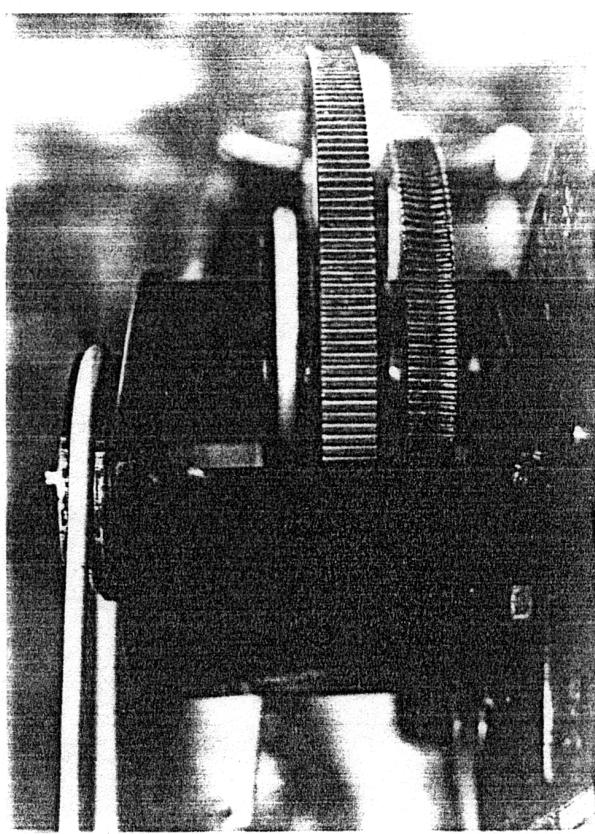
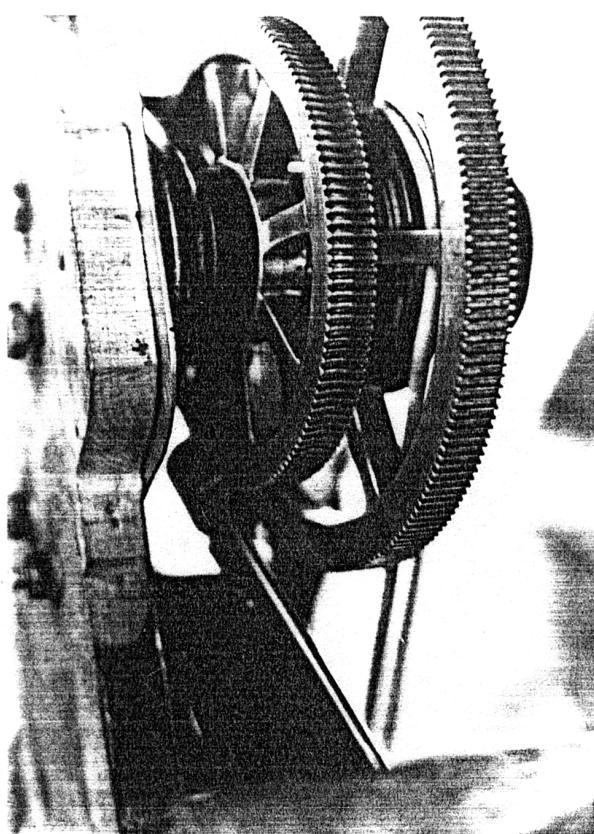
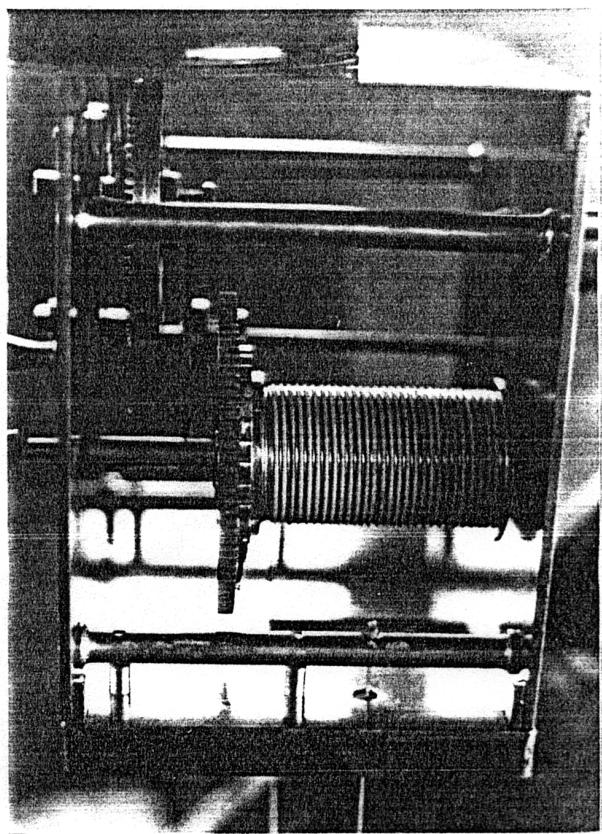
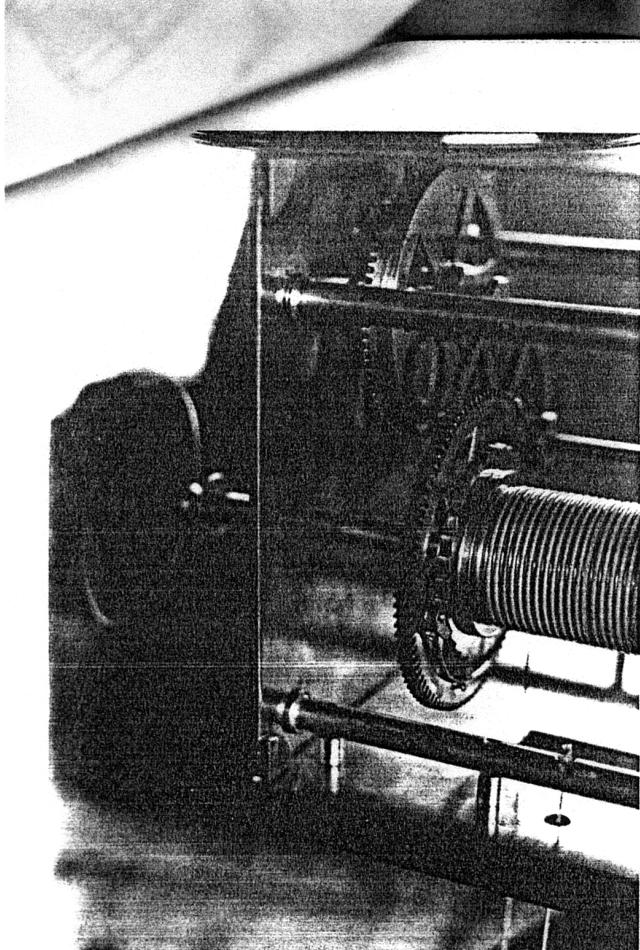
[1] I've made a slug for the big can and for the smaller ones, that means 2 molds. Problem here. LEAD is becoming scarce as Plumbers now only learn how to smear plastic pipe glue, never how to use lead, especially a joint "wiped" with the glove. I can't get anymore locally. Luckily I've some pieces on hand.

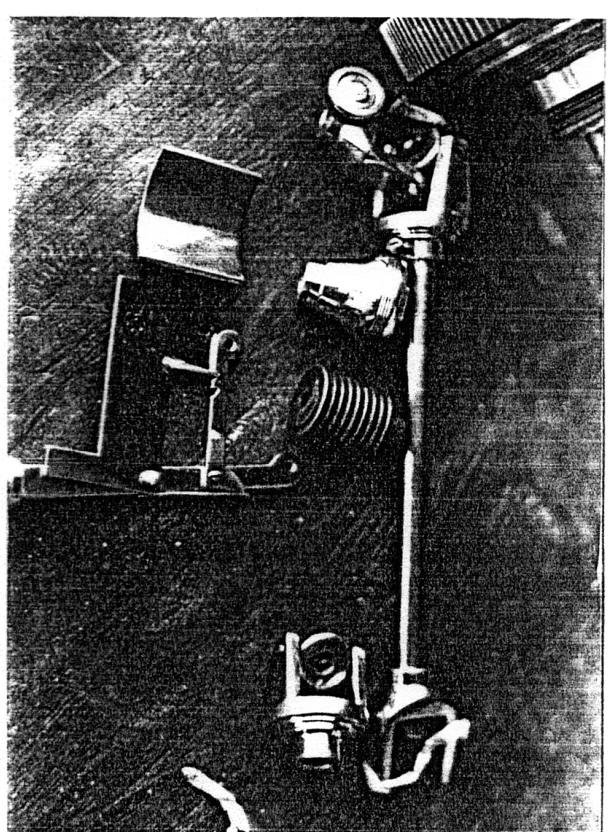
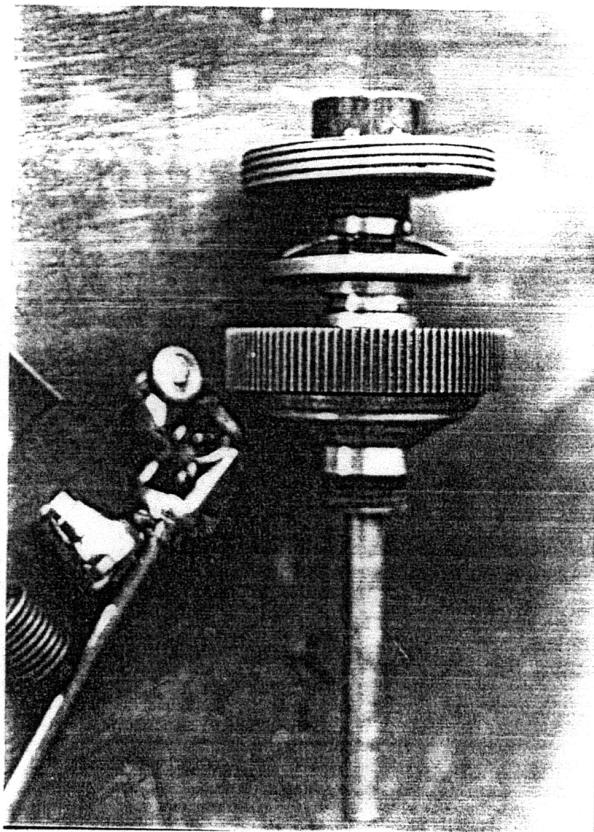
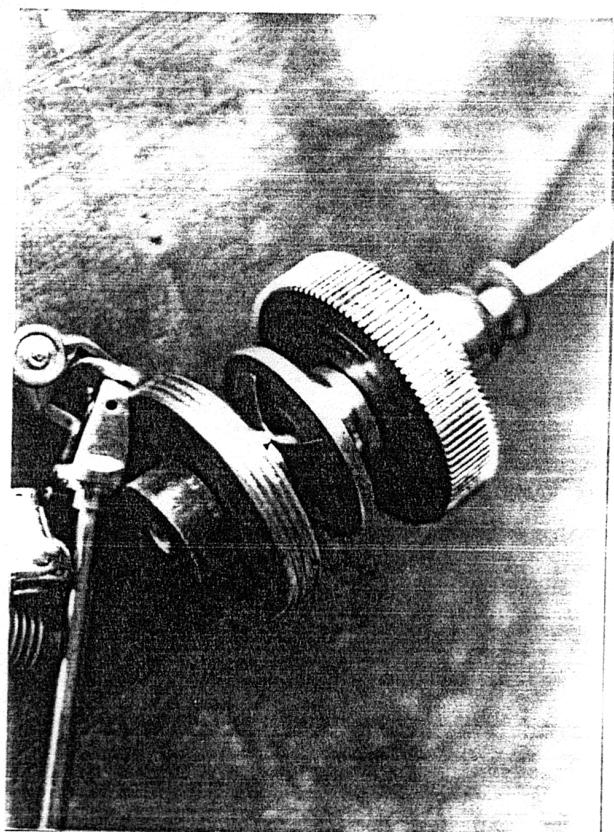
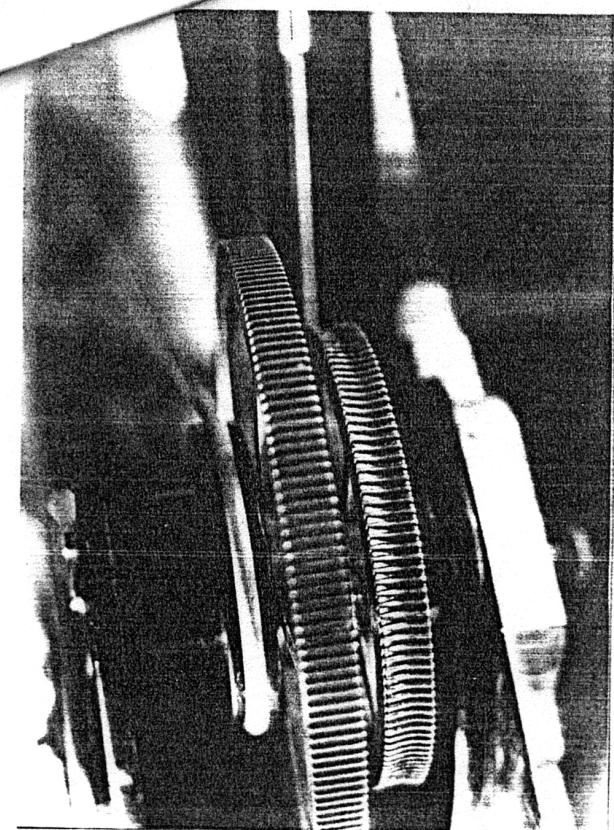
The larger can (②) is a pipe 4" I.D. and 10 $\frac{1}{2}$ " long, turned smooth with a cap at each end and a 3/8" rod through everything. Weight is 10 $\frac{1}{2}$  lbs empty. Its lead slug is 3 $\frac{3}{4}$ "  $\varnothing$  by 1 $\frac{1}{2}$ " tall weighing 6 $\frac{1}{4}$ #. I've made only 1 slug, this size.

The 2 smaller are the same, nearly. Pipe turned smooth cap each end, 3/8" rod through. I.D. is 2", and 8 $\frac{1}{8}$ " long, The one slug I've made is 1 $\frac{7}{8}$ "  $\varnothing$  x 2 $\frac{1}{2}$ " tall - weight is 2 $\frac{1}{2}$ #.

These weights are awesome! I'd not want to put my foot under them, day or night. But everything is a chance. Technology Review Jan 1990, page 53, last paragraph: 103 deaths via Sulphenilamide. I nearly got it then, 1938. Gorgas Hospital - <sup>PANAMA</sup> infected left foot. Too much Sul - and not enough water. My PEE was white. The doctor saw the urinal and yelled - I had to drink a full gallon of water, under supervision. 18 babies died there and rumor said 150 G.I.'s at Fort Clayton hospital also died. I never ate the second salt tablet from the damned plastic salt dispensers of 1935 to 1980.







MEMO TO: Distribution

Nov 7  
1994

FROM: Nate Hazen

SUBJECT: Discussion with ATM'ers about new 15" drive

DATE: October 31, 1994

On this date I had occasion to visit with two members of the Amateur Telescope Makers at the 15" telescope. This long-delayed discussion stemmed from a presentation to their group last spring, at which these two indicated an interest, as volunteers, in constructing a replacement RA drive for the instrument along the lines of the lost Alvan Clark drive. Hugo Logemann and Henry Drinker both are retired and live in Bedford. They have access to a machine shop, and have appropriate skills in that area and in electronics.

At the telescope we reviewed the nature of the three drives that have been on the telescope over time - the Merz and Mahler drive, 1847-1855, which was so unsatisfactory; the Clark drive, 1855-1955, that replaced it; and the variable frequency electric motor drive, 1956-recent, which never really worked. We recognized that the design data on the Clark drive was sketchy, consisting of half a dozen photos over a period of time and rather low on detail, and discussed two alternatives of a) trying to reconstruct a fairly good replica of the Clark drive with mechanical escapement (although the photos show two versions quite different in detail), or b) using the essential good features of the Clark drive (large sector yoke and taut-band final drive) and a modern prime mover such as a stepper motor to create a working emulation of the Clark drive that looked somewhat the same.

We also talked about the climate at the Obs. regarding activities relating to the 15" telescope - relatively low levels of interest and commitment, poor fiscal climate, divergence of opinion on goals, uncertain future, etc. - and whether a project along either of the lines above was worth their effort, which would be substantial especially on their parts but also for those that would support them.

We concluded with the agreement that I would document the discussion and circulate it to those who might be interested at the Observatory, and we'd see what happened.

Distribution: Owen Gingerich ✓  
Fred Seward  
Jim Cornell  
Pam Lodish  
John Huchra  
Charlie Hughes  
Hugo Logemann  
Henry Drinker

Harvard University/Atmospheric Research Project



Engineering Sciences Laboratory  
40 Oxford Street, Cambridge, MA 02138

617-495-5922

MAY 1<sup>st</sup> 1990

MEMORANDUM

TO: Fred Seward, Owen Gingerich  
FROM: Nate Hazen *✓*  
DATE: May 15, 1990  
SUBJECT: Task Report and Budget; 15" Telescope and Sears Tower

Enclosed is my summary of the tasks that have to be accomplished for the renovation of the telescope and the building following the general approaches that we have been discussing for the past few months. The cost data are a compilation as is described; a certain amount of judgement has been applied. In reality, I don't think one could get a much more reliable set of numbers without a formal work statement and bid process. There will always be a level of risk involved, even then. The management skill is to keep it on target during the course of the work regardless of the budget; this involves the ability to make tough choices during the project.

I really look forward to the prospect of participating in this effort and would love to direct the work on the instrument itself. Please let me know if I can provide any more information.

cc: Pam Lodish

Irwin Shapiro



# Harvard-Smithsonian Center for Astrophysics

60 Garden Street, Cambridge, MA 02138

(617) 495-7000



To: Fred Seward, Chairman,  
Committee for the Restoration of the Rotunda

From: Edward Lilley *EL*

Subject: Suggestions

7 December 1989

Recent surgery prevented my attendance at the December 4th meeting of our committee. Had I been there I would have presented some thoughts on the restoration which are summarized here.

I believe the committee has agreed that the telescope and dome should undergo an authentic period restoration for which some of us argued at the outset. I hope that this restoration objective is no longer in question except for the necessary historical research, the technical challenge of an accurate mechanical reconstruction and an adequate budget.

It appears to me that we are not clear in our formulation of a plan for the restoration of the rotunda. The prospect of modern exhibits, now under discussion, has never been attractive to me for several reasons. Although the rotunda would have visitors during open nights, and would benefit from possible historical tours, it is not a central traffic area for the Observatories. While modern exhibits are appealing, they are not yet historical. Furthermore, exhibits of scientific achievements of the last few years (or last few months!) should be located for convenient viewing by our students, faculty, staff, by visiting scholars and by visiting NASA, NSF and other agency scientists and administrators. Modern exhibits would be somewhat isolated if located in the rotunda. In contrast, a location in the Perkin lobby or in the proposed new building would provide attractive exposure to daily traffic and could be included in open nights and historical tours as well. Modern exhibits are necessarily short-lived as a cursory inspection of the present rotunda unfortunately demonstrates. Replacement of exhibits to illuminate advancing scientific achievements demands periodic contributions of staff time for design as well as repetitive funding.

I have an alternative proposal. I suggest we consider exhibits that display Harvard astronomical achievements of the 19th and early 20th centuries, viz. early daguerreotypes, exhibits of historical scientific papers, objective prism spectral plates, variable star plates, time keeping services, scientific instruments of the period and historical photographs. Even earlier astronomy at Harvard presents extraordinary historical exhibit opportunities ranging from Cotton Mather to telescope theft by British troops to John Quincy Adams. There are more candidates for historical exhibit than available presentation space. What we need are careful selections among subjects that are historically significant, well suited for exhibit and, if possible, replaceable if stolen or damaged. If the displays are well chosen and effectively displayed, they could serve as a nearly permanent tribute to early astronomy at Harvard. Costs would be restricted to design, construction and maintenance. Coping with the rapid obsolescence of "modern" exhibits could be avoided in this project. And, the entire restoration -- telescope, director's office, rotunda and exhibits -- would have a common historical unification.

If you and the committee react favorably to these arguments, I think we should ask Owen Gingerich for his views. Also, he could provide the necessary oversight of the historical subjects selected for exhibition. I look forward to your comments.

Harvard University/Atmospheric Research Project



Engineering Sciences Laboratory  
40 Oxford Street, Cambridge, MA 02138  
617-495-5922

January 18, 1990

Ms. Andrea Gilmore  
SPNEA Conservation Center  
185 Lyman Street  
Waltham, MA 02154

Dear Andrea,

Thanks for forwarding Conor Power's report and pictures on the structural condition of Harvard Sears Tower and dome. I think the level of detail is just about right, and he has certainly raised some issues - particularly about the nature of requirements on the first floor - that had not been identified before. It is also heartening to get such an encouraging view of the state of the dome's condition. We also appreciate your willingness to float the costs of the consultation in the short term. Please send along the bill as soon as can so we can initiate the process of getting it paid.

The background material you sent along last month was also most interesting, some for reasons unrelated to the immediate issue; thanks for that, too.

As we discussed recently on the phone, there are two specialized "carpentry" tasks associated with stabilization and refurbishment of the Harvard Observatory's 15" telescope. These are relatively unrelated to the issues of the building structure reported by Conor and will benefit from a creative and eclectic approach to woodworking similar to elements of furniture restoration or strip-planked boat construction. These tasks are described in the attached sheet. You said that you might be able to find someone interested in doing this work (eventually) and perhaps giving us some guidance now on what it might cost, for our budget. If you could steer us in an appropriate direction, we'd appreciate it. We could arrange for additional inspection time, as required.

Thanks again for your help.

Sincerely yours,

  
Nathan L. Hazen



# Harvard-Smithsonian Center for Astrophysics

60 Garden Street, Cambridge, MA 02138

*Seward*  
(617) 495-7000  
Telex # 921428



A208 or Mail Stop 9

GINGER@CFA or CFA::GINGER

(617) 495-7216

February 27, 1990

## MEMORANDUM

To: Fred Seward

From: Owen Gingerich

Subject: Renovation of Great Refractor and Museum Room on the Landing.

After the external work has been accomplished on the dome and the shutters, the first priority would be the telescope itself. A replica of the original clock drive has been completed, but there is not much sense in installing it if the telescope itself has to be dismounted for general repairs. The metal replacement section at the upper end of the tube should be replaced with a laminated mahogany veneer section. The motor drive from the declination axis should be removed. These changes will lighten the instrument and make it possible to remove most of the ugly set of lead counterweights near the eyepiece end.

The observing chair is in bad disrepair and needs to have a fractured member replaced, new upholstery, and paint. It needs a fresh set of pulley ropes so that the chair can revolve around the dome. In conjunction with the restoration of the chair, the floor needs to be refitted and the iron rails on which the chair moves have to be re-anchored.

We will clean out the two alcoves on the northeast and northwest sides of the dome and fit these with special high-security plexiglass doors. The alcoves need attractive indirect lighting for the exhibits to be chosen by Will Andrewes, curator of the Historical Scientific Instruments Collection. We expect to place early brass telescopes in the northwest alcove and a variety of nineteenth-century instruments in the northeast alcove. Robert Noyes has promised some original drawings of Donati's comet made with the 15" telescope, and it would be appropriate to place them in the northeast alcove. The Smithsonian is purchasing a set of Trouvelot astronomical drawings, and since Trouvelot worked with the 15" telescope, it would be appropriate to frame a few of them to place on the walls of the dome, if the temperature extremes do not propose a problem with the plates.

It seems to me desirable to include a sound-and-light program in the dome so that an automatic program would spotlight various parts of the telescope and exhibits in synchronism with a short soundtrack.

In the room on the landing we propose to install the famous rotating desk purchased by Pickering in 1905 and later used by Harlow Shapley. The desk is now in the hands of his son, Alan Shapley, in Boulder, Colorado, but has been

Fred Seward

- 2 -

February 27, 1990

promised to us. There will be some shipping fees for this and also for the two chairs from the residence, once owned by Bart J. Bok and now in the hands of Ray White in Tucson. We have recently received the candelabrum from Annie J. Cannon's family home, whose prisms inspired her to think about spectra. We expect to place the candelabrum and other artifacts in this room. Presumably we will have to construct a glass or plexiglass viewing cage.

OG/jj  
Xc: B.L. Welther

*Own*

## UNLEAVENED COST COMPARISONS - SEARS TOWER RENOVATIONS - NLH 5/4/90

-Preservation Project-      Connor      Briggs/  
 Pre-App.      Full Appl.      Power      Bonica  
 12/5/89      4/14/89      12/26/89      5/1/90

Item:	469	391	500	
Photos	469	391	500	
Sign				10,000
Preservation Consultant; Architect	23437			
Masonry		19000	3500	10,000
Metal Railing		1000		1,000
Carpentry: Cornices, gutters Chair, Dome, <del>Stairs</del> doors	109375 12500	9000	20000	20,000
Sheet Metal; Roofing	3125	18000	45000	65,000
Caulking		1000		1,000
Doors, Windows, Shutters	4688	8000	(5000)	5,000
Telescope Shutter Rehabilitation		8000		8,000
Plaster Repair		1400		— <i>display</i>
Floors: "Resilient" Flooring Second (observing) Floor First Floor/ Basement "Wiring/ Fireproof Basement Ceiling/ Plaster"	7300 25000	20000	35000	35,000
Paint: Exterior Interior	12500 4687	15200 11600	(5000)	10,000 <i>display</i>

OTHER ASPECTS      SPNEA      NLH  
4/12/90      Estimate

Observer's Chair Refurb. incl. Paint & Cushions	15000
Telescope, Mount, etc.	
Scaffolding	TBD
Disassembly of Whole Telescope & Mount	TBD
Tube: Objective end rebuild (woodwork)	9500
Brasswork: Clean, polish and protect	15000
Refurbish RA & Dec. axes; associated parts	37,000
Adapt Replica Merz drive	TBD
Refit Objective cell	TBD
Reassembly of Whole Telescope & Mount	TBD
Misc. General Refurbishment, Teles. & Pier	TBD
Dome Drive; Restore Machinery as Necessary	TBD
Aperture Door Drives; Restore Mechanical Aspects	(TBD)

~ 30K *guess*.



# Harvard-Smithsonian Center for Astrophysics

60 Garden Street, Cambridge, MA 02138

(617) 495-7000



FEB 12 1991

To: Nat Carleton and John Huchra  
From: Irwin Shapiro *IS*  
Date: 7 February 1991  
Subject: Great Refractor

After receiving each of your memos on the Great Refractor, I asked Pam Lodish at my next meeting with her whether she knew of any "goings on" at the Great Refractor. She told me that in fact someone had tried to turn on some mechanism or other, but that it had not responded. She was not clear on the details, but said that Owen Gingerich would know.

Be that all as it may, Pam will contact Nate Hazen and involve him to the extent he wishes to be involved in the restoration project, which we hope to start soon.

cc: O. Gingerich✓  
P. Lodish

IS/db/janfeb91.carlhuch



# Harvard-Smithsonian Center for Astrophysics

60 Garden Street, Cambridge, MA 02138

(617) 495-7000



To: Fred Seward  
From: Irwin Shapiro IS  
Date: 12 February 1991  
Subject: The Sears Tower and Its Innards

FEB 19 REC'D

Thanks for sending me a copy of your rather complete and well-written report on the plans for refurbishment of the Sears Tower, the Great Refractor, and the rotunda. I, in turn, passed a copy on to Pam Lodish.

As you correctly point out, the project is indeed expensive. The funds we have in hand should cover the exterior; I hope we can raise at least the exhibit funds through the Smithsonian. Perhaps one of the two Worcester foundations that Owen will soon approach will be enthralled sufficiently to provide the restoration funds for the Great Refractor. At least we're off to a good start with the funds already in hand for the exterior work.

Thanks again for all your efforts on this project!

IS/mft/janfeb91.seward

7461

Harvard University/Atmospheric Research Project



Engineering Sciences Laboratory  
40 Oxford Street, Cambridge, MA 02138

617-495-5922

MEMORANDUM

TO: Owen Gingerich, Pam Lodish, Fred Seward  
FROM: Nate Hazen, x5922 *7278*  
DATE: February 22, 1991  
SUBJECT: Repair/ Upholstery of Observer's Chair - 15" Telescope

At this writing, the Observer's Chair for the 15" telescope has been removed from its frame and been partially disassembled. The left hand wrought iron portion of the chair support frame has been separated so as to allow the repair of break (temporarily covered in 1955 with an aluminum doubler plate).

After consultation with people aware of such things, I approached an upholsterer - The Fabric Showroom - to advise on appropriate ways to deal with the "restoration" of the furniture portion of the chair; i.e. the wooden frame and the upholstery. This firm came highly recommended for quality and sensitivity to historical aspects, while at the same time offering a pragmatic solution. I met with one of the partners, Barry Shapiro, on 2/5 in the dome and we looked over the chair quite carefully. The end result was his recommendation to re-upholster the chair and cushion in a way very similar to their present character - antique velvet over horsehair filling, finished with decorative gimp - as this was representative of the practices in 1845. We further agreed that a utilitarian replica cushion - of naugahyde with polyurethane filling - might be useful if significant public exposure was anticipated. Mr. Shapiro subsequently sent a written budgetary proposal describing this approach; a copy is enclosed.

I intend to go ahead with the welding repair (perhaps a \$100. item), if it's OK with you all, and would like to go ahead in due time with the upholstery.

Please advise.

P.S. I also have fabric samples.

# Proposal

Page No.

of

Pages

## THE FABRIC SHOWROOM

Brighton Upholstering Co., Inc.  
319 Washington Street  
BRIGHTON CENTER, MA 02135  
(617) 782-3169 783-4343

PROPOSAL SUBMITTED TO		PHONE	DATE
STREET		495-5922	2/5/91
40 OXFORD STREET		JOB NAME	Observatory - Bench
CITY, STATE AND ZIP CODE		JOB LOCATION	GARDNER ST. Cambridge
ARCHITECT	DATE OF PLANS		JOB PHONE
NATHAN HAZEN			

We hereby submit specifications and estimates for:

REUPHOLSTER BENCH AS PER EXISTING-  
STYLE. TIGHT ARMS & BACK WITH HORSEHAIR  
FILLING, FINISHED WITH DECORATIVE MATCHING GIMP.  
BOXED & WELTED LOOSE FITTED CUSHION WITH  
CUT OUT AS PER STYLE. CUSHION FILLING: HORSEHAIR  
LABOR \$550.00 + REQUIDES 8 YARDS — ADDITIONAL  
STRUCTURAL REPAIRS ADDITIONAL  
ADDITIONAL LOOSE CUSHION FOR PUBLIC USAGE.  
FILLING: HIGH DENSITY POLYURETHANE, WELTLESS  
LABOR & FILLING \$135.00 PLUS 3 1/2 YARDS VINYL  
SAMPLES ENCLOSED

V00050 ANDREA ANTIQUE VELVET 27.50 PER YD  
CRIMSON NAUGAHYDE (VINYL) 14.95 PER YD

WE HAVE A LARGE SELECTION OF NAUGAHYDES & VELVETS IN STOCK ♀

We propose hereby to furnish material and labor — complete in accordance with above specifications, for the sum of:

Payment to be made as follows:

APPROXIMATE dollars (\$ 918.32 )  
+ 10% Sales Tax

All material is guaranteed to be as specified. All work to be completed in a workmanlike manner according to standard practices. Any alteration or deviation from above specifications involving extra costs will be executed only upon written orders, and will become an extra charge over and above the estimate. All agreements contingent upon strikes, accidents or delays beyond our control. Owner to carry fire, tornado and other necessary insurance. Our workers are fully covered by Workmen's Compensation Insurance.

Authorized  
Signature

Note: This proposal may be withdrawn by us if not accepted within \_\_\_\_\_ days.

Signature \_\_\_\_\_

Signature \_\_\_\_\_

**Acceptance of Proposal** — The above prices, specifications and conditions are satisfactory and are hereby accepted. You are authorized to do the work as specified. Payment will be made as outlined above.

Date of Acceptance: \_\_\_\_\_

William E. Knight  
7 Shornecliffe Road  
Newton, MA 02158  
(617) 969-6548

September 23, 1991

SEP 27 1991

Mr. Nathan Hazen  
Project Engineer  
Engineering Sciences Laboratory  
40 Oxford Street  
Cambridge, MA 02138

Dear Nate:

Harvard College Observatory  
15 in. Telescope

We were pleased to receive your letter of September 11, 1991  
bringing us up to date on progress since our last discussion.

Regarding the mechanism for operating the observing doors  
in the dome, I would be glad to assist you in reinstalling the shaft  
and gears at any mutually convenient time.

Yours very truly,

  
William E. Knight  
For Amateur Telescope Makers

WEK/mk

cc Dr. Owen Gingerich  
Mrs. Marion Hochuli

M E M O

To: Irwin Shapiro

Date: 24 September 1991

From: Owen Gingerich

Re: Report to Perkin Fund on the Sears Tower Project

After many months of paralysis because of grossly conflicting advice as to what was required with respect to the repair of the Great Refractor's dome and roof, we finally, with coordination from the Harvard Planning Office, interviewed three different consulting engineers. Each had a totally different view on the cause of the past leakage, and the future prospects with the present copper sheathing, but we chose Len Brown of the Boston Building Consultants to investigate the situation more closely and to prepare the documentation necessary for the construction bids. We were convinced that he combined both the sensitivities for historical preservation and the meticulous approach required really to establish what was needed to be done.

In August Mr. Brown brought in a crane to get close and full access to the dome so a thorough inspection could be made. He also erected scaffolding inside the dome and took out a number of boards to check on the internal state of the framing. In the meantime, Nate Hazen with assistance of a few of the Amateur Telescope Makers discovered why the dome could not turn fully--this was traced to a partially shorted underground electrical cable, and when that was repaired, it was possible to rotate the dome completely during Mr. Brown's inspection.

Today Len Brown presented the options to us. The internal structure of the dome is in excellent condition and will not need any repair. The GE silicone coating painted on the copper in 1971 has been highly successful in that it has lasted longer by a factor of two than the anticipated 10 years, but there is no proven coating that can stick to the silicone to extend the lifetime further. While the dome in its present condition could probably stay watertight for a few more years provided work is done on the shutter area, it seems preferable to reclad it now in order to protect the restoration that we intend to carry out inside. Unfortunately the estimate for the entire resheathing of the dome and apron areas, as well as the urgently needed repair of the much-deteriorated gutter edges, is \$125,000-\$150,000, and the money we have in the bank from the Perkin Fund and other gifts is at present only \$117,000. We (Pam Lodish, Nate Hazen, Richard Beckwith from the Planning Office, and Len Brown) have discussed the less desirable and ultimately more expensive options that involve postponing part of the repairs. There is always the hope that, because of the present business depression, the bids may come in lower than the estimates, but this type of specialized work is limited to four or five possible bidders, and the

estimates are already considerably lower than would be the case in a healthier business economy. In any event, we anticipate that some kind of contract will be opened for bids within the next few weeks, and that possibly the work can be carried out before the end of the year.

Meanwhile, we are committed to further fundraising to match the generous \$78,000 from the Perkin Fund. We have not been successful in two strong appeals to foundations in the Worcester area, but the Harvard Development Office has two more prospects and we'll approach them just as soon as we know what the status of the present repair work is.

*Oliver*

Len Brown

## Boston Building Consultants

Need to look at copper carefully to decide if it's OK.  
Bulk of cost would be to find out what to do,  
rather than supervising job itself.

\$9200 fee

1500 crane

1500 carpenters & mech.

Nick Bedwith -  
would get report.  
& put out bids.

Roger Paniello  
Preservation Architect

Mike Williams

Would not recover dome at all, but would work  
hard on shutters, which he thinks is source of leaks.  
He says for 100K this would include paint, shutters,  
entrance (opposite side), probably floors.  
Says reseathing is absurd or misinformed;  
a sacrifice to destroy historical materials &  
would not accomplish anything.

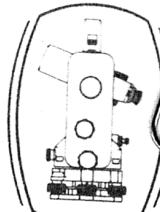
Ralph Noblin

Briggs: Moisture Protection Group

(Bruce McRitchy - <sup>looked with</sup>  
(Bob Bonebrake) <sub>charley</sub>  
(David? - )

40' ladder to get to top; old bldg: Brown's oldest.  
Suggest copper wears out with age erosion, gets  
pinholes, probably needs replacing. Break prices now.  
Emphasize aesthetics. 3-5 weeks to initial specs -  
9 weeks to bids in; could be done this October.  
(Blomes have been done.) Discussed problem entirely  
in generalities. No major framing work seems required.  
(Have done Bldg B, Blomes, with contractor.)  
will match aesthetics.

Says dome OK. Leaching from aperture suggests  
shuttering is merely old. Says coating is effective -  
could extend life indefinitely.



DAVID V. ST. JOHN  
Technical Director

## Benchmark Instruments



David V. St. John  
Technical Director



**Examination**

**Documentation**

**Preservation**

**Restoration**

**Display**



**Replicated  
Components**

**Lens Repair**

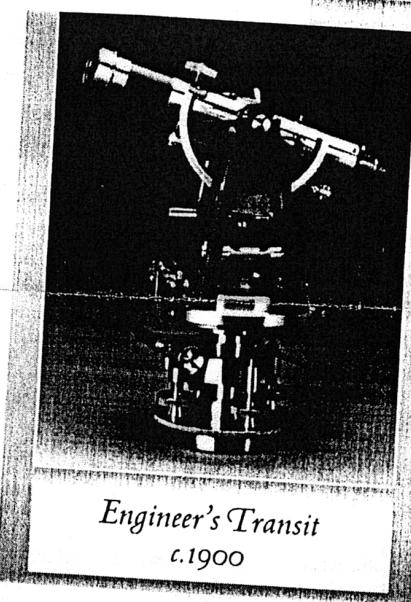
**Spider Web Reticles**

**Lacquering**

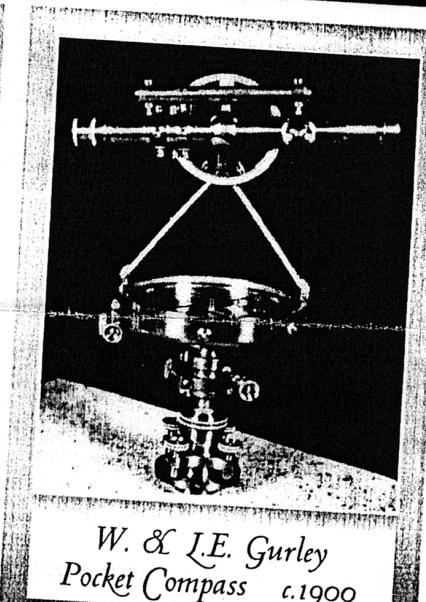
**Level Vials**

**Compass Needles**

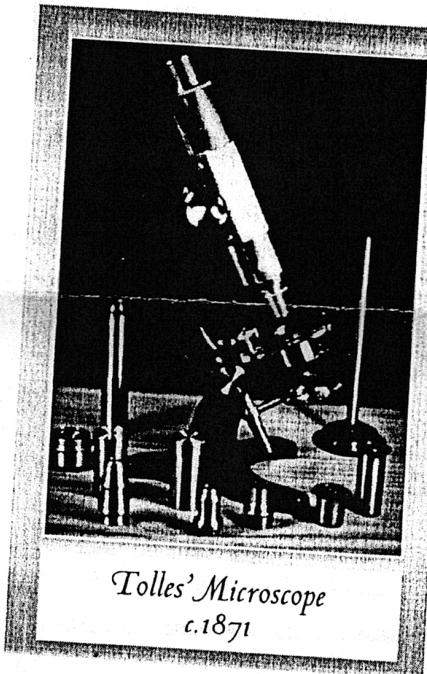
**Silvering**



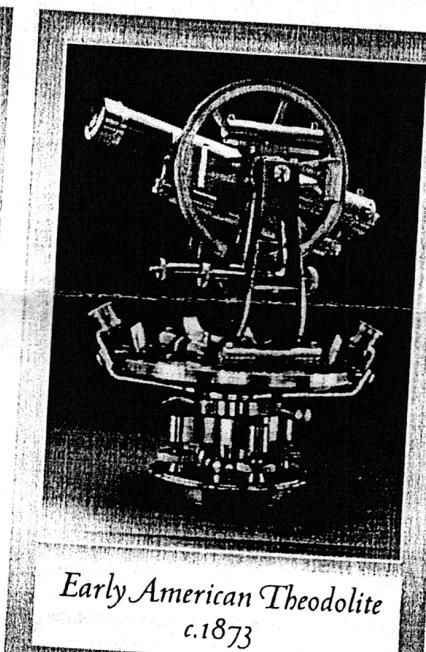
*Engineer's Transit*  
c.1900



*W. & L.E. Gurley  
Pocket Compass* c.1900



*Tolles' Microscope*  
c.1871



*Early American Theodolite*  
c.1873

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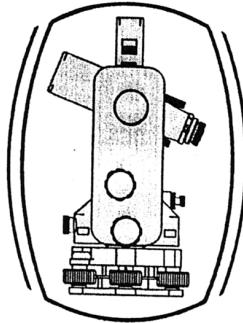
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David V. St. John  
Technical Director



**Examination**

**Documentation**

**Preservation**

**Restoration**

**Display**



**Replicated  
Components**

**Lens Repair**

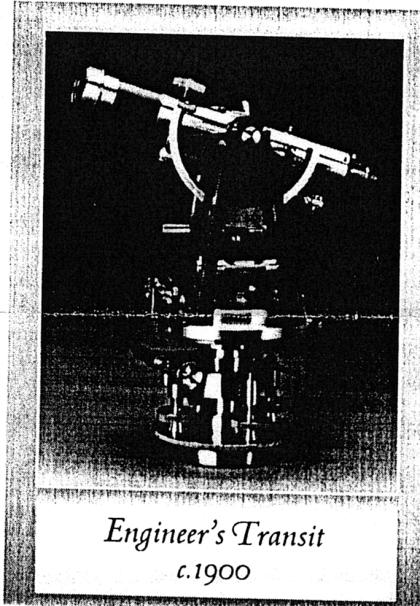
**Spider Web Reticles**

**Lacquering**

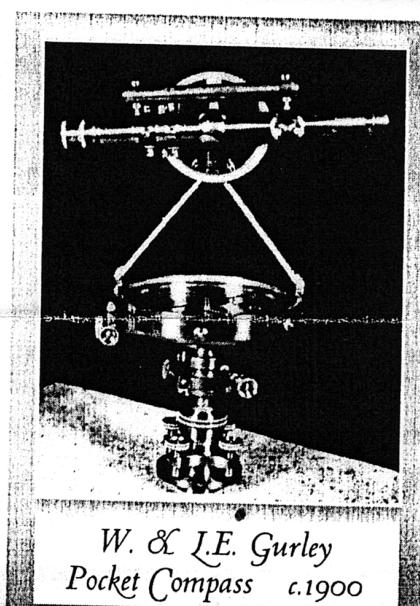
**Level Vials**

**Compass Needles**

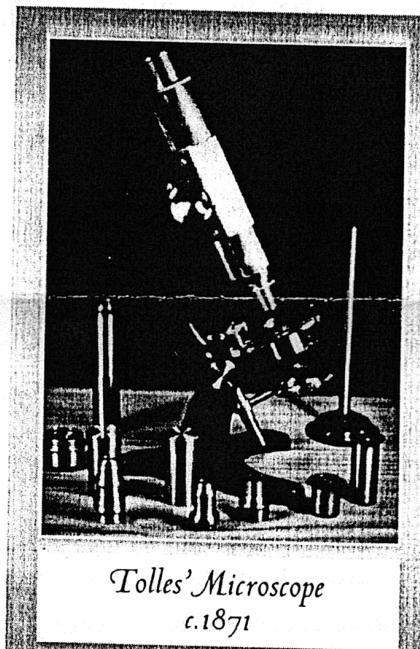
**Silvering**



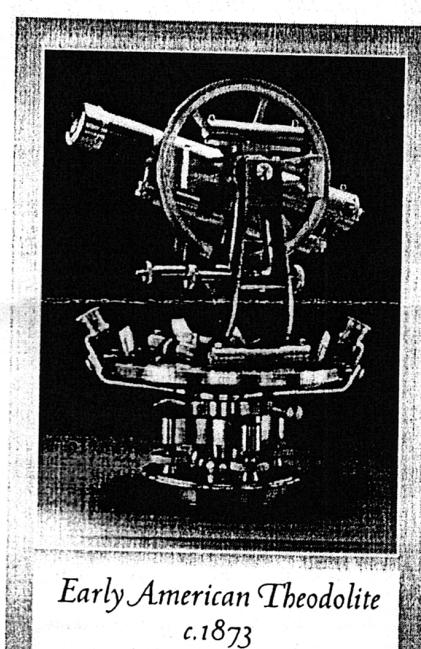
*Engineer's Transit*  
c.1900



*W. & J.E. Gurley  
Pocket Compass* c.1900



*Tolles' Microscope*  
c.1871



*Early American Theodolite*  
c.1873

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## PRECISION SPIDER RETICLES

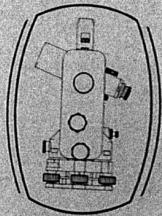


Fig. 1

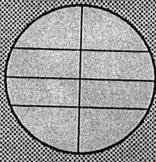


Fig. 2

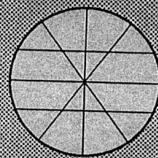


Fig. 3

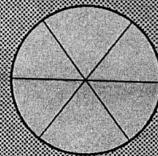


Fig. 4

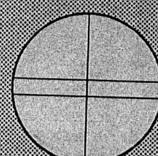


Fig. 5

Large numbers of active engineering instruments are equipped with "Spider" reticles. Many service oriented companies are confronted with finding a reliable source for replacement of these special reticles which have to be matched to the optical characteristics of standard and unusual measuring instruments.

**Benchmark Instruments** has developed the facilities for precise placement and delicate handling of "Spider" webbing which in general is not readily available except at the original manufacturer. Special instrumentation is required to measure and maintain near perfect intercept values for a wide range of optical instruments. Specific attention to line weight, stadia balance, parallelism, perpendicularity, precise angles, tension and cleanliness have become a matter of routine concern.

Intercepts may be matched within 0.03% of the Stadia Ratio of an objective system when the telescope is supplied with the order. This effort assures compliance with standards for 1st Order measurement and alignment tasks.

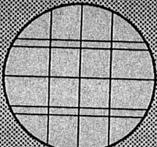


Fig. 6

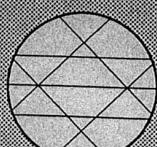


Fig. 7

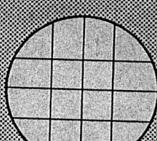


Fig. 8

Many patterns are available, some of which are shown in Fig. 1 through Fig. 8. Standard configurations with disappearing stadia are available.

The telescope should be sent to our laboratory for the necessary optical measurements and installation of the new reticle. In this manner you can be confident of receiving a finished assembly, cleaned and lubricated, containing a matched and centered reticle.

Reticle diaphragms sent without the telescope cannot be matched to 0.03% but will comply satisfactorily in all other respects. Wire tension will be set at standard unless otherwise specified for mining, tropical, or arctic applications, etc.

Prices are set at \$15.00 U.S. per wire, plus shipping. Matching and assembly to telescope \$50.00 additional. Initial orders require prepayment. Open accounts may be accepted thereafter for established companies with appropriate credit, after which all accounts are payable 30 days net. No discounts for quantity. Delivery one week A.R.O. Units shipped UPS, insured at full value unless otherwise specified.

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## LENS CEMENTING SERVICE

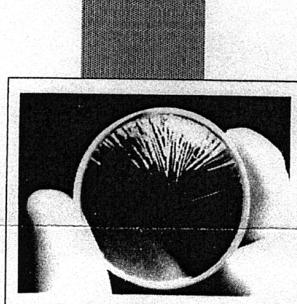
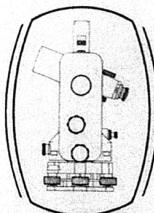


Fig. 1

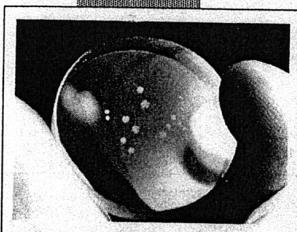


Fig. 2

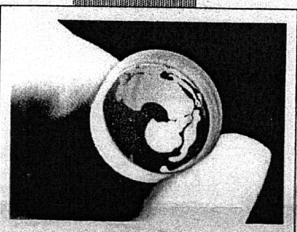


Fig. 3



Fig. 4

With modern synthetics, one does not often find a defective lens assembly in an optical system, but it does happen. More frequently, lens repair is done on those elements which are cemented with Canada Balsam and have separated because of age, mechanical damage or have cosmetic defects (Feathering) which have encroached on the clear aperture.

When a defective lens is received an evaluation of the optical properties, coatings, cell design, mechanical damage, cement type and amount of labor required to restore the lens to original specifications are recorded and a firm price and delivery is then given to the customer.

After approval, the lens assembly is carefully removed from its cell. The elements are separated by the appropriate technique. Cleaning is accomplished by special methods using Ultrasonics, and chemical vapor wash with static eliminators. Final assembly is done in precision Laminar Flow Clean Benches and optically centered to secure the original design characteristics.

The Optical Cements used are the purest available and polymerized at controlled temperatures to assure a stress free permanent bond. After cementing, the edges are cleaned and optically blackened to suppress unwanted internal reflections. The lens is then mounted to its cell with a retainer or spun in.

Often surfaces of cells are damaged or require machining to remove the elements. Such surfaces are chemically oxidized at final assembly to reduce reflections. Each assembly, as near as possible, approaches or matches the original manufacturers specifications.

When cells are damaged beyond repair, a new replacement cell can be fabricated from materials similar to the original. Often, when this is the case, the telescope should be supplied so that the fine threads can be properly matched.

Initial orders require prepayment. Open accounts will be accepted thereafter for established companies with appropriate credit, after which all accounts payable 30 days Net U.S. funds. No discounts on quantity.

You will receive a written quotation within a few days for the repairs on your lens. Return the acceptance card with payment. Normal delivery 1 week A.R.O. Units shipped UPS insured at full value unless otherwise instructed.

INSTRUMENT  
MAKER

# Center for Astrophysics

Harvard College Observatory  
Smithsonian Astrophysical Observatory

## MEMORANDUM

October 24, 1991

To: Rotunda Committee  
From: Fred Seward  
Subject: Rotunda Committee Meeting

*OCT 25 1991*

There will be a meeting of the Rotunda Committee, on 31 October at 2:00 p.m. in the Pratt Conference room at the Observatory. The discussion will involve the proposal that has been prepared regarding restoration of the Sears Tower and the 15-inch telescope. If you have not received a copy of the proposal please call me at 5-7282 and let me know.

*5-7206*

### Distribution

Will Andrewes	5-2779
James Cornell	5-7461
<u>Owen Gingerich</u>	<u>5-7210</u>
Edward Haack	5-2474
Nate Hazen	5-5922
Pam Lodish	5-2540
Fred Seward	5-7282

FDS/sf



HARVARD  
UNIVERSITY

JAN 28 1992

University Development Office  
University Place  
124 Mount Auburn Street  
Cambridge, MA 02138-5762  
(617) 495-1629  
FAX: (617) 495-0521

LESLIE D. DAMON  
Assistant Director of  
Corporations and Foundations

January 22, 1992

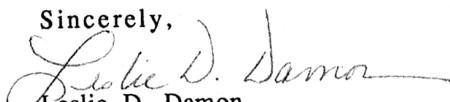
Prof. Owen Gingerich  
Harvard-Smithsonian Center  
for Astrophysics  
60 Garden Street

Dear Prof. Gingerich:

While you were away our researchers finished examining the list of copper companies which manufacture or distribute copper sheeting, as supplied to us by the Copper Development Association.

We have identified seven additional companies which appear to be interesting prospects. I suggest you approach these companies in the same manner as Phelps Dodge and the Olin Corporation. On the attached pages I have listed the name and company address for each prospect. Additionally, I have indicated some minor adjustments which should be made to the basic letter, to adapt it to each particular company.

Please let me know if you have any questions on the enclosed. I hope your cruise was enjoyable!

Sincerely,  
  
Leslie D. Damon

cc: J. Nunnally

Sources of Funding		Expenses not included above	
01/25/89 Perkin	\$25,000	05/08/90 Briggs	\$1,000
04/17/89 H. Sears	\$200	06/30/90 Briggs	\$3,400
12/26/89 Wolbach	\$15,000	08/16/91 Adm.Metals	\$75
12/27/89 Perkin	\$25,000	10/08/91 C.Hughes	\$602
01/25/90 J. Sears	\$250	12/31/91 Hazen	\$253
12/27/90 Wolbach	\$25,000	12/31/91 Briggs	\$200
12/27/90 Perkin	\$28,500	09/18/92 Herb.Com.	\$756
06/30/91 Interest	\$2,506		-----
02/04/92 Ford	\$5,000		\$6,286
02/26/92 Sadler	\$750		
05/12/92 Gingerich	\$150	Expenses listed above	\$139,500
06/19/92 Lowenthal	\$200	Expenses pending	\$8,250
06/25/92 Huchra	\$100		-----
06/30/92 Interest	\$3,917		\$154,036
09/04/92 Cohn	\$50		
09/15/92 Interest	\$2,373		
01/21/93 SAO Funds	\$5,900	Shortfall	(\$8,225)
	\$139,897		(\$5,000 of shortage due to fact that Clint Ford died before paying his FY93 pledge of \$5,000.)
07/31/92 Interest	\$419		
08/31/92 Interest	\$291		
09/30/92 Interest	\$204		
Total funds rec.	\$140,811	Balance in 5430	\$5,195
Pending contribution		Owed to maint. res.	(\$5,809)
H. & J. Kloss	\$5,000	Overdraft in capital acc	(\$4,360)
		Expenses pending	(\$8,250)
		Contrib. pending	\$5,000
Total funds avail.	\$145,811	Total underfunding	(\$8,225)

Marr Scaffolding	01/26/93	\$400.00			
Marr Scaffolding	03/16/93	\$400.00			
Marr Scaffolding	03/31/93	\$400.00			
Marr Scaffolding	04/30/93	\$400.00			
Marr Scaffolding	04/30/93	\$400.00	\$4,000	\$0	\$4,000.00
Shaughnessy & Ahern	12/31/92	\$2,399.39	\$2,399	\$0	\$2,399.39
Lakeview Hydraulics	04/07/93	\$7,500.00	\$7,500	\$0	\$7,500.00
Beckwith reimbursables	04/12/93	\$107.03	\$107	\$0	\$107.03
		-----			
		\$139,499.52	\$139,500	\$134,225	\$5,274.52
BALANCES		(\$4,360.14)	(\$4,360)	\$0	(\$4,360.14)

## Pending

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Shaughnessy & Ahern	\$2,076.48
Lakeview Hydraulics	\$1,030.00
Lakeview Hydraulics	\$640.00
Boston Building Consultants	\$46.49
Gilbert and Becker (retainage)	\$4,457.50
	-----
	\$8,250.47

INCOME	TO 04/30/93	Actual	Budgeted	Variance
		Totals	Totals	
Transferred to Ledger 29	08/22/91	\$20,000.00		
Transferred to Ledger 29	06/11/92	\$114,225.00	\$134,225	\$134,225
Interest earned	07/31/92	\$419.17		
Interest earned	08/31/92	\$291.30		
Interest earned	09/30/92	\$203.91	\$914	\$0
				(\$914.38)
		\$135,139.38	\$135,139	\$134,225
				\$914.38
EXPENSES	TO 04/30/93	Actual	Budgeted	Variance
		Totals	Totals	
Boston Building Consult.	12/27/91	\$6,000.00		
Boston Building Consult.	07/31/92	\$3,200.00		
Boston Building Consult.	07/31/92	\$3,000.00		
Boston Building Consult.	11/30/92	\$3,000.00	\$15,200	\$15,200
				\$0.00
Boston Building Consult.	12/27/91	\$1,519.00 Aerial lift		
Boston Building Consult.	12/27/91	\$96.68 Reimbursables		
Boston Building Consult.	07/31/92	\$320.92 Reimbursables		
Boston Building Consult.	12/31/92	\$480.00	\$2,417	\$0
				\$2,416.60
Management Fee	09/30/91	\$4,953.74		
Management Fee	11/21/91	\$2,201.66		
Management Fee	01/31/92	\$1,100.33		
Management Fee	01/31/92	\$275.21		
Management Fee	02/29/92	\$275.21		
Management Fee	04/30/92	\$550.42		
Management Fee	05/31/92	\$275.21		
Management Fee	07/31/92	\$275.21	\$9,907	\$9,907
				(\$0.01)
Gilbert & Becker Co. Inc.	07/31/92	\$26,419.50		
Gilbert & Becker Co. Inc.	08/31/92	\$21,793.50		
Gilbert & Becker Co. Inc.	10/31/92	\$17,217.00		
Gilbert & Becker Co. Inc.	11/30/92	\$9,765.00		
Gilbert & Becker Co. Inc.	12/31/92	\$3,233.50		
Gilbert & Becker Co. Inc.	12/31/92	\$7,090.00		
Gilbert & Becker Co. Inc.	01/26/93	\$9,497.50		
Gilbert & Becker Co. Inc.	04/30/93	\$2,600.00	\$97,616	\$88,500
				\$9,116.00
Ferranti Dege Inc.	10/14/92	\$15.51	\$16	\$0
Misc. Carpentry		0	\$0	\$3,000
				(\$3,000.00)
Insurance	01/31/93	\$4.00	\$4	\$300
				(\$296.00)
Lead Paint		0	\$0	\$500
				(\$500.00)
Bonding		0	\$0	\$1,150
				(\$1,150.00)
CAPS Fee	07/31/92	\$334.00	\$334	\$668
				(\$334.00)
Contingency		0	\$0	\$15,000
				(\$15,000.00)
Marr Scaffolding	11/30/92	\$2,000.00		