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AEDi Journal No 3

Cambridge

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Blue Hill, Tuesday, Oct. 10, 1893

8.32 Band was clearly marked by a dark space underneath it, of this shape ⌒ stretching from 40 to 50° along its highest parts.

8.45. the eastern end of above band shows but the western part is very difficult to see.

8 52 Above band is probably auroral as now then is another beginning at β Sagitt. and with Formalhaut on its south edge & β Cetî on its northern

9.00 Watch set 2m.5 ahead to agree with 9h clockbells

9.10 The auroral band between Formalhaut & β Cetî, retains its position but is more hazy.

10 12 In drawing region a (of Sagan) is much brighter than that. All other lines are contours of equal brightness

10 44. Of section 5 of Sg of Peg the lower (S) branch has the light of region ε Peg 0.6 2 Drlph. and the upper (or N) branch that of ε Peg 0.4 to 2 Drlph.

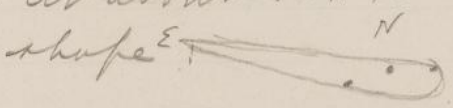
11 02 Upper (N) of two bands, light = ε Peg 0.4 to 2 Drlph
Lower (S) " " " " = ε Peg 0.5 to 2 Drlph

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Blue Hill. Tues. Oct 10. 93

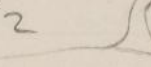
11 13.5 many 2½ 4½ 5½ 9. ⊥ Btr 0.5 R 0.4

11 34 at about 10h 40 Tobs^d the Nbg in this shape 

in Pisces.

At 11h 30 It certainly seems ~~elongated~~ ~~solar~~, only about twice as long (E & W) as broad (N & S)

12 05. In line ⊢ Nbg to ♌ Cati, there is a general hazy brilliance, more dense at center. There may be a band close in towards ⊢ Nbg, say 3° away (to the S)

12 18. 2 7½ 9½  ⊢ Nbg to β Arietis,

12 21 Nbg ≤

of Nbg at	12h 05	was	5
then "	12h 17	"	4
"	12 20	"	2±

12 30 2½) d and ♌ β Arietis

From recollection have placed a d between marks (1- - -d- - -1) to indicate certain lines of which Nbg has less than the others.

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Blue Hill - Tues. Oct 10. 1893

12 53 2, 5, 9 ϕ Peg ⊼ ε Piscium. Sag 2.

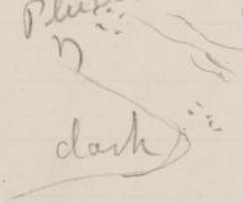
13 10 Sag  Brilliance equal to light at ~~ε~~ λ Androm. 0.1 to β Cassiop On the old scale (and ~~4~~ light at 12h05 being 5) it is 2⁻

13 22 θ Ceti 0.2 ε Pisc.
ζ " 0.25 2 Pisc.

13 27 Sag. 1½ = ζ 2nd scale λ And. 0.05 to β Cassiop

14 22 1 2 6 9 2 Arich ⊼ 2 Ceti.

14 59 θ Tauri 0.35 to η Tauri
" 0.5 to Aristes = 0.75 to do



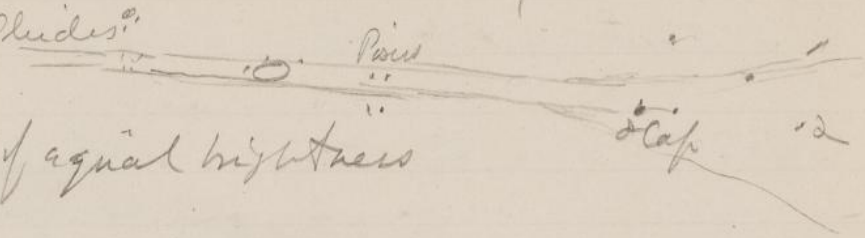
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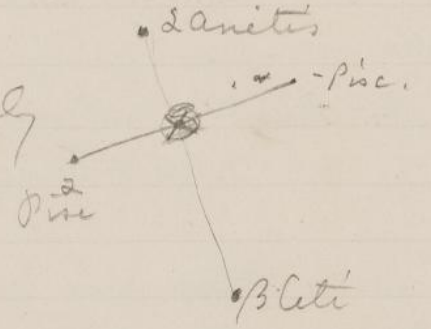
Sagan.
Bands
Aurora
at
Blue Hill

Blue Hill. Wednesday. Oct 11 93

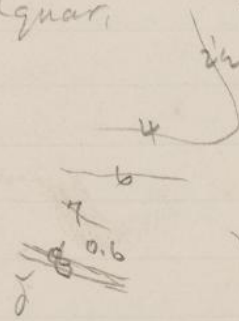
9 50 Slides.



10 00 – 15.
Sag 10 to 15
brightest point only



10 39 2½ 4 6 7 8 | 0.6 0.3 to 0.4 bright.
ε Peg to δ Aquar. ε Peg to 2 Delph



not 0.3 to 0.4

11 28 Auroral (?) band

11 35 279 278
2 and ti 2 Aquar. γ Peg to 2 Aquar.

11 46 β to 2 Aq. Punk. 3 stars

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Began Bands at Blue Hill

Blue Hill, Wednesday, Oct 11.93

11 56.5 2 4 5½ 7½

~~2~~ Pag & 2 Aquar.

This throws doubt on a place marked a It may be that absorption now nucleus like a less distinct - ~~also~~ and make the region east of a appear vacant.

12 11 - 2 4 5³ 7 9 2 Pag & ~~X~~ + 4 Aquarii

12 18,5 ½ 2-2½ 9½) Pag &

12 25 Seq. Brightness in λ and 0.1 & β Classif

12 3r≠1m ε Pisc 0.8 θ Cati, ± {-¼ ε P. & θC.}

12 46≠1m N side of band from 3 stars in Pisces to Pleiades.

Think that absorption begins about 1½ or 2hr after culmination, on all portions of these bands.

13 03 S side from λ Cati & the Pleiades. "Marked "Fainter" a certain region which on preliminary examination seemed to be a part of the band, but which on closer examination appeared much fainter

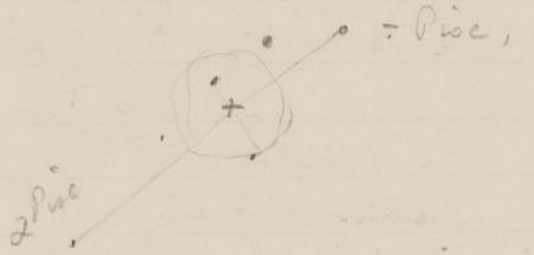
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Nagm.
Bands.
od. Light
at Blue Hill

Blue Hill, Oct. 11, 1893

if existing at all.
Marked as "Probably Faintest" a region which was first considered of equal brightness with the adjacent regions but which in later Obsns ~~was certainly~~ appeared distinctly fainter

13 20 Nag. 

13 44 Nagm. Same brightness. 

14 55 Nagm. Slightly less bright, (?)
3 stars 

Nebm. In my contour drawings the dotted lines merely mean that I made no accurate estimate of position as in the heavily drawn lines, and there may be a small error usually not more than ½°

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Blue Hill or Zod. Light

Blue Hill Oct. 11. 1893

15 30 Axis of ☿ Zod Lt. Regulus, Praesepe, δ Leo

15 34 Cusps of inner cone

15 42 outer contours of Z. L. as I was observing the ~~Z L seemed to shade off with great distance~~ sky showed perceptibly. The outer contours selected is not the outermost limit, but is really the limit on the southern side when it could still be distinguished before entering the Mild.

15 54 Outermost N contours. This does not come parallel with next contour The error probably lies in this one, it being very hard to determine accurately. Should also question whether the tip of the inner cone should not be on or S. of δ Leonis instead of on the cusp

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Blue Hill
on
Organ
Bands &c

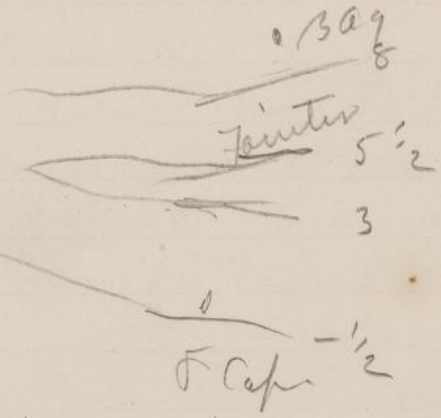
Blue Hill, Oct 12, 1893

7 41 Aq.



7 47. Bands

1 7 57 −½ 3 8 δ Cap & β Aqr



1 7 59 2 & β Cap = ab.

Also another
branch from
δ & W Caprie,

Edge — 1 ab

Centre — 2 ab

Edge — 3 ab

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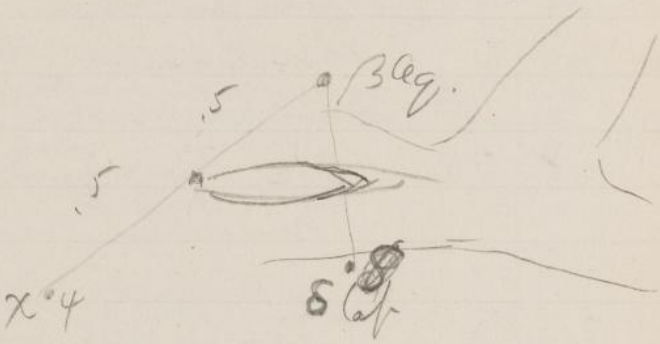
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8 06 Careful Obsn on Degen places it thus! -

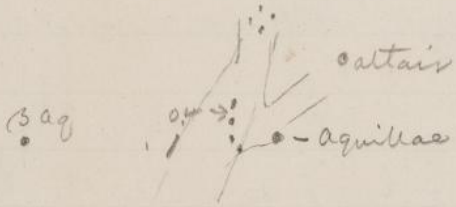


Band-edges at ε Aq. & 0.4 towards β Aq.

8 12.



8 17



8 23. 3 Obsns on Degen. all in the same place



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Blue Hill, Oct. 12, 1893

8 31 After (N) edge of band ~~[illegible]~~ ρ 0.5 to 2 Aq.

8 37 Begin 4 2 and 5 & 7 bright band 2 to 5 Aq.
On account of haze the brightness
can't be well compared but think
this northern branch from ρ Aq. to-
wards Aquilla & Dolph. is distinctly
fainter than the southern, say ½ to
brightness. The small bottom around ρ & θ
Aquarii encloses a region of the same brightness as the
main band. It is surrounded by a fainter region

8 46 1½ 3½ 5 6½ & 2 Peg to χ & 4 Aquarii
middle branch fainter. Think
S branch may be fainter than
N. but ~~other~~ this may be due to
the haze spreading over to
the

8 57 1½ 2½ 3½ 7½, γ Peg to ~~α~~ Cet, also
a blank space S. of Sq of Peg
and just N of pentagon



Thus:-

8 56 23 5½ 7½ 2 to 2 Peg.

9 00 1-5, 6 7 8 10, γ Peg to 2 nebulæ,
also N edge forms just N of 1 & 2 of 3 Stan

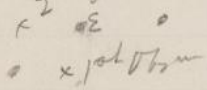
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9 03 About 8.50 Noticed that Engan. was practically not visible while some of these bands showed - probably due to local haze. The sky is not nearly so good as last night. A storm is approaching from the S.

9 09 Engan.  Very faint. The bands are so wound with haze that there can be no reasonable certainty of their contours.

12 40 Enganschein.



Roughly outlined bands.

12 47.5 σ 2 Piscium, ξ, & 2 Ceti. edges.

12 53. δ ρ τ μ Ceti to δ Arietis. S edge

13 03 N side - W of Pleiades.

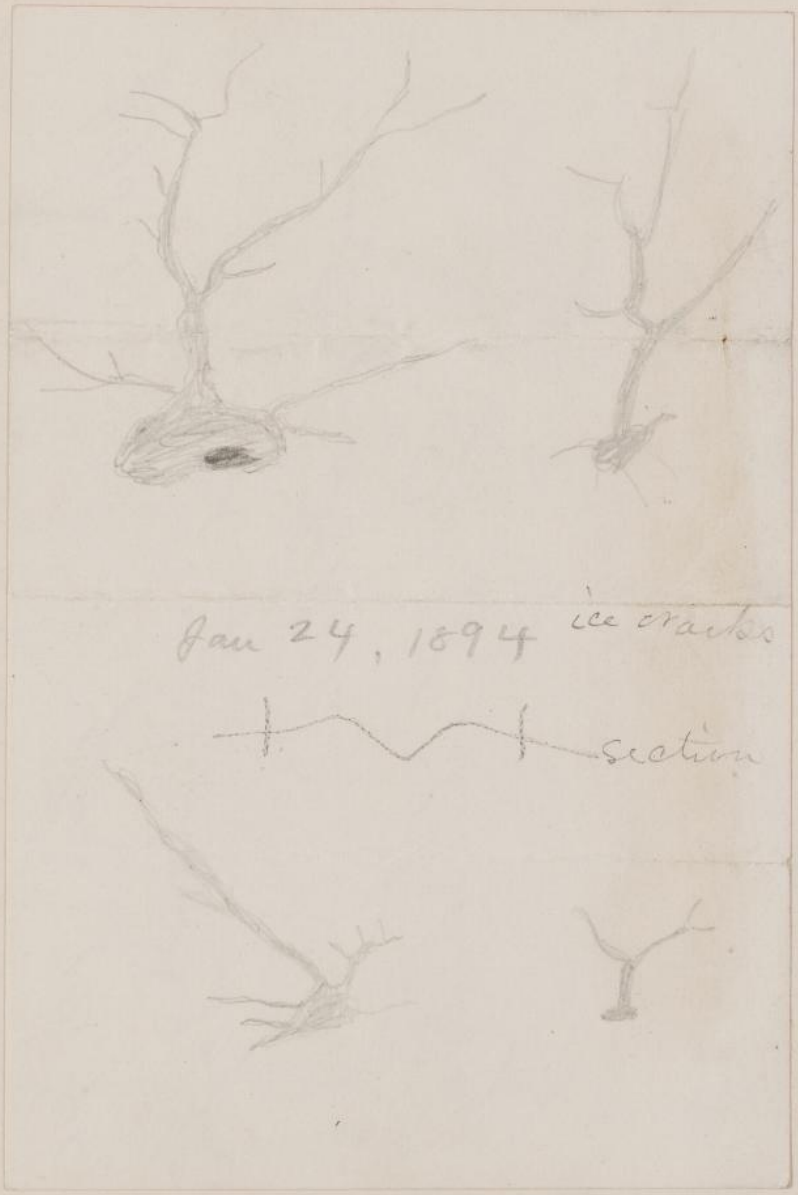
13 23 Edges around δ Arietis.

14 .. We can select as a reference scale from ρ Orionis to ε Tauri. The contours of this evening are all 0.4 on this scale, except those enclosing regions marked faintest [illegible]

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To be compared with W. H. Pickering's sun-spots in the Moon.



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Jan. 12, '94.

$95.13

Received of A. L. Douglas

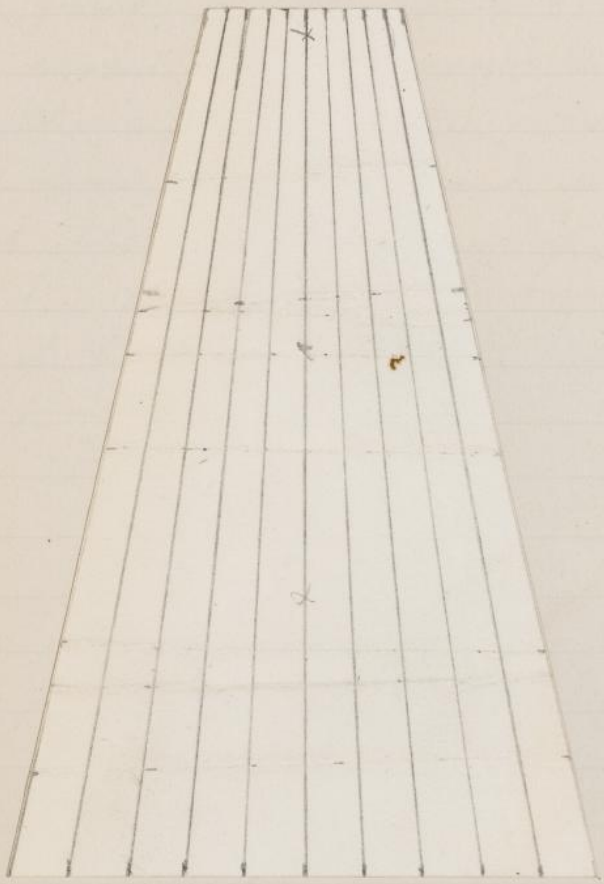
ninety-five 13/100 dollars.

W. H. Pickering.

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1893phae.proj..526D



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Flagstaff. A.T.

Saturday. Sept. 1. 1894

On Aug. 18. I tried getting widths of threads in our Brashear position micrometer, by bring movable wire into contact with the stationary one first on one side & then on the other. The screw was always moved so as to increase the reading when a setting was made. Difficulty was first found in bringing the threads into the same degree of contact but when that was settled the following readings of the screw were obtained. The ½ in eyepiece was used.

		.145 +	Reads.
.652	.153	8	6
.805	.148	3	1
.657	.145	0	-2
.802	.147	2	0
.655	.149	4	2
.804	.150	5	3
.654	.148	3	1
.802	.150	5	3
.652	.144	-1	-3
.796	.145	0	-2
.651	.144	-1	-3
.795	.145	0	-2
.650	.147	2	0
.797	.147	2	0
.650	.147	2	0
.797	.145	0	-2
.652	.147	2	0
.799	.149	4	2
.650	.148	3	1
.798			

19 | 43 → 2.3 19 | 33 → 1.7

Mean = 0.147.3

Av. Res. = 0.001.7

Or expressed in smallest graduated divisions of micrometer screw head

Mean = 14.73

Av. Res. 00.17 or 1/87

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Sept. 1. 1894

Watch

On Aug. 23d at noon. Watch was found
to be $2^m 38^s$ slow. It was then set
$0^m 22^s$ fast.

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Oct. 15. 1894

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Lowell
Polar Sirius
Manuscript
Drawings
Report
Cloud

				Eq.	1	2	3	4	5	6 for me
5		5 copies for me								
6		W H Pickering		-				✓	✓	
7		P. Lowell		✓				✓	✓	
8	1	S. E. Douglass	East Wareham, Mass	-				✓		
9		J S Luther	Trinity College. Hartford Conn	✓	✓	✓		✓	✓	
10		Trinity College?								
11	ecp	Harvard Obsy		✓				✓	✓	
12		P. H. Tyler						✓		
13		Dr E. E. Barnard	Lick Obsy. Mt Hamilton Cal	✓				✓	✓	
14		C Flammarion						✓	✓	
15		S. Schiaparelli						✓	✓	
16		Rayard								
17		Lee ?								
18		Burnham								
19		Milton Updegraff	Univ. State of Missouri. Columbia Mo.	✓				✓		
20		Huggins							✓	
21		Royal Ast. Soc. Burlington H							✓	
22		Campbell.							✓	
23		E.S. Holden or Lick Obsy							✓	
24		Pawtin							✓	
25		Keeler						✓		
26		Young ?								
27		Prof. A. Searle		✓						
28	✓	W. D.		✓				✓		
29	✓	W. C. D.		✓	✓	✓				
30	✓	B. H. D.			✓	✓		✓	✓	
31	✓	A. E. D.		✓				✓		
		Professor S. Newcomb.		✓						
		Carden					✓			
		Stratton			✓	✓		✓		

T. L. Bolton H
Hennessy 4
Stanley Williams 4 5
Wm. H. Pickering 4 5
Wm. H. Pickering 4
Wm. H. Pickering 5
C E D
Lowell Jr.
Lawson
Torbert

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Professor Simon Newcomb. Nautical Almanac office. Naval Observatory, Georgetown Heights. D.C.

D.M. Riordan. Flagstaff A.T. 5
Dr Hunter. Arequipa Peru
W.W. Goldsmith Andover Mass
Mrs C.I. Thomson Baltimore Md.
A. Cowper Ranyard. (Knowledge) 326 High Holborn. London W.C.

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Oct. 19. 1894

Distance at which Earth (E) & Mars (M) can hold a moon

Let S = mass of sun
P = " " planet
D = distance of planet from sun
d = " " " " satellite.
q = satellite

The principle for the solution of this problem is that when the satellite can leave its planet the attraction of the planet on the satellite equals the difference in the attraction forces of the sun on the planet and satellite.

Substitute acceleration for attraction

$$\text{Attraction } S \text{ on } P = k\frac{S}{D^2}$$

$$\text{" } S \text{ on } q = k\frac{S}{(D-d)^2}$$

$$\text{" } P \text{ on } q = k\frac{P}{d^2}$$

$$\text{and } k\left(\frac{S}{(D-d)^2} - \frac{S}{D^2}\right) = k\frac{P}{d^2}$$

in which d is required.

We have $$\frac{SD^2 - S(D-d)^2}{D^2(D-d)^2} = \frac{P}{d^2}$$

$$\text{or } SD^2d^2 - SD^2d^2 + 2SDd^3 - Sd^4 = PD^4 - 2PD^3d + PD^2d^2$$

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Oct. 19, 1894

Continued.

or $2SDd^3 - Sd^4 = PD^4 - 2PD^3d + PD^2d^2$

or $-PD^4 + 2PD^3d - PD^2d^2 + 2SDd^3 - Sd^4 = 0$

or $d^4 - 2Dd^3 + \frac{P}{S}D^2d^2 - \frac{2P}{S}D^3d + \frac{P}{S}D^4$

If for any given planet whose mass and distance are known, we put $D = 1$ and $P = 1$ and S = mass of sun in terms of that planet. then:
we have $d^4 - 2d^3 + \frac{1}{S}d^2 - \frac{2}{S}d = -\frac{1}{S}$

For example let us take Mars, assuming that $d = \frac{1}{100}D$; then we have $D = 141,500,000$ & $S = 3,093,500$, therefore

we have $\frac{1}{100\,000\,000} - \frac{2}{1\,000\,000} + \frac{1}{30,935,000,000} - \frac{2}{309\,350\,000} = -\frac{1}{3\,093\,500}$

For $d = \frac{1}{10}$ we get

$$\frac{1}{10\,000} - \frac{2}{1000} + \frac{1}{309\,350\,000} - \frac{2}{30\,935\,000} = \frac{-1}{3\,093\,500}$$

This is evidently very far out. For ~~$d = \frac{1}{1000}$~~ $d = \frac{1}{1000}$ we get

$$\frac{1}{1000\,000\,000\,000} - \frac{2}{1000\,000\,000} + \frac{1}{3,093,500,000,000} - \frac{2}{3,093,500,000} = \frac{1}{3\,093\,500}$$

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Oct. 19, 1894

Continued,

We find that: 1st $\frac{1}{100}$ is much better than the others for Mars, and 2nd that between $d = \frac{1}{10}$ & $\frac{1}{1000}$ the 2nd ~~term~~ quantity $-2d^3$ is the most important. It is affected by the others in the following manner:—

putting 2nd quantity = 1 the others are

$d =$	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$d = d$
1st Q	$-\frac{1}{20}$	$-\frac{1}{200}$	$-\frac{1}{2000}$	$-\frac{d}{2}$
3d Q	$-\frac{1}{61800}$	$-\frac{1}{61870}$	$-\frac{1}{6187}$	$-\frac{d}{25d}$
4th Q	$+\frac{1}{309350}$	$+\frac{1}{309}$	$+\frac{1.0}{3.1}$	$+\frac{1}{5d^2}$

For numbers about $\frac{1}{100}$ (value of d) we may use the 2nd Q, alone

The 3d Q we may leave altogether out Omitting 1st Q would require a change of the 2d term of by $+\frac{1}{200}$ of $\frac{1}{5}$ and omitting the 4th Q would require a change of $-\frac{1}{319}$: These counteract each other and we have, omitting both, a value only $\frac{1}{600}$ out, Therefore $2d^3 = \frac{1}{5}$ ~~or~~ or $+\frac{1}{600 s}$

$$d^3 = \frac{1}{25} \text{ or } + \frac{1}{600 s}$$

$$d = \frac{1}{\sqrt[3]{25}} \text{ ~~or~~ } \text{or } \sqrt[3]{\frac{301}{600 s}}$$

$$= \frac{1}{183.6} \text{ or } \frac{1}{183.8}$$

Therefore $d = 770800$ or 769500

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Oct. 19, 1894
Continued

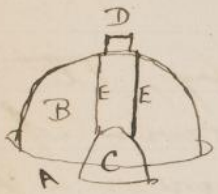
A similar computation regarding the earth places it limit in its power of holding a satellite at 1 067 000 or 1 x.

Our moon as seen from Mars at a moderately near opposition, makes at elongation an angle of about 20', therefore a satellite of Mars might reach a distance of very closely 1° from its primary.

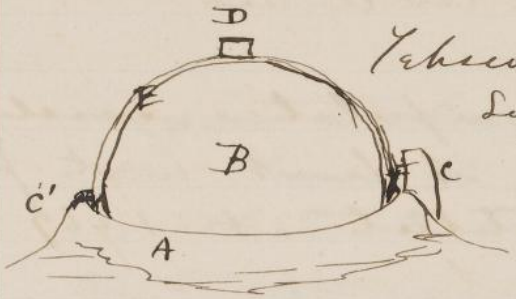
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Flagstaff. A.T. Nov 7. 1894



(Design I)



Telescope Mounting.

Suppose Focus = 100 ft in diam
" Lens 6 ft in diam

A is a bank or wall enclosing a cylindrical hollow 100 ft in diameter and some 30 or 40 ft deep, which can be filled with water from a constant inflow and the height of the water adjusted by raising or lowering the outflow.

B. is a sphere of aluminum or steel floating on the water in A.

D is a projection about 5 ft high and about ~~6 x 9~~ 7 x 10 ft in section, entered only from inside and surrounded perhaps by an air tight case to avoid temperature changes. ~~The~~ near the top of D is the lens. The extra width one way is to allow a man to enter to clean the lens. By projecting it allows a cap ~~to be~~ mounted like the prisms on the 11" M.C.O. telescope. It probably would be quite as well to have the top of D flush with the sphere and have the cap roll off & on on wheels. The ~~lens~~ lens tube for changing & adjusting could be reached by a permanent staging within.

(Lens and Carriage (See Moore. Lick Tube)

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Nov 7. 94

Mounting, Continued.

E E are two rings that encircle the sphere and in which, on tracks preventing side motion in the rings, it may be rotated. These rings are securely joined at ~~two points on the~~ opposite sides and at those points axles project which serve as the N & S polar axes.

On the inside opposite the box is the top for the observer with apparatus that he needs hung on compass-sights above. The micrometer is firmly fastened and of course is entirely rid of movement produced by flexure or shaking of tube by wind. If desired the telescope can have a tube compass-sighted at the lens end and with the eye end swinging between dividing engine screws by which measurements up to 1° or 2° could be made with great accuracy. (It was the extreme discernability of all the small motions which now interfere with micrometer measurements which first started the development of this idea)

(Suspension of Tube)

(Entrance (I))

The door of admission will be near the ~~lens axis when the lens points toward the zenith.~~

(Dr C. Circle of Diurnal Motion)

In the bottom of A is a movable support which can be used under E E if necessary

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Nov. 8. 1894

Telescope Mounting, continued.

(Large. Tube)

The object in having the objective project beyond the sphere is to reduce size of sphere and consequently amount of material.

(Entrance Lighting)

The interior of sphere would have electric light placed when needed. Each incandescent light would be surrounded by a network of wire. The wire to feed these lights & for any other purpose would enter near the objective and pass thence to some point, where by means of pulleys & weight the slack would be taken up when the tube was moved in that direction.

(Large. Tube)

The tube could be without tube but hung in a powerful compass mounting with the means to change its position. On the cell would be placed an adjustable mirror. On the mounting of the eye is a small light behind a circle of thin ground glass. This is reflected in the mirror and back to a little telescope with cross-hairs close beside the light. Cords run from the eye to the

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Nov. 8, 1894

fine screws moving the objective. In this way, after the lens has been once adjusted for a given portion of the sky, any movement of the telescope can be at once compensated for in the objective. So the whole eye mounting can be moved over 6° or more by dividing engine screws yet without having the weight of a tube. The eye mounting will also carry a fine micrometer.

An index bar near the objective and viewed through a small telescope will give the declination. Another index with an E & W level and set in a compass mounting but so arranged that metal circle which holds the level and is graduated, will always be perpendicular to the polar axis. Balancing this sphere is delicacy in that is required, will be done by pumping water into tanks near the objective. This pump can be near the eye end and run by an electric motor.

(Lieut. Tebbe)

(Dr. Gould)

(R. A. Moore)
(Asst. Bakeney)

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Tuesday, Nov. 13, 1894

New Telescope Mounting. Cont'd

My latest points on this subject are as follows.

The spheres had best be supplied with trunnions and revolve like a globe, with the weight relieved from the bearings by water in a ~~tub~~ tank below as previously described.

One side of the sphere will have a slit for the telescope to work in the Dec. motion will be obtained in an immense wheel placed ~~inside~~ the sphere (like E E in the figure placed inside) This will will have rollers or anti-friction wheels on its circumferance and wherever necessary on its sides. It may have an ~~axle~~ axle also if desired. The tube of the telescope will pass to one side of such axle and allow a view of the pole if the ~~latitude~~ latitude is sufficiently great.

The lens itself will be hung in a C.M. (Compass Mounting) and have a very light tube attached - made even of tin or light galvanized iron. This tube will come down to the eye and carry a micrometer. The whole eye & lens may be moved

(R.A. motion Sphere II)

(Dec Circle rollers)

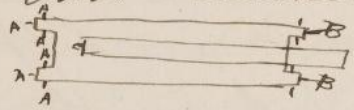
(Light tube)

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Nov. 13. 94

(as described) within large Mic. screws which will give a full field of over 1°

A section of this interior wheel will be like this:  At each of the points marked "A" there are wheels placed to receive the weight of the great wheel. The projecting parts B, B, serve as braces for the spheres when the slit weakens it. This great wheel carries an index near the E of which works along scale on the sphere indicating the declination. Near by is the wheel for moving the telescope in Dec working on a cog (of chain

(Dec. Circle)

The movement in R.A. may be accomplished by a line of cogs ~~to~~ vertical passing underneath the sphere and in which works a cog wheel whose axle passes through the bottom of the dome. This may be extended near the polar axis to run a motor whose speed will be controlled by the tuning fork arrangement of Wood & Pickering. This tuning fork perhaps had better be placed on a column so that too strong a current does not go through it. It may be placed on the platform at the E. end of the telescope.

(R.A. movement)

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Dome-telescope Nov. 13. 94

The gearing can easily be so arranged that the same motor may be used for turning the dome rapidly in R.A. in order to set on an object. If desired a differential action may be put in the gearing to produced slow motion in R.A. by hand. Balancing.

While with so much power at command, the telescope will probably move steadily without perfect balancing. It would be better to have it in as true balance as possible. For this purpose a tank may be placed near the objective. Into this tank water may be pumped by a motor at the bottom.

Another scheme is to have entrance near the objective and weights of 125 lbs or more on ropes running between the objective & the center. The stationary position of the weight would be at the center. When a person entered he would put his seat on a shelf attached to the rope and descend to the center, raising the weight to the top. Then when he reached the bottom the sphere

(R.A. movement)

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Dome-telescope. Nov. 13. 94

would be but little out of balance, which could be corrected by further raising the weight.

R.A. index.

Such an index could be put on a Circle at the E end & read off by using a level. This would be valueless for H As of about 90°. An adjustable but permanent index reading to fractions of seconds of time could be attached directly to the axle which enters bottom of dome as above mentioned.

Automatic Balance.

The axle passing through bottom of dome would have a cog wheel which dome run by another cog wheel connected with the motor. Either of these cog wheels or both could have the teeth on a movable ring connected by a powerful spring with the axle so that two great or two little resistance would slightly move the spring and by electric or other connection pump water into tanks near objective.

Weight as bearing, if polar axis can be adjusted automatically by having such weight affect directly the weight of the outflow from the large tank.

(R.A. movement)

(Polar Axis)

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(History) Finished Nov. 11, 94. Nov. 14.

Dome-telescope Friday, Nov. 16. 1894
(Copy of note of that date)
Have today for the first time read over the account of Snubbi and mounting. This was mentioned to me as seen in a newspaper but not described so that I could understand it by Mr Sisson on Nov. 13. ~~It~~ It was after that that I came home and wrote in this journal what I had already learned on my mounting since the first entry.

Some advantages of this mounting.
(Copy, as above)

Nov. 16. 1. Steady motion mechanically.
2. " " from absence of wind.
3. Large Min. field.
4. No moving or setting motor.
5. Near and thorough control of slow motions
6. No need of singular temperatures in tube.
7. Comfortable temperature to work in revolving
Nov. 21. 8. No ropes for moving telescope or gear for dome
9. No expensive & clumsy observing chair
10. No need of raising or lowering floor.
" 27 11. Can be run by one person more quickly, i.e., with less loss of time than older form with same size telescope - or even smaller.

(Advantages)

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Wednesday, Nov. 21. 1894

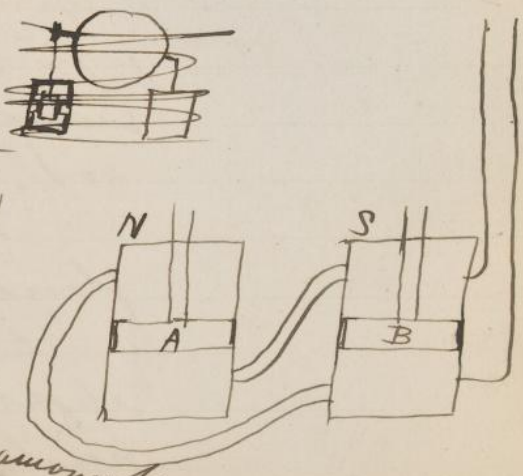
Name, "The Dome-Telescope Mounting".

The telescope may be made so that it never goes nearer the horizon than 15° & 20° nearer than that a small telescope is equally efficient. In fact this limit might be much higher, but 20° is probably not far out.

Weight on polar axis bearings.

There are two new ideas on this point as follows:-

(A) The axle projects from the pole of the globe. It is held between four wheels set on ball bearings and barely but certainly touching the axle. These four wheels are supported in one casting which can move vertically between guides. For one pole these guides are movable sideways, for azimuth adjustment in azimuth. The casting in turn is supported on a vertical bar or piston rod which works in a cylinder, thus:-



The upper half of cylinder N is joined by a tube to the lower half of S, and the upper half of S to the lower half of N. So that when A rises, B must rise by the same amount.

(See Circle)

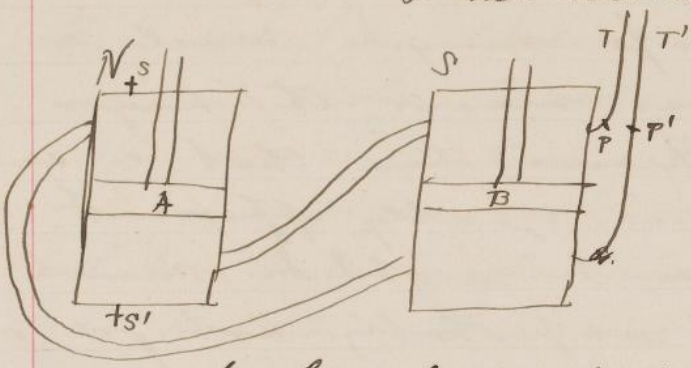
(Weight on Polar Axis)

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Wednesday, Nov. 21, 1894

Some-time soon



the faucets S & S' allow the air to escape in filling cylinders with water, which is poured or pumped into the tubes T & T'. ~~The stops~~ The tops of T & T' are level with each other so that the pressure may be equal ~~on~~ on both sides of each piston. Adjustment may be made by extending length of one tube & the extra weight of water will change relative height of poles. Turning the stop-cocks P & P' confines the movement of water altogether to the cylinders and intermediate pipes. There is also an adjusting ~~screw~~ device on each piston rod.

Now when extra weight is placed in the sphere it sinks deeper in the cistern & both pistons descend slightly without changing relative height and there is no pres-

(Continued on following page)

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Nov. 21, 1894

Dome-telescope.

sun on the bearings

Indices should be placed

A for height of water in cistern

B. for position of each piston A & B (fig 38)

C. for height of each pole with reference to guides.

(Entrance)

Entrance:

A flat revolving circle containing door is near upper (or lower) polar axis. A stairway like this  can easily follow the semi-circle of its motion. The intermediate point I has a ~~bridge~~ bridge, passing from one quadrant of stairs to the other, and separated further from the dome. An ordinary stairway goes directly to I.

(Entrance outside)

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Friday. Nov 23. 1894

Desk Shade.

Good thing to have on desk at night while working would be:-

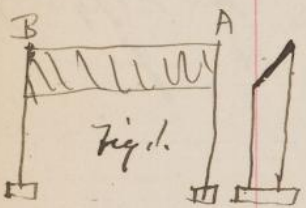
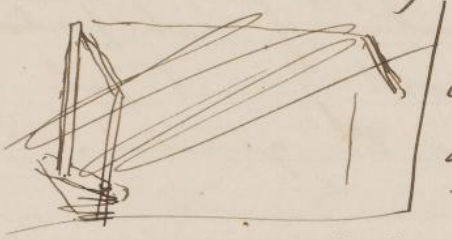


Fig 1.


a shade inclined at an angle of 40° from the perpendicular and supported at ends - The whole stretching across front of desk so that lamp can be placed beyond it & not shine in the eyes but thoroughly illuminate the whole desk and room.



or Fig 2.

Fig. 1. shows it on a light wooden support with the shade made in one piece and movable. make adjustable

Fig. 2. shows how to ~~adjust~~ a height.

The shade may be hinged at A and swing up into position of dotted lines when not in use - Or it may be made to roll up so that the whole shade is drawn up in line with (A B Fig. 1.)

The whole may be made permanent on desk.

It may be bought of different manufactured lengths - movable but with screw holes for making it permanent

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Tuesday, Nov. 27, 1894

Stairway for towers & court room.
Designed first to be used in the Dome-telescope as a means of descending from the entrance. (I do not use in its present form but contains an idea)

Two parallel ~~of~~ vertical bars with teeth pointing upwards. Two treadles passing between bars, and hinged together behind them and at some point fastened to a carriage which runs up & down on bars. Ratchets for treadles. A person in going up stairs would go through act of pumping with feet. To go down ratchets would be removed from teeth and brake applied.

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Nov. 27. 1894

Dome - telescope

Supports.

Beneath sphere there should be four or more supports ~~etc~~ upon which the sphere will rest when water is withdrawn

The bearing cylinders for polar axis should ~~not~~ allow the sphere to fully reach these supports.

Entrance.

As described the entrance would be through door revolving about its center. Immediately inside would be a semicircular pathway leading to near center of "equator", i.e. to a point near the intersection of Equator and the Dec. wheel. When the ~~tele~~ H-A. is near 0, this pathway has this position ⌣ - its diameter is 7 ft or 7½ ft. It is divided into several narrow paths separated by raised ridges and each path with steps ~~etc~~ so ~~arranged~~ arranged that they are of the right character to walk on when that path becomes the lowest in the semicircle. Electric lights may be distributed along overhead.

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Nov. 27. 94

Dome - telescope

Entrance - continued from last page

The lower end of this pathway is close to the electric motors for turning dome & pumping water to the objective-tank. A somewhat similar pathway will be continued up the slope of the dome towards the opposite pole. Another also returns beneath this one up the reverse slope of dome.

— Or rather, a similar pathway traverses nearly half the inner circumference of the declination wheel so that one can enter it from the foot of this one and walk to the E end of Tel. near the eye end will be ladders ascending close to the objective. This also enables one to ascend this ladder and get over into the main pathway by a short cut if the visit is so placed.

Iron bars — will be fastened outside the dome & brick the slit so that one may ascend to the objective. A small door in that region makes another entrance.

In the bottom of the interior a short walk goes from the Dec. wheel along the equator past the motors. This walk has two halves, one of this section ~~~~ so as

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Nov. 27. 94

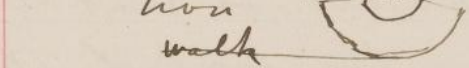
Dome-telescope

Entrance. Cont'd

to be used as a stairway when the slope is strong in either direction the other half merely has slats nailed across to be used in slight inclinations. At the foot of the main pathway this walk is raised so as to allow easy entrance to the Dec. pathway.

Desk & book rack.

On one side of the Equa. walk is a desk of this E & W section



at A then is a light. B is the top of desk and C is the standing room so that one may always get a vertical & comfortable position for handling books &c. Between A & B are racks for books — They may be like plate racks on sideboard.

Duplicate Driving machinery.

Driving and pumping machinery should be in duplicate. In construction a space should be left for a large weight which can be used for driving. A hand power-pump may be used for balancing.

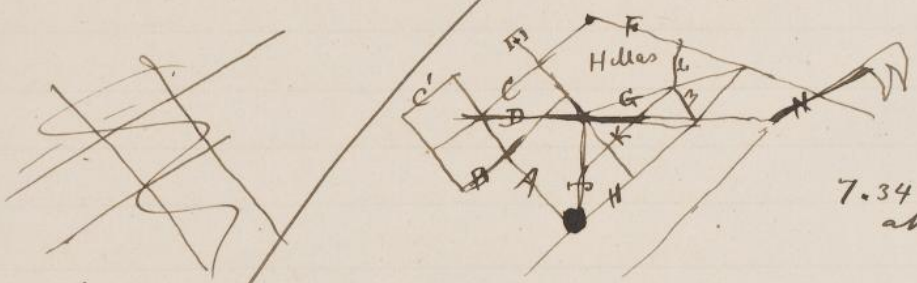
(R. A. movement)

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Wednesday, Nov. 28. 1894

Relative positions of canals in dark region
1 Mass.
(in 18" Vol. IV. page 52)



7.34-8.06 Center at Intersec. E+D

Canal D is the standard.

Canal	Angle I 7.34-8.06
A	- 30.8
B	+ 57.3
C	+ 60.3
C	+ 63.2
C'	about same
E	-38.7
A	- 31.9
F	- 20.2
G	+ 28.8

See L. O. Journal
page 2, Dec 8 94.

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Friday, Nov. 30, 1894

Dome Telescope.

Some recent ideas on this subject.

Dec. Wheel outside = sphere revolving in Dec as well as the whole in R.A.

This is the form first devised. It allows much greater strength and probably rigidity and consequent greater perfection of motion

Motion in Dec would not be difficult

Motion in R.A. would have to be made in this way: The Dec circle or wheel encircling the sphere would be composed of two separate circles - parallel - forming crowns of sphere. There would be 2 to 3 ft wide radially. In the quadrant below the upper fork a large tube would go down to the equator, with a ladder inside for descent. At the bottom would be the motor for driving the sphere in R.A. All controls of this motor would have to be electrical.

(Design I. R.A. driving gear) & (Design II is always used & unless otherwise specified)

Entrance for Design I.

This would have to be at the objective with ladders going to the eye end.

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Friday, Nov 30. 1894

Dome Telescope.

Driving gear as affected by rise & fall of sphere.

The line of vertical cogs beneath sphere can best be rather narrow as three methods for allowing for this rise & fall are as follows.

1. Have a long axle for the wheel that passes through sphere and allow wheel to work up & down in lengthened cogs. This plan wont work when the H.A. is large.

2. Have the axle extensionable - the lower wheel have a square axle sliding up & down in a square hole in the axle passing through dome. This also wont work at large H.A.s.

3. Have the line of cogs rise and fall with the dome, on rigid vertical guides. This will be accomplished by supporting the cogs on pistons working in cylinders connected in series with the polar axis cylinders. The wheels with them rise & fall together.

(Rid. driving gear, Dragon II)

(Pattinson)

Material used for anything under water might be aluminium bronze.

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Li. Nov 30. '94

Dome telescope.

New form of Dre. Wheel.

This form will, I think, give greater rigidity than any previous forms for design II. & perhaps for design I.

The sphere has a slit some 7 ft wide and extending through about 120° It need not be quite so much. The dome will then be made in two halves which can only be fastened together in certain places

The new form of Dre. Wheel consists ~~in a tube~~ carriage suspended on a central axis and revolving in Dre. In one half of this carriage, running at beside the axis is the telescope tube. In the other half, at the top are the water tanks, & weights if necessary are at the bottom and a stairway or ladder connects the ends. Now the axle being very long and strong allows a good connection between the two halves.

(2) The motion being only 120° there are left at opposite sides about two and a half attics 40° or 50° when does may

(Carriage: Dre. Movements)

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Fri. Nov 30 94

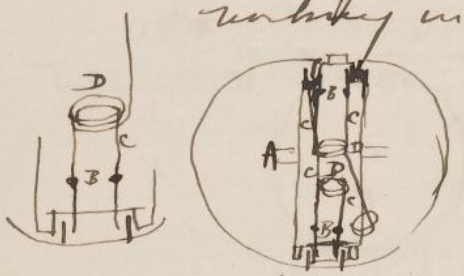
Dome-telescope

(Dec.: Braces and Bee clamps)

be put across, and on each side these braces may extend in quite a distance towards the center.

(3) Outside the sphere in any part except over the slit bracing of great strength may be put.

(4) At each corner of the bottom and top of this carriage is a clamp working in this fashion:



A = axle

C = lever arm for clamp. pivoted at B B. The lever arms are very long and pulled together by block and tackle at D D. The ends of these ropes go over a windlass with a ratchet. The method is better shown in the little side drawing.

Shutters.

Since the top of this carriage only covers a small part of the slit other automatic shutters may be arranged in this way. They are in separate sections, say 12 ft long, & divide in center sliding outwards on tracks. Each shutter is moved by a cog wheel beneath it turning an excentric. On the side of the top of the carriage is a line of cogs which turns each shutter cog wheel as the lens approaches, so that while the lens is there the shutter is removed and when the lens

The top of the carriage has an extension so that it may cover the slit as far as for as possible.

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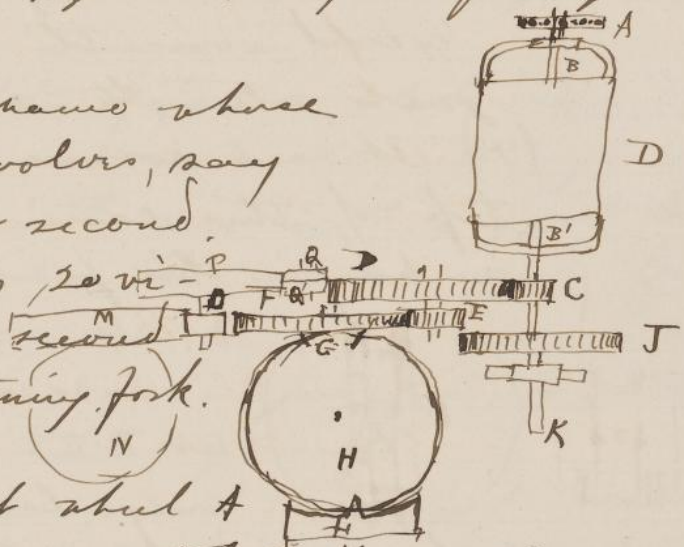
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Sunday, Dec 2, 1894

Dome-telescope

Some details of driving gear.
Tuning fork is arranged as a shunt and regulates speed of dynamo.

D is the dynamo whose axle K revolves, say 5 times per second. This allows 20 vibrations per second for the tuning fork.



The sprocket wheel A may be connected to the ordinary Watt and Bond spring governor driving gear by a chain, but ordinarily this wheel is loose on axle K.

C is 2 in D and has ½ in teeth or 12 on the circumference. D is 20 in in chain with similar teeth so that it revolves in 2 sec. E = C and F = D so that F revolves in 20 sec. G & H are bevelled, their axes equally E & F so that H revolves in 3 in 20 sec or about the required time for moving 100 ft telescope

For rapid motion axle K is moved towards A bringing J into connection with E so that F revolves at the

(R.A. movement)

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1893phae.proj..526D

Dec. 2. 94
Dome-telescope

(R. A. movements)

some rate as K
As a matter of safety, when K has moved 1/4 & 1/2 in it automatically ~~breaks~~ ~~hot~~ breaks the circuit and 1/2 or 1/4 in before reaching final position it closes another circuit which omits the tuning fork but includes regular brushes B B' so that the motor possess its own rate without reference to the tuning fork. Attached to H is or ~~close~~ in connection with it is an index and cog wheels with a second index, all so arranged as to give the H.A. to within 1 sec.
By the way, the axle of wheel H passes through dome and has a cog wheel 3 in in diameter (with helpful cogs) working the line of vertical cogs below dome.
Automatic Balancer, and Backlash Absorber
The Balancer as described before is placed on wheel D. N, M, O, & P, are wheels exactly like H, G, E, & D. N has an axle passing through dome and a cog wheel working in the row of cogs. Q & Q' are two independent wheels on the same axis, one working in P and the other in D. The effort of the machinery is to revolve them in the same direction; if therefore we turn them as far as possible in opposite directions and join them in that position by a strong spring, the backlash is ~~entirely~~ taken up

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1893phae.proj.526D

Dec 2. 94

Dome-telescope

Automatic Balancer

(R.A. movements)

It would be seen that for rapid out motion in ~~Dec.~~ R.A. this is thrown ~~XX~~ The balancer will be joined to the motor pump by electric wires. The direction of the current must be changed at H.A. 0h 0m 0s. A switch to throughout this current out altogether should be placed at the observing chair or else this may give trouble at the wrong time.

Slow motion in R.A.

This will be done chiefly at the Eyepiece but should it be desired to get greater range it is well to provide a slow motion similar to that on the Greenwich mark with differential wheels. This had been to be applied at wheel D.

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Thursday, Dec 6. 1894

Dome - telescope

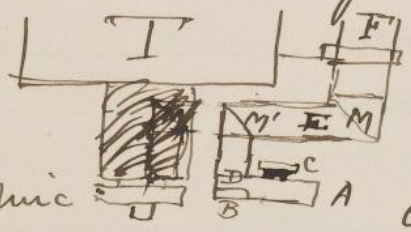
Backlash absorber.

(R. A. movement)

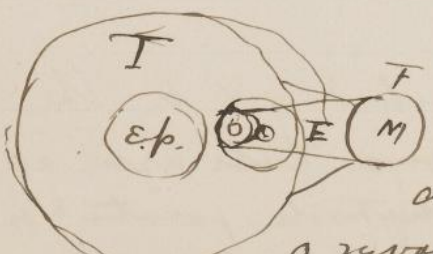
While this tool better be inside the dome so that adjustment can be applied to it, it could be entirely outside and close to the regular driving wheel. That would save putting the second axle through the dome. Inside it could be placed as ~~to~~ well between wheels N & H or M & F as between P & D The means D & P is comes the greater will be the power of a given spring and the more rapidly will the wheels revolve

Finder.

The finder of proper size will be placed along the tube as usual Its focus will be some distance beyond the end of the big tube.



M & M' are mirrors. The arm E may revolve on F so as to be placed in a convenient position for use or entirely out of the way.



Cross threads at D

A is a box containing the different Eps mounted on a revolving frame turned by screw C

By beginning with a very low power and ascending one finder may be sufficient. The ep. at B is ready for use.

(Dup. of Tube)

The ~~arm~~ tube by a good thing if the ~~arm~~ of T & F were so near together that the eye could be used in each of the same time.

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Dec. 6. 94

Dome - theodolite

Driving machinery; Slow motion arrangements, Backlash absorber, & Automatic balancer.

(R.A. movement)

Q + Q' are joined by a strong spring so that from the A.B. (auto. Balancer) to the last line of cogs, there is no backlash.

The AB is placed at wheels S & D

The axis of D runs from end to end and has two tubes at one end - a, B, connecting with metal

Fig. 1.

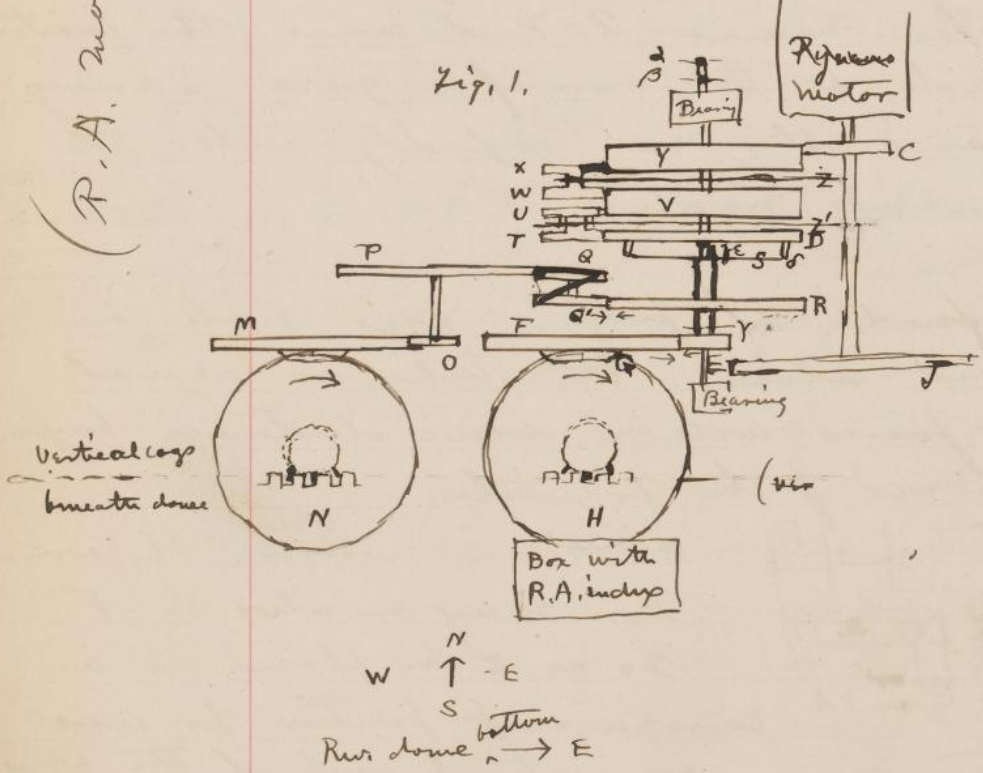
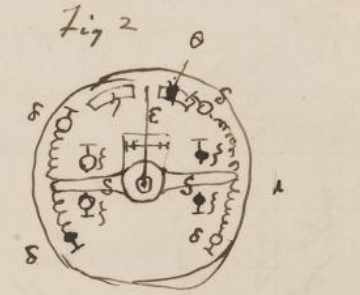


Fig 2



Wheels D & S
(automatic balancer)

surfaces on D marked η & θ The two arms of S are the same tube arch as R + E The adjustable electrode pointer ε is in connection with the brush γ near E The springs from the four δ's allow

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Dec. 6. 94

Dome-telescope

Driving gear - continued,

movement of S with reference to D the butting screws ζ, ξ, ξ, ξ, permit two quick motion. The positions of η & R are also adjustable. The tension of the springs from the δ's is adjustable. When ε touches η (for e.g.) it ~~[illegible]~~ causes a motor to pump water into the objective tank and when it touches δ it opens a valve and allows the tank of the required weight.

The other wheels between D & C are for slow motions either way. V & Y_1, Z_1 & Z_1' are to move on axle of D V may have one more tooth than Y & D or else W & U may each have one more than T & X. The stopping (by a ~~[illegible]~~ catch worked by electricity) of 2 or 2′ will cause increase or decrease in speed of D, as required.

(R.A. movement)

(is used off E, one of the electrodes)

See page 81.

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Friday Dec. 7. 1894

Cloud on Term. of Mers

Record of Obsns.

Nov. 25. "94

9.34 Closed on Term

Sep 1 = 23 3/4 miles 36.½ Sep 0.m3, 0.m2 high & rapidly increasing

Sep 71. Ht 48 = 119 in length. P.A. 8th parallel & Term at that point 309.4 1

NOS 142 38 NOS width 6 2

41.5 P.A. as before 308.6 better than before

46 With better seeing think separation 4

s h
119 + 58 = 177 is 5 and height 2 or 3 — in 3/4 seeing 7

48.1 With ½ in thick tel height is 7 and 5

= 166 NOS
× 142 NOS length 6.

s
119 = 54 (W.H.P.) Sep 5 in ½ in perhaps lighter 6

than Term near it

10.01-7 Mic. Tel. of Proj. Disappearance estimated at 10.05 or 06. : but seeing went down to 4 at that time

appr.

Sep 110. Ht 55. height 142 with tendency to increase height. 1st Obsn was smallest

Nov. 26, 94

10.14.3 Cloud has appeared since leaving int to wind clock — 3/4 pros.

S 96. h 24 H 120 22. Sep 4 thickness 1 length 8, Seeing 4 7

½ pros — limb generally 3/5

33 Seeing 8 — no cloud

34,4 Momentary cloud

36.0 No cloud — 7 in 3/4

38. Think sometimes that in region of cloud

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Dec 7. '94

Cloud on Terra.

but on disc I can see small white patch.

10.39 No cloud – 7in 3/4

40.4 Cloud nap.

44 Cloud gone at 43m Total height 5, possibly spread over great depth of Terra (30°) (8

H 118

46.1 Cloud nap.

249 248=H97 48.3 Sep 2 & Ht 2. now about gone

50.9 Cloud nap.

52.4 " gone

56 Think Cloud may have nap'd for 1m 2m seeing 4

58 No cloud S6

59.7 Cloud Nap.

11.01.4 no cloud S6

(02&3) absent from telescope

04 No cloud S7

*#10 Surfaced cloud,

12. No cloud S5.

Nov. 27.

10.50 No cloud. S5. in 3/4

Mic. Lab. ~~Rag~~ Cloud. Nov 25. 10h01m-04m. 104.0-½-7

Sea

10.01 7 N E D 16.788

.04 7 N " 15.045 1.743

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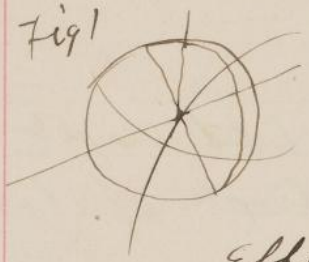
Cor 60
76 8.96.

Dec 7. 94

Cloud on Venus.

Position of cloud,
Mars tilted at 49.3 on all
three nights.

Fig 1



	Ephemeris. Axis P.A.	our time	long. cent.	Lat	Diam.	Defect	P.A. Phase Eq. Q	angle between ⊕ & S E
Nov 24 d 17 h	325.4		87.4	−23.3	16".08	0".85	67.9	26.5
For 1st Obsn.				"	15.96	.86	68.0	26.8
25 " 17	325.4		78.2	"	15.90	.87	68.0	27.0
For 2nd Obsn				"	15.78	.88	68.1	27.3
26 " 17	325.4		69.0	−23.3	15.72	0".89	68.1	27.5
27 " 17	325.4		59.8	"	15.54	.91	68.2	28.0

Lats were taken by P.A. of Venus and
by phase latitudes & one true Lat.

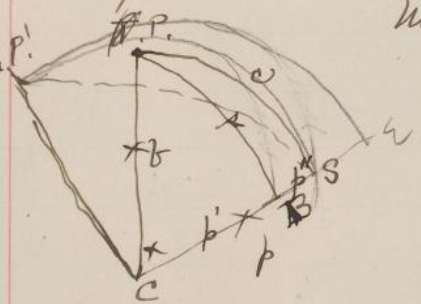
360 − 325.4 = 34.6 // 49.3 − 34.6 = 14.7 True equator
68.0 − 90 = 338.0 // −360 = 22.0 // −49.3 = 27.3 True pole

The phase lat. Mars was in center
of Venus. (Nov 26) To work this out we have

Nov 26. Ph − P = 12°.6

P.C.S = 90 − 12.6 = 77°.4 = C
P C = 90 − 23.3 = 66.7 = b
C S = 90 − 27.3 = 62.7 = p
26.9
35.8 = p"

Fig 2



$\bar{1}.9631$	0.3659
$\bar{1}.9894$	$\bar{1}.3387$
$\bar{1}.9525$	$\bar{1}.7046$
a = 63.7	p' = 26.9

Sin b Sin C = Sin a
tan b Cos C = Tan p'
p" = p − p'
Cos a Cos p" = Cos c

$\bar{1}.6465$
$\bar{1}.9803$ = Cos 26.9 which is wrong
$\bar{1}.5468$

Log Cos 35.8 = $\bar{1}.9091$ → $\bar{1}.6465$
$\bar{1}.5556$

c = ~~66.7~~ 68.9 Lat = ~~23.3~~ 21.1

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Dec. 7. 96

Cloud.

Position -

~~Position by R.A. of term. near cloud.~~ Last continued.

With Lat 23.°3 on Nov. 26, the Long. was :.

1st Obsn $10^h 14^m$ to $11^h 01$ = $12^h - 6^h 46^m$ & $12^h - 0^h 5$ 9

Nov $26^d 17^h$ Long Cent = 69.0 (73) = 429.0 (73,1)

" 12^h " " " 355.9 355,9

2.5,8 & 14,3

330,1 to 341,6

From Fig 2. we have

$$\frac{\sin P}{\sin C} = \frac{\sin \phi}{\sin c} \quad \text{or} \quad \sin P = \frac{\sin \phi}{\sin c} \sin C.$$

Log sin C = $\bar{1}.9894$

" " ϕ = $\bar{1}.9487$

$\bar{1}.9381$

" sin c = $\bar{1}.9634$

" sin P = $\bar{1}.9747$

$\bar{1}.9682$

P = +~~70.8~~ +68.3

330.1 & 341.6

H.A. = 70.8 - 2.5 = 70.8 - 2.5

400.9 & 412.4

360.0 -360.0

40.9 - 2.5 52.4 - 2.5

= 38.4 49.9

Towle's Cor -5 -5.

33.4 44.9

The position observed Nov 26 was therefore

Long ~~41~~ 33 to ~~52~~ 45 by Lat - ~~23.3~~ 21.1

Long ~~41~~ 33 (or ~~40.9~~ 33.4) = time $10^h 14^m.0$

Feb 8.96

Upon comparing old result with globe I got

	Comput	Globe
$\Delta\lambda$	+70.°8	+68.3
Lat	-23.3	-21.3

This seemed too great an error & I reviewed logs and now get

	Globe	Comput
$\Delta\lambda$	+ 68.3	+68.3
Lat	- 21.3	- 21.1

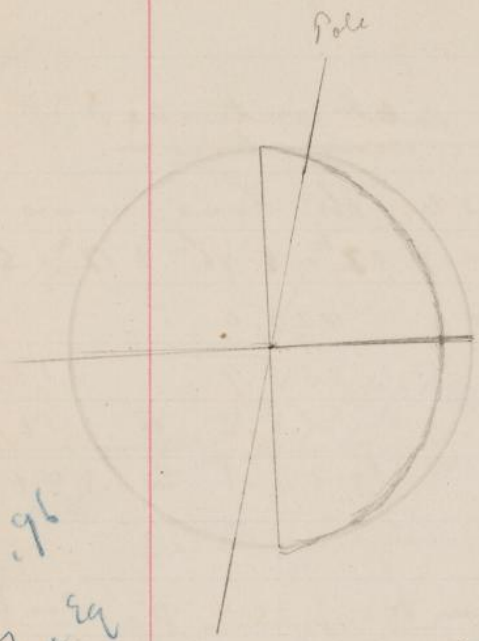
This discovery of error is due to disagreement on trying this with computers globe.

Feb 8.96

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Dec. 7. 94



Cloud.

Position for Nov. 25.

Observed P.A. 308.8 (best mean of 308.6 & 309.4)

on on of the quartz threads.

P.A. Pl. P on Sth is 14.7

~~Then~~ Mass tails as follows (cor

Sunph Th. 49.~~7~~

Sth. Q. " 318.7 +0.6.

Nor. Q. " 317.9 +1.4

Feb. 8. 96

14.7 True Eq

90 " Pole

104.7 "

180 "

284.7

309.8

25.1 from True Pole

As I doubt now which of these was used added 1.0 & get 309.8 + 90° = 39.8

39.8 − 14.7 = 25.1 turned from the ~~Mass Equa~~ True Pole.

Try a check in the other method,

Cloud was found to be 1.743 from N.

at Nov 21d 11h Star diam was 2.5536 Au Dis 0.00044

Diam then was 16.66

20d 17h	16.80	18/4 = 4½
21 17	16.62	
22 17	16.44	18

Log 2.5536 = 0.407153

" 16.66 = 1.221675

" 1.0 = $\bar{1}$.185478

1.0 = 0.1532 or .1533

0.814522

Approx. 1 Div. Mic. Value of 1 Sec. arc. (True value 0.1512)

or 1.000 = 6.5241

Log 1.R = 0.814522

" 1.743 = 0.241297

1.055819

11.37 from N ~~Pole~~ true pole.

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Dec 7. 94

Cloud

Position

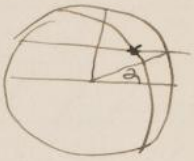
Diam Nov 25 $\quad 15.96$

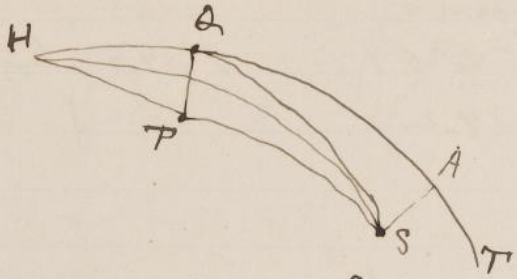
7.98

11.37

$3.39 = \sin^{-1} 2$

7.98





$\log 339 = 2.5302$

$798 \quad 2.9020$

$\therefore \sin 2 = \bar{1}.6282$

$2 = 25.1$

$QS = 64.9$

$PQ = 23.3$

$HQ = 12.6$

$TQP = HQP = 90.0$

$QHS = 26.8$

$SAH = 90.0$

Solve for PS = Lat

$\angle QPS = 180 - H.A.$

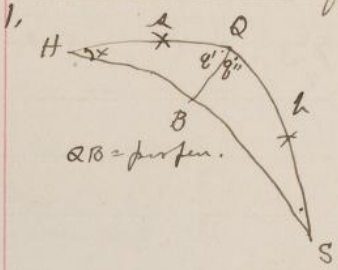
1, Solve QHS for $\angle Q$ } gives PQS

2, " PQH " $\angle Q$ }

2. " PQS for $\angle P$ & PS



2



$\cos Q = \cot QS \tan QC$

$\tan QC = \cos Q \tan QS$

9.6828

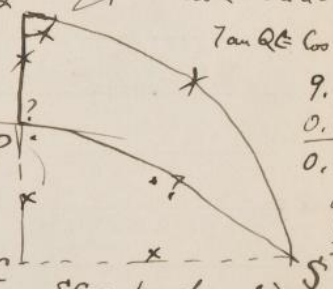
0.3294

0.0122

45.8

23.3

22.5



$\frac{\sin S}{\sin H} = \frac{\sin s}{\sin h}$

$12.6 \quad \bar{1}.3387$

$26.8 \quad \bar{1}.6541$

2.9928

9.9569

9.9427

9.8996

$CS = 52.5$

$PC = 22.5$

$\bar{1}.9569$

$\bar{1}.0359$

$S = 0.6.2$

$\cos PS = \cos PC \cos CS$

9.7844

9.9656

9.7500

$\text{Lat} = 34.2S$

$\cos s = \cot H \cot q'$ $\quad 0.2966$

$\tan q' = \frac{\cot H}{\cos s}$ $\quad 9.9894$

0.3072

$q' = 63.8$

$\sin PC = \tan CS \cot CPS$

$\tan CPS = \frac{\tan CS}{\sin PC}$

$\bar{1}0.1150$

$- 9.5828$

$\bar{1}0.5322$

$\tan q'' = \frac{\cot S}{\cos h}$ $\quad 0.9640$

$\bar{1}.6276$

$\bar{1}.3364$

$q'' = 87.4$

63.8

$HQS = 151.2$

$PQH = 90.0$

$PQS = 61.2$

$HA = 73.6^{\circ}$

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Saturday, Dec. 8. 1894

Cloud.

Position.

The position obtained Nov 25, by a direct Lat. observation was

Long ~~43~~ 38 to ~~51~~ 46. $9^h 34.^m 0 = \text{Long } 38.^\circ 1$

Lat − 34.2

Nov 25.^{d} 17.^{h}0 Long Cent = 78.2

$9.34 = 12^h - 2^h 26^m$

$10.06 = 12^h = 1\ 54^m$

	360	
	438.2	438.2
	73.1	
	365.1	365.1
	35.6	27.7
	329.5	337.4
H. A.	73.6	73.6
	403.1	411.0
−	360.0	360,0
	43.1	51.0
Towlls Cor	− 5.	− 5.
	38.1	46.0

146

29.2
6.0
35.6

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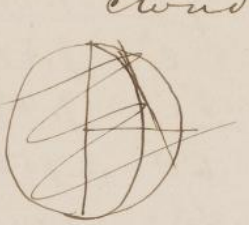
1893phae.proj..526D

Dec. 8. 94

Cloud

Position

No. method (Rad Nov 25th of P.A. of 7 cm. at cloud with Ghum' to be solved algebraically



$a^2y^2 + b^2x^2 = a^2b^2$

$2a^2y\,dy + 2b^2x\,dx = 0$

$\frac{dx}{dy} = -\frac{a^2y}{b^2x}$ $\quad 7\text{an} = (90° - 25.1) = 64.9$

or $+\frac{a^2y}{b^2x} = 7\text{an } 64.9°$

(It should be $\frac{dy}{dx} = -\frac{b^2x}{a^2y}$)

Then we should have $-\frac{b^2x}{a^2y} = 7\text{an } OSD$

$+\frac{b^2x}{a^2y} = 7\text{an } 25.1° = 0.4684$

In this ellipse we have

$a = 1.$ & for b

Diam $= \frac{15".96}{7.98}$ defect $= 0".86$

$\log \frac{8.6}{7.98} = 1.9345$

$\log 7.98 = 2.9020$

7.0325

defect $= 0.1080$ or 0.1078

So $b = 0.892$ & $a = 1.000$ // $\log b = 9.9503$

$\log b = 9.9503$

$\log b^2 = 9.9006$

$\log a^2 = 0.$

$\log \frac{b^2}{a^2} = 9.9006$

$\log 7\text{an } 25.1° = 9.6706$

$\log \frac{b^2}{a^2} = 9.9006$

$\log \frac{x}{y} = 9.7700$

$\frac{x}{y} = 0.589$

$x = (0.589)\,y = cy$

$a^2y^2 + b^2c^2y^2 = a^2b^2$

$y^2(a^2 + b^2c^2) = a^2b^2$

$y^2 = \frac{a^2b^2}{a^2 + b^2c^2}$

$y = \sqrt{\frac{a^2b^2}{a^2 + b^2c^2}}$

over

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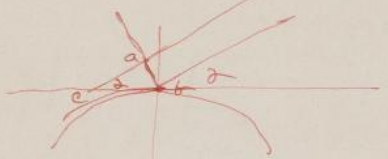
7 | 791 — 6 | 487 From Table II.

Sep. 113 — 81 | H.

H 81

194

ab = 97



Lat Computed 34.2
.5
33.7

Δ Long = +73.5

For bottom page 67
nov 25 — 25th

61, 114, 95, 77, 45
106, 148, 132 | 106, 95, 90

97 = bc — log 97 = 1.9868

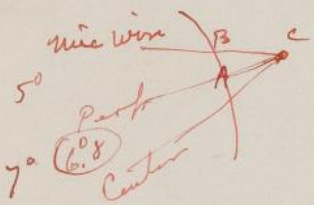
Sin t — 4 Sin 26.8 = 9.6541

AC = 215 miles — 2.3327

Lon 37.8 miles — 1.5775

log AC in degrees = 0.7552

AC = 5.°69



BA = AC Sin BCA

5.°7 Sin 5°

.087

5.7

609

435

~~.4959~~

.5

∴ Nearest point on 7 error is 0.°5 to N.

The diff. bet. this method and the P.A. of 7 error was 34.4 − 33.7 (in Lat) = 0.°7

∴ Nearest point on 7 error was Lat 33.9 | Δ Long 73.5

P.A. method on globe — Lat 33.7 | Δ Long 73.°0

} agreement of methods on globe

Given in Table II the point on 7 error.

In line with center & david.

QHS = 26.8

S

This will come out about Lat 4-5 S of

long 45 to 53

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Dec, 8, 94
Cloud
Position.

$$y = \sqrt{\frac{a^2 b^2}{a^2 + b^2 c^2}}$$

$a = 1.000$ $\log b^2 = 9.900$
$\log c = 9.770$
$\log c^2 = 9.540$
$\log b^2 c^2 = 9.440$
$b^2 c^2 = .2758$
$a^2 + b^2 c^2 = 1.2758$

$\log a^2 b^2 = 9.9006$
$\log (a^2 + b^2 c^2) = 0.1058$
$2 \log y = 9.7948$
$y = 9.8974$

Note: the sin E used at first of course really is SinHS sin E H being distance of point from earth.

Nov 25 | Nov 26
61, 114, 95 | 47, 45
106, 148, 132 | 106, 95, 90

Now the globe I found that the angle E for Nov 25 should be about 25.8 instead of 26.8 to allow for position on ellip. From. This last is not right. Each obs corner. Each obs should be subtract 0.0116. Or take off 1%
From dist. should be divided by cos of ellipse

$\log \sin 26.8 = 9.6541$
9.6387
0.0154
25.8

	61	114	95	106	148	132
	1.7853	2.0589	1.9777	2.0253	2.1703	2.1206
	9.6541	9.6541	9.6541	9.6541	9.6541	9.6541
	2.1312	2.4028	2.32,36	2.3712	2.5162	2.4665
+	0154	0154	0154	0154	00154	154
	125	233	211	235	326	293
	2.1466	2.41682	2.3390	2.3866	2.5316	2.4819
	~~1460~~	~~2622~~	~~2155~~	~~244~~	~~2400~~	~~303~~
	~~157~~	~~234~~	~~216~~	~~242~~	~~227~~	~~200~~

Nov 25 | Nov 26

	77	45	106	95	90
	1.8865	1.6532	2.0253	1.9777	1.9542
	9.6615	9.6615	9.6615	9.6615	9.6615
	2.2250	1.9917	2.3638	2.3162	2.2927
	1.5775	1.5775	1.5775	1.5775	1.5775
	0.6480	0.4142	0.7863	0.7387	0.7152
	168	98	231	207	196
	4.45	2.60	6.11	5.48	5.19

Log 8 | Log 9

	3.3243	7.2259	3.2795
	9.6541	9.6541	8.1960
	2.9784	8.8718	3.0
PCT =	~~2.0~~ 2.1		
	3.3243		
	9.6615		
	2.9858		

$\log \sin 26.8$

$= E(27.3)$

8.8729
4.3
293. 2.0755
2.9784
9.0971
7.1

4. − 1.9823
2.9858
8.9968
5.7

5. − 1.6902
2.9858
8.7044
2.9

Nov 25 26.8
" 26.8 27.3

B TC, anobserved
= E in Ephem. =

$$\tan PCT = \frac{AT}{R(\text{illegible}) \sin E}$$

3.75 = PC − R

Cloud
long
Lat
Cor = −7.°5

at $10^h 14^m$ 3.3.4 − 21.1
at $11^h 01$ 44.9

$X = 0.4649$ = hal sin 27.7

90 − 27.7 = 62.3

QH =	12.°6
QP =	23.3
HS =	62.3
HQP =	90.0
QHS =	26.8

This will come out about Lat 4-5 S
long 45 to 53

1° = 26 miles
1.0 = 23.7.6 in 1 = 24. miles

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Dec, 8, 94

Cloud Position.

$y = \sqrt{\frac{a^2 b^2}{a^2 + b^2 c^2}}$

a = 1.000 $\log b^2 = 9.90$

$\log c = 9.770$

$\log c^2 = 9.540$

$\log b^2 c^2 = 9.440$

$b^2 c^2 = .2758$

$a^2 + b^2 c^2 = 1.2758$

$\log a^2 b^2 = 9.9006$

$\log a^2 + b^2 c^2 = 0.1058$

$2 \log y = 9.7948$

$\log y = 9.8974$

$y = 0.7896$ or 0.790

$x = cy$

$\log y = 9.8974$

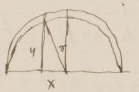
$\log c = 9.7700$

$\log x = 9.6674$

$X = 0.4649$

or .465





Check

$\log x = 9.6674$

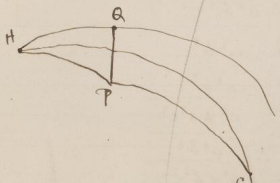
$\log y = 9.8974$

$\log \tan \lambda = 9.7700$

$\lambda = 30.5$ $\sin 30° = 0.5$ $\cos 30° = 0.9$

$X = 0.4649$ = Nat Sin 27.7

$90 - 27.7 = 62.3$



QH = 12°.6

QP = 23.3

HS = 62.3

HQP = 90.0

QHS = 26.8

This will come out about Lat 45 S ☌ long 45 + 5.3

Now the globe I found that the angle E for Nov 25 should be about 25.8 instead of 26.8 to allow for position on ellipse. From this last is subtract 0.0116 to correct for polar flattening or 1%

Nov 25: 61, 114, 95 / 106, 148, 132 / long Sin 26.8 = 9.6541 / 25.8 / 9.6387 / 0.0154

Nov 26: 47, 45 / 106, 95, 90 / 106 / 148 / 32 / 95 / 114 / 61

2.0253 / 9.6541 / 2.3712 / 0154 / 2.3866 / 2.5316 / 2.4819 / 2.4665 / 2.3390 / 2.4182 / 2.1466

1.5775 / 0.8091 / 0.9541 / 0.5691 / 0.8407 / 0.7615 / 6.44 / 9.02 / 9.03 / 9.0 / 3.71 / 5.7 / 6.93 / 6.9 / 5.77 / 5.8 / 6.4 / 0.9044 / 8.02 / 8.0

Note: the sin E used or found of large really should be Sin H's Sin E. H's being distance of point from earth.

expressed in miles of app. size.

TC, anobserved / in Ephem. = Nov 25 26.8 / N 26.8 27.3

$\log PCT = \frac{AT}{R(\text{=}2110) \sin E}$

PS = PC − R

$\log R = 3.6254$ / 9.2259 / 9.6541 / 8.8798 / PCT = 2.1 / E(27.3)

3.3243 / 9.6541 / 2.9784 / 3.3243 / 9.6615

$\log \sin 26.8$ / $\log R$

1. — 1.8513 / 2.9784 / 8.8729 / 4.3 / 2.0755 / 2.9784 / 9.0971

4. — 1.9823 / 2.9858 / 8.9968 / 5.7

5. — 1.6902 / 2.9858 / 8.7044 / 2.9

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1893phae.proj..526D

Dec. 8, 94

Cloud

Seige.

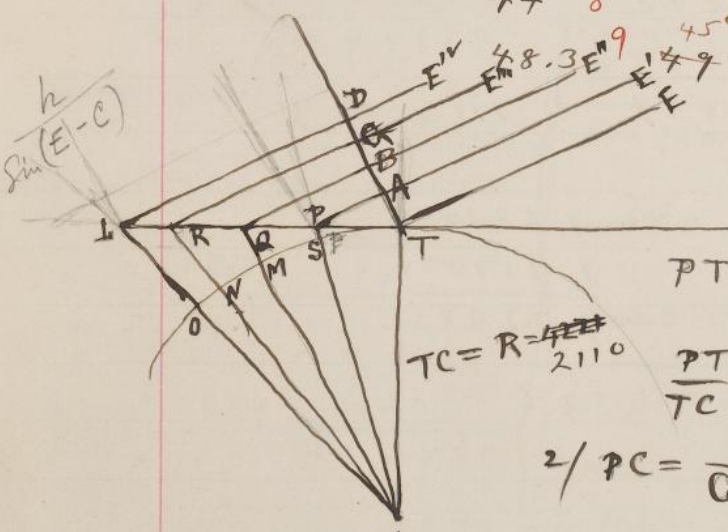
Note: the sin E used at foot of page really should be Sin HS Sin E H S being distance of point from crest.

Nov 25 43 8 51 x - 34.2

Nov 26 ~~47 8 52~~ 33.4 44.9 x - ~~23.3~~ 21.1

Obns on seige. Corrected as to C. Expressed in miles of app. seige.

		Obsn				
Nov. 25.	9h 36.5	1	~~71~~ 61	4.3	~~48~~ 45	~~H 119~~ 106
	38.0	2				L ~~142~~ 114
	46.0	4	~~119~~ 95	7.1	~~58~~ 53	~~148~~ 132
	48.1	5				~~166~~ 132
	54.0	6	~~119~~ 95	7.1		~~142~~ 114
From recollection	40ᵐ	3	6= ~~143~~ 114		joint	~~143~~ 114
Nov. 26.	10h 22m	7	~~96~~ 77	5.7	~~24~~ 29	~~120~~ 106
	44	8				~~118~~ 95
		9	~~149~~ 45	2.9	~~48~~ 45	~~97~~ 90



TA, TB, TC, anobserved.

∠ETS = E in Ephem. = Nov 25 26.8 27.3
" 26.8 27.3

TC = R = ~~4211~~ 2110

$PT = \frac{AT}{\sin E}$

$\frac{PT}{TC} = \text{Tan } PCT$

$\text{Tan } PCT = \frac{AT}{R(=2110)\sin E}$

2/ $PC = \frac{R}{\cos PCT}$

3. $PS = PC - R$

Log R = ~~3.6254~~
Sin 2° 9.6541
3.2795

1. Log ~~71~~ = ~~1.~~ 8513
" R = 3.6254
~~9.~~ 2259
9.6541
~~8.~~ 8718
PCT = ~~2.0°~~ 2.1°

Log Sin 26 X = 9.6541
2.9784
3.3243 = Log R
9.6615
Sin E (27.3)
2.9858

2. Log 119
2.0795
3.2795
8.7960
3.6

1. — 1.8513
2.9784
8.8729
4.3
273. 2.0755
2.9784
9.0971
7.1

4. — 1.9823
2.9858
8.9968
5.7

5. — 1.6902
2.9858
8.7044
2.9

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See p. 94
(cloud
Size + height.

E	Sep.	Sep.	C Angles.	~~Δ~~	h	E-C	
26.8	3	71	4.3	6	48	22.5	~~+25~~ 52
"	5	119	7.1	17	58	19.7	62
"	5	119	7.1	17		19.7	
27.3	4	96	5.7	11	24	21.6	26
"	2	49	2.9	3	48	24.4	53

log R. =	3.324282	3.324282	3.324282
" cos 4.°3	9.998776	9.996657	9.997847
	3.323506	3.327625	3.326435
	2116 - 6	2127 - 17	2121 - 11

3.324282
9.999443
3.324839 ≈ 2113 - 3

48. — 1.6812
log Sin(E-C) = 9.5828
2.0984

125

48. — 1.6812
log Cos(E-C) = 9.9656
1.7156

51.95

58. — 1.7634
9.9738
61.6 1.7896

24 — 1.3802
9.9684
1.4118

25.8

48. — 1.6812
9.9594
1.7208

52.6

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Dec. 8. 94

Cloud

Length 142 miles.

		S	h	H	Sys. & height. min. bottom	top	min. top.
	1	71	48	119	6	5	17
26.8	2 recollection	43	point.	143	24	24	24
	3	119	58	177	17	79	38
Nov 25	4			166			34
	5	119			17		
	6	96	24	120	11	37	16
Nov 26. 27.3	7			118			16
	8	49	48	97	3	56	11
					Cloud & surface	Top of cloud & bottom surface	

Tan PCT = $\frac{AT(=H)(km)}{R \sin HS \sin E}$

HS = about 80° for Nov 25
" = " 90° " " 26. & may be omitted for both, or better call HS 79° & affix.

log R = 3.3243
" Sin 79° = 9.9919
" " E = 9.6541
2.9703

2/143 — 2.1553
− 2.9703
8.7 9.1850

log R 3.3243
" Cos 8.7° = 9.9950
2134½ 3.3293

3. 177 — 2.2480
2.9703
10.7 9.2777
3.3243
9.9924
2147½ 3.3319

4. 166 — 2.2201
2.9703
10.1 9.2498
3.3243
9.9932
2143½ 3.3311

For Nov 26 use as before
R sin E = 2.9858

6 — 120 — 2.0792
2.9858
7.1 9.0934
3.3243
9.9967
2126 3.3276

7/118 — ~~2.2853~~
~~2.9858~~
~~10.5 9.2695~~

7. 118 — 2.0719
2.9858
7.0 9.0861
3.3243
2125½ 9.9968
3.3275

8/97 — 1.9868
2.9858
5.7 9.0010
3.3243
9.9978
2121 3.3265

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Dec. 8. 1894

Cloud.

Height - Summary

	№	S	h	H	min. bottom	Dist. f. Zenn	Vert. top	min. top	Dist. from Zenn
Nov. 25.	1	71	48	119	6	4.°3	58	17	7.°1
	2								
	3	143		143	24	8.7	24	24	8.7
E = 26.8	4	119	58	177	17	7.1	79	38	10.7
	5			166				34	10.1
	6	119			17	7.1			
Nov 26	7	96	24	120	11	5.7	37	16	7.1
E = 27.3	8			118				16	7.0
	9.	49	98	97	3	2.9	56	11	5.7

By a graphic solution I find that for Nov. 25. this "Dist. from Zenn" extends ~~about exactly E & W.~~ while for Nov. 26. an increased long. requires a more northerly Lat.

Measurements with thread on globe, as follows

Nov 25. H.A. Lat -1

70	~~34.6~~	34.5
74	34.3	34.2
80	33.1	33.1
90	30.0	29.9

Nov 26.	70	23.5	23.5
	71	23.2	23.2
	80	20.8	20.8

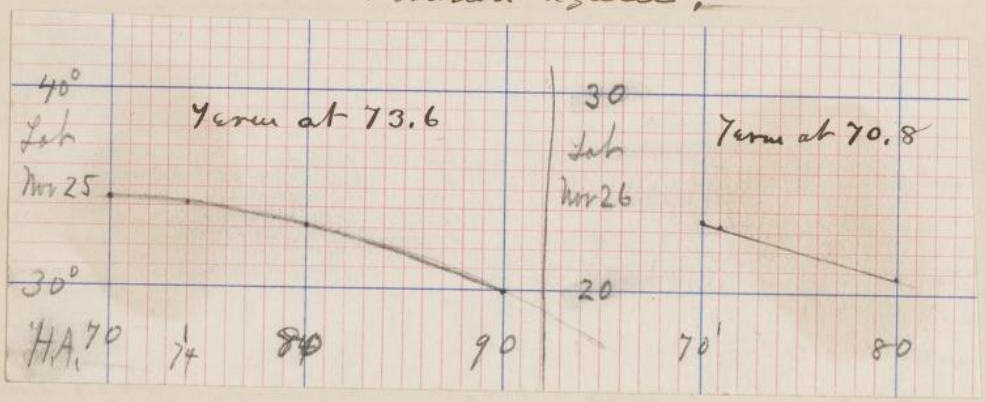
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Dec. 8, 94

Cloud

Position again.



13.4 mm = 10°

For Nov. 25. H.A. 70 & 80 in line "dist" = 11.2 mm = 8.4°

80 & 90 " " " " = 12.2 = 9.1

For Nov 26. H.A. 70 & 80 " " " " = 12.8 = 9.6

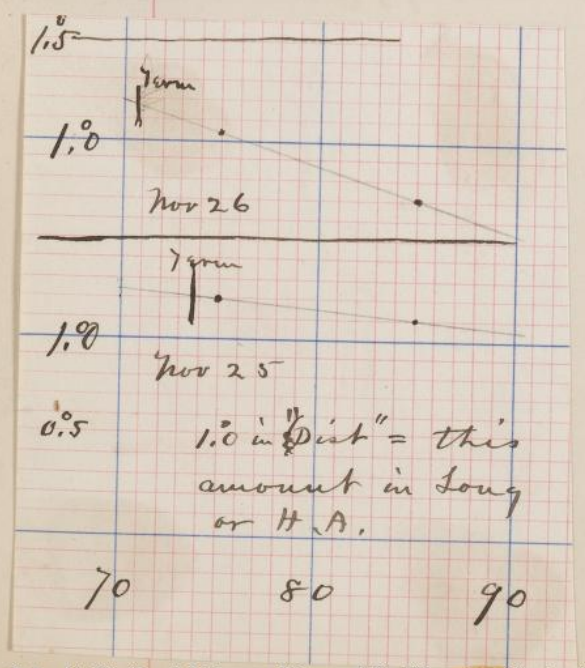
80 & 90 " " " " = 13.8 = 10.3

25th At H.A. 75 — 1° ~~H.A.~~ = 0.84 Dist 1° dist = 1.19 H.A.

" 85 — 1° H.A. = 0.91 " 1.10 "

26th at " 75 — 1° H.A. = 0.96 " 1.04 "

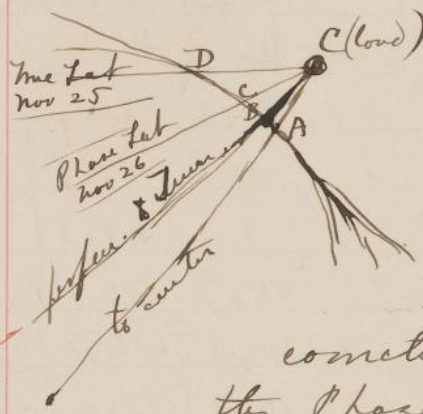
" " 85 — 1° H.A. = 1.03 " .97 "



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Dec. 8, 94
Cloud
Position again.
Possible final correction for different methods of taking Lat.



ACB = about 5° and we can call all "distances" equal to either AC or BC.

Mic wire 5°.

7°

On Nov 26 there will be no correction of this kind since the Phase Lat C ran through the center

On Nov 25. the C was about 12° S of phase Eq. as seen from center.
The angle between phase pole & true pole is 12.6
12° + 12.6 = 24.— = Angle DC A.
D A = AC Tan DC A.
A mean value of AC = ~~145~~ miles. 215
Tan DC A = Tan 24° = ~~7113~~ 12°
log 145 = 2.1614
" Tan 24° = 9.6486
" D A = 1.8100
D A = 64.6 or 65 miles.
1.8100
log 37.8 1.5775
0.2325
D A in % = 1.7
North 1.7 in Lat makes H.A. -0.3 or 73.3
& Lat - 32.5

little change
Exact.
The final value of change is 1°.2 in Lat.

+.08 = 1.4
-.24 would perhaps be necessary.

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Dec. 8. 94

Cloud

Position again.

Find Corr. of Lowe's.

Nov. 25, pg 64. 9 34.0 = 43.1

Cor of last page — .3

42.8 at 9 34

+0.2 for mean second shown on 7 row.

	9h 34	Slow	
Error in time 1m slow.	36.5	1	43.4
	38.0	2	43.8
	40 ±	3	44.2
	46.0	4	45.7
	48.1	5	46.1
	54.0	6	47.7

−5.0 Lowells Cor.

Nov 26. pg 61.

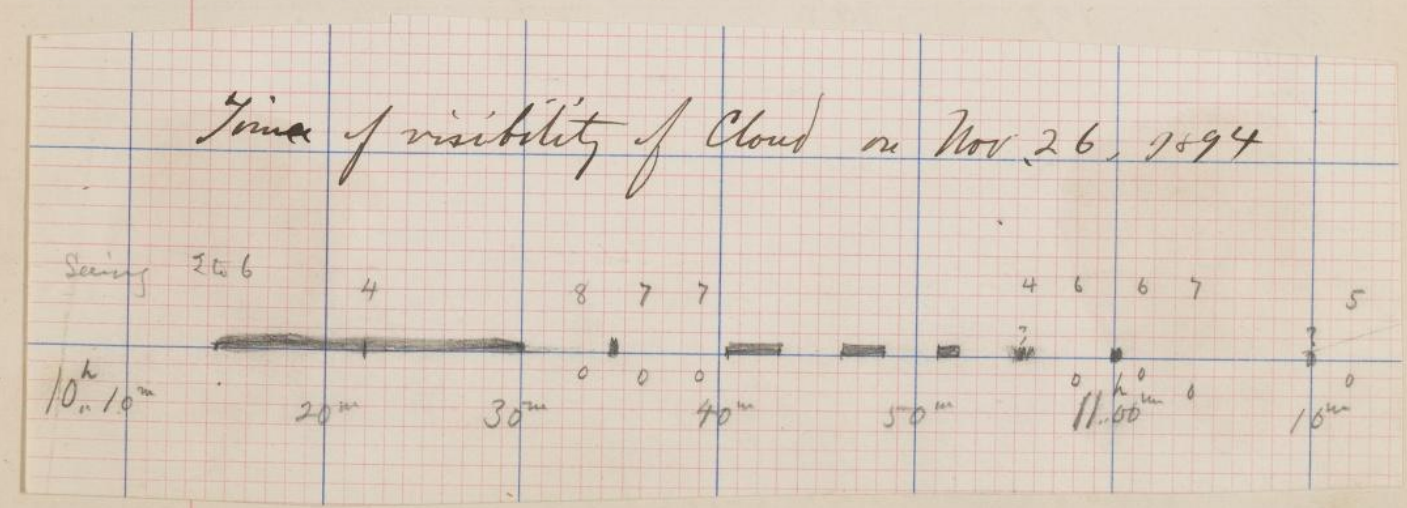
	10	14m.0 =	~~40.9~~	33.4
7	10	22.0	42.8	35.3
8		44.0	48.1	40.~~8~~1
9		48.3	49.2	41.7

5.3

1.1

Cor. in table in pamphlet am prob. better

This should by 42



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Monday Dec. 10. 1894

Cloud

Portion.

Values of 1° on Mass & gen distance of cloud long pow Tem.

Diam = 4221 miles

3.1416

log = 3.6254

log π = 0.4971 — 2110.5

4.1225 — log = 3.3244

log 360 = 2.5563

log = 1.5662

36.83

	8.7	7.1	5.7
log $1^{\circ}.0$ = 1.5662	1.5662	1.5662	1.5662
4.3 = 0.6335	0.9395	0.8513	0.7559
2.1997	2.5057	2.4175	2.3221
158	320	262	210

2.9	10.7	10.1	7.0
1.5662	1.5662	1.5662	1.5662
0.4624	1.0294	1.0043	0.8451
2.0286	2.5956	2.5705	2.4113
107	394	372	258.

for tangential distance

4°.3	8.7	7.1	5.7	2.9
3.3244	3.3244	3.3244	3.3244	3.3244
8.8762	9.1848	9.0954	8.9992	8.7046
2.2006	2.5092	2.4198	2.3236	2.0290
159	323	263	211	107

10.7	10.1	7.0
3.3244	3.3244	3.3244
9.2764	9.2507	9.0891
2.6008	2.5751	2.4135
399	376	259

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Observed

			S	W	H	L	Pg 75 Long. Term	Lat (as below)
Nov 25, (1)	9	36.5	71	48	119		43.4	-30.3
2,		38.0				142	43.8	"
3,		40±	143		143		44.2	"
4.		46.0	119	58	177		45.7	"
5,		48.1			166	142	46.1	"
6,		54.0	119				47.7	"
Nov 26 (7)	10	22.0	96	24	120		42.8	-21.5
8,		44.0			118		48.1	"
9.		48.3	49	48	97		49.2	"

Computed results

		Min. ht bottom	Dist.	Cor. Long	Long of this	Vert of	Min Vert of	Dist	Cor. Long	Long. of this	Lat
Nov 25,	(1,)	6	(4°.3)	+5.1	48°.5	58	17	(7.1)	+8°.3	51.7	-30.3
	2,	—	—	—	—	—	—	—	—	—	"
	3	24	(8.7)	+10.1	54.3	24	24	(8.7)	+10.1	54.3	"
	4	17	(7.1)	+8.3	54.0	79	38	(10.7)	+12.3	58.0	"
	5	—	—	—	—	—	34	(10.1)	+11.7	57.8	"
	6	17	(7.1)	+8.3	56.0	—	—	—	—	—	"
Nov. 26,	7	11	(5.7)	+6.1	48.9	37	16	(7.1)	+7.5	50.3	-21.5
	8	—	—	—	—	—	16	(7.0)	+7.4	55.5	"
	9	3	(2.9)	+3.2	52.4	56	11	(5.7)	+6.1	55.3	"

Latitudes

Lat. = av. of corrd ridges on pg 73

Final Table was corrected & some explanation

8) 48.1 − 0.5 + 0.2 = 47.8

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Tuesday, Dec. 11, 1894

Height of atmospheric currents,

The first measurement of division between the currents was for Dec. 2. when a height of 3800 ft was obtained no allowing for 3 d of mines.

Dec. 10. 2nd currents.

An extension of focus by 17^{mm} or $0.^{in}7$ showed height of 10700 allowing for 30° Zd.

Estimated swiftness at 4 to 10 diameters of app. circle of light per ½ second. This circle = Diam of objc. + Diam mass exhibits at distance of 10700 ft or = 18in + 12in + = 2½ ft Thus swiftness = 14 to 35 miles per hour

For convenience in this work a curve of distances for increased focus better be constructed.

Formula

$$\frac{1}{F} = \frac{1}{f} + \frac{1}{f'} \text{ or } \frac{1}{F} - \frac{1}{f} = \frac{1}{f'}$$

$$\frac{f - F}{fF} = \frac{1}{f'} \text{ or } f' = \frac{fF}{f - F}$$

put $f - F = \varepsilon$ then

$$f' = \frac{F(\varepsilon + F)}{\varepsilon}$$ all in inches.

$$f' \text{ in feet} = \frac{F(\varepsilon + F)}{12\varepsilon} \quad \text{Constant} = \frac{F}{12}$$

$$\frac{F}{12}\left(1 + \frac{F}{\varepsilon}\right)$$

$$\log \frac{F}{12} = 1.419818$$

Dec. 7, Dec. 12, 14

All computations for article on this subject with be done again specially for that article. The work here requires a correction in ε / 17 – 2.5in to focus obtained on as stars.

This assumed Dec 11 check that 2 times for 60 sec. Diam of Earth 10 times for 60 sec. Ten times 60 sec. 12 & 30 miles/hour

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1993phae.proj..526D

Dec 11, 94 Colog 12 = 8.920819
Comments, log 12 = 1.079181
1 in = 25.4 mm F = 315.5 in log = 2.498999

log ε	ε,	ε + F	log ε + F	
9.294466	5 mm =	0.197	315.697	2.499271
9.595496	10 mm =	.394	315.894	499542 271
9.771587	15 mm =	.591	316.091	.499812 270
9.896526	20 mm =	.788	316.288	.500082 270
9.993436	25 mm =	.985	316.485	.500353 271
0.072617	30 mm =	1.182	316.682	.500623 270
0.197556	40 mm =	1.576	317.076	.501162 539
0.294466	50 mm =	1.970	317.470	.501703 541
0.376647	60 mm =	2.364	317.864	.502242 539
0.440594	70 mm =	2.758	318.258	.502779 537
0.498586	80 mm =	3.152	318.652	.503317 538
0.549739	90 mm =	3.546	319.046	.503853 536
0.595496	100 mm =	3.940	319.440	.504389 536
0.634677	120 mm =	4.728	320.228	.505459 1070
0.741624	140 mm =	5.516	321.016	.506527 1068
0.799616	160 mm =	6.304	321.804	.507591 1064

mm	Quint Log.	Quint.	mm		
5.	4.624624	42132	80.	3.424549	2658
10.	4.323864	21080	90.	3.373932	2366
15.	4.148043	14062	100.	3.328711	2132
20.	4.023374	10553	120.	3.250660	1781
25.	3.926735	8448	140.	3.184721	1530
30.	3.847824	7044	160.	3.127793	1342
40.	3.723424	5290			
50.	3.627055	4237			
60.	3.545413	3511			
70.	3.482003	3034			

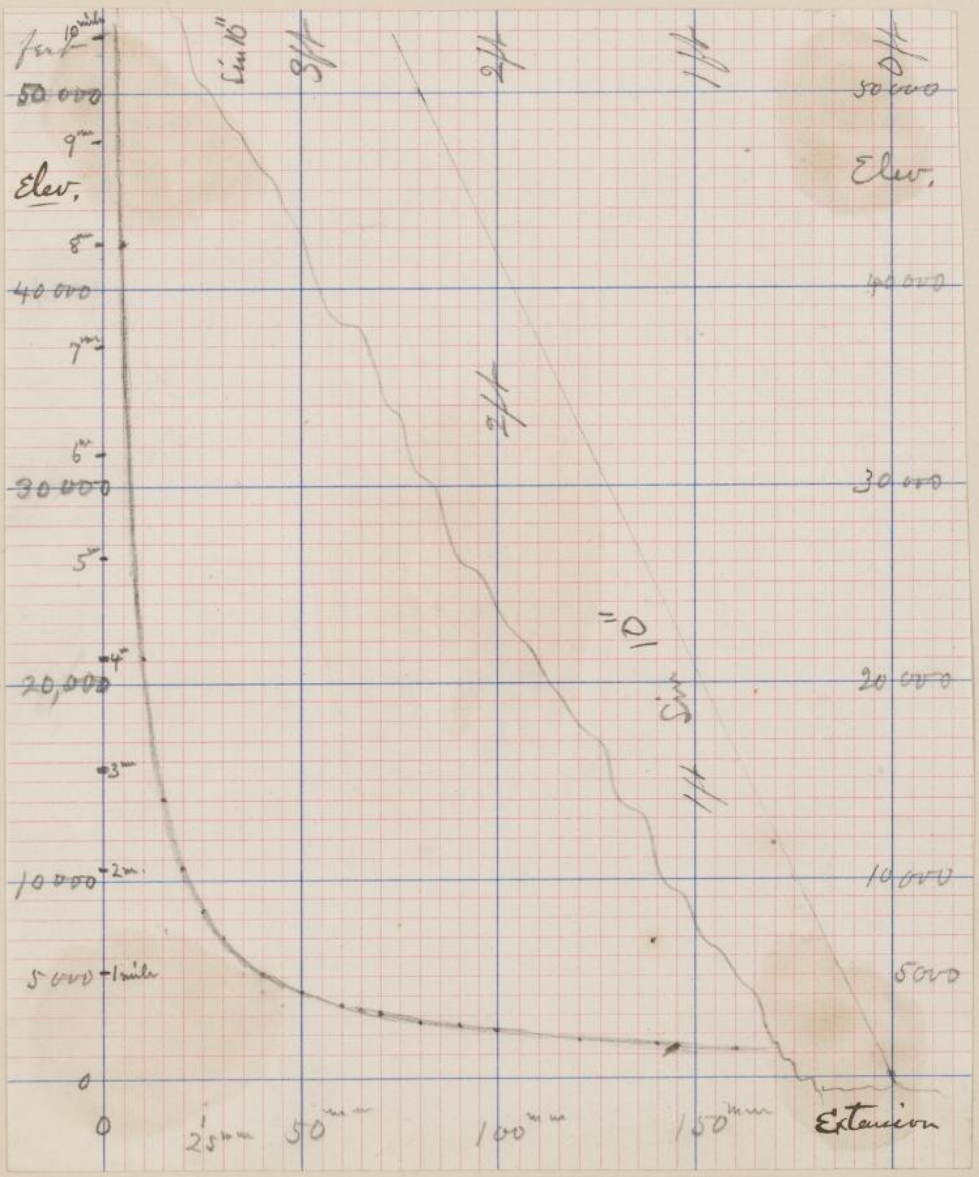
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1893phae.proj..526D

Dec 11, 1894

Atmospheric Currents.

Extinsions of focus on the Brashear 18in
comafree & certain elevations
as in the following curve made
from figures on last page.



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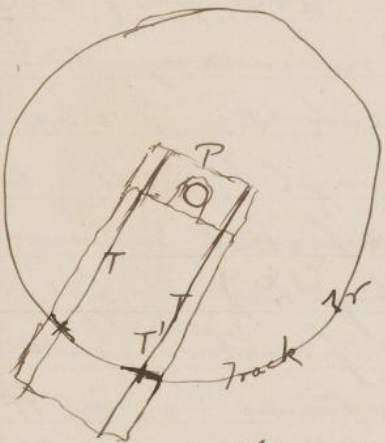
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Tuesday, Dec. 11. 1894

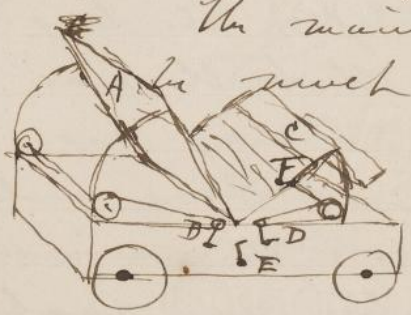
Dome-telescope see page 57

Observing chair - from notes dated Dec. 7.

In line with the optical axis of telescope in its central position is a post projecting from the floor of the Dec. carriage About this as an axis ~~rotates~~ revolves a carriage supporting two tracks T & T'. This carriage usually falls by gravity into position but should be supplied with a clamp to hold it in a definite place if desired.



The main track (Tr) probably cannot be much over 8 ft in diameter.



On the track T T' runs a chair (see drawing). A is the back rest raised or lowered by crank B. C is the leg board or rest, moved by D. Crank E moves the car along the track it rests on. At F is a hook on which the switch board may be hung. This board is connected by its wires to some point above and when wanted may be swung near the chair and hooked at F ready for use. Two wires from this switch board may be put into binding posts near F & serve in lighting the lamps necessary at the chair (see over)

Rotary Chair

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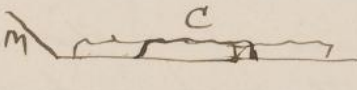
Dec 11, 94

Dome-telescope

Observing chair.

At the top of the ~~head rest~~ back rest A is a head rest that slides sideways. This rest can be raised or lowered a trifle (this ~~rest~~ is not necessary, being done by the crank B. I think it ~~would~~ be brought into better adjustment by special means of raising them by B)

At each end of this rest[x] at a suitable distance is a ~~R~~ mirror placed at 45° from the length of the rest, so that the head may be moved — i.e. may move the rest D one side and place the mirror be-



neath the micrometer and enable the head still on the cushion C, to be far enough off to read micrometer with ease. On each side of each M is an electric light ~~wire~~ screw to illuminate both the micrometer & book.

Eye pieces may be kept in a drawer placed on the left side of the observing chair.

(Observing Chair)

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1893phae.proj..526D

Dec. 11, 94

Dome-telescope

Times.

(Observing Chairs)

Time had best be brought in on a sounder omitting the 60th second of each minute. This would be supplemented by a good clock placed on compass mounting near observing chair and also by a watch attached to the head rest so as to be illuminated by the lights. This watch then could be easily corrected by the clock and sounder & would be in most convenient possible position for use. It might be placed on the end of the large telescope tube facing the observer so that he could see the time by turning on the light before he changed positions in order to record in book.

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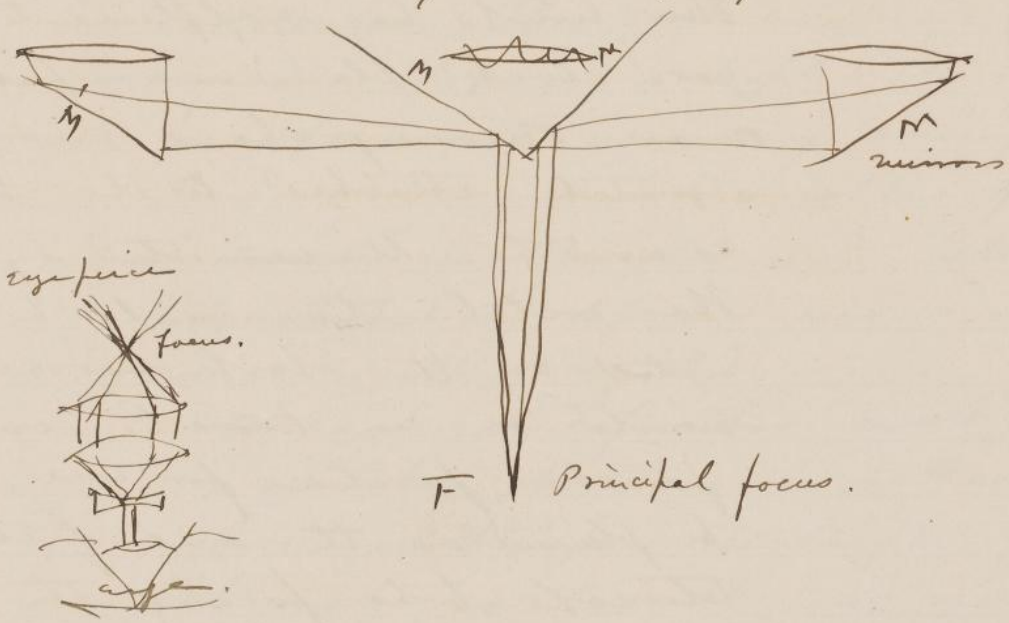
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Range-finder
Mars-Hypothesis.

Sunday, Dec 23, 1894

Range finder.

This invention is the result of an attempt to construct an apparatus for measuring cloud height by means of focus extension



f.

No matter an object gets the farther will be the focus. The lens ~~will~~ may have to be ground to a particular curve - as if they were parts of one big lens.

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Thursday. Jan. 3, 1895

My patterns for Mars.

Yesterday afternoon while looking as had chat in the patent chat-whisker in Babbitt's store, I was struck with the resemblance of the figures they made when pressed against the glass, to the ~~temporal canopy~~ six-pointed stars which ~~we~~ I long ago recognized as a typical form on Mars. — e.g. Solis Lacus (not very good specimen) Fall. and of Cimmerium Sea on Oct 22. 94. and several specimens near Solis seen recently.

This suggested at once that Mars might be composed of meteorite or a compact collection of solid bodies of nearly equal size and that the canals mark pour ~~their~~ the cracks which would be left between such bodies. The bodies would be in diameter, say $\frac{1}{22}$ of the diameter of Mars. This would explain pretty nearly all the most incomprehensible phenomena of Mars.

Experiments were tried with chat but looking a glass often to see them arrange themselves in. I could not get any definite results. — Try with sphere and photograph it.

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Mars
Hypothesis

Jan. 3. 95

Hypothesis for Mars.

Fired shot 505 in an alcohol lamp about 20 times diameter of shot.

After shaking it well and revolving it backwards & forwards, noticed characteristic lines between shot — as follows.

1. Perfectly straight long lines are very rare though the lines are usually pretty long
2. There is a crisscross around the equator thus 
3. At one point in upper (& lower) hemisphere is a place some 60° across where continuity of lines is badly broken Don't find any such place in lower hemisphere but think lines in general are not so straight as in upper.

Repetition

1. In upper Hemis. for 240° along the lines show remarkable regularity & parallelism
2. For 120° in Up. Hem. lines are broken and crooked and vary in width — write here and there large bare spaces — or hollow — spaces. Upto & some extent lines can be traced through this region continuously.

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Jan. 3. 95

Hypothesis for Mars

3. In lower lens (when shot are better packed) the symmetry is more continuous. Can see the fold on account of light and thickness of the glass, but I can't find any serious break in sym. as in upper lens.

3d Trial - after much handling of globe of shot around the zodiac - 70° only lack symmetry.

4th trial - after revolving rapidly backward and forward in hand. In Zodiac only 20° lack symmetry with one or two very faint nodes elsewhere.

Note. This globe should be of white or transparent glass and each trial should have one or two photographs taken of it, of some certain long. or longs. so as to get impartial views of each trial.

Some notes on this Hyp. on page on following page.

This Hyp. should be in the L.O. Journal.

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D.T.
12 ft draught

Tuesday. Jan 8. 1895

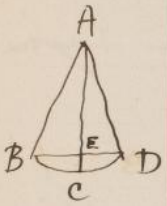
Dome-telescope.

Amount it will sink in water ~~to~~
from Molesworth's (Sykes') book of formulae & got

Eq. of them = $0.5236\ H(H^2 + 3r^2)$

H = height of segment.

r = radius of base of do



$ED = r$ & $EC = H$, $R = AB = AC = AD$

$r = \sqrt{R^2 - (R-H)^2}$

$r^2 = R^2 - (R^2 - 2RH + H^2)$

$3r^2 = 6RH - 3H^2$

Sph. $S = 0.5236(6RH^2 - 2H^3)$

$= 1.0472(3RH^2 - H^3)$ put ~~1.0472 =~~ c

$S = 3cRH^2 - cH^3$

$S = 3cRH^2 - cH^3$

For the dome-telescope

$R = 50$ ft. $3c = 3.1416 = \pi$

$3cR = 157.080 = a$ & $c = \frac{1}{3}\pi = 1.0472 = b$

and

$S = aH^2 - bH^3$

Now.

Suppose sphere & 1" thick of iron, Sp $S = 7.7$

$R = 50$ ft.

~~Also~~ a sphere $= \frac{4}{3}\pi R^3$ and

a shell $= \frac{4}{3}\pi(R^3 - r^3)$

50 ft = 600 inches or say 601 inches

This shell $= \frac{4}{3}\pi(601^3 - 600^3) = \frac{4}{3}\pi(1.081,801$ cubic inches)

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Jan 8. 95

Dome - telescope

Draught.

Log 10 & 2 000	=	6.0342
" π	=	0.4972
" 4	=	0.6021
		7.1335
" $\sqrt{3}$	=	0.4771
		6.6564
$\sqrt{1728}$	=	3.2375
" cu. ft. Vol. 7t.	=	3.4189 = 2623 cu ft. iron
~~Sp. g.~~ of 7t.	=	0.8865
		4.3054

For 1 in metal 20200 cu ft Water

For ½ in metal 10100

$20200 = a H^2 - b H^3$ ($a = 157.1$; $b = 1.05$)

Try $H = 10$ ft.

$T' = 15708$

$T'' = 1050$

Sum $= 14658$

Try $H = 12$ ft

Log 144	=	2.1584
" 157.1	=	2.1961
		4.3545

1728	
1.05	
8640	
1728.	
1814	

22620
1814
20806

For 1 in metal or it equivalent it would sink in 12 ft.

Try 8 ft.

157.1	
64	
6284	
9426	
10054.4	
537	
0007	

512	
1.05	
2560	
512	
537	
10054	
537	
9517	

For ½ in metal it would be a little over 8 ft.

1 person say = 2½ cu ft water or 150 lbs.

(over)

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90

S.T.

12 ft draught

Surf. displ. wt.

Jan. 8. 95

Dome-telescope

Draught.

For 1st metal draught = 12 ft.

$S = a H^2 - b H^3 \quad (a = 157.1 ;\ b = 1.05)$

$\frac{dS}{dH} = 2aH - 3bH^2$

$dS = 2\frac{1}{2}$ cu. ft.

$dH = \frac{2\frac{1}{2}}{2aH - 3bH^2}$

$H = 12$

144

3

432

7

439

$a = 157.1$

2

$2a = 314.2$

12

$2aH = 3770.4$

439.

3331

$= \frac{2\frac{1}{2}}{3331}$



Check

$r^2 = R^2 - (R-H)^2$

$R - H = 38 \vee 38^2 = 1444$

$R^2 = 2500$

1444

1056

$\vee 1056 = 32.5 = r$

$\log r = 1.5119$

2

3.0238

" $\pi = 0.4972$

" $\pi r^2 = 3.5210$ sq. ft.

" $2\frac{1}{2} = 0.3979$

4.8789

$\log 2.5 = 0.3979$

" $3331 = 3.5228$

4.8751

0.000075

12

.00900

or $\frac{1}{100}$ of one inch.

.000757/12

.000076/12

.000912

9

or $\frac{9}{1000}$ in.

One man (150 lbs) will sink the dome about $\frac{1}{100}$ inches.

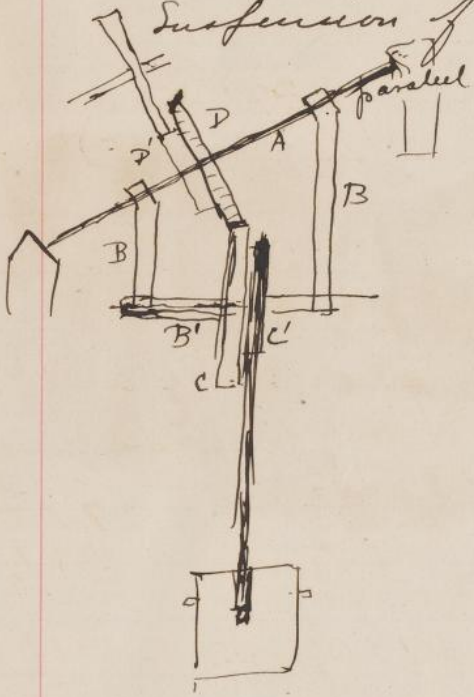
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Thursday. Jan 10. 1895

Dome telescope.

Suspension of driving Wt for duplicate driv. gear.



A is parallel to polar axis. supported above & below firmly

BBB' is suspended from A & turns on it

C C', wheels, revolve on B'

C' Load weight, his sprocket wh.

D D revolve on A

D' communicates motion to fixed machinery which has a Bond spring governor.

Assuming a cistern 100 ft in diam. (I used hourly 80)

The area of ring outside the sphere will be $\pi(R^2 - r^2)$

$= \pi(R+r)(R-r) = \pi\, 1444$

log 1444 = 3.1596
" π = 0.4972
3.6568
" $2\frac{1}{2}$ 0.3979
4.7411

(Jan 10.)

.00055 ft
12
.00660
or $\frac{7}{1000}$ in.

	effect on globe
1. Taking 2.5 cuft from Cistern	$-\frac{7}{1000}$
2. putting 2.5 cuft in globe	$-\frac{9}{1000}$
3. putting 150 lbs in "	$-\frac{9}{1000}$

2 × 3 would raise the water in the cistern

This $(2+3=)\frac{18}{1000}$ represents the total required change in draught. If the dome sinks $\frac{9}{1000}$ it causes the water to rise $\frac{7}{1000}$ which effects a change of $\frac{16}{1000}$. Hence for $\frac{18}{1000}$ ~~this~~ increase of draught we must take $\frac{18}{16}$ 9 or $\frac{9}{8}9 = 10$. Hence 2 × 3 cause the dome to sink $\frac{10}{1000}$. #1 adds $\frac{7}{1000}$ so the total sinkage of dome for 150 lbs is $\frac{17}{1000}$ in. or $\frac{1}{60}$ inches

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92

DS.
Index &
Scheme.

Wednesday. Jan. 9, 1895

Dome-telescope.

Index to dome-telescope notes.

In order of time:

Page	Date	Topic
28	Nov. 7.	I Support. ✓
		I Dec. M.
		Sup. tube
29.		I Dec. M.
		Sup. tube
		Entrance
30	Nov 8	Sup tube
		Entrance
31		Sup. tube
		I Dec M index
		R A M. A.B. ✓
32	Nov 13	R A M ✓
		II Dec M. (old form)
		Sup tube
33		Dec M.
		R.A. M
34		R.A. M Bal.
35		" Index out Bal.
36	Nov 16	Support. Cont flow adj ✓
		History
		Advantages
37	Nov 21	Dec M. (limit of range)
38		Support (cylinders) ✓
39		" " ✓
		Entrance

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Jan. 9. 93

Dome - telescope. Index

Page	Date	Topic
42	Nov 27	Support V
42-3	"	Entrance
44	"	" Desk &c
"	"	R.A. mov. Duplicate machine.
48	" 30	I new R.A. driving gear
"	"	I entrance.
49	"	R.A. movement.
"	"	Material
50	"	Dec. M. Carriage
50-1	"	" Bracing, clamps
51	"	Shutters. Cuts.
52	Dec. 2.	R.A. Mo. Preliminary gear
53	"	" do & AB. BA
54	"	" AB & slow mot.
55	" 6	" B.A.
"	"	~~Susp~~ - tube - finder.
56-7	"	R.A. Mo. complete gear.
81	" 11	Observing chair.
82	"	"
83	"	" (time)
88-90	Jan 8	Computation of draught for 1st Dome.

Index by subject.

I. Support. pages (28) (36) 38, 39 42,

II. R.A. Movement. pages, 31, 32, 33, 34, 44, 35 (48), 49, 52 & 57

III. Dec. Movement: pages, (28), (29), (31), (32), 33, 37, 50, 51,

IV. Suspension tube: pages, 28, 29, 30, 31, 32, 55,

V. Shutters; pages, 51.

VI. Observing chair; pages. 81, 82, 83

VII. Entrance: pages. 29, 30, 39, 42 43, 44, (48),

VIII. Miscellaneous points.

History 36

Advantages 36

Material 49

Draught 88-90.

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94
D.F.
Skin resistance.

Saturday. Jan 12. 95

Skin resistance.

S = area under water in Sq. ft
V = velocity in knots per hour
x = coefficient for surface
r = Skin resistance of vessel in lbs

$r = S \times V^2$

x = 0.007 Smooth copper sheets
.01 Wood planed & painted
.016 do sawn
.014 iron painted
.047 to 0.06 foul with barnacles & weed.

Molesworth. fg 556

With 12 ft draught the radius of base of segment is 32.5 ft.

Area of seg. = 6.2832 R H. = 2 π R H.

R = 50 & H = 12

Log 2 = 0.3010
" π = 0.4972
" 50 = 1.6990
" 12 = 1.0792

Area = 3771 sq ft. Log = 3.5764

Area = 3771 sq. feet.

69½ miles = 60 knots

Veloc. Equator = 8.7 miles in 3⅓ m

12 | 26 in. 100 10 m
2 ft. 175 à 10 m
6 6
13.050 in 1 h

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Sunday. Jan. 13, 1895

69.5 miles = 60 knots

1 knot = 1.16 or 1.1583

log 1.158 = 0.0637
" 5280 = 3.7226
3.7863
" 13.05 = 1.1156
2.6707
log V = $\bar{3}$.3293 V = 0.002135
" V^2 = $\bar{6}$.6586
" X = $\bar{2}$.1461 for iron pointed.
" S = 3.5764
$\bar{4}$.3811
.000 2405
3[illegible].6189 or $\frac{1}{4160}$

Thin ~~rubber~~ resistance = $\frac{1}{4000}$ lbs, carried through 13.05 per 1 or through 1 in 4 1/4° in 1

"On a well equipped railway the force required to start a vehicle at rest, well lubricated with grease axleboxes, on the level, varies from 11 lb to 8 lb per ton load, & to keep this in slow motion 8 lb to 12 lb per ton of load"

J. Walwyn White
in a paper on
light railways.

with Tramcars with grooved rails the force required to start them on the level is for 50 to 100 lbs

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D L,
Horse-power
Letters.

Jan. 13. 1895

Dome-telescope.

Energy stored up in ~~700~~ 600 ton dome revolving once in 24 hours.

For revolving shell - 1 rev. per min.

$$H = \frac{w(d^5 - d_1^5)}{112\,126}$$

w = wt per cu. ft
d & d_1 are outside & inside diameters.

d = 100 ft + 2 in or 100.16
d_1 = 100 ft 100.00

w for steel is 499 & for iron is 450,
call w = 475

log 100.16 = 2.000724 × 5

10.003620 × 10.000000

10,083,700,000 = 10 000 000 000

log 83,700,000 = 7.922725
" 475 = 2.676694
10.599419

" 112126 = 5.049706
5.549713

354580 foot pounds = 11 horsepower.

That is if 1 min. is taken to get the dome up to this speed it would require 11 horsepower. 2 horsepower would start it in 5 minutes.

log 1 H.P. = 1.03012
" 60.24 = 3.15584
1440
7.87728 = 1/134 H.P.

Less .00746

log = 5.54971
" 1440 = 3.15584
2.39373
= 246 foot pounds.

log — 5.54997
" 83 000 000 = 4.51 & 5
1.03012

H.P. = 10.764

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36 INCH LICK TELESCOPE

Jan. 22, 1895.

Rec'd Jan 26

Mr. A. E. Douglass,

Lowell Observatory,

Flagstaff, A. T.

Dear Sir,-

We take pleasure in acknowledging receipt of your favor of the 14th inst., requesting information regarding the mechanism for moving the 40" Telescope, and in reply are glad to tell you that the weight of the Driving Clock of this instrument falls at the rate of about 354 foot pounds per minute, and in the Clock of the 26" Equatorial at the New Naval Observatory at Washington the corresponding figure is 65.4 foot pounds per minute.

In the construction of our Driving Clocks, which are mounted isochronously, the driving weight is provided in excess of that required to actually move the instrument in Right Ascension, for this gives us extra power in case additional accessories are at any time to be used with the instrument, and the overplus of power, when not required, is taken up by the friction ring and pads provided for this purpose in the controlling mechanism, and we estimte that at least a third or a half the foot pounds mentioned above is used up in this

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98
D.J.
Letters.

way. At the Quick Motion Hand Wheel, which is 17-1/2" in diameter, it requires 25 or 30 pounds to move the Polar Axis, the ratio of gearing being 120 - 1, and turning the hand wheel at the rate of about 30 revolutions per minute rotates the Polar Axis once in four minutes.

Regarding the Dome for the 40" Telescope we are glad to tell you that we have just received the order for the same, but as yet have no ~~figures~~ data upon it. The 45ft Dome, however, at the New Naval Observatory, Washington, requires about 2-1/2 pounds per ton to revolve it, and we presume that this figure is approximately correct for the 90ft Dome. The 45ft Dome can easily be revolved at the rate of one revolution in two or three minutes, but it would be difficult for a single operator to continue this rate of motion throughout an entire revolution.

Hoping that this information will prove of service to you, we remain

Very respectfully,

Warner and Swasey

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MOUNT HAMILTON, Jany. 31, 1895.

A.E. Douglass Esq.
Lowell Observatory,
Flagstaff, Arizona,

Dear Sir:—

Professor Holden who is absent from the Observatory on a vacation, has requested me to reply to your inquiry of 14th. inst.

Dome - 75 feet.

The moving parts of the large dome weigh 200,000 pounds. The dome revolves in about 8 minutes, requiring about 300 gals. of water, the pressure of which is 75 pounds upon opening the valves, but which falls to from 40 to 50 pounds when the engine is working.

Telescope - 36-inch

The weight of the moving parts when the telescope is moving in R.A. is 28847 lbs.
when " " Dec. " 14539 "
Radius of Hand wheels for quick motion 11 inches
A pull of 20 to 25 pounds on the spokes

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of these wheels is required to start the telescope from a position of rest. A pull of 8 to 10 pounds only is required after it is started.

The ordinary rate of motion when turning the telescope from the head of the pier by the quick motion hand wheels is about 7½ h of R. A. per minute.

Driving Clock – 36-inch telescope.

Driving weight	810 lbs.
Falls	$17\frac{4}{10}$ feet
Drives Clock + telescope	131 min.
Horse Power	$\frac{1}{307}$

Clock alone passes from rest to full speed in $2^m\ 20^s$.
" and telescope pass " " " " " " $2^m\ 30^s$.

Trusting that the above will serve your purpose, I remain

Yours very truly

C. S. Pervine

Secretary L. O.

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Feb. 6, 1895.

Mr. A. E. Douglass,

Flagstaff, A. T.

Rec'd Feb. 10.

Dear Sir,-

We were duly in receipt of your favor of the26th ult., and have been looking up the items about which you inquire. The approximate weight of the 90ft Dome for the Yerkes Telescope is 165 tons. This Dome is built with steel ribs and frame but is covered with 1-1/8" pine sheathing, which is tinned inside and ot. We have no figures that would enable us to tell accurately the weight of an 100ft Dome but it would probably be relative to its diameter about that of the 90ft Dome, and the additional weight for using 3/16" steel would add more to its weight though just how much we can not say.

We regret that we are not able to give you more exact information regarding your inquiry but hope that the figures we have given you will be a basis from which you can determine what you require. And holding ourselves in readiness to serve you further in any way in our power, remain

Very respectfully,

Warner and Swasey

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D.T. name
Draught.

Sunday - Feb. 17. 1895

Dome - telescope.

Should the name be "Dome - telescope"
or The Spherical Telescope.
or The Sphero - telescope
Upon a special consultation with
2 Sykes, he still holds to the idea
that 300 tons will suffice for
the Dome - telescope.

From page 89.

1 in metal = 20200 cu ft water
1/2 in " = 10100 " "

Draught.

Formula

Vol. Seg. = $S = a H^2 - b H^3$

$a = 157.08$ & $b = 1.0472 = \frac{\pi}{3}$

H = draught.

S = 10100 cu. ft.

$H = 8$ ft.

157.08
8
1256.64
8
10053.12 = aH^2
538 = bH^3
9515 = S

64
8
512
+ 26
538

.05 = 1/20

1893phae.proj..526D

D.J. draught.

Feb. 17. 95

Dome-telescope

From fig 90.

$$dH = \frac{dS}{2aH - 3bH^2}$$

$10100 - 9515 = 585 = dS$

$dS = 585$; $H = 8.0$; $a = 157.1$; $b = 1.05$

$2aH$. $H = 157.08$, $a = 8$, 1256.64, 2, $= 2513.28$

$H^2 = 64$, 3, 192, 10, $202 = 36H^2$

$\frac{202}{2311} = 36H^2$

$dH = \frac{585}{2311}$ log $= 2.7672$ " $- 3.3638$ 9.4034

$= .253$

Hence $H = 8.25$ ft. or 8 ft 3 in.

---

1 cu. ft. water weighs 63 lbs.

1 ton = 2000 lbs

300 " = 600 000 lbs log $= 5.7782$

log 63 $- 1.7993$

Volume $= 9526$ 3.9789

$dH = \frac{11}{2311}$ log $= 1.0414$ " $= 3.3638$ 7.6776

$dH = 0.00476$ ft $= \frac{1}{200}$ ft

$\frac{12}{0.05712}$ inches $= \frac{1}{16}$ in.

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D.T. Draught
8 feet -

Feb. 17. 95

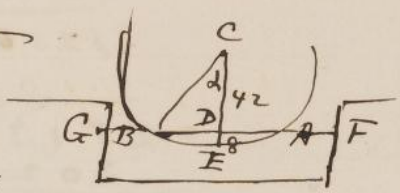
Dome telescope.

Draught

(A.) We therefore get this
A 300 ton dome has a draught of 8 ft. 1/16 in

11 cu ft changes draught by 0.in06
one man or 2 1/2 cu ft would be

$\frac{2\frac{1}{2}}{11} 6 = \frac{15}{11} = 0.^{in}014$



At depth of 8 ft.,
Cos d = $\frac{42}{50}$ = .84. d = 32.9
32.86

Sin d = .5426 AD = 27.1 ft. = r
7C = 70 ft. ∠FD = 35.0 ft. = R
62.1

Ana ring = $\pi(R+r)(R-r)$
$= \pi(R^2-r^2)$

8.9
496 ft = ana ring,
62.1
7.9
55.89
434.72
490.6 sq. ft. = ana ring

$27.1^2 = 734.41$
3/16
2203.2
122.4
2325.6 = ana circle.

Owing to automatic balancing one person would make a diff in draught of 0.028 or 0.03 inches.

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D.N.
drought

Feb. 17. 95
Dome-telescope
drought

Read. When dome sinks 0.in01 it means a bulk of 1.7 ft of water pushed up in the surrounding space. or

let r = AD
d = change of ~~drought~~ height of sphere
R = FD
D = rise of water in ring.

then: dif. S = $(\pi r^2) d$ = a d
= $(\pi R^2 - \pi r^2) D$ = A D

a = area circle = 2325.6 log = 3.3665
A = " ring = 490.6 " = 2.6911
0.6754

& a d = A D

$D = \frac{a\,d}{A} = \frac{a}{A} d$ & $\frac{a}{A} = 4.74$

Hence of change in drought
$\frac{1.00}{5.74}$ is due to change in elev. of sphere
& $\frac{4.74}{5.74}$ " " " " " " " of water in ring.

& $\frac{1.00}{5.74} = 0.17^{+.004}$ due to change of dome 1/6
$0.83^{-.004}$ " " " " water. 5/6

Hence dome changes its elevation
(B) ~~(A)~~ $\frac{0.030}{6} = 0.^{in}005 = \frac{1}{200}$ for one person.

(C) ~~(B)~~ Without the crowding of the water (which may be a bad thing) the change is a little less than $0.^{in}03$, or $\frac{1}{38}$ in.

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J.J.

Cistern
Change for 300 lbs - rigorous.

Monday, Feb 6.18.1895

Dome-telescope

Height of water in cistern.

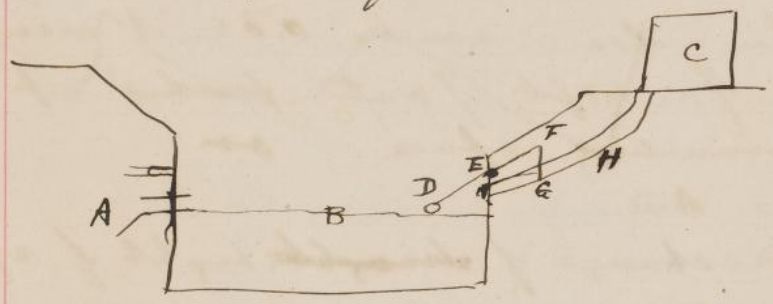
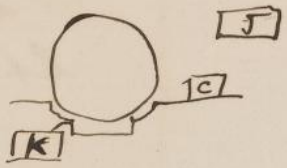


Fig 2



It seems to me probable that the height of water in the cistern will be gauged as follows:

In above diagram, B is water-level, A is overflow, C is a water-supply above B, with ~~water~~ water tending to enter cistern through pipe H. G is a valve worked by float D so that when B gets low G is opened & water is kept to its proper level. The only care then is to see that C is kept well-supplied.

In fig 2

K = reservoir for overflow

J = " " storage for automatic Balance.

Pipe HG should be arranged to fill C from J and an engine & pump for lifting water from K to J.

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Feb. 18, 95

Dome - telescope

Resistance Coeff. of change in draught for 300 lbs.

63 / 300 lbs. (4.762

252

480

441

390

378

120

11 ft — 0.in05712 for 103

$\frac{4.762}{11}$ 0.05712.

log 4.762 = 0.6778

" .05712 = $\frac{8.7568}{9.4346}$

" 11 = $\frac{1.0414}{8.3932}$

" ch for 300 lbs.

5

1 " = 0.in0247 3

(C) $\frac{1.0}{40.4}$ in for 300 lbs

with crowding of water

(B) the dome would sink 0.in0042 = $\frac{1}{250}$

of water would rise 0.0205

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108
D.T.
Objective tank
Horsepower

Feb. 18. 95

Dome telescope

Objective tank

This tank can be in the form of a tube say 10 ft long by 2 to 4 ft in diameter, mounted parallel to the telescope so that water may flow in at the top or out at the bottom in any position.

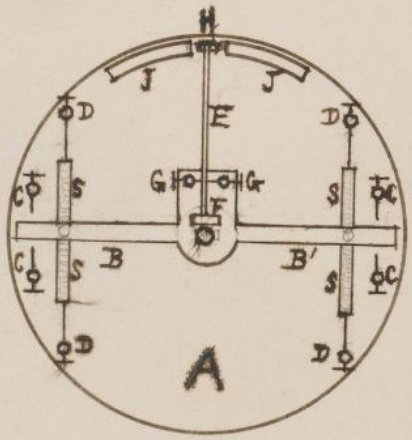


Fig. 3. Detail of automatic balancer.

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Tuesday. Feb. 19. 1895

Dome telescope

Horse-power to drive it.

Thickness of metal at 475 lbs per cuft to give 300 tons.

$\frac{4}{3}\pi R^3 - \frac{4}{3}\pi r^3$

$\frac{4}{3}\pi(R^3 - r^3) = V$

$V \cdot 475 = 300.2000$

$V = \frac{600\,000}{\frac{4}{3}\pi 475}$ = $R^3 - r^3$ = ~~thick~~

log 6.000 000 = 5.7782
475 = 2,6767
3.1015
" π = 0.4972
2.6043
" 4 = 0.6021
2.0022
+ 1.3 = 0.4771
log $R^3 - r^3$ 2,4793

$301.5 = R^3 - r^3$

$r^3 = 125{,}000$
$+ \quad 301.5$
$R^3 = 125301.5$

log R^3 = 3 | 5.097956.2
" R = 1.699318.7

$R = 50.0402$

100.0804
100.0000
.0804

Thickness to give 300 tons
weight = 0.04 ft = 0.48 in.

$m = \frac{w(d^5 - d_1^5)}{112126.}$

$w = 475$
$d = 100.08(04)$
$d_1 = 100.0000$

log R = 1.699318.7
" 2 = 0.301030
2.000348.7
5
10.001743.5

d^5 = 10,040,240,000
d_1^5 = 10 000 000 000
$d^5 - d_1^5$ = 40 240 000
log = 7.604658
$\therefore w$ = 2.676694
10.281352
" 112126 = 5.049706
5.231646
· 33000 = 4.518514
0.713132
5.1657

Horse-power = 5.17

170470 ft lbs.

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~~Sol~~ Energy.

Comp with 26" 36" & 40"

Wednesday Feb. 20, 1895

Dome-telescope.

HP in turning. Compare pg 86

1440
1440
576
576
144
207 3,600

In Comp. pg 96.

The result obtained of 10.74 H.P. is per 1 Rev. per minute.

Instead of that only $\frac{1}{1440}$ Rev. is required per minute. We have therefore to divide 354580 ft lbs by $1440^2 = 2,073,600$

log 354580 = 5.54973

" 1440 = 3.1584

2.39133

" 1440 = 3.1584

" ft lbs = 9.23293

600 tons, ft lbs = 0.171 = $\frac{1.00}{5.85}$ foot pounds.

log 1m ft lbs = 5.2346

3.1584

2.0732

3.1584

" ft lbs = 8.9148

M = 170470

300 tons ft lbs = 0.0831 = $\frac{1}{120}$ foot pounds

This is more comprehensible when we remember that this pressure takes a minute in stopping the dome.

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Feb. 20, 95

Dome telescope

Data from Perrine & Warner & Swasey

A. Power for following stars
B. " " starting this speed.
C. " " rapid motion
D " " starting this speed
E " " turning dome &c

A.

40" 354, ft lbs — 1/3 or 1/2
26" 65.4 " —" —(?)
36" 107.6 " ?

Driv. Wt 810
falls 17.4 ft
in 131. min.

" Wt moving is 28847 lbs. 14 tons.

log 810 = 2.9085
" 17.4 = 1.2405
4.1490
" 131 = 2.1173
" ftlbs = 2.0317

B 36in Clock starts alone in 2m 20s
" & Telescope start " 2m 30s

C 40in Rotates 90° per 1m - Hand wheel R = 9" Rotates 30 turns per 1m gearing 120-1
pull of 25 to 30 lbs.

36in " 112.5 per 1m - Hand wheel R = 11" Rotates
pull of 8 to 10 lbs

D 36in Hand wheel R = 11" Rotates
pull of 20 to 25 lbs to start.

E. 45 ft dome 1 Rev. in 2 or 3m 2½ lbs per ton (41 tons = 1/4 165)
90 ft " about 2½ lbs per ton. 165 tons
75 ft " 1 Rev in 8m 300 gals. water 75 closed valves 40 to 50 open " 100 "

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D.S. Confessions
Topic B.C

Feb 20 x 95

Dome-telescope.
Comparisons with Clock in starting to full speed.

Clock alone starts in $2^m\ 20^s = 2.\dot{3}^m = t$
" + telescope " " $2^m\ 30 = 2.5 = t_1$

Veloc. attained is 108 lbs 1 ft in 1^m
From laws of falling bodies

$$v = gt \qquad g = \frac{v}{t} \qquad g_1 = \frac{v}{t_1}$$

$$s = \tfrac{1}{2} g t^2$$

$$g = \frac{1}{2.\dot{3}} = 0.429 \qquad g_1 = \frac{1}{2.5} = 0.400$$

acceleration $= \frac{108}{46.3}$ ft lbs (for 1^m) $\qquad \frac{108}{43.2}$ ft lbs (for 1^m)
$\qquad\qquad\qquad\qquad\quad c \qquad\qquad\qquad\qquad\qquad c+t$

Addition of clock retards acceleration by 3.1 ft lbs per 1^m

If DS gets full speed in 1^m by $\frac{1}{12}$ ft lbs
100 ft lbs would start 1 in $\left(\frac{1}{\sqrt{1200}}\right)$ minutes.

~~1200~~ $\sqrt{1200} = 34.64$

$\log 60 = 1.7782$
$\log 34.64 = 1.5396$
0.2386

$= 1.73$ sec. Probably wrong.

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Thursday, Feb. 21. 1895

Dome = telescope

Speed measured by 100 foot pounds

$v = gt$ | v = 1° in 4^m

$s = \frac{1}{2} g t^2$ | $t = \frac{1^m}{1.73} = \frac{1^m}{34.64}$

$g = \frac{v}{t} = \frac{1^\circ}{4} \times 34.64 = 8.66^\circ$

Hence accel. in 1^m = ~~34.64~~ 0

or rotation = ~~17.32 per m~~

360. / 112.5

2.5563
2.0511
0.5052

Time of revolution.

$g = 34.64$

$s = 180^\circ = \frac{1}{2} g t^2$ ∴ required t

$t^2 = \frac{360}{g}$

log = 2.5563
" = 1.5396
2 | 1.0167
0.5084

1^m+

360.
17.3
342.7

log = 2.5350
" = 1.5396
0.9954

$t^m = 3.22$

to accel. 1^m & then 34.6 = 9.9
let it run — 1.0 H accel.
with resistance — 10.9 or 11^m

time the dome would have turned 69°.3
would have 290.7 at rate of 34.6
13^m for 1 revolution.

To reach a speed of 90°, in 1^m

100 | 90 / 34.6

log 100 = 2.0000
" 90 = ~~1.9542~~
log 9.000 = 3.9542
" 34.6 = 1.5396
2.4146

260 ft lbs

Write $g = 8\frac{2}{3}^\circ$

$s = 360^\circ$

we have

$t^2 = \frac{2s}{g}$

$t = 9^m+$

With $g = 8\frac{2}{3}^\circ$

It would take 4^m to get on speed of 34°.6 and in that which

log 290.7 = 2.4634
" 34.6 = 1.5396
0.9238

time = 8.4
4.0

total = 12.4

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14

9.7.

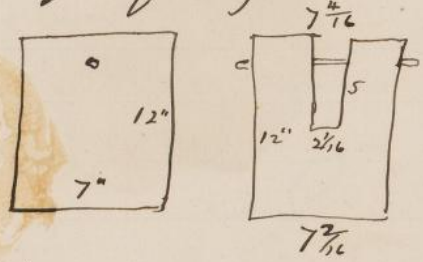
Horse-power
18in - flt hds.

Friday. Feb. 22. 1895

Dome. telescope

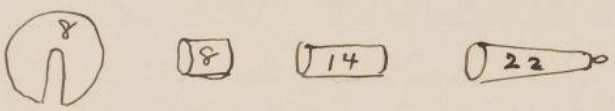
Notes on 18in & Trouble Brig.

Sight & big Wt.



& wheel 6in in diam. 1in thick.

Balance Wt 10 lbs. (against above)



Top of level bed plate & rest 7.87 + 1 6/16 in
7h 40m.0 . Top Wt 17.0in below top of lev. B.P.
8h 53.3 Bottom " 9.0in above rest
9h 04.8 Wt reached rest.

9 04.8
7 40.0
1h 24.8

Top of Wt can go 7 in above top of lev. B.P.

½ large Wt pulled by 30 lbs at 3 7/16 in from center
chain of wheel 1 9/16 in from same center.
— 9 links = circum. = 10 6/16 in

count. 11
2.30 6 55/25/5 = W = 2.6.11 = 132 lbs or 13 lbs too small.

R = c/2π × C = 10 6/16 in = 10.375 log = 1.0160
R = 1.65in = 26.4/16
log 2 = 0.3010
.7150
log π = .4972
0.2178

8/16 = 13 65/100/10 50 = x/16 = 104/10 = 10.4/16

This result will be 250/264 132 or about 125.

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Feb 22. 95

Dover - Interval.

H Obs used in 18th f. Herrell Shop.

Cu. contents of Wt. in cu. inches.

$(7 \times 7\frac{1}{8} \times 12) + (3^2 \times \pi) - 2\frac{1}{16} \times 5 \times 7$

598.5 + 28.275 − 72.2 = 554.6

log 554.6 = 2.7440

∴ 1728 = 3.2375

9.5065

554.6 cu in = 0.321 cu ft and 1 cu ft cast iron weighs 450.5 lbs

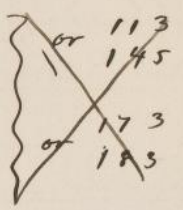
log 450.5 = 2.6537

∴ 0.321 = 9.5065

2.1602

133.+

By measurement 133+ Driv. Wt wighs ~~144.6~~ lbs.



It has had extra 38

171

Map ~~183~~ lbs min ~~145~~

133

Driv. Wts. Balance wts − 10 " − 32

Map 173 lbs min. 113

Rate of falling.

7.87 ft + $1\frac{6}{16}$ in $\frac{1}{16}$ = 0.0625 $\frac{6}{16}$ = 0.375 or 1.375 in

1.375 in = .1146 ft, This dist = 7.98 ft.

In 84.8 Wt fell from 17 in below top to 12 in above mat

= 29 in = 2.42 ft or it fell 5.56 ft.

per 1 m its rate was $\frac{5.56}{84.8}$ log = 0.7451

" = 1.9284

8.8167

rate = 0.06558 ft per 1 m

133	171	113	145	173	183
2.1239	2.2330	2.0531	2.1614	2.2380	2.2625
8.8167	8.8167	8.8167	8.8167	8.8167	8.8167
0.9406	1.0497	0.8698	0.9781	1.0547	1.0792
8.72	11.2	7.41	9.51	11.34	12.0

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D.S.

Work in revolving Sith dome.
Sith motion 18in & 16in dome (notes) Saturday, Feb. 23, 1895
Dome - telescope

Assume piston 12in in diam.
Area = 113.09 Sq. in.
1 gal. (Sup. Meas) = 277.274 cu in.
Assume 1 gal to a stroke of piston, or 277.274 cu in.
length of stroke = $\frac{277.274}{113.09}$
and there are 300 such strokes.

I find 1 cu ft = 6¼ gals.

log 277 1/4 = 2.4429
" 113 1/10 = 2.0535
" length stroke = 0.3894
" " = 2.45 in.
Length 300 strokes = $\frac{735}{12}$ ft = 61.25 ft

Pressure per sq in on piston is 40 & 50 lbs
or 45 lbs. Area = 113.09 Sq. in.
Total pressure = 45 · 113.09 ~~log 113.0~~
log 45 = 1.6532
+
" 113.09 = 2.0535
" pressure 3.7067
Ep = 5090 lbs - through 61.25 ft in 8 sec.

1/6 off is a good allowance for friction.

Total ft lbs = 5090 × 61.25. = 312 000
Horse power = $\frac{5090 \times 61.25}{8 \times 33000.} = \frac{39,000}{33000} = 1.18$ H.P.

log 5090 = 3.7067
" 61.25 = 1.7871
5.4938
" 8 0.9031
4.5907
" 33000 = 4.5185
log HP = 0.0722

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Feb. 27. 1895

Dome- telescope

Notes on 18" Lowell- quick motion of dome.

$\frac{18}{36} \cdot 11 = \frac{198}{8} = 25^{sec}$ Took about 18 beats of clock & turn 160°

3.7 lbs to overcome friction & about 24 lbs to stop telescopes motion in 1 or 2 sec

Dome.

$\frac{6.}{10} \cdot \frac{48}{5} = \frac{48}{5} = 9.6^{sec}$

10" for 1/12 Rev.

1 Rot in 2 min

Pull 60 lbs start

50 lbs - run

Rate $\frac{144}{240}$ ft per min

Time doubled by using block & tackle.

64 lbs & start it pulley on rope & 2 blocks

In 16 beats of clock dome moves 1/12 Rev

post moves 8.00 - rope must move 24 ft

unhitching block just doubles time

Moving one way (to left)	64 lbs	start	then 56
" reverse (to right)	~~28~~ 56	"	" ~~22~~ 44
mean	60	"	" 50

Driving weight = 133+ lbs by measurement

$\frac{144 \quad 288}{14,400} \quad \frac{50}{} = 3/14$ H.P.

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D. J.

Spin - resistance to rapid motion

Sunday. Feb. 24. 1895

Dome - Telescope

from pg 24

$r = S \times V^2 = \frac{1}{4160}$ lbs

With $S = 3771$ ($\log = 3.5764$) & $V = 13.05$ ft per 1" or 1° in 4m

Required value of r when H = 8ft instead of 12

and " V = 34.6 per 1m instead of 1/4°

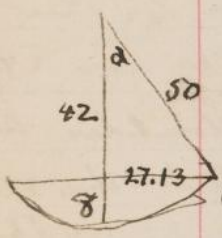


fig 104

$\angle d = \cos^{-1} \frac{42}{50} = \cos^{-1} .84$. $d = 32.^\circ 9$

Any Segment = $2\pi R H$

Hence area here = $\frac{8}{12} f = \frac{2}{3} f$ $\sqrt{3}$ $\left(\frac{3771}{1257}\right)_2$

2514 sq. ft.

or $r' = \frac{2}{3} r$ lbs $\times \frac{\left(\frac{34.6}{1/4}\right)^2}{}$

$\frac{34.6}{1/4} = 138.4$ $\quad 138.4^2 = 19,144$ about $\sqrt{3}$ $\left(\frac{6381}{2}\right)_2$

12762

or $r' = 12762\, r = \frac{12760}{4160} = 3.07$ lbs

$\log 1276 = 3.1058$

" $416 = 2.6191$

" $3.07 \quad 0.4867$

$r' = 3.07$ lbs carried through $34.^\circ 6$ in 1^m. $34.^\circ 6 = 30.235$

$\log 314.16 = 2.4972-$

" $34.6 = 1.5396$ cn

4.0368

" $360 = 2.5563$

1.4805

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Feb. 24. 95

Dome - telescope

Slow-resistance to rapid motion.

$r' = 3.07$ lbs 30.24 ft in 1^m

100 ftlbs $= 3.07$ lbs $\frac{100.00}{3.07}$ ft in 1^m

$= 3.07$ lbs, 32.57 ft in 1^m

But as speed decreases the resistance decreases.

or

$r' = \frac{100}{30.24}$ lbs. $\times$ ft in 1^m

$= 3.3$ lbs, $\frac{307}{331}\ 30.24$ ft in 1^m

$= 3.3$ lbs. 28.01 ft in 1^m

lbs.
3.3069

log 307 = 2.4867
" 30.24 = 1.4805
3.9672
" 331 = 2.5198
1.4474

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120

D. T.

Skin-resistance

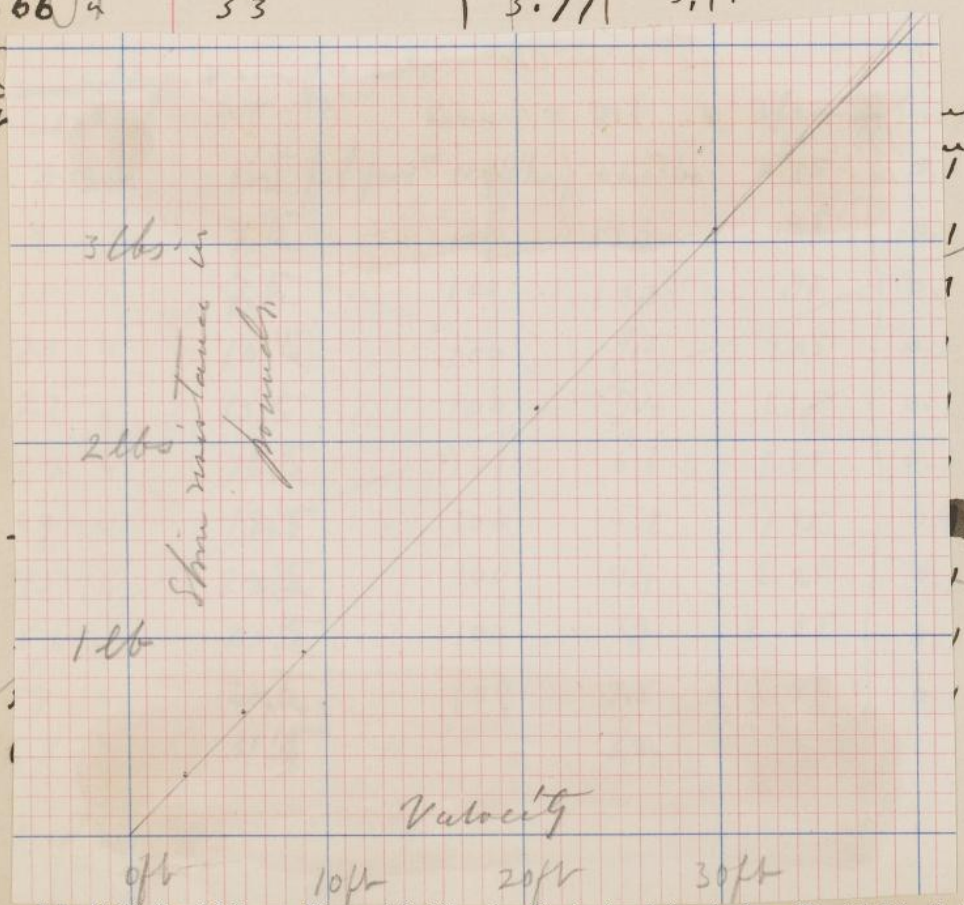
Feb. 24. 1895

Dome-telescope.

Skin-resistance & high speeds.

From curves ? fwd.

(Speed of)	Velocity per 1 m	Resis.	
6 sec	3 ft	0.06 lbs.	.31 lbs.
12 "	6	0.12	.61
18 "	9	.27	.93
24 "	12	.48	1.24
30 "	15	0.77	1.53
36 "	18	1.08	1.86
42 "	21	1.53	2.17
48 "	24	1.92	2.48
54 "	27	2.49	2.73
60 "	30 (24)	3.07	3.07
66 "	33	3.71	3.41



Sums	
.15 ft	0.1 m
.60	0.2
1.35	0.3
2.40	0.4
3.75	0.5
5.40	0.6
7.35	0.7
9.60	0.8
12.15	0.9
15.00	1.0

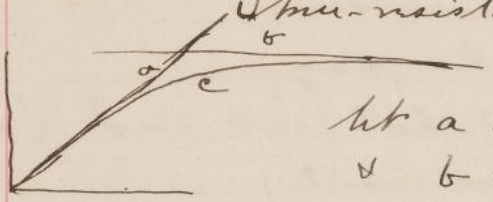
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Monday, Feb. 25, 1895

Dome-telescope

Skin-resistance, by another method.

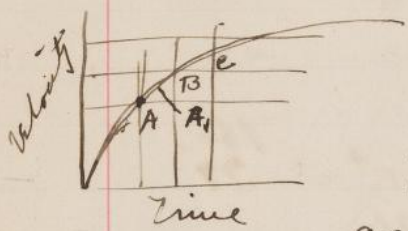


It seems likely that

let a = line of velocity without resist.

& b = ultimate speed attained with "

then C = the curve of ~~mean~~ speed, being the hyperbola between these lines as asymtotes.



The mean velocity during any interval as AB = velocity at A (initial velocity) + ½ of the acceleration during A.B.

Let the true mean velocity during AB = V

" " initial velocity = w

" " acceleration = v

then V = w + ½ v

let us assume a value of v = v'

then our assumed V will = V'

Let the interval of time = i

Then for V' we can take from which r' = assumed resistance.

r' will be expressed in ft lbs.

subtract from 100 and get true v for i

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D J

Speed - Hp & C - new formulas.

Tuesday, Feb. 26, 1895

Dome - telescope

Speed, torque - power &c.

From lower half of pg 122

$$\left(\frac{v \text{ in feet per 1}^{m}}{\text{Circum}}\right)^2 170470 = E \text{ in ft lbs.}$$

or for a special case

$$\frac{v^2 \quad 170470}{314.16^2} = E = 100$$

or $v^2 \quad 1.727 = 100,$

$$v^2 = \frac{100,000}{1.727}$$

$\log = 2.0000$

$\log = 0.2372$

$2 \overline{|1.7628}$

$\log v = 0.8814$

$v = 7.61$ ft per 1m

Now we have - ft lbs $= E = \frac{wt}{2} v^2 = \frac{wtg}{2} t^2$

in which g is the variable. $2g$

Now if E is supplied constantly at 100 ft lbs per min, we can plot t with reference to a uniform increase of E. (Maxwell) $(v = gt)$

$E = \frac{wg}{2} t^2$

$\frac{2E}{wg} = t^2$

$t = \frac{2E}{wg}$

$t = \frac{\sqrt{E}}{10}$

g (suppose) $= \frac{7.61}{2} = 3.805$ ft ft

when $t = 1$, $E = 100$

hence $\frac{wg}{2} = 100$

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Feb 26, 95

Dome - telescope

For computing curve of speed and distance

$\mathcal{E} = M v^2$ ($v =$

$M = 170470$

$t =$ revs per 1^m

$\mathcal{E} = \left(\frac{v \text{ in ft}}{\text{circum}}\right)^2 M$

$\mathcal{E} = pnt \frac{M}{\text{Circum}^2} = k$

& $\frac{1}{2}$

$\mathcal{E} = k v^2$

$k = 1.727$

$\mathcal{E}$ is proportional to time

$\mathcal{E} = 100 t$

$100 t = k v^2$

$\frac{100 t}{k} = v^2$

$v^2 = \frac{100}{k} t$

$v = 10 \sqrt{\frac{t}{k}}$

$v = \frac{10}{\sqrt{k}} \sqrt{t}$ $\sqrt{1.727} = 1.315$

$v = 07.6 \sqrt{t}$ $\frac{10.}{1.315} = 07.60$ 07.5955

v in feet, t in minutes.

$360^\circ = 314.1$

$\log 314 = 2.4972$

$360 = 2.5563$

9.9409

$1^\circ = 1.873$

$11^\circ = 1.145$

Time for reaching speed for following steps $\frac{1}{20}$ sec.

$v = 7.6 \sqrt{t}$

$\sqrt{t} = \frac{v}{7.6}$

$t = \frac{v^2}{7.6^2}$

$v = \frac{1}{4}$ $1.0 = 0.218$

0.000823

$\frac{1}{20}$ sec.

$\log v = 9.3385$

$\log 7.6 = 0.8808$

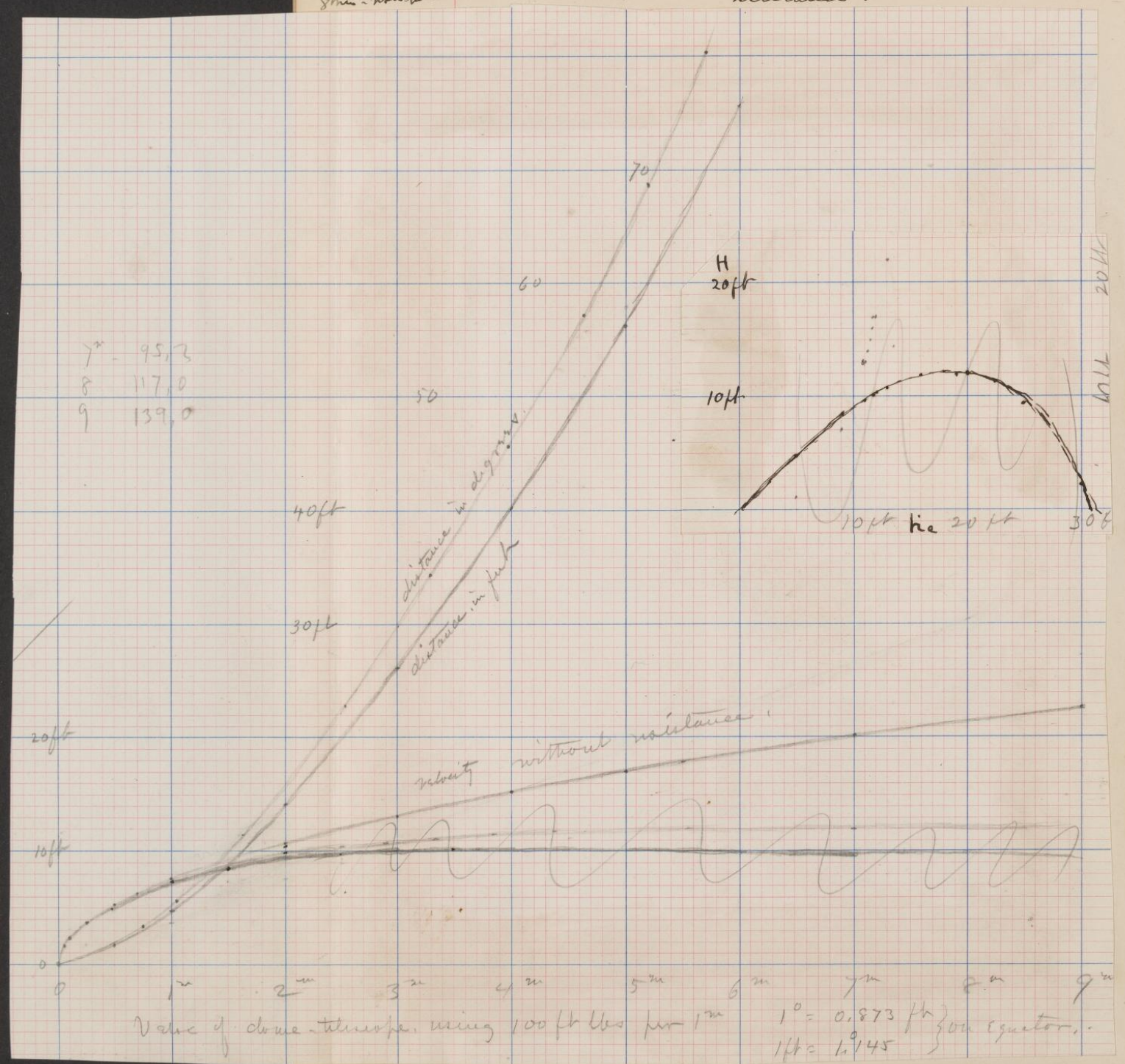
0.45577

6.91154

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126 Curves. Feb 26. 95

Dist. Normal curves of speed and distance, not counting shunt-resistance. shunt-resistance.



T^m 95,3
8 117,0
9 139,0

Value of degree-telescope, using 100 ft lbs per 1m 1° = 0,873 ft } on Equator.
1ft = 1°,145

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Wednesday, Feb 27. 1895

~~Feb. 26. 95~~

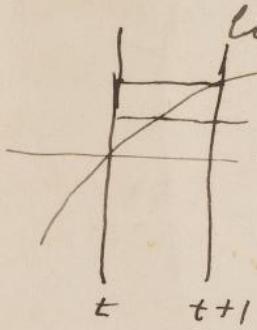
Dome-telescope

Effect of skin resistance.

Average speed for diff. min. an

By method of getting g. for each ft. 125
succession minute. minutes

Computation of g. - taken by



$v_{(t+1)\varepsilon}$ = velocity at end of int.

$v_{(t+1)i}$ = velocity at begin. of int.

$g_{(t+1)} = v_{(t+1)\varepsilon} - v_i$

Now. let E = energy expended at t

$E + \varepsilon_1$ = " " " $t+1$

then (fg 125) $\varepsilon = k v^2$ $(k = 1.727)$

and $v_\varepsilon^2 = \dfrac{E+\varepsilon_1}{k}$

& $v_i^2 = \dfrac{E}{k}$

Hence $v_\varepsilon^2 - v_i^2 = \dfrac{E+\varepsilon_1}{k} - \dfrac{E}{k} = \dfrac{\varepsilon_1}{k}$

but $v_\varepsilon = v_i + g$

hence $v_\varepsilon^2 - v_i^2 = (v_i+g)^2 - v_i^2 = \dfrac{\varepsilon_1}{k}$

$(v_i+g)^2 = \dfrac{\varepsilon_1}{k} + v_i^2$

$v_i + g = \sqrt{\dfrac{\varepsilon_1}{k} + v_1^2}$

$g = \sqrt{\dfrac{\varepsilon_1}{k} + v_i^2} - v_i$

Which gives g in terms of ε_1 and v_i

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1893phae.proj - 5426

28

D.J.
Shin mistaken
" "

Feb. 27. 95
Dome telescope
Effect of shin-resistance
Computed from minute to minute.

From pages 125 and 127.

$v = 7.6\sqrt{t}$; for $t = 1$, $v = 7.6$ ft

and $g_n = \sqrt{\frac{\varepsilon_n}{k} + v_{ni}^2} - v_{ni}$

Neglect r for $n = 1$ m

v_{2m} = about 9.3 ft $r_2 = 0.9$ lbs $R_2 = 8.1$ ftlbs.

$v_{1i} = .0$
$v_{2i} = 7.6$
$v_{3i} = 10.6$
$v_4 = 12.7$

$\varepsilon_2 = 92.$ log = 1.9638
$k = 1.727$ " = 0.2375
1.7263

$\frac{\varepsilon_1}{k_2} = 73.25$
$\frac{}{7.6^2} = 57.76$
131.
$= 11.5$
7.6
$g = 3.9$
7.6
.5

$\frac{\varepsilon}{k} = 53.25$
$\frac{}{7.6^2} = 57.76$
111.0
$= 10.5$
7.6
$g = 3.0$

Modification of formula.

$v_{(n+1)i} = \sqrt{\frac{\varepsilon_n}{k} + v_{ni}^2}$

v_{3m} = about 10.8, $r_3 = 1.1$ lbs $R_3 = 12$ ftlbs.
$\varepsilon_3 = 88$ ftlbs, log = 1.9445+
log k = 0.2375
" ε/k = 1.7070

$\varepsilon/k = 50.9$
$v_{3i}^2 = 111.0$
$v_{4i}^2 = 161.9$
$v_{4i} = 12.7$

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Feb. 27. 95

Dome - telescope

Shim - resistance. computation.

$v_{4c} = 12.7$

$v_{4m} =$ about 13.7 r_4 1.4 $R_3 = 19.2$ ft lbs

$\varepsilon_4 = 80.8$ log $= 1.9074$

$.2375$

1.6699

$\frac{\varepsilon}{k} = 46.8$

161.9

$v_{5i}^2 = 208.7$

$v_5 = 14.4$ $v_{5c} = 14.4$

$v_5 m =$ about 15.3 $r_5 = 1.56$ $R_5 = 24.0$

$\varepsilon_5 = 76.0$ log $= 1.8808$

$.2375$

1.6433

$\frac{\varepsilon}{k} = 44.0$

$v_5^2 = 208.7$

$v_6 = 15.9$ $v_{6i}^2 = 252.7$ $v_{6i} = 15.9$

$v_6 m =$ about 16.6; $r_6 = 1.7$ lbs; $R_6 = 28.2$

$\varepsilon_6 = 71.8$ lbs log $= 1.8561$

$\varepsilon/k = 41.65$ $.2375$

252.7 1.6186

$v_{7i}^2 = 294.3$ $v_{7c} = 17.2$

$v_7 = 17.2$

$v_7 m =$ about 17.7. $r_7 = 1.80$ $R = 32.0$

$\varepsilon_7 = 68.0$ log $= 1.8325$

$.2375$

1.5950

$\frac{\varepsilon}{k} = 39.3$

294.3

333.6

$v_8 = 18.3$ v_{8i}^2 $v_{8i} = 18.3$

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D.T.

Thin-resistance Computations

Feb. 27. 95

Dome-telescope

Thin-resistance, computation

better 18.7 [illegible] 35.7

$V_{8m} = 19.1$, $r_8 = 1.95$ $R_8 = 37.2$

64.3

$\varepsilon_8 = 62.8$ $\log = 1.7980$ 8082

$\log k = 0.2375$ .2375

$\log \frac{\varepsilon}{k} = 1.5605$ 1.5707

$\frac{\varepsilon}{k} = 36.45$

333.6

$V_{qi}^2 = 370.0$ $V_{qi} = 19.2$ 37.2 333.6 370.8

$V_q = 19.2$ not enough diff. to count

$V_{qm} = 19.7$ about; $r_q = 2.$ $R_q = 39.4$

$\varepsilon_q = 60.6$ $\log = 1.7825$

.2375

1.5450

$\frac{\varepsilon}{k} = 35.1$

370.1

V_{10i}^2 405.2 $V_{10i} = 20.1$

$V_{10} = 20.1$

$V_{10m} = 20.5$ $r_{10} = 2.09$ $R_{10} = 42.8$

$\varepsilon_{10} = 57.2$ $\frac{\varepsilon}{k} = \frac{\varepsilon}{1.727} = \varepsilon\ 0.579$

.58

4576

2860

33.276

405.2

$V_{11i}^2 = 438.4$ $V_{11i} = 20.9$

$V_{11} = 20.9$

$V_{11m} = 21.3$ $r_{11} = 2.17$ $R_{11} = 46.2$

$\varepsilon_{11} = 53.8$

0.6 $-\frac{1}{50}$

32.28

108

31.2

438.4

V_{12i}^2 469.6 $V_{12i} = 21.7$

$V_{12} = 21.7$

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Feb. 27, 1895

Dome-telescope

Computation of skin-resistance

$V_{12m} = 22.1$ $r_{12} = 22.6$ $R_{12} = 50.2$

$\varepsilon_{12} = 49.8$

,6 — 1/50

29.88

1.996

28,9

469.6

498,5

$V_{13i} = 22.3$ V_{13i}^2 $V_{13i} = 22,3$

$V_{13m} = 22.6$ $r_{13} = 2,31$ $R_{13} = 52,4$

$\varepsilon_{13} = 47.6$

,6

28.56

,95

27.6

498.5

$V_{14i} = 22.9$ V_{14i}^2 $V_{14i} = 22.9$

$V_{14m} = 23.2$ $r_{14} = 23.7$ $R_{14} = 55.2$

$\varepsilon_{14} = 44.8$

.6

26.88

.9

26.0

526,1

$V_{15i} = 23.5$ $V_{15i}^2 = 552.1$

$V_{15m} = 23.8$ $r_{15} = 2,43$ $R_{15} = 57.6$

$\varepsilon_{15} = 42,4$

,6

25.44

,85

24.6

552.1

$V_{16i}^2 = 576.7$

$V_{16i} = 24,0$

$V_{16m} = 24.2$ $r_{16} = 24.8$ $R_{16} = 60.0$

$\varepsilon_{16} = 40.0$

,6

24.00

.8

23.2

576.7

600.0

$V_{17i}^2 = 599.9$

$V_{17i} = 24.5$

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1993pinae.proj..526D

Normal velocity curve - no variables.

Velocity curve - taking account of plain-mesh lenses.

Not. to scale of value.

6.27.95

Run worn into complete a revolution.

$V_{17m} = 24.7$ $r_{17} = 2.53$ $R_{17} = 62.5$

$\varepsilon_{17} = 37.5$

22.50

21.85

599.9

$\frac{V_{17}^2}{V_{17}} = 6211.7$ $V_{17}' = 24.9$

$V_{17m} = 24.7$

40°

30°

20°

10°

0°

10ft 20ft 30ft

To reduce degrees to feet or feet to degrees, use diam-steps.

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D. S. Feet & degrees
Rad / Comps.
Curve.
Begin. / Comp for 400 ft lbs per minute.

Feb 27. 95

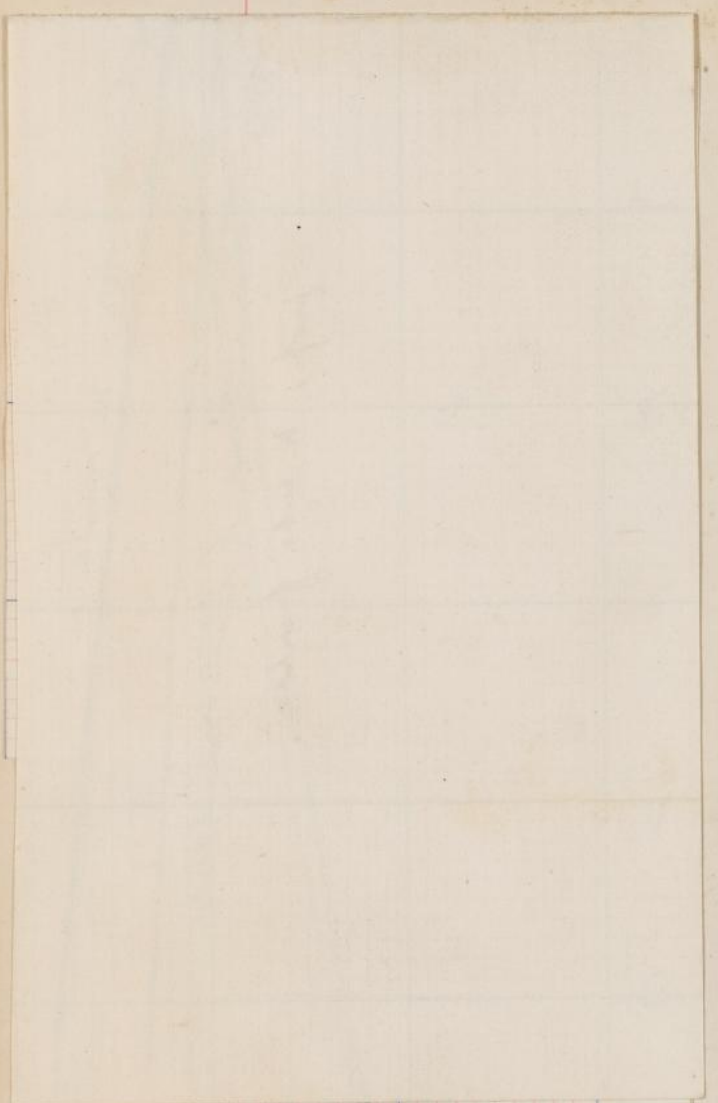
Run worn with complete a resolution.

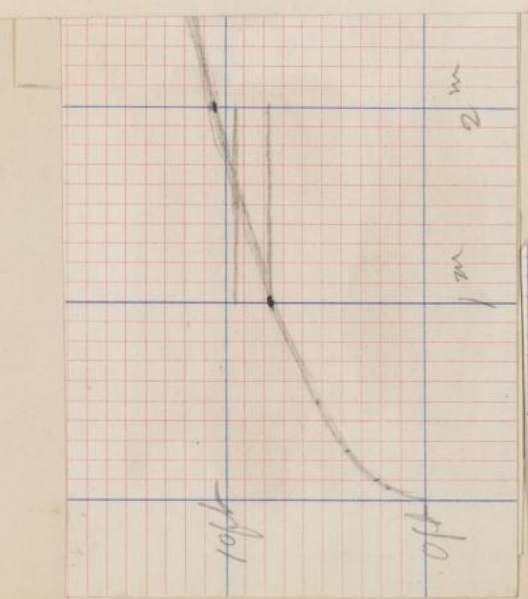
$V_{17m} = 24.7$ $r_{17} = 2.53$ $R_{17} = 62.5$

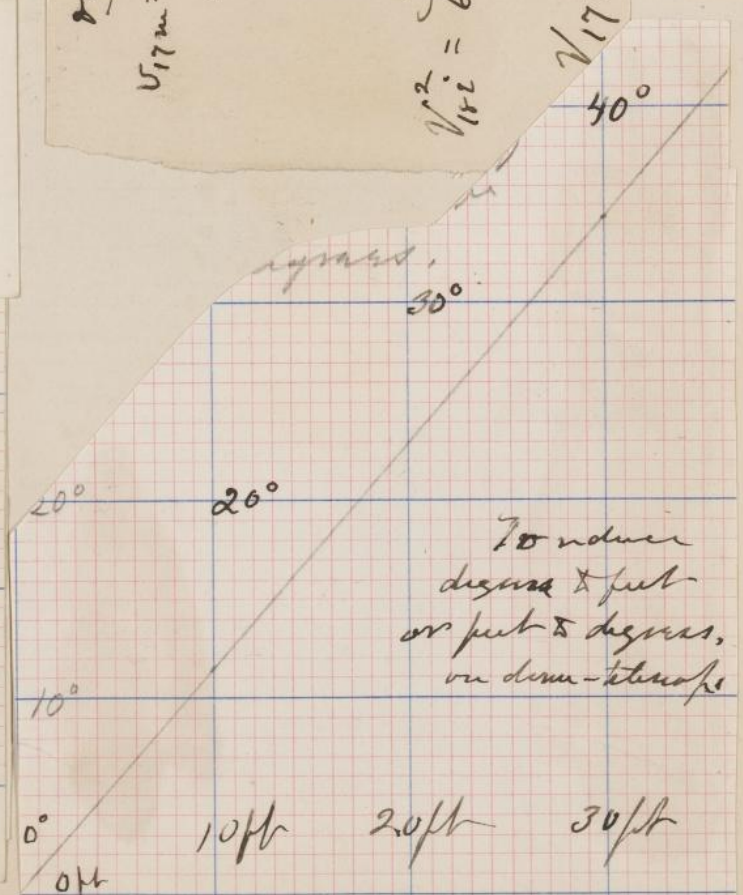
$\varepsilon_{17} = 37.5$
.6
22.50
.75
21.85
599.9

$V_{17i}^2 = 6211.7$ $V_{17i} = 24.9$

$V_{17m} = 24.7$







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Feb 27, 95

400 lbs for 1st dome - telescope - skin-resistance

$v = 7.6\sqrt{t}$ $\quad V_{t+1} = \sqrt{\frac{\varepsilon_t}{k} + V_t^2}$ $\quad v = 15.2\sqrt{t}$

$\varepsilon = 100$ $\qquad\qquad$ $\varepsilon = 400$

The normal curve without resistance is proportional to $\sqrt{\varepsilon}$

V_{2m} will then be about 18.3 $\quad r_2 = 1.67 \times R_2 = 34.2$

$\varepsilon_2 = 365.8$

.6

219.48

73.2

212.28

$15.2^2 = 231.0$

443.2

$V_{2i} = 21.6$ allowing for skin resistance.

10.52

15.2

1.42

304

608

152

21.684 by $v = 15.2\sqrt{t}$

V_{3m} = about 23.2 $\quad r_3 = 2.37 \quad R_3 = 55.2$

$\varepsilon_3 = 344.8$

.6

206.88

6.9

200.0

443.2

643.2

15.2

1.713

1064

152

51

2635

normal curve

$V_{4i} = 25.3$

Feb. 28, Or for the lesser estimate of sk. R.

$R_3 = 2.4 \quad \varepsilon_3 = 397.6$

assuming $V_{3i} = 21.6$

.6

238.56

−7.95

230.6

466.6

697.2

$V_{4i} = 26.4$ - normal curve is 26.4

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D. I.

100 + 400 ft lbs

neglecting resist.

Comps for nominal cents 100 + 400

Thursday. Feb. 23 1895

Dome - telescope

$v = 7.6\sqrt{t}$ for 100 ft lbs. $v = 15.2\sqrt{t}$ for 400 ft lbs

$V_{n\,m} = 30$ ft, $R_n = 3.07$

$\varepsilon_n =$ ~~96.9~~ 96.9

,6

58.14

1.94

56.2

864.4

920.6

30.3 +

i.e. this resistance according to: ~~(~~ horse power to drive a vessel increases with the square of the speed ~~)~~ makes a diff of less than 0.1 when going at 30 ft per sec.

$30.3 = 7.6\sqrt{t}$

$\frac{1.0}{0.253} = 3.95$

$t = 15.6$

$n = 16$

$V^2 = 3,874$

7.6

2322

2709

$V_{ni} = 29.41$

7.6

4.

$V_{(n+1)\,i} = 30.4$

From the above and the note at foot of last page I think it safe to neglect this resistance for velocities below 30 ft anyway

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Feb 28, 93

Dome - Telescope

		Velocity 100	Velocity 400	mean value for 1m	Distance 100	Distance 400
1m =	1.000 × 7.6 =	7.6	15.2	4.9	4.9	9.8
2	1.417	10.8	21.6	9.3	14.2	28.4
3	1.733	13.2	26.4	11.9	26.1	52.2
4	2.000	15.2	30.4	14.2	40.3	80.6
5	2.238	17.0	34.0	16.2	56.5	113.0
6	2.450	18.6	37.2	17.8	74.3	148.6
7	2.647	20.1	40.2	19.3	93.6	187.2
8	2.830	21.5	43.0	20.7	114.3	228.6
9	3.000	22.8	45.6	22.0	136.3	272.6
10	3.163	24.0	48.0	23.4	159.7	319.4
11	3.317	25.2		24.5	184.2	
12	3.465	26.3		25.8	210.0	
13	3.606	27.4		26.9	236.9	
14	3.742	28.4		27.9	264.8	
15	3.874	29.4		28.8	293.6	
16	4.000	30.4		29.8	323.4	
1/4		3.8				
1/16		1.9				

This gives 10m for 1 Rev with 400 ft/lbs per 1m
" " 16m " 1 " " 100 " " 1m

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136

D. L.
Lick Boy - letter
Mrs Lillie.

Saturday. March 2nd. 1895
Letter rec'd today.

MOUNT HAMILTON, July 25, 1895.

Mr. A. E. Douglass,
Lowell Observatory,
Flagstaff, Arizona.

Dear Sir:—

Replying to your inquiries of 21st inst. I beg to say,

(1.) Sixty revolutions of the hand-wheel on the balcony of the 36-inch pier, revolves the polar axis once.

(2.) Friction, ball-governor. (Conical pendulum.)

(3.) The large dome was designed and built by the Union Iron Works, San Francisco.

Trusting that this may be the information desired, I am

Yours very truly

C. D. Perrine,
Secretary L. O.

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36 INCH LICK TELESCOPE

Feb. 28, 1895.

Fowle Warner & Lovering

Rec'd March 4.

Prof. A. E. Douglass,

Lowell Observatory,

Flagstaff, A. T.

Dear Sir:-

We take pleasure in acknowledging receipt of your favor of the 23rd inst., and in reply are glad to tell you that the figure 2-1 2 pounds per ton for revolving the 45' Dome of the New Naval Observatory at Washington is the power required at the circumference of the Dome. The hand wheel is geared about 10 - 1, but the figure which we gave you is not the pull required at the hand wheel but is reduced to the actual power required at the circumference of the Dome. The 90' Dome is to be revolved by an electric motor, but as we are not to supply the electrical parts, the ratio of gearing has not as yet been figured out, and we are therefore unable to answer your question on this point definitely, and we are also unable to give you exactly [illegible] to turn the 90ft Dome, for this will be a matte[illegible] 45' Dome are approximate[illegible] the Dome is tested we [illegible]

Copies Sections to MS

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36 INCH LICK TELESCOPE

Feb. 28, 1895.

From Warner & Swasey

Rec'd March 4.

Prof. A. E. Douglass,

Lowell Observatory,

Flagstaff, A. T.

Dear Sir:-

We take pleasure in acknowledging receipt of your favor of the 23rd inst., and in reply are glad to tell you that the figure 2-1 2 pounds per ton for revolving the 45' Dome of the New Naval Observatory at Washington is the power required at the circumference of the Dome. The hand wheel is geared about 10 - 1, but the figure which we gave you is not the pull required at the hand wheel but is reduced to the actual power required at the circumference of the Dome. The 90' Dome is to be revolved by an electric motor, but as we are not to supply the electrical parts, the ratio of gearing has not as yet been figured out, and we are therefore unable to answer your question on this point definitely, and we are also unable to give you exactly the power required to turn the 90ft Dome, for this will be a matter of actual test, though the figures of the 45' Dome are approximately correct for the 90' Dome. As soon as the Dome is tested we will send results. Compliments of W. & S.

From S. Sykes,

60/100
1/4/6 # pressure.

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* The idea of using a diaphragm instead of an ordinary piston is due to Mr Godfrey Sykes of this town. He also suggested the following modifications which will subsequently be mentioned: (1) rise and fall of dome in a line perpendicular to polar axis instead of vertical; (2) weight of dome 300 tons instead of 600; (3) an outside elevated reservoir for supplying water to tank near objective, instead of pumps; (4) Main entrance at lower pole instead of upper. He also called my attention to the mechanical difficulties involved in right ascension movement and a large part of the final topic entitled "comparison with other mountings" is the result of investigations on the subject.

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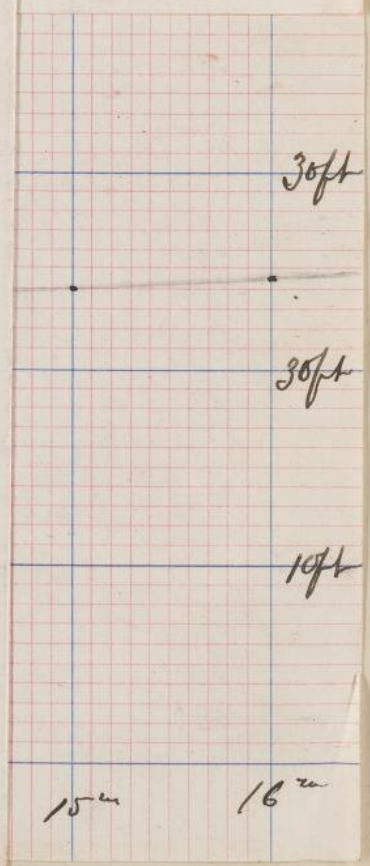
Dome-telescope Comes

Velocity & distance

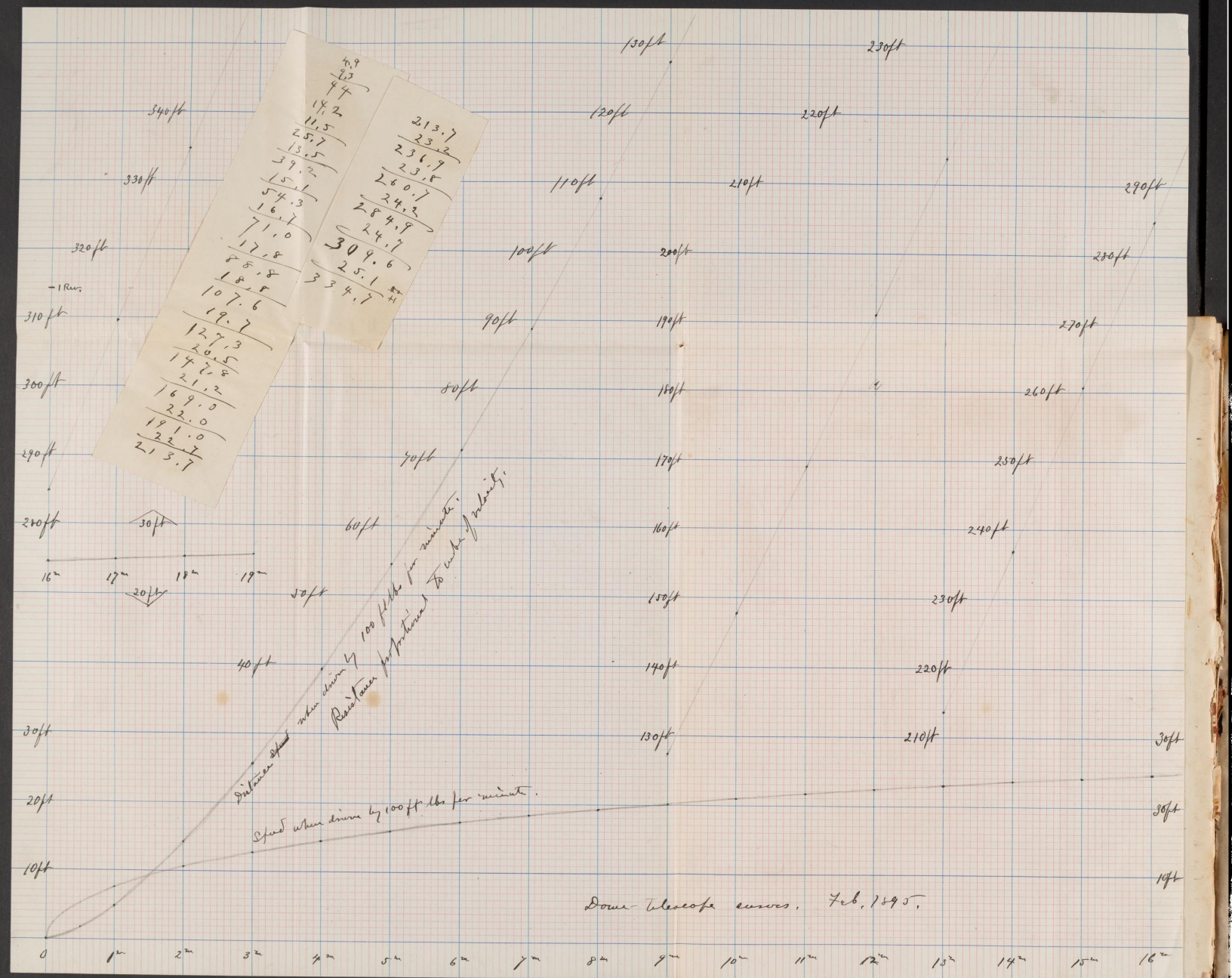
Resistance proportional to

cube of velocity.

100 × 400 ft lbs per 1 m



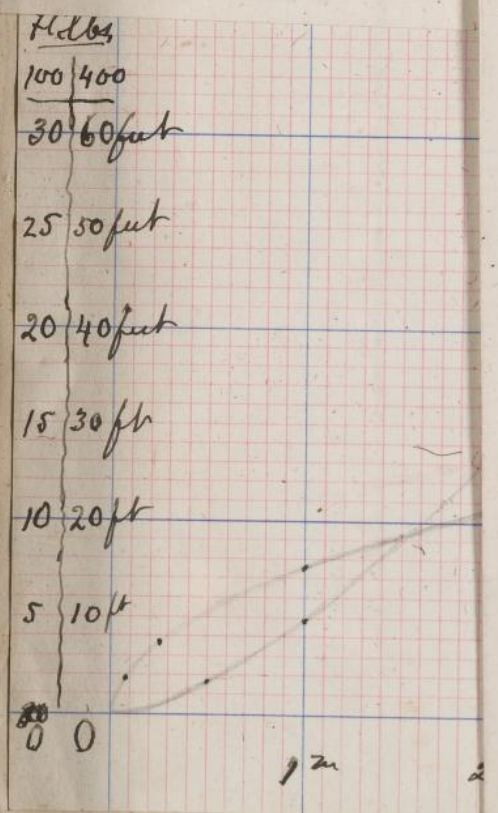
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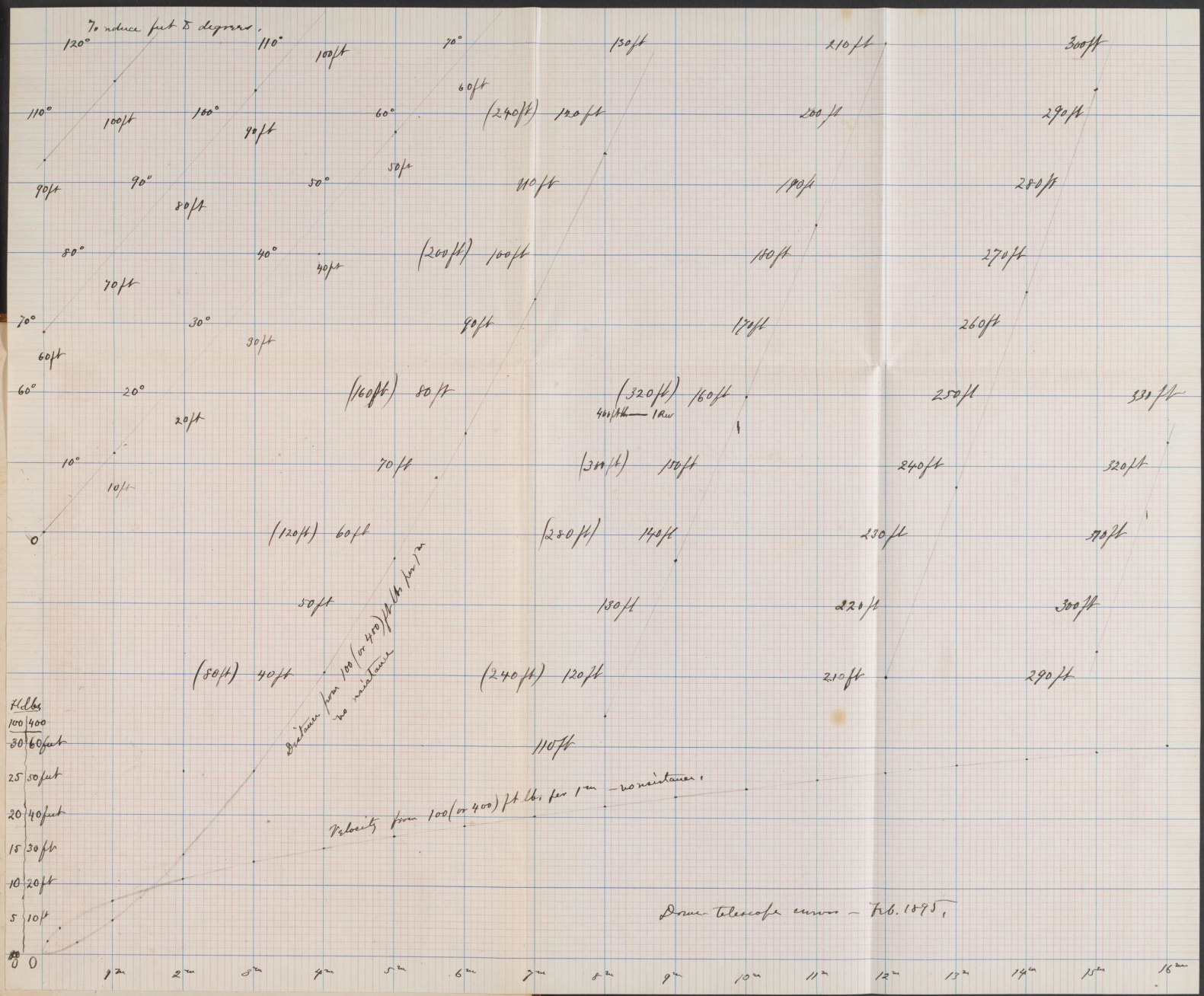
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Dome Telescope curves.
velocity & distance.
No resistance
100 & 400 ft lbs per 1 sq in.



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