Measurement of Horses

Publication/Creation

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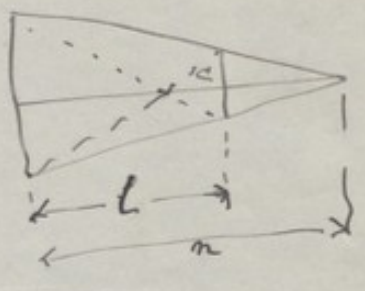
for further distance of plate
nearer — — — object

$$\frac{x-m}{c} = \frac{x}{a} \qquad ax - am = xc \qquad x = \frac{am}{a-c} \quad (1)$$

$$\frac{1}{x} + \frac{1}{v} = \frac{1}{f} \qquad fv + fx = xv \qquad x = \frac{fv}{v-f} \quad (2)$$

$$\frac{1}{m} + \frac{1}{\mu} = \frac{1}{f} \qquad m = \frac{f\mu}{\mu - f} \quad (3)$$

$$\frac{fv}{v-f} = \frac{af\mu}{(\mu-f)(a-c)}$$



$$\frac{v}{v-f} = \frac{a\mu}{\mu a - \mu c - fa + fc}$$

$$v\mu a - v\mu c - vfa + vfc = a\mu v - a\mu f$$

$$v(\mu c + fa - fc) = a\mu f$$

$$v = \frac{a\mu f}{\mu c + fa - fc}$$ right

write for v $x_2 + f$
μ $x + f$

$$x_2 = -f + \frac{afx + af^2}{cx + fa - fc} \qquad \frac{afx + af^2}{cx + fa}$$

$$= \frac{-fcx - f^2a + afx + af^2}{cx + fa}$$

$$= \frac{fx(a-c)}{cx + fa}$$ right

$$x_2 = \frac{fx(a-c)}{cx + fa}$$ right

$\frac{m-l}{c} = \frac{l}{a}$ $\quad am = l(a+c)$ $\quad l = \frac{am}{a+c}$

$l\lambda = f$ $\quad l = \frac{f}{\lambda}$ $\quad \frac{f}{\lambda} = \frac{am}{a+c}$

$m\mu = f$ $\quad \frac{f}{\lambda} = \frac{a\frac{f}{\mu}}{a+c}$

$\frac{f}{\lambda} = \frac{af}{\mu a + \mu c}$ $\quad \frac{1}{\lambda} = \frac{a}{\mu a + \mu c}$

$\lambda = \frac{\mu a + \mu c}{a}$

---

for λ write $x_1 + f$

μ " $x + f$

$x_1 + f = \frac{ax + af + cx + cf}{a}$

$x_1 = \frac{ax + cx + cf}{a}$

(This seems right)

$$\frac{y-y_1}{c} = \frac{y_1+f}{a} \qquad ay-ay_1 = cy_1+cf$$

whence $y_1(c+a) = ay - cf$ (1)

$$y_1 = \frac{f^2}{x_1} \quad (2) \qquad y = \frac{f^2}{x} \quad (3)$$

$$\frac{f^2}{x_1}(c+a) = \frac{f^2}{x}a - cf$$

$$xf(c+a) = x_1(fa - cx) \qquad (4)$$

$$\frac{y_2-y}{c} = \frac{y_2+f}{a} \qquad ay_2-ay = cy_2+cf$$

whence $y_2(a-c) = ay + cf$ (5)

$$y_2 = \frac{f^2}{x_2} \quad (6) \qquad \text{and } y = \frac{f^2}{x} \text{ as in (3)}$$

$$\frac{f^2}{x_2}(a-c) = \frac{f^2}{x}a + \frac{cfx}{x}$$

$$xf(a-c) = x_2(af + cx) \qquad (7)$$

---

from (4) $\quad x_1 = \dfrac{xf(a+c)}{af - cx}$ (8)

from (7) $\quad x_2 = \dfrac{xf(a-c)}{af + cx}$ (9)

in rectangular perspective

2) gives a ~~perspective~~ sketch of the ~~sight~~ ~~and other~~ general geometry of the problem

3) is a plan ~~of~~ so much of the really important part

2) ~~so far~~ as ~~it~~ can be seen in ~~plan~~ elevation plan.

) is the side view or elevation of a section through the ~~site~~ 1 (2).

~~The ground is supposed to be level.~~

description letters) refer to the same ~~points~~ (in all four diagrams). ~~Separate~~

~~are intended~~ ~~should be followed for simultaneous~~

~~points~~ ~~The~~ as follows –

is the point of sight, which is raised above the ~~and~~ (to ~~the~~ a height MN), M lying perpendicularly ~~w~~ N. AB is the intersection of the vertical

Pyn. focal length f = 3.0 in. distance of object		Reduction 1 to:	R = 0.4 = 2.5 $\frac{1}{1000}$ = .001		$\frac{A}{r}$ = 0.3		= 0.2	
inches	feet		$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{100}$	$\frac{1}{200}$
120	10 –	$\frac{1}{40}$	7 ft. 6 in. 90 – 180	3 ft. 5 103 – 144	11 ft. 1 83 – 216	4 ft. 8 98 – 154	24 ft. – 72 – 360	7 ft. 6 90 – 180
150	12.6	$\frac{1}{50}$	13 ft. – 106 – 262	6 ft. 3 in. 115 – 190	~~[illegible]~~ 20. – 97 – 337	~~[illegible]~~ 7 ft. 7. 117 – 208	68 ft. 2 82 – 900	12 ft. 8 106 – 258
180	15 –	$\frac{1}{60}$	20 ft. – 120 – 360	8 ft. – 144 – 240	36 – 108 – 540	12.1 135 – 280	infinite 90 – ∞	20 ft. – 120 – 360

$a = Rf$

$\frac{afm}{af - cm} = \frac{Rf^2 m}{Rf^2 - cm} = l$

$R = 2.5$
3.0
3.5
4.0

$\frac{Rf^2 m}{Rf^2 + cm} = n$

the reduction at 20 feet = 240
is [illegible] a camera of 3 inch focus

$\frac{1}{80}$

$m l' = f l' + ~~m l'~~ f m'$

$l'(m' - f) = f m'$

$\therefore m m' = f m' + f m$

$m'(m - f) = f m$

$\frac{720}{3 - .720} = \frac{720}{2.28} = \frac{3 ~~\ldots~~ 240}{63} = ~~\ldots~~$

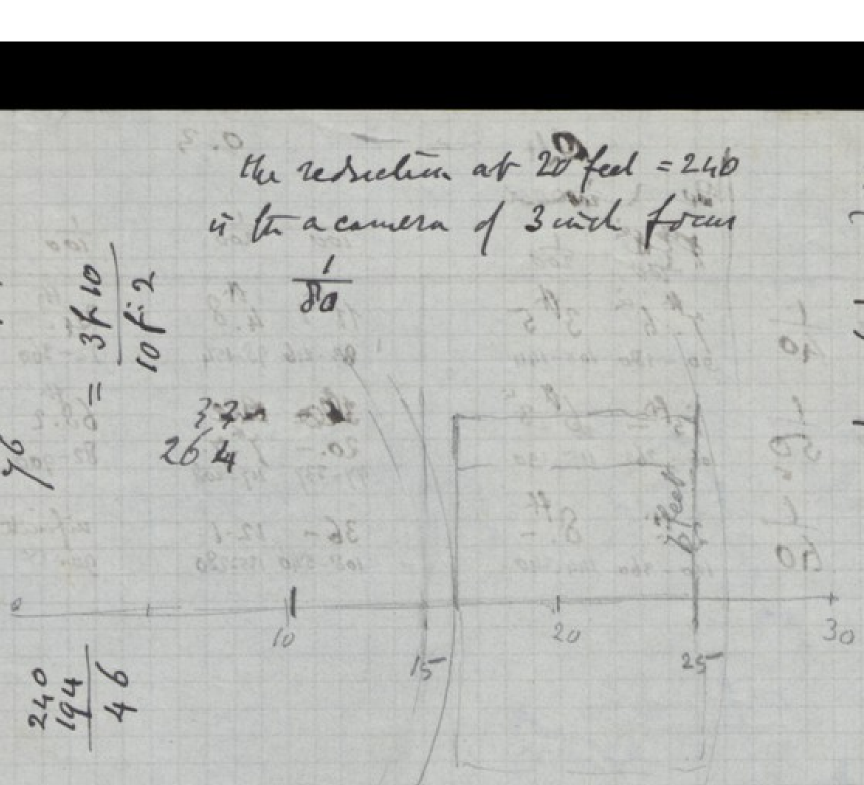
$af = 3$
$cm = 0.720$

$= 316 \quad \frac{240}{76} = 6f4$

$\frac{720}{3.72} = \quad \frac{240}{194} \quad 46$

$= \frac{3f10}{10f2}$

~~3.2~~
26.4



$R = \frac{a}{f}$ $f = 3.0$ $m = 120$

$l = \frac{Rf^2m}{Rf^2 - cm}$ $\quad n = \frac{Rf^2m}{Rf^2 + cm}$

$c = \frac{1}{100}$ $\quad Rf^2m = 2.5 \times 120 = 225 \times 120 = 2700$

$R = 0.4$ $\quad Rf^2 = 2.7 \times 0.4 = 1.08$ $\quad Rf^2 - cm = 71.3$ $\quad 177$

$f^2 = 9.0$ $\quad cm = 1.2$ $\quad Rf^2 + cm = 25.7$ $\quad 114$

$c = \frac{1}{100}$ $\quad cm = 1.2$

$R = \frac{a}{f} = 0.4$ $\quad Rf^2 = 3.6$ $\quad Rf^2m = 432$

$f^2 = 9$ $\quad cm = 1.2$

$Rf^2 - cm = 2.4$ $\quad l = 180$ $\quad 90 = 7^{ft}.6^{in}$

$Rf^2 + cm = 4.8$ $\quad n = 90$

$c = \frac{1}{200}$ $\quad cm = .24$

$Rf^2 = 3.6$

$cm = 0.6$ $\quad l = 144$ $\quad 41 = 3^{ft}.5^{-}$

$Rf^2 - cm = 3.0$ $\quad n = 103$

$+ \quad = 4.2$

$R = 0.4$ $\quad Rf^2m = 3.6 \times 150 = 540$

$f^2 = 9.0$ $\quad Rf^2 = 3.60$

$m = 150.$ $\quad cm = 0.54$

$c = \frac{1}{100}$ $\quad Rf^2 - cm = 3.06$ $\quad 180$

$+ \quad = 4.14$

as above $\quad Rf^2 = 3.60$

Graph $c = \frac{1}{200}$ $\quad cm = 0.75$ $\quad l = 190$ $\quad 75 = 6ft3in$

$- \quad 2.85$ $\quad n = 115$

$+ \quad 4.35$

$m = 180$ $\quad Rf^2m = 3.6 \times 180 = 648$

$R = 0.4$

$f^2 = 9.0$ $\quad Rf^2 = 3.6$

$c = \frac{1}{100}$ $\quad cm = 1.8$

$- \quad = 1.8$ $\quad l = 360$ $\quad 240 = 20ft$

$c = \frac{1}{200}$ $\quad + \quad = 5.4$ $\quad n = 120$

$Rf^2 = 3.6$

$cm = 0.9$

$- \quad 2.7$

$+ \quad 4.5$

$l = 240$ $\quad 96 = 8ft$

$n = 144$

$R = 0.2$ $\quad Rf^2 = 1.8$ $\quad Rf^2m = 216$

$f^2 = 9$ $\quad cm = 1.2$

$m = 120$ $\quad 0.6$ $\quad 360$ $\quad 288 = 24^{ft}$

$c = \frac{1}{100}$ $\quad 3.0$ $\quad 72$

$c = \frac{1}{200}$ $\quad 1.8$

0.6

1.2 $\quad 180$ $\quad 90 = 7^{ft}6$

2.4 $\quad 90$

$R = 0.2$ $\quad Rf^2 = 1.8$ $\quad Rf^2m = 270$

$m = 150$ $\quad cm = 1.5$

$c = \frac{1}{100}$ $\quad 0.3$ $\quad 900$ $\quad 818 = 68^{ft}2^{in}$

$f^2 = 9$ $\quad 3.3$ $\quad 82$

$c = \frac{1}{200}$ $\quad 1.80$

0.75

1.05 $\quad 258$ $\quad 152 = 12^{ft}.0^{in}$

2.55 $\quad 106$

$m = 180$ $\quad Rf^2 = 1.8$ $\quad Rf^2m = 18 \times 18 = 324$

$c = \frac{1}{100}$ $\quad cm = 1.8$ $\quad l = \infty$

0.0 $\quad n = 90$

3.6

$c = \frac{1}{200}$ $\quad 1.8$

$cm = 0.9$

0.9 $\quad 360$ $\quad 240 = 20^{ft}$

2.7 $\quad 120$

$R = 0.3$ $\quad Rf^2 = 2.7$ $\quad Rf^2m = 324$

$f^2 = 9.0$ $\quad cm = 1.2$

$m = 120$ $\quad - \quad 1.5$ $\quad 216$ $\quad 133 = 11^{ft}.1$

$c = \frac{1}{100}$ $\quad + \quad 3.9$ $\quad 83$

$c = \frac{1}{200}$ $\quad 2.7$

0.6

$- \quad 2.1$ $\quad 154$ $\quad 56 = 4^{ft}8^{in}$

$+ \quad 3.3$ $\quad 98$

$m = 180$ $\quad Rf^2 = 2.7$ $\quad Rf^2m = 486$

$f^2 = 9.0$ $\quad cm = 1.8$

$R = 0.3$ $\quad 0.9$ $\quad 540$ $\quad 432 = 36^{ft}-^{in}$

$c = \frac{1}{100}$ $\quad 4.5$ $\quad 108$

$c = \frac{1}{200}$ $\quad 2.7$

0.9

1.8 $\quad 280$ $\quad 145 = 12^{ft}.1$

3.6 $\quad 135$

$m = 150$ $\quad Rf^2m = 405$

$f^2 = 9$ $\quad 2.7$

$R = 0.3$ $\quad 1.5$

1.2 $\quad 337$ $\quad 240 = 20^{ft}-$

$c = \frac{1}{100}$ $\quad 4.2$ $\quad 97$

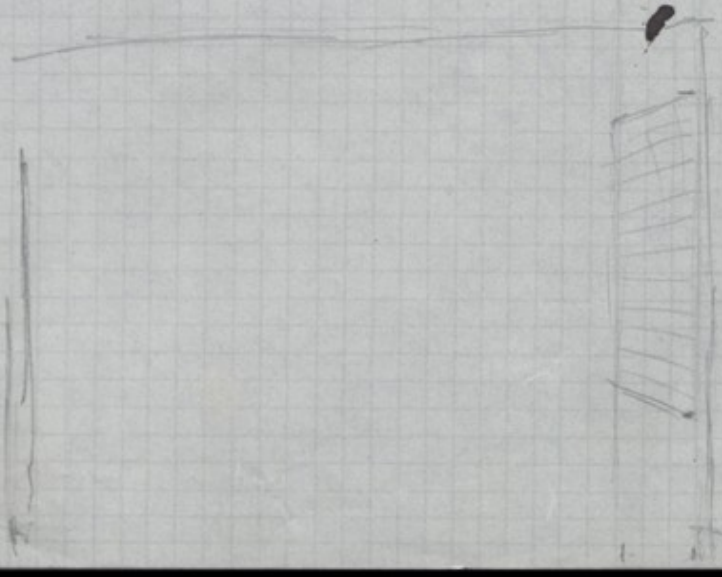
$c = \frac{1}{200}$ $\quad 2.70$

0.75

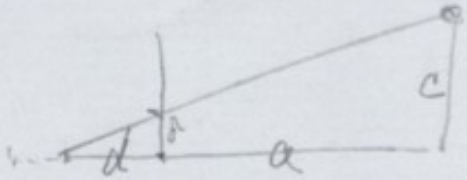
1.95 $\quad 208$ $\quad 91 = 7^{ft}7^{in}$

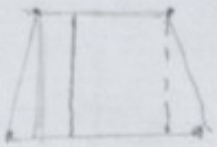
3.45 $\quad 117$

Point / S Lat / East Long	Square ways		Diagonal ways		
	S Lat	E Long	S Lat	E Long	
Point	70	50	60	90	
North Intersection		55	66		
South "		35		18	
Point	80	70	60	100	Fairly good
North I	100	74	60	100	
South I	0	54	0	37	
Point	80	50	70	80	Good
North Int.	100	52	95	100	Calc 20 42
South	0	40	0	27	" 22 42



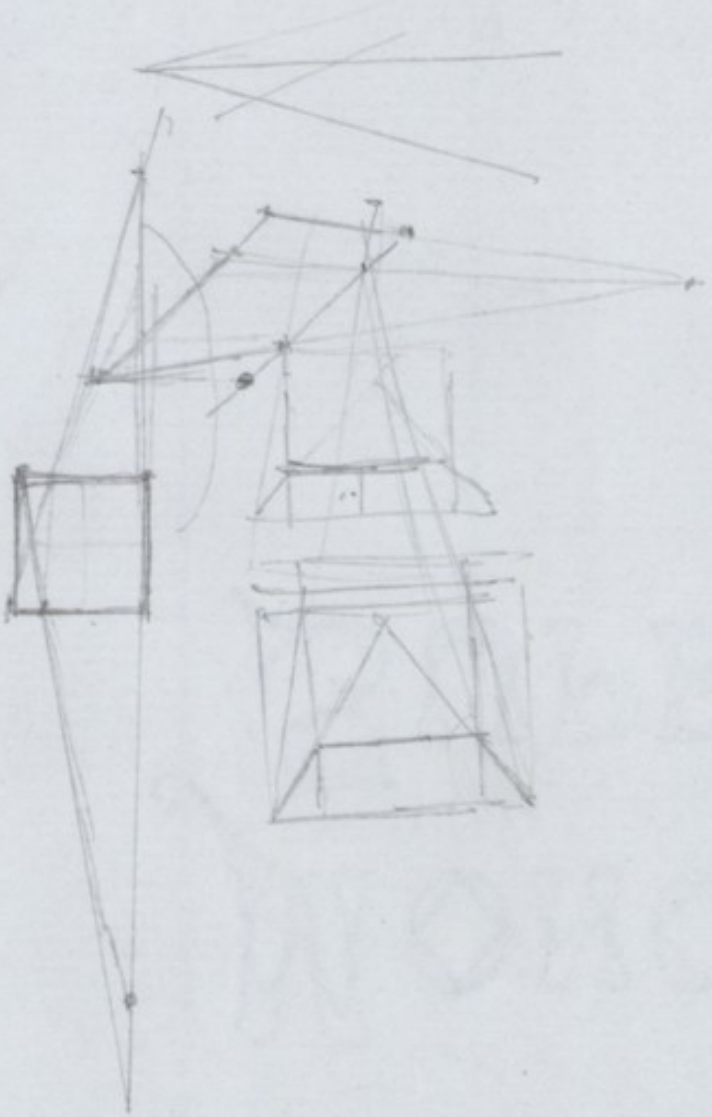
f.6

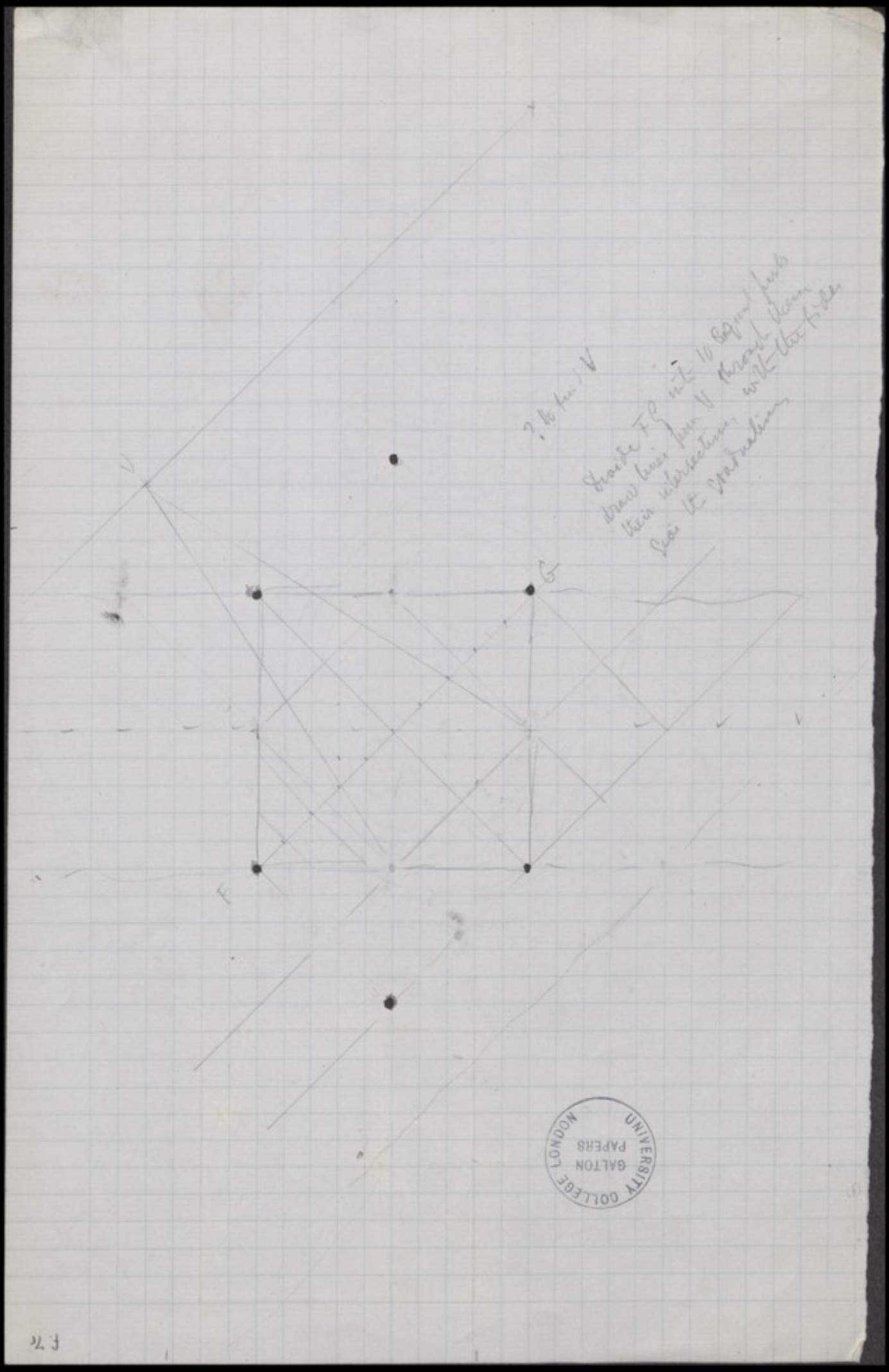




$\delta = \frac{d\,c}{a+d}$ $\quad d = 0.1 \;\; 0.2 \; - - - \; 0.9$ ten.

a $d = \frac{\delta c}{a+d}$





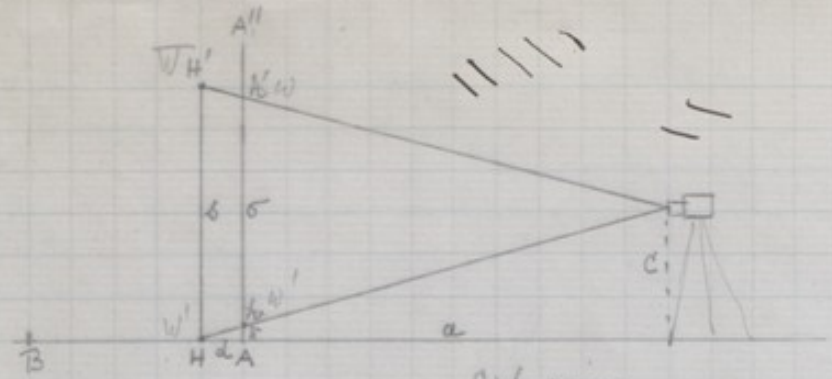


Fig 3

Side view

AA'' is the vertical edge of the plane of reference
HH', = δ, is a vertical line behind AA'', touching the ground at H
hh', = σ, is the apparent height of HH', as projected upon AA'',
when viewed from the camera
HA = d,
Ah, = δ, is the projection of d upon the plane of reference, when
viewed from the camera
C is the height of object glass of camera above the ground

then $\frac{\delta}{\sigma} = \frac{a+d}{a}$

(2) whence $\delta = \sigma \cdot \frac{a+d}{a}$ $\sigma = \frac{\delta a}{a+d}$

again $\frac{\delta}{d} = \frac{c}{a+d}$

(3) whence $\delta = \frac{dc}{a+d}$

Tofts Library Fig 4

Lofty living

Ground plan Horizontal
Plane of reference Vertical
any of the objects & fiducial scale of inches
true for any measure either on the ground plan or on the Plane of Refer^ce Y

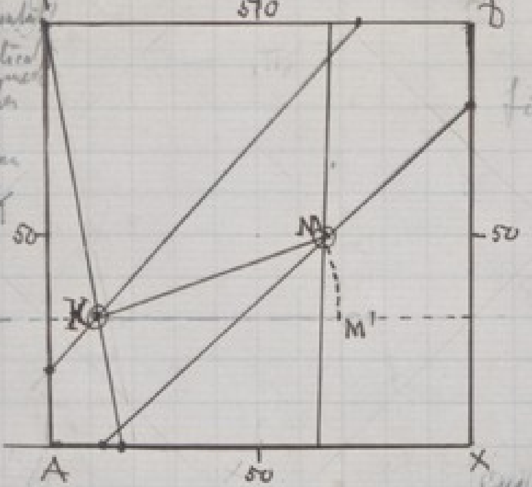


fig 4

2 suspended balls P, Q

Intersection of vertical planes through camera I and P with the ground fig 4 runs from $y=10, x=0$ to $y=0, x=14$ that through Camera II & P with the ground runs from $y=16$ $x=7.4$ to $y=1.8$ $x=0$ The point at which these lines cross gives the base of the vertical from P to the ground. Similarly as to that from Q to the ground. [their perspective distances from AP are found to be 3.0 & 5.0] Consequently by the method already explained the heights of P & Q are determined by formula ( ). The length PQ is determined by measure, it is 5.7 this length measured along the line PQ parallel to AB is PQ' whence the length according to the fiducial scale is determined by formula ( )

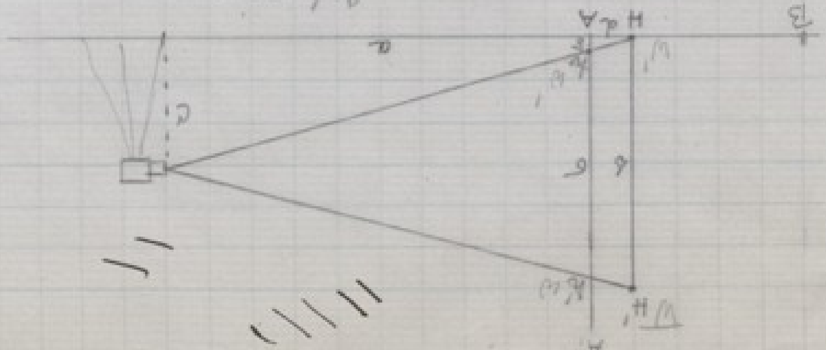


Fig 3

Side view

AA'' is the vertical edge of the plane of reference
HH', = s, is a vertical line behind AA'', touching the ground at H
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HA = d,
Ah, = δ, is the projection of d upon the plane of reference, when viewed from the camera
c is the height of object glass of camera above the ground

then $\frac{s}{\sigma} = \frac{a+d}{a}$

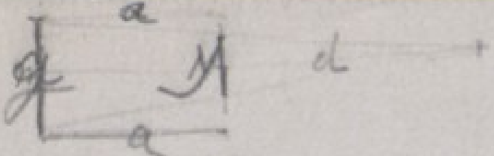
(2) whence $s = \sigma . \frac{a+d}{a}$ $\quad \sigma = \frac{sa}{a+d}$

again $\frac{\delta}{d} = \frac{c}{a+d}$

(3) whence $\delta = \frac{dc}{a+d}$

Tofty living Fig 4

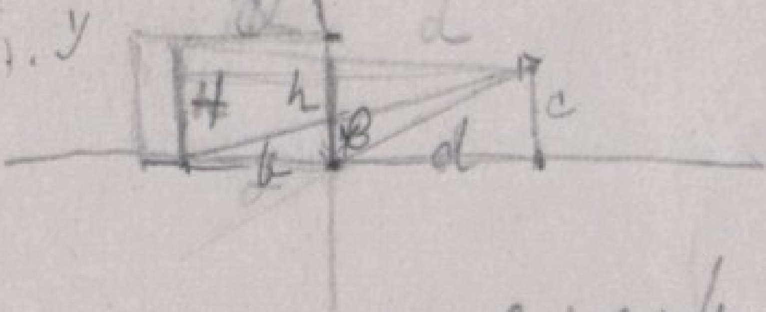
15 + f. 8r



~~$y = d \frac{g}{g+d}$~~

$g = \left(\frac{d+a}{d}\right) \cdot y$

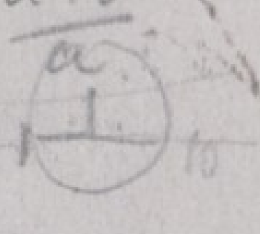
29/3000 (103.5
29/100
87/130



a : a+b

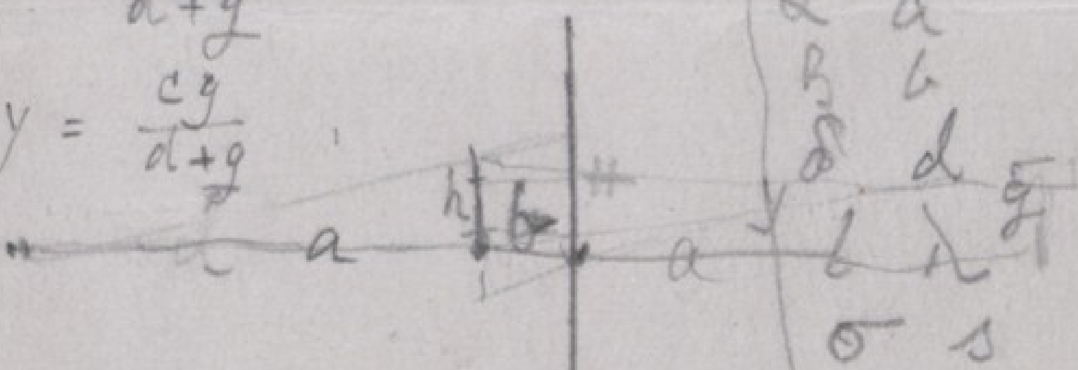
h : H :: d ~~: d~~ + ~~a~~

$H = \frac{d+a}{d} = h\,\frac{a+b}{a}$



$\frac{y}{g} = \frac{c}{d+g}$

$y = \frac{cg}{d+g}$



α	a
β	b
δ	d
γ	g
λ	l
σ	s
μ	m
ν	n
π	p
ρ	r
ξ	x

distance from Camera of plane of reference d

Height of Camera c

length of a graduations g y

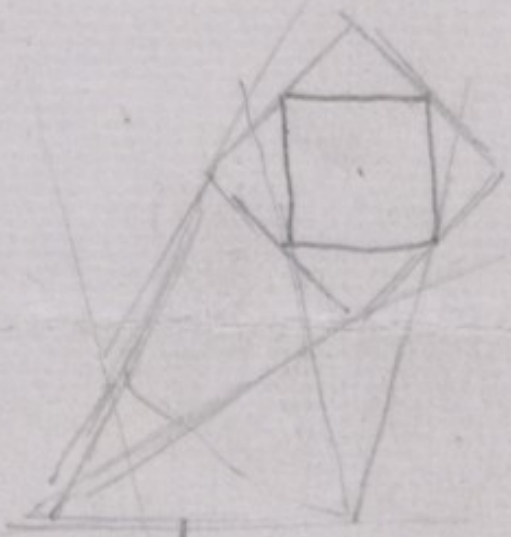
horse height σ

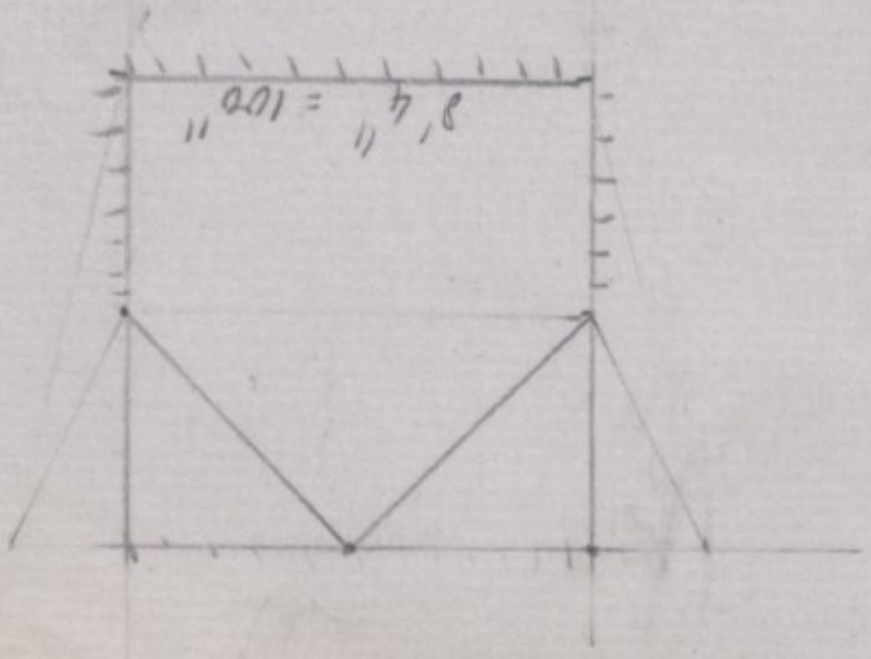
stature s

between horse & plane b) β

$$\frac{100 \times 40}{40} = 100$$

$$\text{tr} \quad \frac{40 \times 100}{20} = 200$$





f. 8v

$a = 20 \text{ feet} = 240 \text{ inches}$
$c = 5 \text{ feet} = 60 \text{ inches}$
$b = 10 \text{ feet} = 120 \text{ inches}$
to find values of δ for $d = 10'', 20'', 30'', \text{ and } 40$ inches, also for $d = b = 120''$

from 3 $\quad \delta = \dfrac{dc}{a+d}$

$d = 10 \quad \dfrac{600}{250} = 2.40$

2.22

$d = 20 \quad \dfrac{1200}{260} = 4.62$

2.05

$d = 30 \quad \dfrac{1800}{270} = 6.67$

1.90

$d = 40 \quad \dfrac{2400}{280} = 8.57$

1.78

$d = 120 \quad \dfrac{7200}{360} = 20.00$

$d = 50 \quad \dfrac{3000}{290} \quad 10.35$

$d = 100 \quad \dfrac{6000}{340} = 17.7$

Take diameter of efficient-circle on plane of reference $= 12'' = 144$ in.
and axis of camera at the center

$d = 60 \quad \dfrac{3600}{300} = 12.00$

1.65

$d = 70 \quad \dfrac{4200}{310} = 13.55$

1.55

$d = 80 \quad \dfrac{4800}{320} = 15.00$

1.36

$d = 90 \quad \dfrac{5400}{330} = 16.36$

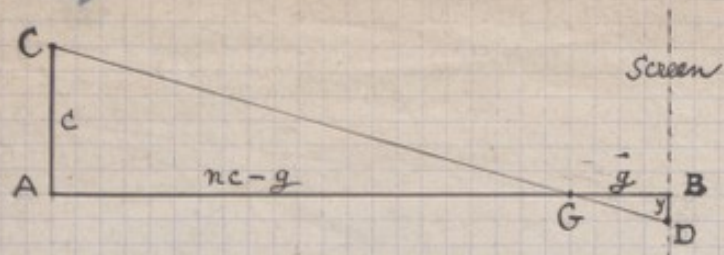
1.29

$d = 100 \quad \dfrac{6000}{340} = 17.65$

31/420 (13.55
31
110
93
170
155
150

33/540 (16.36
33
210
198
120
99
210

34/600 (17.65
34
260
238
220
204
160
136



AB = distance of Camera from screen, measured along the horizontal base
AC = height of Camera

Let G be some point on the horizontal base AB
then BD, (which is the intersection of CG produced, with the screen) is the projection of the horizontal distance GB, as viewed from C, upon the screen

Call AC, c; AB nc; GB, g; BD, y

then $\frac{y}{g} = \frac{c}{nc-g}$, $y = \frac{gc}{nc-g}$.

Values of y for those of c = 40, 50; n = 4, 5; g = 10, 20, 30, 40

	c = 40 inches				c = 50 inches				c = 60 inches			
	values of g in inches				values of g in inches				values of g in inches			
	10	20	30	40	10	20	30	40	10	20	30	40
n = 4	2.67	5.71	9.23	13.33	2.63	5.55	8.82	12.50	2.61	5.45	8.61	12.00
n = 5	2.10	4.44	7.06	10.00	2.08	4.35	6.82	9.53	2.07	4.29	6.67	9.29
n = 3	3.63	8.00	13.33	20.00	3.57	7.69	12.50	18.18	3.53	7.56	12.00	17.14
n = 6	1.74	3.64	5.71	8.00	1.73	3.57	5.56	7.69	1.71	3.53	5.45	7.51
n = 7	1.48	3.08	4.80	6.67	1.47	3.03	4.69	6.45	1.46	3.00	4.62	6.32

values of nc

n	c = 40 inches	c = 40 feet-inches	c = 50 inches	c = 50 feet-inches	c = 60 inches	c = 60 feet-inches
3	120	10-0	150	12-6	180	15 -
4	160	13-4	200	16-8	240	20 -
5	200	16-8	250	20-10	300	25 -
6	240	20-0	300	25.0	360	30 -
7	280	23-4	350	29-2	420	35 -

F. 11c

$y = \frac{qc}{nc - q}$

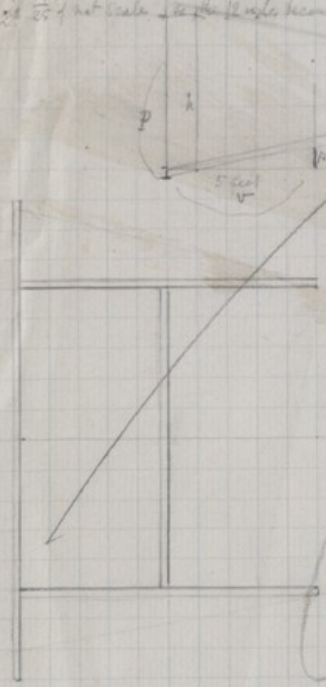
	$C = 40$, $n = 4$, $nc = 160$		$C = 40$, $n = 5$, $nc = 200$	
$q = 10$	$\frac{10 \times 40}{160 - 10} = \frac{400}{150} = 2.67$	3.04	$\frac{10 \times 40}{200 - 10} = \frac{400}{190} = 2.10$	2.34
$q = 20$	$\frac{20 \times 40}{160 - 20} = \frac{800}{140} = 5.71$	3.52	$\frac{20 \times 40}{200 - 20} = \frac{800}{180} = 4.44$	2.62
$q = 30$	$\frac{30 \times 40}{160 - 30} = \frac{1200}{130} = 9.23$	4.07	$\frac{30 \times 40}{200 - 30} = \frac{1200}{170} = 7.06$	2.94
$q = 40$	$\frac{40 \times 40}{160 - 40} = \frac{1600}{120} = 13.30$		$\frac{40 \times 40}{200 - 40} = \frac{1600}{160} = 10.00$	

	$C = 50$, $n = 4$, $nc = 200$		$C = 50$ $n = 5$ $nc = 250$	
$q = 10$	$\frac{10 \times 50}{200 - 10} = \frac{500}{190} = 2.63$	2.92	$\frac{10 \times 50}{250 - 10} = \frac{500}{240} = 2.08$	2.27
$q = 20$	$\frac{20 \times 50}{200 - 20} = \frac{1000}{180} = 5.55$	3.27	$\frac{20 \times 50}{250 - 20} = \frac{1000}{230} = 4.35$	2.47
$q = 30$	$\frac{30 \times 50}{200 - 30} = \frac{1500}{170} = 8.82$	3.67	$\frac{30 \times 50}{250 - 30} = \frac{1500}{220} = 6.82$	2.71
$q = 40$	$\frac{40 \times 50}{200 - 40} = \frac{2000}{160} = 12.50$		$\frac{40 \times 50}{250 - 40} = \frac{2000}{210} = 9.53$	

	$C = 40$ $n = 3$		$C = 50$ $n = 3$	
$q = 10$	$\frac{10 \times 40}{120 - 10} = \frac{400}{110} = 3.63$	4.37	$\frac{10 \times 50}{150 - 10} = \frac{500}{140}$	3.57 4.12
20	$\frac{20 \times 40}{120 - 20} = \frac{800}{100}$	8.00 5.33	$\frac{20 \times 50}{150 - 20} = \frac{1000}{130}$	7.69 4.81
30	$\frac{30 \times 40}{120 - 30} = \frac{1200}{90}$	13.33 6.67	$\frac{30 \times 50}{150 - 30} = \frac{1500}{120}$	12.50 5.67
40	$\frac{40 \times 40}{120 - 40} = \frac{1600}{80}$	20.00	$\frac{40 \times 50}{150 - 40} = \frac{2000}{110}$	18.18

$9 / 1200 (133$ $\frac{9}{30}$ $\frac{27}{3}$

$11 / 2000 (18.1$ $\frac{11}{90}$ $\frac{88}{20}$ $\frac{11}{9}$


P
h
5 feet
V

$C = 40$, $n = 6$

$q = 10$	$\frac{400}{240-10} = \frac{400}{230} = 1.74$	1.90	
20	$\frac{800}{240-20} = \frac{800}{220} = 3.64$	2.07	
30	$\frac{1200}{240-30} = \frac{1200}{210} = 5.71$	2.29	
40	$\frac{1600}{240-40} = \frac{1600}{200} = 8.00$		

$C = 50$, $n = 6$

$\frac{500}{300-10} = \frac{500}{290} = 1.73$	1.84	
$\frac{1000}{300-20} = \frac{1000}{280} = 3.57$	1.99	
$\frac{1500}{300-30} = \frac{1500}{270} = 5.56$	2.13	
$\frac{2000}{300-40} = \frac{2000}{260} = 7.69$		

$C = 40$, $n = 7$

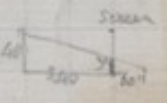
10 $\frac{400}{280-10} = \frac{400}{270} = 1.48$	1.60	
20 $\frac{800}{280-20} = \frac{800}{260} = 3.08$	1.72	
30 $\frac{1200}{280-30} = \frac{1200}{250} = 4.86$	1.87	
40 $\frac{1600}{280-40} = \frac{1600}{240} = 6.67$		

$C = 50$, $n = 7$

$\frac{500}{350-10} = \frac{500}{340} = 1.47$	1.56	
$\frac{1000}{350-20} = \frac{1000}{330} = 3.03$	1.66	
$\frac{1500}{350-30} = \frac{1500}{320} = 4.69$	1.76	
$\frac{2000}{350-40} = \frac{2000}{310} = 6.45$		

	$n=3$, $c=60$	$C=60$, $y = \frac{nc}{nc-q}$, $c=60$ $n=4$, $nc=240$	$n=5$, $nc=300$	$n=6$, $nc=360$	$c=60$ $n=7$, $nc=420$
10	$\frac{600}{170} = 3.53$ 4.03	$\frac{600}{230} = 2.61$ 2.84	$\frac{600}{290} = 2.07$ 2.22	$\frac{600}{350} = 1.71$ 1.82	$\frac{600}{410} = 1.46$ 1.54
20	$\frac{1200}{160} = 7.56$ 4.44	$\frac{1200}{220} = 5.45$ 3.16	$\frac{1200}{280} = 4.29$ 2.38	$\frac{1200}{340} = 3.53$ 1.92	$\frac{1200}{400} = 3.00$ 1.62
30	$\frac{1800}{150} = 12.00$ 5.14	$\frac{1800}{210} = 8.61$ 3.39	$\frac{1800}{270} = 6.67$ 2.62	$\frac{1800}{330} = 5.45$ 2.06	$\frac{1800}{390} = 4.62$ 1.70
40	$\frac{2400}{140} = 17.14$	$\frac{2400}{200} = 12.00$	$\frac{2400}{260} = 9.29$	$\frac{2400}{320} = 7.51$	$\frac{2400}{380} = 6.32$

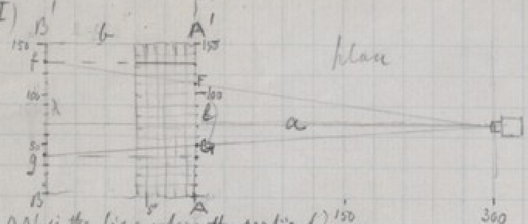
for a mark 60" beyond base
i.e. 100" from transport horizontal mark which is 40" on the camera



$y = \frac{60 \times 40}{240+60} = \frac{240}{300} = 0.8$

To find distance of camera from screen — see also fig 3

(I)



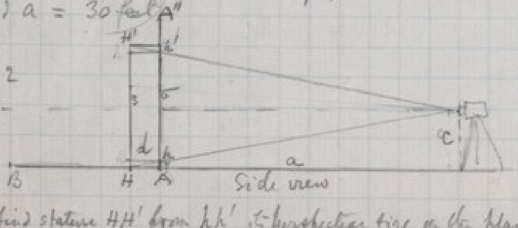
AA' is the line where the vertical plane of reference, call the ground,
BB is a back scale, AA' & BB' [illegible]
(FG) portion of AA', which appears to
l cover as many graduations as viewed from the camera as that between
f & g ($=\lambda$) on the back scale BB — call FG, l; fg, λ,
a = distance between object glass of camera & 'AA'
b = distance between AA' and BB'

then $\frac{a}{l} = \frac{a+b}{\lambda}$ $a\lambda = la + bl$ $a = \frac{bl}{\lambda - l}$

which determines a (the unknown) in terms of the known b, l, and λ

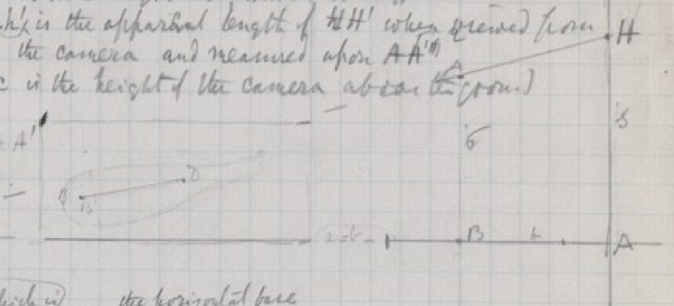
The graduations on AA' & BB' being sharp & clear and the distance b being considerable, [illegible] the value of the λ can be found with considerable precision
take b = 10 feet, $l = 4$, $\lambda = 6$, hence $\lambda - l = 2$
and a = 30 feet

fig 2



2) To find stature HH' from hh', its perspective size on the plane of reference
AA'' the vertical edge of the plane of reference. HH' the height of a vertical line standing on the ground)

AA'' is the vertical edge of the plane of reference
(, = s,) HH' is a line drawn vertically from a point H behind AA'' down to the ground touching it at H
(, = σ,) hh' is the apparent length of HH' when viewed from the camera and measured upon AA''
c is the height of the camera above the ground



3) to find the projection hA, which is the horizontal base HA upon the plane AA''
HA = d, & let hA = δ
then $\frac{\delta}{d} = \frac{c}{a+d}$

$$\frac{H}{h} = \frac{CP}{CB} = \frac{a}{a-b}$$

$$H = h \cdot \frac{a}{a-b}$$

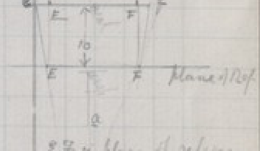
$$\frac{s}{\sigma} = \frac{HH'}{hh'} = \frac{a+d}{a}$$

$a s = a\sigma + d\sigma$
$s = \sigma\left(\frac{a+d}{a}\right)$

a = 30 ft
d = 2 ft
σ = 5 ft
$s = 5\frac{32}{30} = 5\frac{1}{3}$ feet $= 5$ ft 4 in.

at a distance HA behind
Call HH', s; hh', σ; HA, δ

EF = 10
ef = 8
[illegible]



EF in plane of reference occupies perspectively as much length as ef situated 10 feet behind it
a = dist. of cam. fr. EF

$\frac{a}{EF} = \frac{a+10}{ef}$

$a(ef) = a(EF) + 10\,EF$

$a\{(ef) - (EF)\} = 10\,EF$

$a = \frac{10(EF)}{(ef) - (EF)} = \frac{10 g}{g - 8}$

$l = s$ when plot is square

$$\frac{l}{l'} = \frac{a+l}{a} \qquad al = al' + ll'$$

$$l' = \frac{al}{a+l}$$

let $a = 2l$

$$l' = \frac{2l^2}{3l} = \frac{2}{3}l$$

let $l = 4s'$

$$c = \frac{s'l}{l-l'} = \frac{\frac{1}{4}l^2}{l(1-\frac{2}{3})} = l\,\frac{\frac{1}{4}}{\frac{3}{2}} = l\left(\frac{1}{4}\times\frac{2}{3}\right) = l\,\frac{1}{6}$$

$a = 2l$ $\quad a = 3l$
$c = \frac{3}{4}l$ $\quad c = l$
$s' = \frac{1}{4}l$ $\quad s' = \frac{1}{4}l$

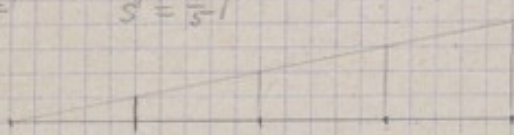
$$\frac{l}{s'} = \frac{l+a}{c} = \frac{l(1+n)}{lr} = \frac{1+n}{r}$$

$$\frac{l}{s'} = 5 = \frac{1+n}{r}$$

$$5r = n+1$$

$n=2 \quad r = \frac{3}{5}$
$n=3 \quad = \frac{4}{5}$

$a = 2l$ $\quad a = 3l$
$c = \frac{3}{5}l$ $\quad c = \frac{4}{5}l$
$s' = \frac{1}{5}l$ $\quad s' = \frac{1}{5}l$

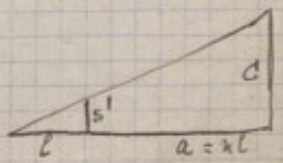


$s' = 0.2\,l$	$s' = 0.25\,l$
$s' = \frac{1}{5}l$	$s' = \frac{1}{4}l$
if $a = 2l$ then $c = \frac{3}{5}l$	if $a = 2l$ then $c = \frac{3}{4}l$
$a = 3l$ $\quad c = \frac{4}{5}l$	$a = 3l$ then $c = l$

These are correct

all for drawing then!

$a = 4l$ then $l' = \frac{4}{5}l$
$3l$ " " $= \frac{3}{4}l$
$2l$ " " $= \frac{2}{3}l$

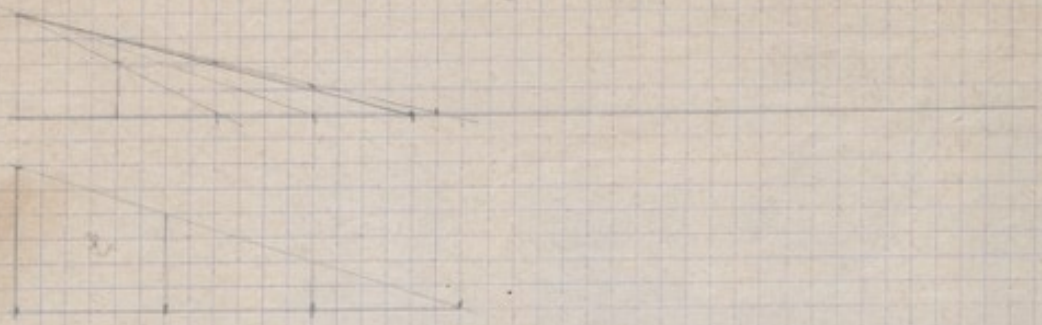


$c = rl$

$\frac{4}{5}l$ $a = 4l$

$l' = \frac{3}{4}l$ $a = 3l$

$= \frac{2}{3}l$ $a = 2l$



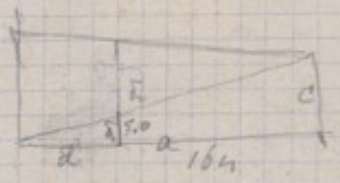
δ_1 δ_2

5.0 35.0

$\delta = 4.8$ $\frac{d}{\delta} = \frac{a+d}{c}$

$dc = a\delta + d\delta$

$d = \frac{a\delta}{c-\delta}$



$= \frac{4.8 \times 164}{35.4 - 4.8}$

$c = \frac{s'L}{l - l'}$ measured roughly 36.5

$c = \frac{8 \times 47.8}{10.8} = \frac{382.4}{10.8} = 35.4$ $l' = 37.0$ $l = 47.8$ $s' = 8$

$a = \frac{47.8 \times 37.0}{10.8} = \frac{1768.6}{10.8} = 164$

$= \frac{767.5}{30.0}$

$= 25.0$

$\frac{d}{5.0} = \frac{164+d}{35.4}$

$\delta = s' = 8$

$\frac{164 \times 8}{35.4 - 8.0} = \frac{1312}{27.4} = 47.9$

$\frac{h}{\delta} = \frac{a+d}{c}$ $dc = a\delta + d\delta$

$d = \frac{a\delta}{c-\delta}$

$= \frac{164 + 5}{35.4 - 5}$ $\frac{820}{30.4}$

$= 27$

$\frac{h}{\delta_2} = \frac{a+l}{a}$ 211.8

$h = \frac{35.0 \times \{164 + 47.8\}}{164} = \frac{7420}{164} = 43.9$

44 : 2 :: 48 : 150 $x = \frac{660}{48} = 13.8$

for $\frac{s'}{s} = \frac{1}{4}$ and $\frac{1}{5}$

$a = 3s$ and $= 2s$

$s' = \frac{s}{4}$ $s's = \frac{s}{4} \times s = \frac{s^2}{4}$ $4s' = s$ $s - s' = s(1 - \frac{1}{4}) = s \cdot \frac{3}{4}$

from (2) $c = \frac{s'L}{L - l'} = \frac{s's}{s - s'} = s \frac{\frac{1}{4}}{\frac{3}{4}} = \frac{s}{3}$

$4s' = s$

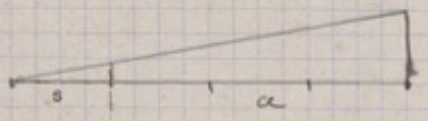
$a = 3s$

$c = \frac{3}{4}s$

$\frac{s'}{s} = \frac{1}{4}$

$s's = \frac{s}{4} \times s = \frac{s^2}{4}$

$s - s' = s - \frac{s}{4} = s(1 - \frac{1}{4}) = s\frac{3}{4}$



$s = 4s'$

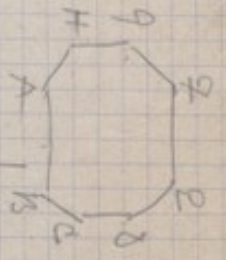
$a = 3s$

then $c = \frac{s}{3}$ $c = \frac{s'l}{L - l'} = \frac{s's}{s - s'} = \frac{\frac{1}{4}s^2}{s(1 - \frac{1}{4})} = \frac{s}{3}$

$s = 5s'$

$a = 3s$

then $c = \frac{s}{4}$ $c = \frac{\frac{1}{5}s^2}{(1 - \frac{1}{5})s} = \frac{s}{4}$

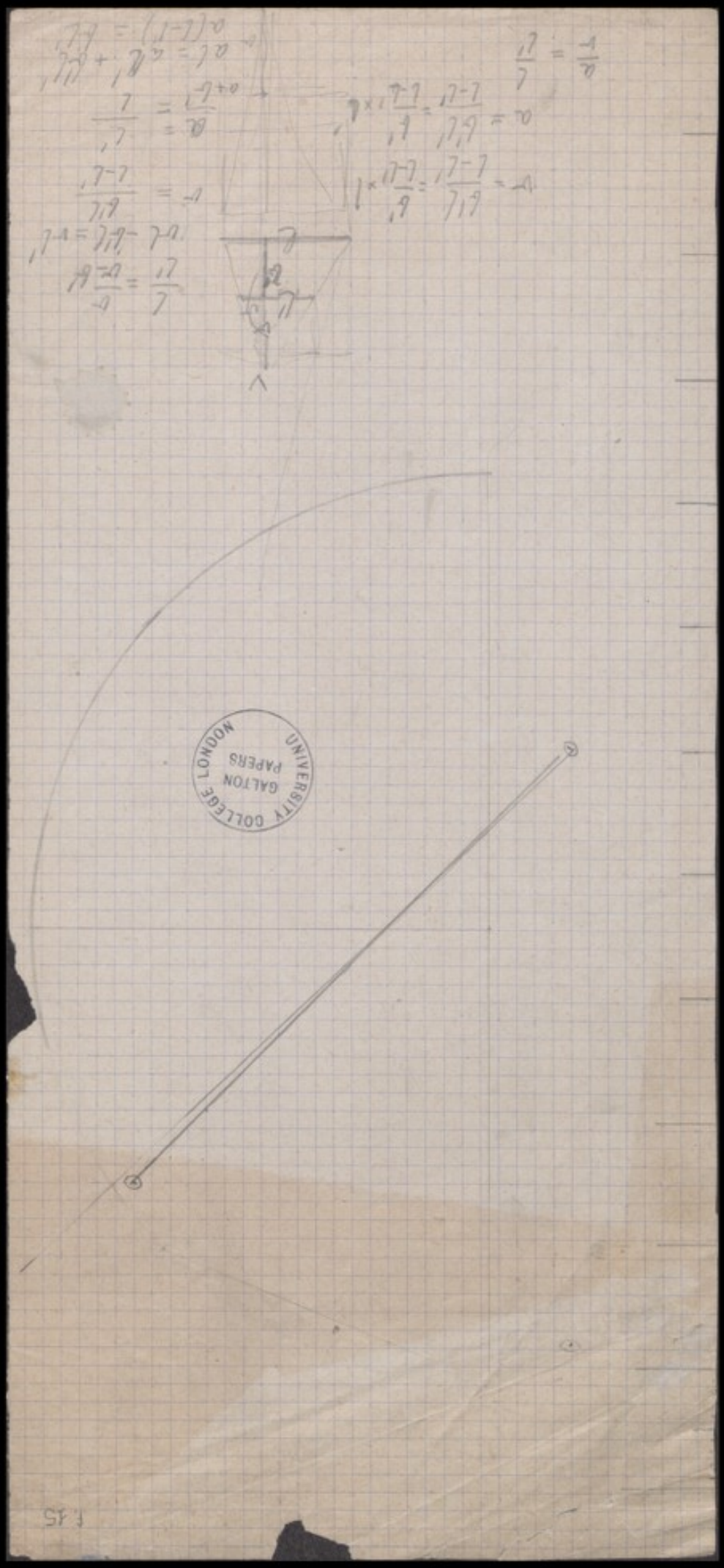


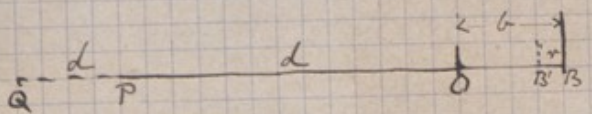
$s = 4s'$

$a = 2s$

$c =$

P.J.4 338





O is the optical centre of lens
B its back focus when its front focus is at P the nearer side of plate
B' " " " Q " further " "
$OB = b \quad OB - OB' = r \quad OP = a \quad PQ = b$
f = equivalent focus of lens

(1) $\frac{1}{f} = \frac{1}{a} + \frac{1}{b}$ $\qquad ab = fb + fa \qquad b = \frac{fa}{a-f}$

(2) $\frac{1}{f} = \frac{1}{a+d} + \frac{1}{b-r}$ $\qquad ab - ar + db - dr = fb - fr + fa + fd$

$b(a+d-f) = ar + dr - fr + fa + fd$

$$\frac{fa}{a-f} = \frac{ar + dr - fr + fa + fd}{a + d - f}$$

$$fa^2 + fad - f^2a = a^2r + adr - afr + a^2f + afd - afr - fdr + f^2r - f^2a - f^2d$$

$$fad = a^2r + adr - 2afr + afd - fdr + f^2r - f^2d$$

$$a^2 + a(d - 2f) = fd - f^2 + \frac{f^2d}{r} \qquad (1)$$

$$a^2 + a\left(\frac{d}{2} - 1f\right) + \frac{d^2}{4} - df + f^2 = fd - f^2 + f^2\frac{d}{r} + \frac{d^2}{4} - fd + f^2$$

$$= f^2\frac{d}{r} + \frac{d^2}{4}$$

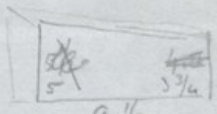
$$a = \sqrt{\left\{f^2\frac{d}{r} + \frac{d^2}{4}\right\}} - \frac{d}{2} + f \qquad (2)$$

14 : 95 :: 1 : x

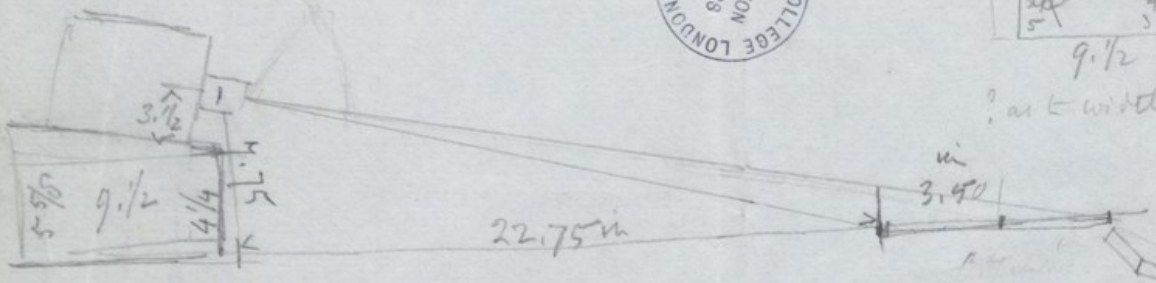
14/95 (7
9 8 tan⁻¹ 1 = 7

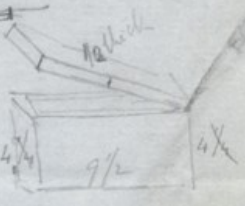
5 5/0
4 2/0
1. 3/0 tube in 9 1/2
tan⁻¹ 1.4 = 9 5

make box 5 1/2



? at ⊢ width





$\frac{22.75}{7.75} = 2.93$ $\frac{2820}{7.75} = 3.63$

$2 \tan^{-1} \frac{1}{2} = 2 \times 26^{0}.35 = 53$

width of my photo. tube 57.5 millim
real width 4 inches = 177. millim
25.3 x 7

2.75 in = 57.5

round. $\frac{177}{575} = 0.308$

Sgl focus about 6"
6 / 4.0
0.66

6 / 37.5
.62

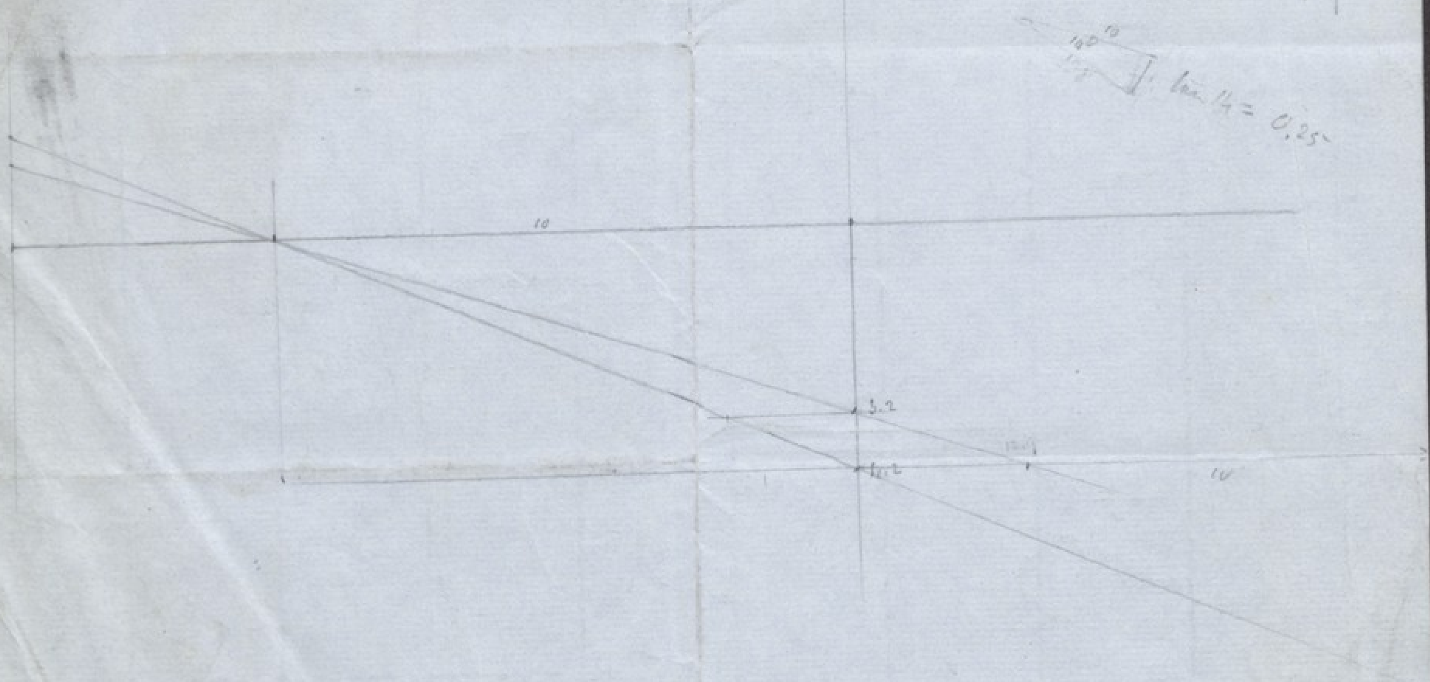
$\frac{1}{2}\theta = 26^{\circ}\ 33'$
$\theta = 53 . 6'$

$\frac{1}{2}$
16½
tan⁻¹ .295

14°
tan⁻¹ = .25

view angle 33°
within acceptable ~~width~~ of camera
longest ~~side~~
with d° depth shutter 5d 28°

40°
tan 14 = 0.25



$x = 100 R f^2$ $\quad c = \frac{1}{100}$ inch $\quad R = \frac{a}{f}$

$= \frac{1}{c} af$ $\quad c = \frac{a}{f} y \quad xy = f^2$

$c = \frac{af}{x}$ $\quad a = 1'' \quad f = 2.76$ inch $\quad x = 240''$ = 20 feet

$= \frac{2.76}{240} = \frac{0.276}{24} = \frac{1}{100} \times \frac{27.6}{24} = \frac{1}{100} \times 1.15$

$= .0115$

magnified 3 times $= .0345$

$= \frac{1}{30}$ths inch

Reduction at 240 inches

$= \frac{240}{2.76} =$ ~~87 of 1~~

87 : 1

$\frac{1}{87} \times 60''$ = height of writing

$= 0.69$ inch

$\frac{1}{f} = 0 + \frac{1}{y} \quad f = y$

$\frac{1}{87} \times 64 = 0.74$ is $\frac{3}{4}$ inch

x3 further by enlargement $= 2\frac{1}{4}$ inch

Camera focused on infinity $\quad$ back focus $= f = y_1$

Camera focused on $x \quad$ " $= y = y_2$

$\frac{1}{f} = \frac{1}{x} + \frac{1}{y}$

$xy = fy + fx$

let $x = ny \quad y = \frac{x}{n}$

then

$\frac{x^2}{n} = \frac{fx}{n} + fx$

$x = f + fn = f(1+n)$

then circle of confusion has diameter $= c$

aperture of lens $= a$

$OF = OF' = f$

$F'X = x \quad FY = y$

$\frac{y}{c} = \frac{f}{a}$

$\frac{f^2}{cx} = \frac{f}{a} \quad \# \quad \frac{cx}{f} = a$

$\frac{1}{c} \cdot x = \frac{af}{c}$ or $c = \frac{af}{x}$

reduction at 240 inches is :: 87 : 1

$\frac{1}{f} = \frac{1}{f+y_0} + \frac{1}{f+x}$

$x^2 + fx + fy + xy$

$= f^2 + fx + f^2 + fy$

$xy = f^2 \quad y = \frac{f^2}{x}$

$= \frac{1 \times 2.76}{240} = 0.0115$

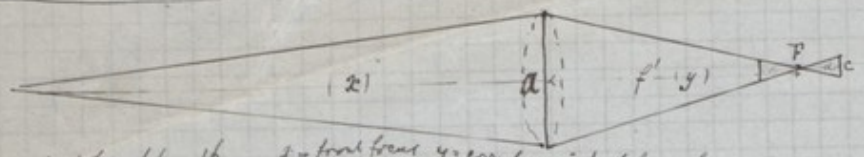
if magnified 3 times $= 0.0345$ inch

& from writers to ground $= 2\frac{1}{4}$ inch

The half of that is all that need be focused on the paper between

From paper by T. R Dallmeyer
Jour: Photo. Soc^y. March 30 – 1888.

I have a little modified it here & rather obscure in print



f = equivalent focal length . x = front focus, y = corresponding back focus to a given object

then if $x = nf$ $\quad y = \frac{1}{n} f$

$xy = f^2$

c = diameter of permissible circle of confusion
a = aperture (diameter of)
f' = back focal length to a particular objective point
d = distance of circle of confusion from f

$$\frac{a}{f'} = \frac{c}{d} \quad \text{or } c = \frac{a}{f'} d \qquad = \frac{a}{f'} y \text{ in this case}$$

Suppose the permissible size of circle to = $\frac{1}{100}$ th
and $\frac{a}{f'}$ is known = R suppose $\quad \therefore \frac{1}{100} = Ry \qquad \frac{1}{y} = R \cdot 100$

as $xy = f^2$ $\qquad x = 100 R f^2$

"table from" $= x + f = 100 R f^2 + f$

permissible diameter varies directly as aperture and therefore as the square of the magnification becomes

i.e. $x + f + d$ and $x + f - d$

To determine distance (on either side of a given point) where images of confusion = c

$x + f$ is given and f is known, to $y = \frac{f^2}{x}$ is known

$$\frac{a}{f+y} = \frac{c}{d} \qquad d = \frac{c(f+y)}{a} = \frac{c\left(f + \frac{f^2}{x}\right)}{a} = \frac{c(fx + f^2)}{ax}$$

let y_1 y_2 be the values to $y + d$ and $y - d$ respectively

$$y_1 = \frac{f^2}{x} + \frac{c(fx + f^2)}{ax} = f \cdot \frac{af + c(x+f)}{ax}$$

$$y_2 = \quad - \quad - \qquad f \cdot \frac{af - c(x+f)}{ax}$$

$x_1 y_1 = f^2 \quad y_1 = \frac{f^2}{x_1}$ $\qquad \frac{f^2}{x_1} = f \cdot \frac{af + c(x+f)}{ax}$, $\quad x_1 = f \cdot \frac{ax}{af + c(x+f)}$

$x_2 y_2 = f^2$ $\qquad - \quad - \quad -$ $\qquad x_2 = f \cdot \frac{ax}{af - c(x+f)}$

writing as $R = \frac{a}{f}$ $\qquad$ ~~$x + f$ = distance of object from~~

~~$x_1 + f = f$~~

$$\left.\begin{aligned} x_1 &= \frac{Rf^2 x}{Rf^2 + \frac{1}{100}(x+f)} \\ x_2 &= \frac{Rf^2 x}{Rf^2 - \frac{1}{100}(x+f)} \end{aligned}\right\}$$

$x_1 - \Delta$ and $x_2 + \Delta$ are the two required distances

these depend wholly on (1) Intensity $\left(\frac{a}{f} = R\right)$ & (2) on focal length f
also the interval varies directly as a

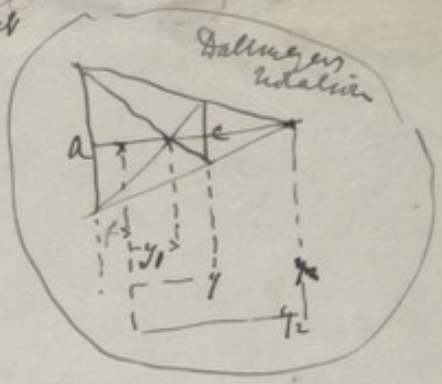
For nearer distance / plate
further ~ ~ ~ object

$$\frac{y - y_1}{c} = \frac{y_1 + f}{a}$$

$$y = \frac{f^2}{x}$$

$$y_1 = \frac{f^2}{x_1}$$

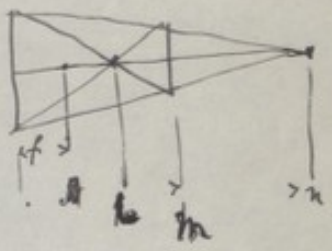
Dallmeyer notation



$$\frac{f^2}{cx} - \frac{f^2}{cx_1} = \frac{f^2}{ax_1} + \frac{f}{a}$$

$$\frac{f}{cx} - \frac{f}{cx_1} = \frac{f}{ax_1} + \frac{1}{a}$$

notation used here



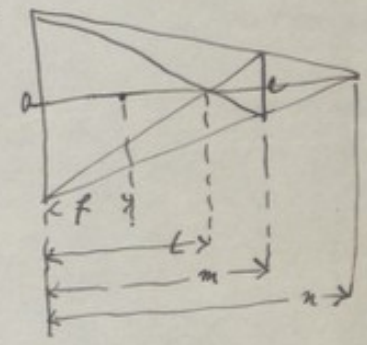
multiply by cxx_1a

$$afx_1 - afx = cfx + cxx_1$$

$$x_1(af - cx) = fx(a+c)$$

$$x_1 = \frac{fx(a+c)}{af - cx}$$

right



$$x_1 + f = \frac{af^2 - fcx + fax + f^2c}{af - cx}$$

$$= \frac{af(f+x)}{af - cx}$$

for x write $\mu - f$
x_1 $\lambda - f$

$$\lambda - f = \frac{f(\mu - f)(a+c)}{af - c(\mu - f)}$$

$$\lambda = \frac{af^2 - f\mu + cf^2 + f(\mu a + \mu c - fa - fc)}{af - c(\mu - f)}$$

$$\lambda = \frac{a\mu f}{af + cf - c\mu}$$ right.

? use dashed letters $l'm'n'$ for the camera and plain letters $l\,m\,n$ for the object

working it thus

$$L = \frac{amf}{af + cf - cm}$$

so

$$x = \frac{amf}{af + cf + cm}$$

or Calotal, instead of Dallmeyer

good

$$L = \frac{afM}{f(a+c) - cM}$$

$$N = \frac{afM}{f(a-c) + cM}$$

for scale of mm

57 : 120 = x : 100 37.5 : x :: 100 : 68

$x = \frac{68 \times 37.5}{100}$

Sec 5 (a)

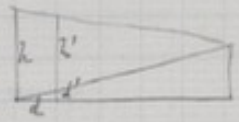
	fore	backward	vertical mm	
(1)	$\frac{3}{12} + \frac{7}{10}\frac{1}{12}$	$\frac{4}{12} + \frac{5}{10} \times \frac{1}{12}$	14.5	$l = l' \cdot \frac{152.3 + 25.5}{152.3} = 14.5 \times \frac{177.8}{152.3} = 14.5 \times 1.17 = 17.0$
	$\frac{37}{120} = 30.8$	$\frac{45}{120} = 37.5$ $\frac{68}{100} \cdot 37.5 = 25.5$ d		
(2)	$\frac{6}{12} + \frac{4}{10} \times \frac{1}{12}$	$\frac{5}{12} + \frac{7}{10} \times \frac{1}{12}$	27.0	$l' \times \frac{152.3 + 32.3}{152.3} = 27 \times \frac{184.6}{152.3} = 27 \times 1.21 = 32.7$
	$\frac{64}{120} = 53.3$	$\frac{57}{120} = 47.5$ $\frac{68}{100} \cdot 47.5 = 32.3$ d		

Sec 5 (b)

(1)	$\frac{3}{12} + \frac{1}{10}\frac{1}{12}$	$\frac{1}{12} + \frac{2}{10} \times \frac{1}{12}$	16.0	$16 \times \frac{152.3 + 6.8}{152.3} = 16 \times 1.05 = 16.8$
	$\frac{31}{120} = 25.8$	$\frac{12}{120} = 10.0$ $\frac{68}{100} \cdot 10.0 = 6.8$ d		
(2)	$\frac{6}{12} + 0$	$\frac{2}{12} + \frac{3}{10}\frac{1}{12}$	29.6	$29.6 \times \frac{152.3 + 13.0}{152.3} = 29.6 \times 1.09 = 32.3$
	$\frac{60}{120} = 50.0$	$\frac{27}{120} = 19.2$ $\frac{68}{100} \cdot 19.2 = 13.0$ d		

$l = 68.0$ $s' = 16.5$ $a = 152.3$

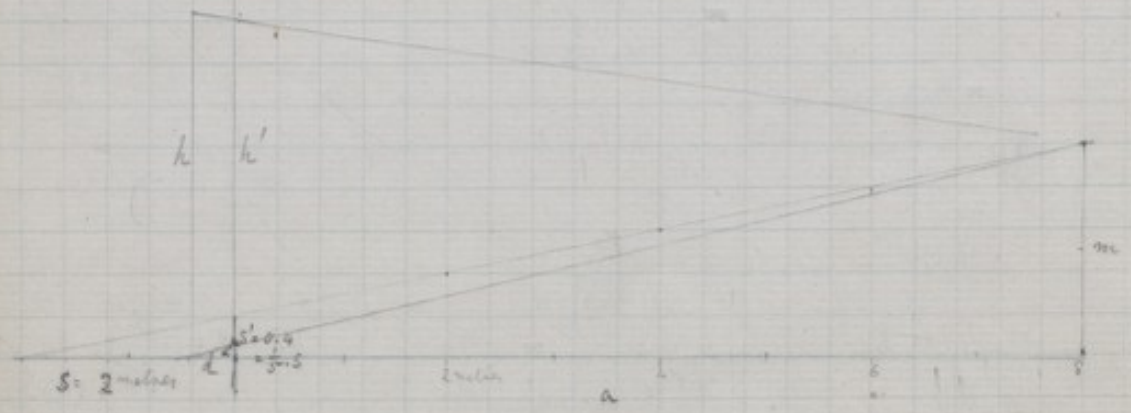
$l' = 47.0$ whence $m = 53.5$



$h = h' \cdot \frac{a+d}{a}$

$\frac{h}{h'} = \frac{a+d}{a}$

Calculate for values of d corresponding to $d' = \frac{s'}{10}, \frac{2s'}{10}$ &c



Calculate for (l = 4 metres)

s = 2

s' = 0.4

m = 2

a = 8

$d = d' \cdot \frac{a+d}{a}$ &c. find d for values of $d' = \frac{s'}{10}, \frac{2s'}{10}$ ... up to $s' = 0.4$

$= \frac{ad'}{a-d'}$

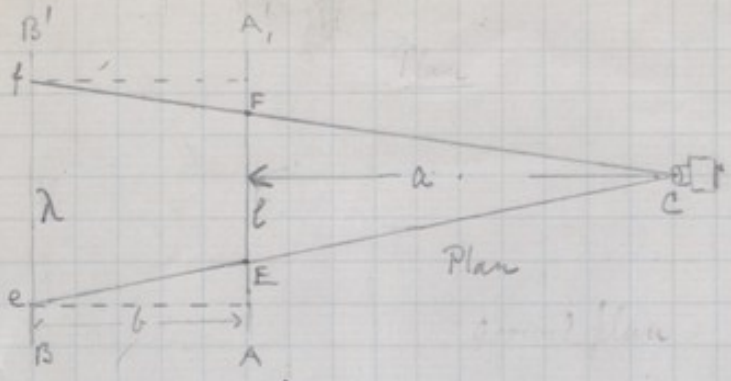


Fig 2

To find the distance of the camera

AA' is the line where the vertical plane of reference cuts the ground

BB' is a line on the ground parallel to AA', and at the distance AB from it; let AB = b

AA' and BB' are graduated alike.

C is the projection of the camera upon the ground plan

EF = l, is a portion of AA'

ef = λ, is the portion of BB' that appears, when viewed from C, to be of the same length as EF.

a is the horizontal distance of the camera from AA'

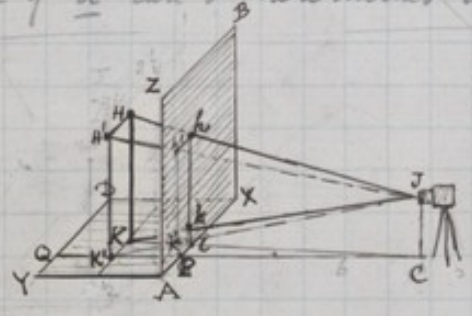
Then $\frac{a}{l} = \frac{a+b}{\lambda}$

(1) whence $a = \frac{bl}{\lambda - l}$,

Example. b = 10 feet, l = 4, λ = 2

$a = \frac{40}{4-2} = 20$ feet

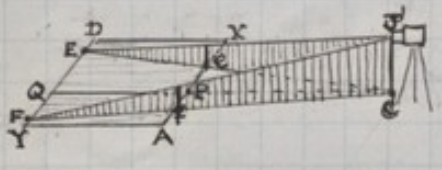
If the graduations on AA' BB' are sharp, and the distance b a considerable fraction of a, as in the above example, the value of a can be determined with much accuracy.



(2) $\frac{hk}{HK} = \frac{h'k'}{H'K'} = \frac{CP}{CP+PK'}$

$hk = \frac{HK \times CP}{CP+PK'}$ (3)

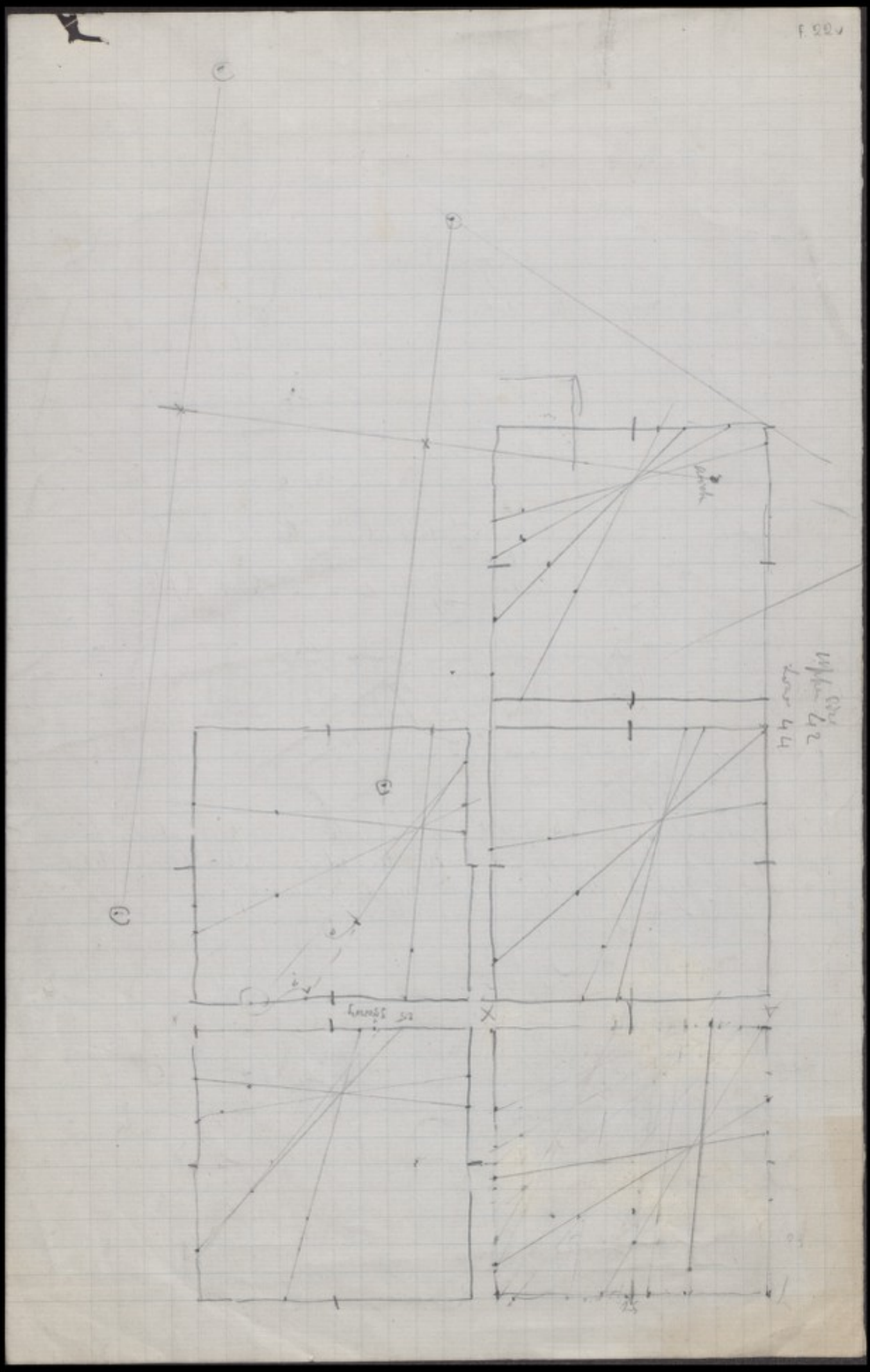
PK' being the horizontal surface distance from K to AX

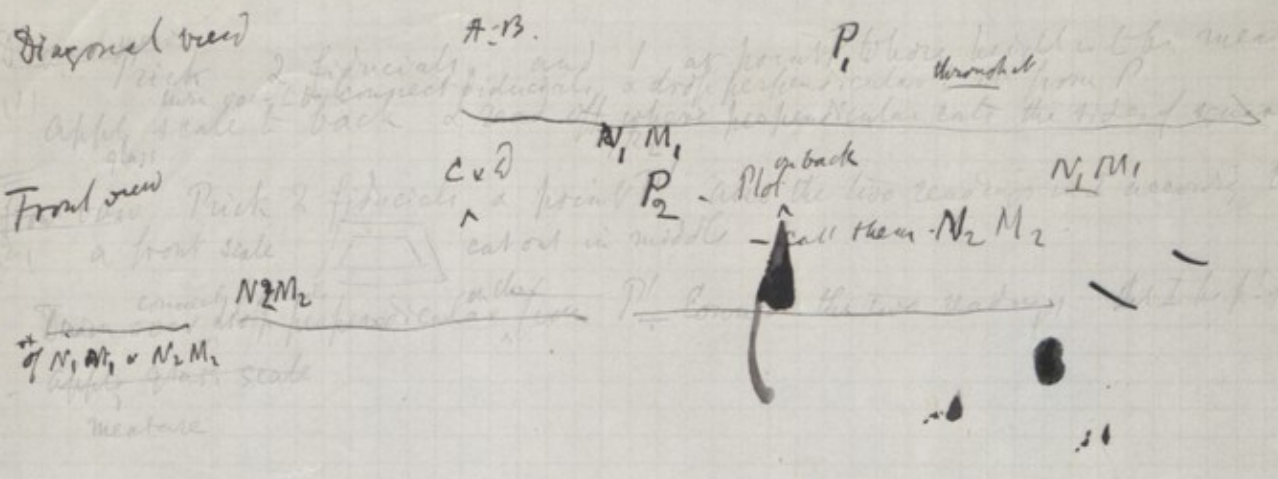


(3) $\frac{CP}{CP+PQ} = \frac{ef}{EF}$

$CP \times EF = CP \times ef + PQ \times ef$

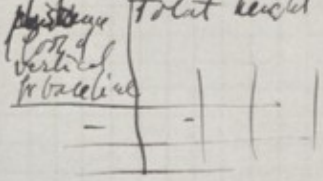
$CP = PQ \frac{ef}{EF-ef}$ (2)





Mark the rod with ● & ~~numbers~~ letters attached

Prepare ⊡ to corner table



Diagonal view

Prick the fiducial points A, B, and the point to be measured P

Call the prick holes as seen in the back, A_1 B_1 P_1

Join A_1 B_1 drop a perpendicular to it from P_1

Place scale ⊡ and note the intersections M_1 N_1 of the perpendicular with its two sides.

Front view

Prick the fiducial points in back line, C, D, and the point to be measured P

Call the prick holes as seen in the back C_2 D_2 P_2

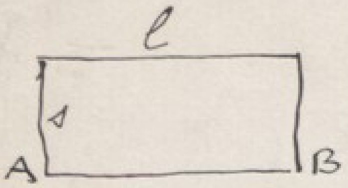
~~Mark~~ Place scale ⊡ and mark M_2 N_2

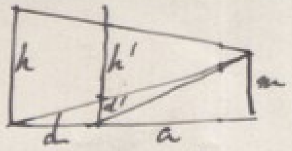
Join M_2N_2 — drop perpendicular from P_2Q_2 on to C_2D_2 ; join M_2N_2 intersecting P_2Q_2 at R_2

Place a millimetre scale with its zero at Q_2 & read off Q_2R_2 & Q_2P_2

Enter the table with these & read off the true value of PR.

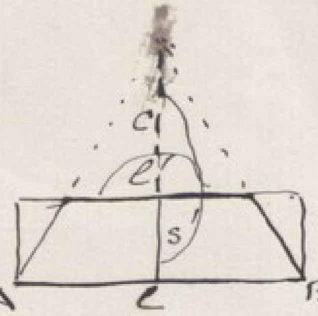
f. 24





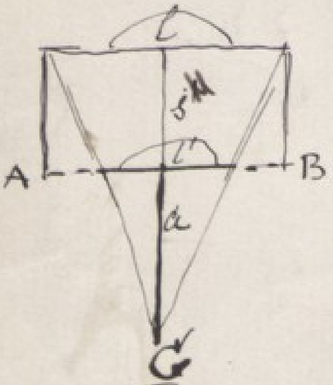
$h = h' \cdot \frac{a+d}{d}$

$d = d' \frac{a+d}{m}$

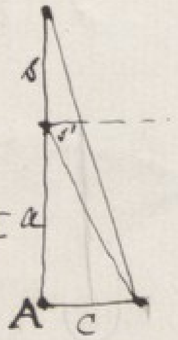


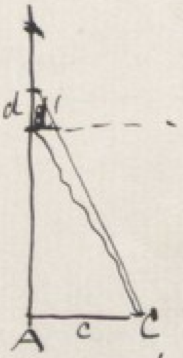
II

I)



III





l may be any portion of AB.

$\frac{a}{c} = \frac{s}{s'}$

(1) $\frac{a}{a+s} = \frac{l'}{l}$ --- $al = al' + sl'$ $a = \frac{sl'}{l-l'}$

$cl' = cl - sl$ $c = \frac{s'l}{l-l'}$

~~$ac + as' = ac + cs$~~

(2) $\frac{c}{c-s'} = \frac{l}{l'}$

$\frac{s'}{s} l = l \frac{c}{a}$ $\frac{a}{a+s} = \frac{c-s'}{c}$

$ac = ac - as' + sc - ss'$

whence

(3) $\frac{s'}{s} = \frac{c}{a+s}$

$s'(a+s) = sc$

or directly

$\frac{s'}{s} = \frac{c}{a+s}$ or $s = \frac{s'(a+s)}{c}$

also $= \frac{a}{c} \times \frac{l}{l'}$
because (1) $s = \frac{a}{l'} \times (l-l')$
$s' = \frac{c}{l} \times (l-l')$

(3') $\frac{d'}{d} = \frac{c}{a+s}$

or, given d', a, c, s, to find d

(4) $d = \frac{d'(a+s)}{c}$ then $\frac{a+s}{c}$ is a constant

Find c by drawing,
a ditto or by calc
s is known
= P' whose perp. dist. from ground line =
for a given d', find d by (4)
Find place on ground line corresp.
to P', by drawing.

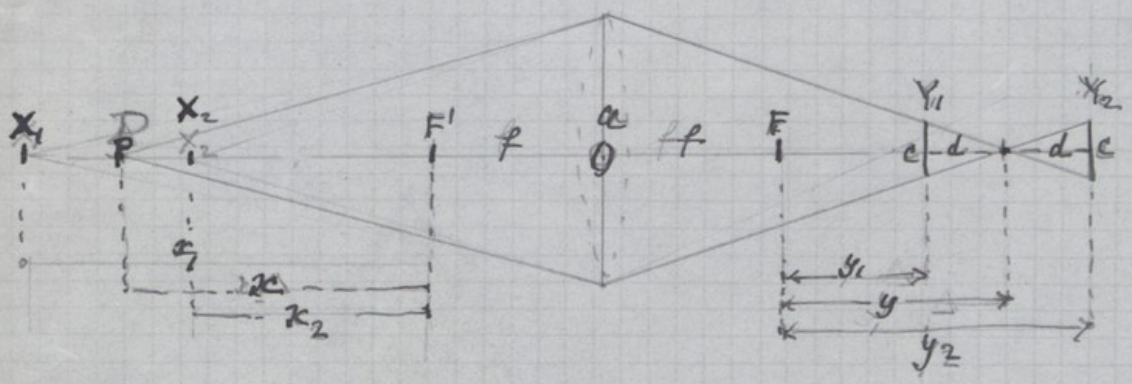
when a is same

$\frac{a}{...} \cdot \frac{l}{l'} = \frac{a+s}{a} = \frac{s}{s'}$, ~~$as' + ss' = sa$~~ ~~$s' = \frac{sa}{a+s}$~~

$= \frac{a+l}{a}$

$al = al' + ll'$

$l' = \frac{al}{a+l}$



To determine $\left\{\begin{matrix} x_2 - x_1 \\ \end{matrix}\right.$ c unless / a, f, x, and $x_1 - x_2$ in terms of a, f, c and $\Delta = x$

$y = \frac{f^2}{x}$ for all values of x

$\frac{a}{f+y} = \frac{c}{d}$ $\quad d = \frac{c(f+y)}{a} = c \cdot \frac{f + \frac{f^2}{x}}{a} = c \cdot \frac{fx + f^2}{ax}$

let $y_1 = y - d$ $\quad y_2 = y + d$

$y_1 = \frac{f^2}{x} - c \cdot \frac{fx + f^2}{ax} = f \cdot \frac{af - c(x+f)}{ax}$

$y_2 = \quad = f \cdot \frac{af + c(x+f)}{ax}$

$x_1 y_1 = f^2$ $\quad x_2 y_2 = f^2$

$x_1 = \frac{f^2}{y_1}$ $\quad x_2 = \frac{f^2}{y_2}$

$x_1 = f \cdot \frac{ax}{af - c(x+f)}$

$x_2 = f \cdot \frac{ax}{af + c(x+f)}$

$x_1 - x_2 = fax \left\{ \frac{1}{af + cx + cf} - \frac{1}{af + cx + cf} \right\}$

but cf is not worth considering, omitting it we have $fax \left\{ \frac{1}{af - cx} - \frac{1}{af + cx} \right\}$

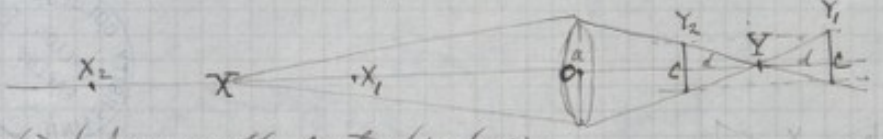
// In the ordinary formula for conjugate foci $\frac{1}{f} = \frac{1}{f'} + \frac{1}{f''}$

substitute $x+f$ for f' and $y+f$ for f''

also let $x = nf$; it follows then that $y = \frac{1}{n} f$

(1) and that $xy = f^2$ whatever the value of n, which is independent

Let the distance of the point on which the camera is focussed from the optical centre of its lens $= x+f$, then the conjugate focus Y in the image, be at $y+f$ the values of x & y being connected by equation (1)



Let c = diameter of permissible circle of confusion

$x \pm d$ = distance from Y at which this occurs viz at Y_1 & Y_2 respectively corresponding to the conjugate foci of X_1, X_2.

Consequently any point between X_1 & X_2 can give rise to a circle of confusion whose diameter exceeds c, which we will take = 0.01 inch

We have to find $X_1 X_2$ in terms of f, a & c, and

write x_1+f for distance OX_1 x_2+f for distance OX_2, y_1+f for OY_1 y_2+f for OY_2

$$\frac{d}{c} = \frac{y \pm f}{a} \qquad d = \frac{c}{a}(y+f) = \left(\frac{c}{a}\left(\frac{f^2}{x}+f\right)\right) = \frac{cfx + cf^2}{ax}$$

$$y_1 = y + d = \frac{f^2}{x} + \frac{cfx + cf^2}{ax} = f\left\{\frac{af + cx + cf}{ax}\right\}$$

in the cases with which we shall be concerned (put as $a=1$ $f=3$ $c=0.01$ $x=240$)

Consequently cf (= 0.03) may be neglected in comparison with af (= 3) $\times$ cx (= 2.4)

hence $y_1 = f\,\frac{af+cx}{ax}$ $\qquad x_1 = \frac{f^2}{y} = f\,\frac{ax}{af+cx}$

Similarly $y_2 = f\,\frac{af-cx}{ax}$ $\qquad x_2 = f\,\frac{ax}{af-cx}$

$$X_1X_2 = x_2 - x_1 = fax\left\{\frac{1}{af-cx} - \frac{1}{af+cx}\right\}$$

take $c = 0.0033$

$fax = 720$
$af = 3$
$cx = 0.7992 = 0.8$

$X_1X_2 = 720\left\{\frac{1}{2.2} - \frac{1}{3.8}\right\} = 720\left\{\frac{1.60}{8.36}\right\}$

(II) $= \frac{1152}{8.36} = 138$ inches $= 11\frac{1}{2}$ feet

$fax = 720$ (I) $af = 3$ $cx = 2.4$

$$X_1X_2 = 720\left\{\frac{1}{0.6} - \frac{1}{5.4}\right\} = 720\,\frac{4.80}{32.4} = 720 \times 1.48 = 1065.60 \text{ inches}$$

$= 88$ feet 10 inches

$12 \times 88 = 1056$, 10

(I) $x_1 = \frac{7200}{6.0} = 1200$ inches $= 100$ feet. $\qquad x_2 = \frac{720}{5.4} = 133$ inches $= 13\frac{1}{4}$ feet

88 feet 11 inches

diff^{ce} 1067 inches = 89 feet

(II) $x_1 = \frac{7200}{2.2} = 327$ inches $= 27$ feet 11 inches $\qquad x_2 = \frac{7200}{38.0} = 190$ inches $= 15$ feet 10 inches

diff^{ce} 137 inches $= 11\frac{1}{2}$ feet

that is when focussed on 240 inches

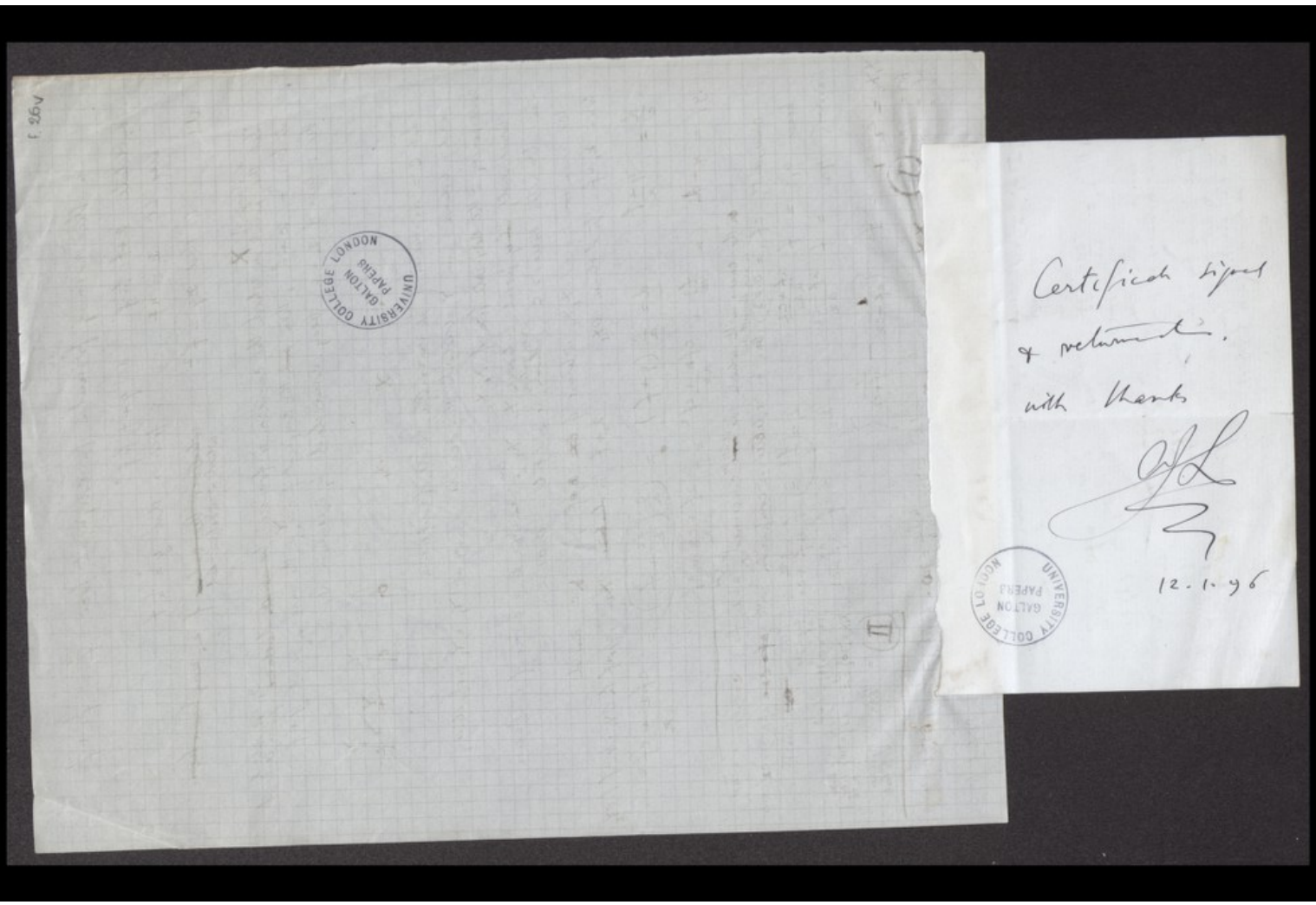
points distant $x+f$ from camera = 243 inches $\qquad$ 243

327 $\qquad$ 190

84 $\qquad$ 53

= 7 feet $\qquad$ = 4½ feet

or points 7 feet beyond and 4½ feet nearer are still sharply in focus, (as above defined, if $c = \frac{1}{300}$ inch.)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with thanks
12.1.96

f. 28

Points of Intersection	AY	YD	DX	AX	AY	YD	DX	AX
	70	90					50	100
I			90	56			50	50
II							50	0
III			40	40				

	AX	AY
1st Point	90	60
1st Pos 1	100	80
2	57	0
2nd Pos 1	100	50
2	50	10
3rd Pos 1	100	36
2	30	0
4th Pos		

	AX	AY	AX	AY	AX	AY	AX	AY	AX	AY	AY	AY
Point	40	86	30	90	60	70	20	80	50	80	70	60
1st 1	44	100	21	6	68	100	22	100	54	100	100	90
2	30	0	30	100	40	0	13	0	30	0	10	40
Point	70	70	52	80	80	60	40	70	60	80	80	50
2nd 1	95	100	62	100	60	82	80	100	60	100	100	70
2	10	0	0	3	35	0	0	11	23	0	30	0
Point	50	80	70	70	90	30	70	60	70	60	90	46
3rd 1	100	60	100	58	100	33	100	74	100	85	100	47
2	0	11	0	28	0	17	6	28	0	0	13	6
Point	90	40	50	70	86	20	70	30	80	40	90	30
4th 1	100	43	100	56	100	17	100	27	100	44	100	34
2	0	17	0	40	0	25	0	37	0	28	0	6

Equated

V. Goth

F. 1c

Permission to use the Reading-Room will be withdrawn from any person who shall write or make marks on any part of a Printed Book, Manuscript, or Map belonging to the Museum.

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Press Mark.	Name of Author, or other Heading of Work wanted.	Place	Date.	Size.
	Title.			
PP 2489 z	Stud Book the last volume published	London	~~1847~~	8vo

(Date) Oct 18 Francis Galton (Signature).

F. 13 (Number of the Reader's Seat).

Please to restore each Volume of the Catalogue to its place, as soon as done with. Not at 1.22 [P.T.O.

W B & L (299zs)—54094—300000-1-95

READERS ARE *PARTICULARLY* REQUIRED

1. Not to ask for more than *one work* on the same ticket.
2. To transcribe from the Catalogues all the particulars necessary for the identification of the Work wanted.
3. To write in a plain, clear hand, in order to avoid delay and mistakes.
4. To indicate in the proper place on each ticket the number of the seat occupied.
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7. To replace on the shelves of the Reading-Room, as soon as done with, such Books of Reference as they may have had occasion to remove for the purpose of consultation.

f. 21

ermission to use the Reading-Room will be withdrawn from any person who shall write or make marks on any part of a Printed Book, Manuscript, or belonging to the Museum.
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Press Mark.	Name of Author, or other Heading of Work wanted.	Place.	Date.	Size.
7291 g	English Cart Horse Society Title. (The Shire horse Stud book) (in progress)	London	the last volume	8.00

(Date) Oct 18/95 Francis Galton (Signature).

F. 13. 4 (Number of the Reader's Seat).

Please to restore each Volume of the Catalogue to its place, as soon as done with. 11-41 [P.T.O.

W B & L (200m)—84094—300000-1-95

f. 2v

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f. 3r

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Press Mark.	Name of Author, or other Heading of Work wanted.	Place.	Date.	Size.
7291 g	Eng. Cart Horse Soc. Stud Book.	Lon	1880	8°

(Date) 18.10.95

F. Galton (Signature).

F. 4 (Number of the Reader's Seat).

Please to restore each Volume of the Catalogue to its place, as soon as done with. [P.T.O.

W B & L (299 ea)—54094—300000-1-95

f. 3v

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F. 45

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Press Mark.	Name of Author, or other Heading of Work wanted.	Place.	Date.	Size.
7291 h	Hackney Stud Book. Vol. XII.	Lon.	'95	8°

(Date) 18.10.95. F. Eaton (Signature).

F. 4 (Number of the Reader's Seat).

Please to restore each Volume of the Catalogue to its place, as soon as done with. [P.T.O.

W B & L (209ks)—54094—300000-1-93

f. 4v

READERS ARE *PARTICULARLY* REQUIRED

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f. 5r

Press Mark.	Name of Author, or other Heading of Work wanted.	Place.	Date.	Size.
07293k	Suffolk. Suff. Chief Soc			
2 vols	Hist Dks Suffolk Bury 57 8			
	Vol I only Sheep St. Edmunds			

(Date) 8 Oct 14

Francis Galton (Signature).

F. 73 (Number of the Reader's Seat).

Please to restore each Volume of the Catalogue to its place as soon as done with.

[P.T.O.

W B & L (299 Bs) — 54094—300000-1-95

f. 5v

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f. 6r

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Press Mark.	Name of Author, or other Heading of Work wanted.	Place.	Date.	Size.
07293	Wensleydale Title. Long Wool Shepherd	Bedale	1890	4°

(Date) 6 Oct 18

F. Galton (Signature).

F. 4 (Number of the Reader's Seat).

Please to restore each Volume of the Catalogue to its place, as soon as done with.

[P.T.O.

W B & L (209ns)—54094—300000-1-95

f. 6v

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F. 7c

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Press Mark.	Name of Author, or other Heading of Work wanted.	Place.	Date.	Size.
	Title.			
07291 k	Herd Book Français 5 Vols 14 + 15 ent.	Paris	1886 & 1889	

(Date) 18/10/95

F. Gabbe (Signature).

F. 4 (Number of the Reader's Seat).

Please to restore each Volume of the Catalogue to its place, as soon as done with. [P.T.O.

W B & L (290ms)—54004—300000-1-95

f. 7v

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f. 8v

A2954

Carlyle's House Memorial Trust.

Received *the Sum of* ***One Shilling,*** *being the Fee charged on Admission to* ***Carlyle's House, 24, Cheyne Row, Chelsea.***

On behalf of the Trust Committee.

y fertility of an individual for deviation x from M_p

M_m mean all males σ_m

M_p parents σ_p

M_o offspring equal no. for each family σ_o

M_1 all offspring σ_1

r_o C[illegible] parent & offspring
supposing offspring equal in no.

ρ - - parent & fertility

v = standard dev. of [illegible] fertility / mean fertility

Prim j_1 = BX_1 = 1 inch
Sec j_2 = HX_2 = 1.41 inch

Prim BG_{x_1} = $BX_1 \frac{bg}{bx_1}$ $\qquad PG = BX_1 \frac{hg}{bx_1}$

Sec HF = $HX_2 \frac{hf}{hx_2}$

For point C

$\frac{bg_c}{bx_1} = \frac{32.5}{58} = 0.56$ $\qquad \frac{hg_c}{bx_1} = \frac{32}{58}$ 0.552

$\frac{hf_2}{hx_2} = \frac{33.5}{70.5} = 0.475$
$\times 1.41 = .67$

balanced to
for
E bo_3 46
C 41
A 20

$x = 0.57$ $\qquad y = 0.57$ $\qquad z = 0.41$

For point A.

$\frac{bg_a}{bx_1} = \frac{14.0}{58} = 0.24$ $\qquad \frac{hg_a}{bx_1} = \frac{18.0}{58} = 0.31$

$\frac{hf_a}{hx_{2a}} = \frac{16.7}{70.5} = 0.237$
$\times 1.41 = .334$

$x = 0,22$ $\qquad y = 0,43$ $\qquad z = 0,20$

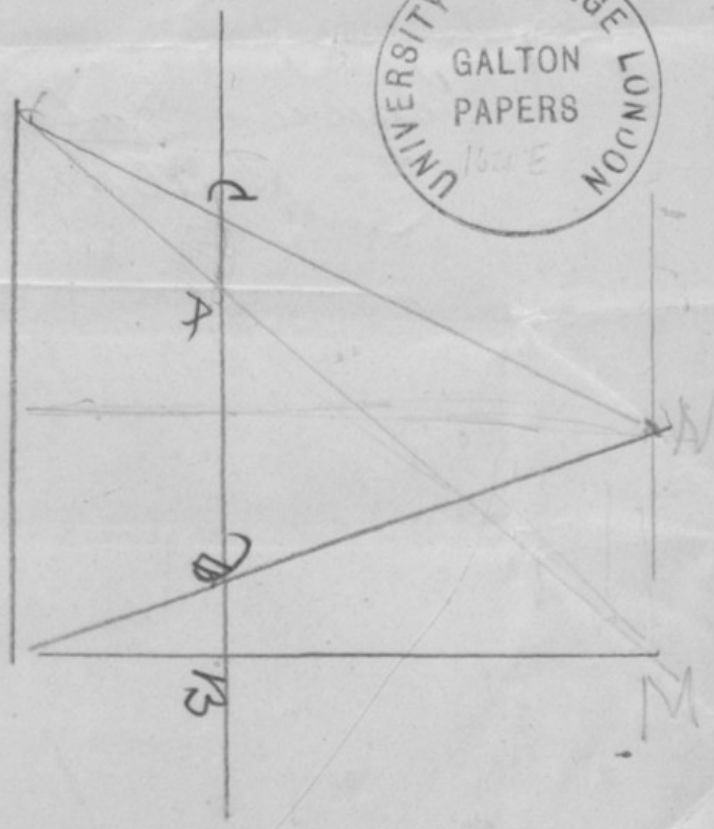
For point D

$\frac{bg_d}{bx_1} = \frac{40.5}{58} = .699$ $\qquad \frac{hg_d}{bx_1} = \frac{32}{58} = .553$

$\frac{hf_g}{hx_{2g1}} = \frac{42}{70.5} = .596$
$\times 1.41 = .84$

$x = .72$
$y = .64$
$z = .46$

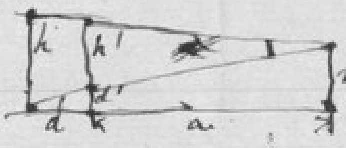
f. 10r



f. 10v

Francis Galton Esq
42 Rutland Gate

f. 110



$h = h' \times \frac{a+d}{a}$ (1)

2.5 ft / 12
30
75 for 60

$\frac{30 \times 12}{5} = 72$

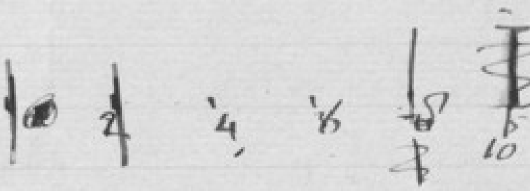
$\frac{20 \times 12}{5} = 48$ is 1 in 60 in

d for values ~~0.5 1.0~~ ...

0.10 0.2 — — 1.0

$d = d' \times \frac{a+d}{m}$ (2)

if $5d' = d$ } then
& $d = 5$ } $5m = a+d$

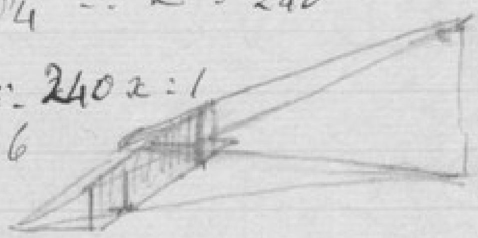


2m = 6.6

30 ft × 90/12 = 6
36 about

$1 : \frac{1}{384} :: x : \frac{1}{240}$

384 : 1 :: 240 x : 1



x = 240/384 (1.6
240
1440
1440

24/384 (16
24
144
144

36/50 (1.4
36
140
152

16/70 (4.4
64
60

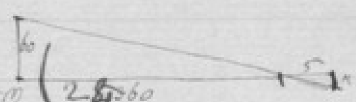
5 : 360 :: x : 100

x = 360/500 (1.39
360
1400
1080
3200
2880
320

1/52

166/4800 (28.9/700 (2.4
332
1480
1328
1520
1494

578
1220



$\frac{1}{360} = \frac{x}{5}$ $x = \frac{300}{360} = \frac{5}{6}$

$\frac{15}{h} = 2.5$

$$(a+d) \times af - ar + rf = a^2f - a^2r + 2arf + adf - adr + rdf$$

$$= \begin{cases} a^2 - a^2 rf + rf^2 \\ + f^2 - f^2 a + adf - f^2 d \end{cases}$$

$$-a^2r + 2arf - adr + rdf - af^2 - rf^2 + f^2a + f^2d = 0$$

$$-a^2 r + a(2rf - dr - f^2 + f^2) + rdf - rf^2 + f^2a + f^2d = 0$$

all re-done for fear of mistake – It is quite correct.

(1) $\frac{1}{f} = \frac{1}{a} + \frac{1}{b}$ $\quad ab = fb + fa$ $\quad b = \frac{fa}{a-f}$

(2) $\frac{1}{f} = \frac{1}{a+d} + \frac{1}{b-r}$ $\quad \frac{1}{b-r} = \frac{1}{\frac{fa}{a-f} - r} = \frac{a-f}{fa - ar + rf}$

$$\frac{1}{f} = \frac{1}{a+d} + \frac{a-f}{fa-ar+rf}$$

$(a+d)\times(fa-ar+rf)$
$= (fa+fd)\times(a-f)$
$+ f^2a - far + rf^2$

$= a^2f - a^2r + aff + adf - adr + drf$
$= a^2f - af^2 + adf - f^2d$
$+ af^2 - afr + rf^2$

$0 = +a^2r - arf - adf + adr - drf + adf - f^2d - afr + rf^2$

$0 = a^2r - 2arf + adr - dfr + f^2r - df^2$

$a^2r + a(dr - 2rf) = dfr - f^2r + df^2$

(3) $a^2 + a(d-2f) = df - f^2 + \frac{df^2}{r}$

$a^2 + a(d-2f) + (\frac{d}{2} - f)^2 = \frac{d^2}{4} - df + f^2 + df - f^2 + \frac{df^2}{r}$

$a + \frac{d}{2} - f = \pm\sqrt{\{\frac{d^2}{4} + \frac{df^2}{r}\}}$

better write $\pm\sqrt{\{f^2\frac{d}{r} + \frac{d^2}{4}\}}$

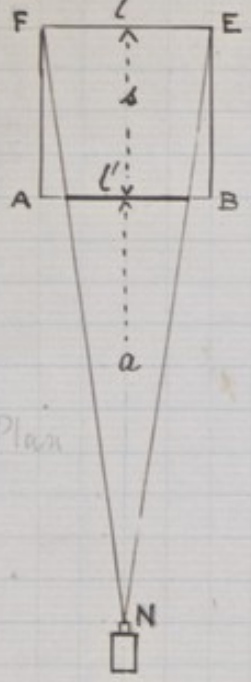
(4) $a = \sqrt{\{f^2\frac{d}{r} + \frac{d^2}{4}\}} + f - \frac{d}{2}$

right – agrees with what I had – Dalmeny.

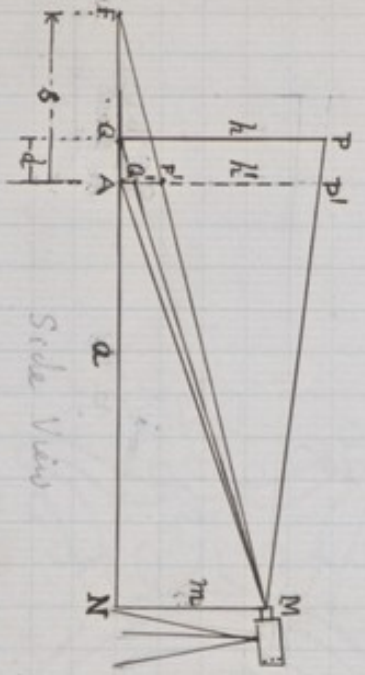
from 3

$r(a^2 + a(d-2f) + f^2 - df) = df^2$

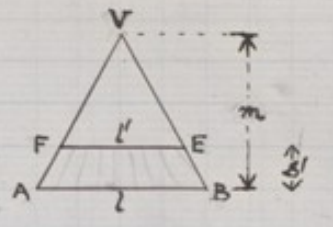
(5) $r = \frac{df^2}{a^2 + a(d-2f) + f^2 - df}$



Plan

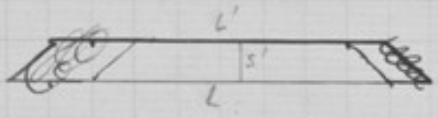


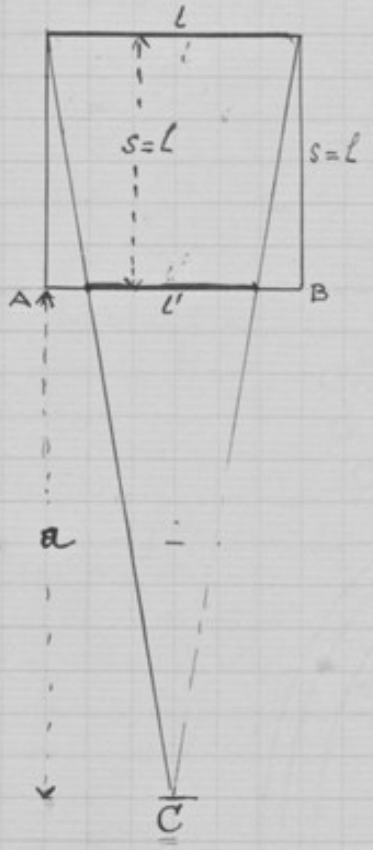
Side View



Picture

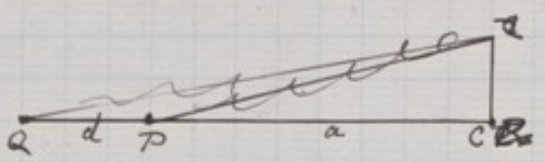
Scales s, s', l, l', to find m and a





$$\frac{a}{a+s} = \frac{l'}{l} \quad \text{whence} \quad a = \frac{sl'}{l-l'} = l' \cdot \frac{l}{l-l'}$$

$$\frac{m}{m-s'} = \frac{l}{l'} \qquad m = \frac{s'l}{l-l'} = l' \cdot \frac{l}{l-l'}$$



P Q are two points ~~on the ground~~ at the respective distances a and $a+d$ from ~~the~~ R, ~~the vertical bottom~~ the optical centre of the lens of the camera, let the equivalent focus of the lens = f

For the purposes of this note, we may, as CR is small compared to a, consider CP (which = $\sqrt{a^2 + CR^2}$), and CQ (which = $\sqrt{(a+d)^2 + CR^2}$) as being practically the same as a and $a+d$.

When the camera is focussed on P, let its back focus be called b; when it is focussed on Q, let its back focus be called $b-r$

Given f, d, and r, to find a.

For the case $\frac{1}{f} = \frac{1}{a} + \frac{1}{b}$ (1) whence $b = \frac{af}{a-f}$

and $\frac{1}{f} = \frac{1}{a+d} + \frac{1}{b-r}$ (2)

Substituting for b in (2),

$$\frac{1}{f} = \frac{1}{a+d} + \frac{a-f}{af - ra + rf}$$

$$a^2f - ra^2 + arf + adf - ard + drf = f\{af - ra + rf + a^2 - af + ad - df\}$$

$$= af^2 - raf + rf^2 + a^2f - af^2 + adf - df^2$$

$$-a^2(r) + a\{2rf - rd\} = -rdf + rf^2 - df^2$$

$$a^2 - a(2f - d) = df - f^2 + \frac{df^2}{r}$$

$$a^2 - a(2f-d) + \tfrac{1}{4}(2f-d)^2 = df - f^2 + \frac{df^2}{r} + \tfrac{1}{4}(2f-d)^2$$

$$a = \tfrac{1}{2}(2f-d) + \sqrt{\left\{df - f^2 + \frac{df^2}{r} + \tfrac{1}{4}(2f-d)^2\right\}}$$

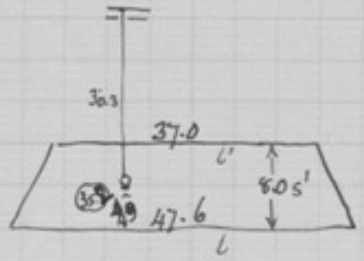
Take $f = 5$ inches, $d = 30$ inches, $r = \frac{1}{100}$ inch

$2f - d = -20$ $(2f-d)^2 = 400$
$f^2 = 25$
$df^2 = 750$

$$a = -\tfrac{1}{2}(20) + \sqrt{\{150 - 25 + 750 \times 100 + \tfrac{1}{4}\cdot 400\}}$$
$$= -10 + \sqrt{\{78225\}}$$
$$= 274 - 10 = 264 \text{ inches} = 22 \text{ feet}$$

$f = 5$ inches $d = 35$ inch. $r = \frac{1}{100}$ inch

$$a = -\tfrac{1}{2}(25) + \sqrt{\{175 - 25 + 100 \times 875 + \tfrac{1}{4}(-25)^2\}}$$
$$= -12.5 + \sqrt{(150 + 87500 + 156)}$$
$$= 296 - 12.5 = 284.5 = 23.7$$



$l' = 37.0$ mm
$l = 47.6$
$s = 8.0$

$$c = \frac{s'l}{l-l'} = \frac{8.0 \times 47.6}{10.6} = \frac{381}{10.6} = 36$$

$$a = \frac{sl'}{l-l'} = \frac{47.6 \times 37.0}{10.6} = \frac{1761}{10.6} = 166$$

$c = 36$
$a = 166$

Scale $\delta = 4.9$ write d'/h'
$h' = 30.3$

$$d = \delta \times \frac{d+a}{c} \qquad dc = d\delta + a\delta \qquad d = \frac{a\delta}{c-\delta}$$

$$= \frac{166 \times 4.9}{31.1} = \frac{813}{31.1} = 26.2$$

whence $d = 26.2$
$h = 35$ mm

$$h = h' \frac{a+d}{a} = \frac{30.3 \times 192}{166} = \frac{5818}{166} = 35.$$

35 mm : x inches :: 47.6 mm : ~~150~~ inches wrong, should be 18 inches

$$x = \frac{35 \times 150}{476} = \frac{5250}{476} = 11.1 \text{ inches}$$

~~for c 36 : x~~ $= \frac{36 \times 150}{476} = \frac{5400}{476} = 11.3$ inches

Real value of $h = x = \frac{35 \times 18}{47.6} = \frac{630}{47.6} = 13.25$

Real value of $c = \frac{36 \times 18}{47.6} = \frac{648}{47.6} = 13.62$

} very exact.

$l = 4$ metres $\quad m = 2$ metres
$s' = 2$ " $\quad a = 8$ "
$s' = 0.4$ "

$$d = \frac{a d'}{m - d'}$$

$$h = h' \times \frac{a+d}{a}$$

$$\frac{a+d}{a}$$

$d' = \frac{s'}{10} = .04$ metre

$$d = \frac{8 \times 0.04}{2 - 0.04} = \frac{0.32}{1.96} = 0.163 \qquad \frac{8.163}{8} = 1.02$$

$d' = 2 \times \frac{s'}{10} = 0.08$ quelque

$$d = \frac{8 \times 0.08}{2 - 0.08} = \frac{0.64}{1.92} = 0.333 \qquad \frac{8.333}{8} = 1.04$$

$d' = 3 \times \frac{s}{10} = 0.12$ metre

$$d = \frac{8 \times 0.12}{2 - 0.12} = \frac{.96}{1.88} = 0.511 \qquad \frac{8.511}{8} = 1.07$$

$d' = 4 \times \frac{s}{10} = 0.16$ metre

$$d = \frac{8 \times 0.16}{2 - 0.16} = \frac{1.28}{1.84} = 0.696 \qquad \frac{8.696}{8} = 1.09$$

$d' = 5 \times \frac{s}{10} = 0.20$ metres

$$d = \frac{8 \times 0.20}{2 - 0.20} = \frac{1.60}{1.80} = 0.889 \qquad \frac{8.889}{8} = 1.11$$

$d' = 6 \times \frac{s}{10} = 0.24$ metres

$$d = \frac{8 \times 0.24}{2 - 0.24} = \frac{1.92}{1.76} = 1.09 \qquad \frac{9.09}{8} = 1.14$$

$d' = 7 \cdot \frac{s}{10} = 0.28$ metres

$$d = \frac{8 \times 0.28}{2 - 0.28} = \frac{2.24}{1.72} = 1.30 \qquad \frac{9.30}{8} = 1.16$$

$d' = 8 \cdot \frac{s}{10} = 0.32$ metres

$$d = \frac{8 \times 0.32}{2 - 0.32} = \frac{2.56}{1.68} = 1.52 \qquad \frac{9.52}{8} = 1.19$$

$d' = 9 \frac{s}{10} = 0.36$ metres

$$d = \frac{8 \times 0.36}{2 - 0.36} = \frac{2.88}{1.64} = 1.76 \qquad \frac{9.76}{8} = 1.22$$

$d' = 10 \frac{s}{10} = 0.4$ metres

$$d = \frac{8 \times 0.40}{2 - 0.40} = \frac{3.20}{1.60} = 2.0 \text{ ou } \infty \text{ si } d' \qquad \frac{10.00}{8} = 1.25$$

f. 18r

$C = 0.003$ $f = 3.0$ $a = 1$

$m = 15$ feet $= 180$ inches $afm = 540$

$af = 3.00$

$cm = 0.54$; $af + cm = 3.54$ $af - cm = 2.46$

$l = \frac{54000}{246} = 220$ inch $= 18^{ft}.4^{in}$

diff^{ce} ~~$47 = 3^{ft}.11^{in}$~~ $67 = 5^{ft}.7$

$x = \frac{54000}{354} = 153$. $= 12^{ft}\,9^{in}$

focus at 180 inch in ground a parallelepiped 1 5 inch. $= 4^{ft}\,11^{in}$ by 5 ft but 180 11 6.6 in breadth a room 7 ft, except a little at further upper corner.

reduction is $\frac{3}{180} = \frac{1}{60}$

---

try $c = \frac{1}{4} \times \frac{1}{60} = \frac{1}{240} = 0.00417$

$cm = 0.75060$ $af + cm = 3.75$ x = 144

$af = 3.00$ $af - cm = 2.25$ l = 240 96 = 8 ft

Here the two equations are

$$l = \frac{afm}{af - cm} \qquad n = \frac{afm}{af + cm}$$

$f = 3 \quad c = 0.003 \quad a = 1 \quad m = 240$ inches

$l = 303$ inch $\qquad n = 194$ inch

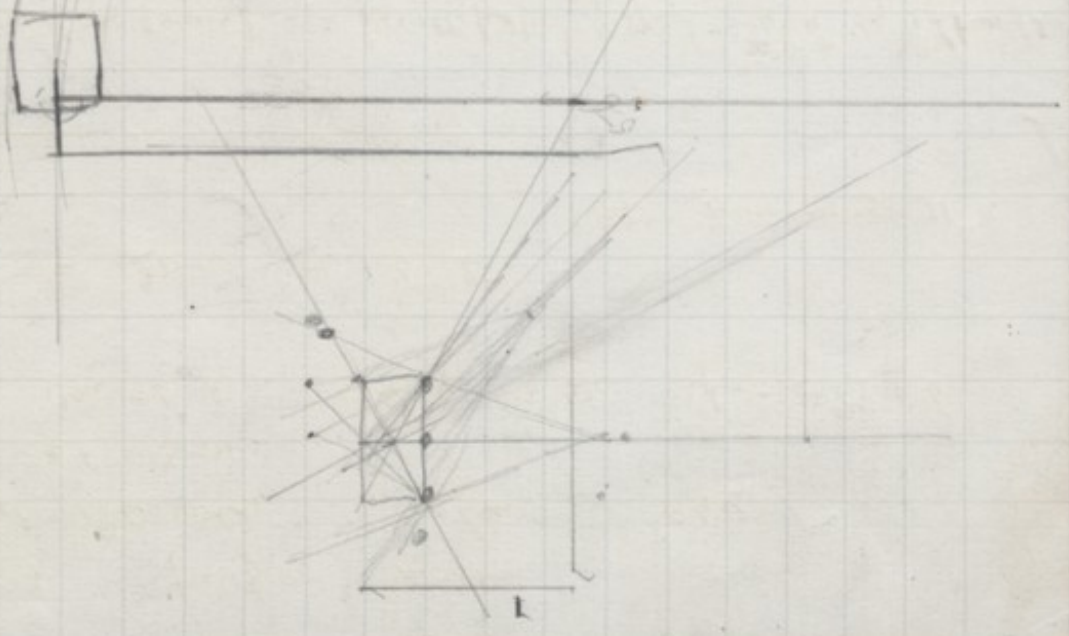
$m - l = 63$ inch $= 5$ ft 3 $\qquad m - n = 46$ inch $= 3$ ft 10

$n - l = 10$ ft 2 inch

$l = 316$ in $= 26$ ft 4 in $\qquad n = 194$ inch $= 16$ ft 2 inch

$l - n = 109 = 9$ ft 1 inch

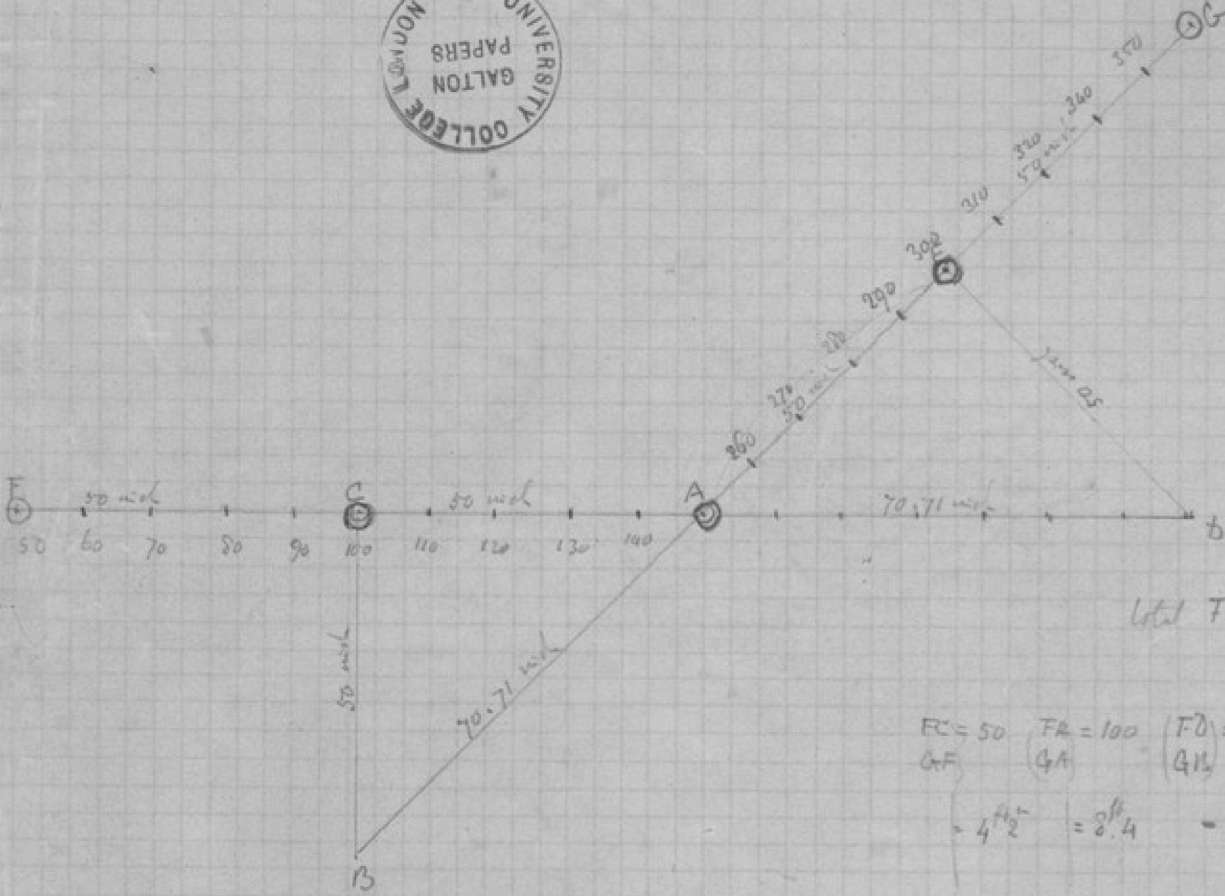
316
194
122



454 / Inverto 122
908
920

f. 48v

f. 19r



total FD = 170.71 inch
= 14 feet 2.71 in

FC = 50 (GF) = 4 ft 2 in
FA = 100 (GA) = 8 ft 4
(FD) (GB) = 170.71 = 14 ft 2.71 in

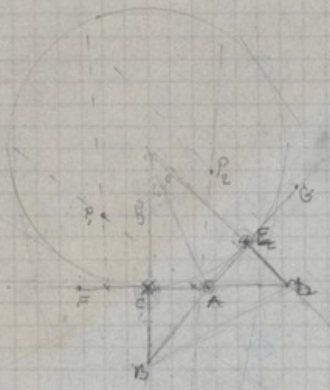
say 14 ft = 2 3/4 inch
1/25 too long
0.1 mm

CM = 180 inch
= 15 feet

f. 19v

$CE = 5'' \tan 22\frac{1}{2}° = 5 \times 0.4142$

$= 2.071$



CE is about $\frac{1}{5}$ rad. of circle

Make $CE = 2\frac{1}{2}$ feet $= 30$ inches

7200

1 in = 8.40

6, 6, 8.4[illegible]
[illegible]

inches 60, 60 84.85

$\frac{84.5}{10} = \frac{x}{8}$. 68. = 10 x
x = 6.8 [illegible]
= 13 [illegible]

7 feet about 7.071
84.84 inches = 84 in, 13 5/16 sixteenths
or 84 in, 13 1/2 sixteenths

25 + 25 49

$\sqrt{50} = 7.071$

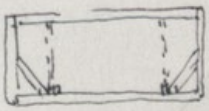
make AC = 4 feet = 48 inches
$AB = \sqrt{2 \times (48)^2} = \sqrt{4608}$

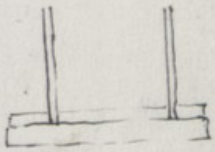
AB = 67.882 inch
= 67 in 7/8 very nearly

.882 : 10 :: x : 8
.7056

AC = 50 inch $AB = \sqrt{5000} = 70.71$

7.1 : 10 :: x : 8
5.68





0 10" 20" 30" 40" 50" 60" 70"

2 feet 3 feet 4 feet

$\frac{17}{36}$ my really lower very faint

1 lobe, more with great loss of light

$39 : x :: 117 : 30x$

$x = \frac{1170}{11} = 106" = 9$ feet

40

200

$2 \times \frac{55}{360} = .336$

diam

55

110

550

$= .467$

$55.30 \quad \frac{1}{2}\theta \; 18.30$

110 diameter

$\frac{140}{55}$ $40.58 \; - 70° \quad \theta = 37$

300

$\sin \frac{1}{2}\theta = \frac{55}{240}$

$\tan \frac{1}{2}\theta = .883$

$\frac{1}{2}\theta = 8°10'$

21

UNDER THE PATRONAGE OF
H.M. THE QUEEN

ALFRED JARVIS.

43, WILLES ROAD,

LONDON: N.W. Dec. 11th 1895

Royal Institution.

Dear Sir,

Having been persuaded to undertake the reproduction of the Jehu Tribute Panel of the Black Obelisk (see p. 10 of brochure presented herewith), I shall be glad to know at an early date whether you wish to subscribe for a copy.

As only 200 copies will be issued the price is net. Several have already been subscribed for, and the remainder are offered first to members of the learned societies, to whom, as I have determined to discontinue the sale, the remaining copies of my other Assyrian Reproductions are offered at a reduction of 33⅓% as per order form attached.

Yours obediently,

Alfred Jarvis

Dr. Francis Galton, M.A., F.R.S.

F 224

NINEVEH

Reproductions from the Assyrian Sculptures, British Museum

ORDER FORM

To Mr. ALFRED JARVIS
43 WILLES ROAD, LONDON, N.W.

Please add my name to your list of Subscribers for .....copies of the reproduction of the *Jehu Tribute Panel* of the *Black Obelisk*, at two guineas per copy.

Also forward to me the following works:—

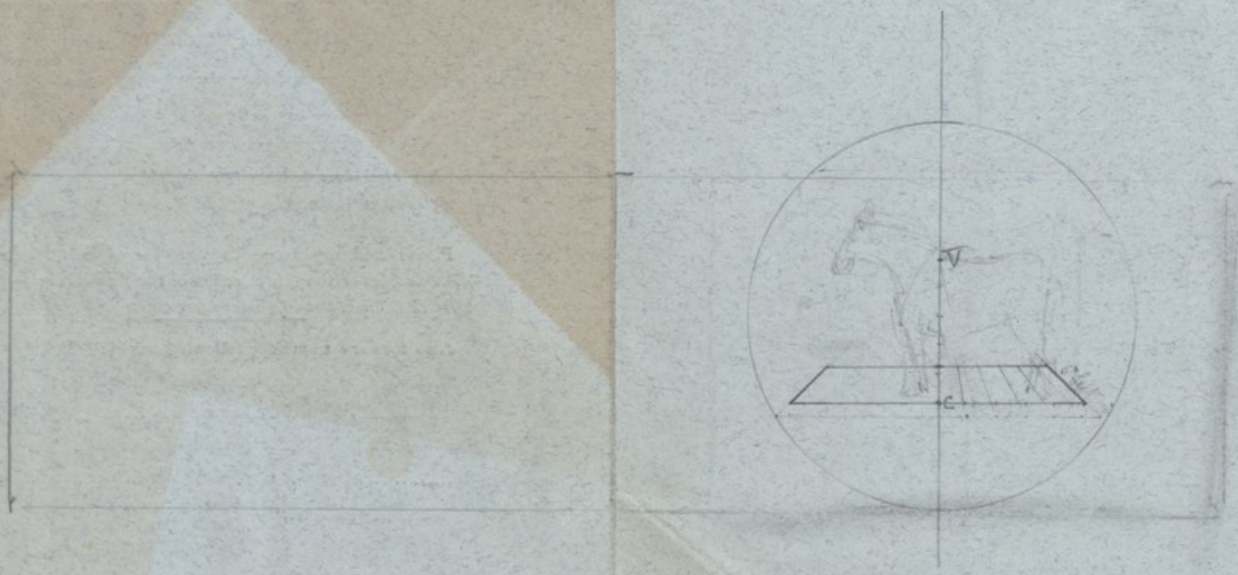
.....	..Cop	of Sennacherib ...	@ ~~30s.~~	20/-
.....	„	„ Assurbanipal ...	„ ~~30s.~~	"
.....	„	„ Queen of Assurbanipal	„ ~~30s.~~	"
.....	„	„ Garden Scene ...	„ ~~42s.~~	28/-
.....	„	„ { Winged human-headed Lion }	„ ~~42s.~~	"
.....	„	„ Do. do. Bull	„ ~~42s.~~	"
.....	„	„ Nimrod's Head	„ ~~10s.~~	6/8
.....	„	„ Lion Weight ...	„ ~~7s. 6d.~~	5/-
The above eight works			„ ~~£11~~	£7.6.8

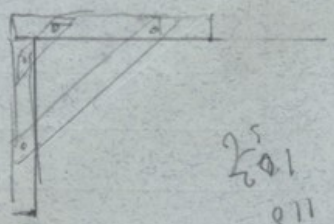
Signature .....

Address .....

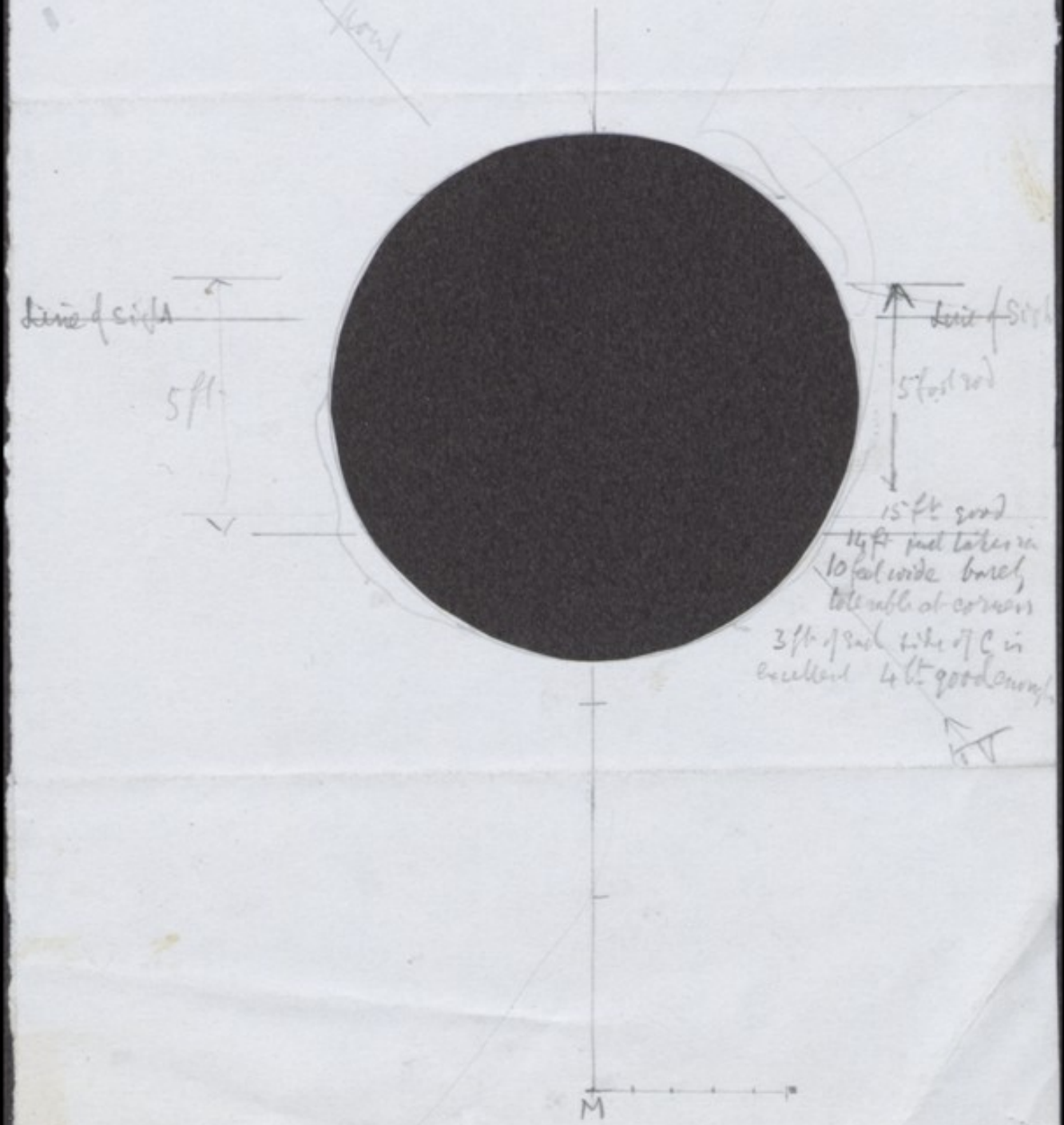
Date .....

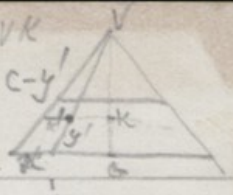
f 22r





f. 23





$x : x' = VG : VK$

$= c : c - y'$

$yc = yy' + ay'$

$y = \frac{ay'}{c - y'}$

$az = yz' + az'$

$I = \frac{z'}{a}\left\{y + a\right\} = \frac{z'}{a}\left\{\frac{ay'}{c-y'} + ac - ay'\right\}$

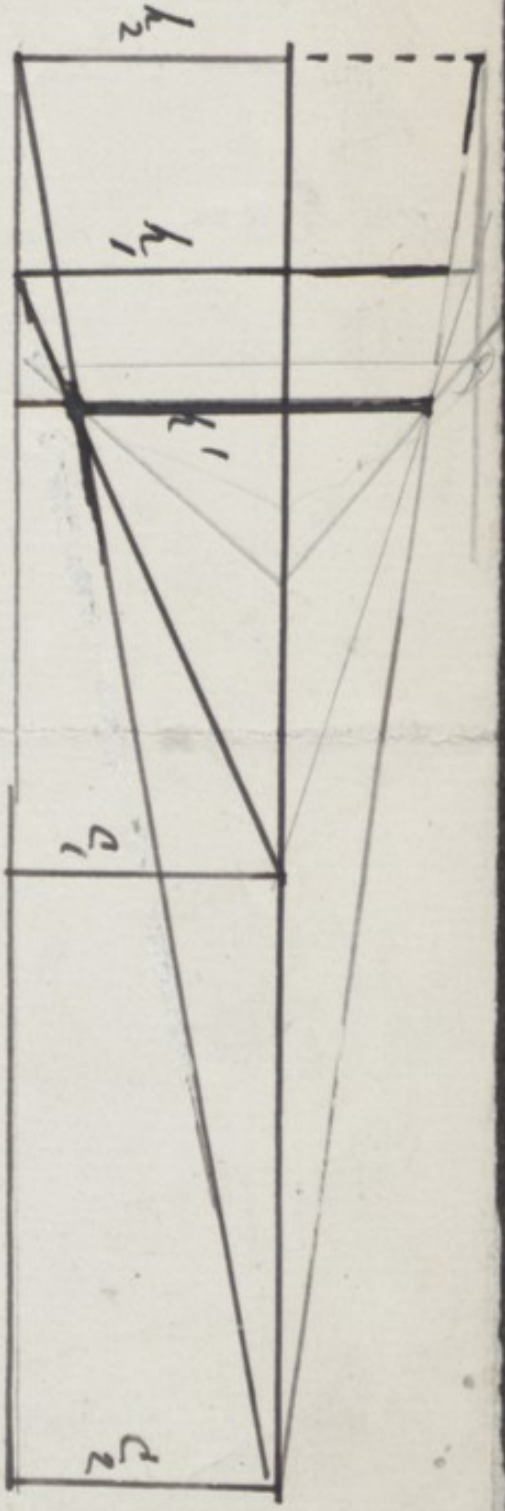
$= \frac{z'\,c}{c - y'}$

f. 24 v

6 Lunæ C.

761/92.

58 3 Port 28/6



F 25

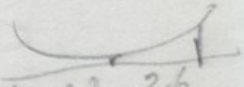
Rop anastigmats
largest dist 2.97
f. 23.5

Notes at Kew

Strathmore
Dalmeyer

Circular image 5.9 in
Angle 46°
f 6.9
a - 2.62
Outside diam 2.75
7 lens

Sag thr at 2.6 from centre of field
Curvature = 0.14 inch



Ground will be assumed the horizontal
Then required internal evidence in picture that
(1) that the Plane of plate in camera is perpendicular reference
(2) ~~That it is to~~ parallel to the vertical plane (real or imaginary) on which the measurements of the horse are (projected in other words that it is not tilted forward or backward
(3) also to determine the distance of the camera (from the plane of reference with such precision
(4) ~~#~~ the height of the camera
(5) ~~#~~ a scale, for the measurements

A perspective drawing ~~being a~~ cannot without other help afford means of determining the true position of a solid object represented in it. Thus ~~in fact~~ a fly poised in the air may be situated anywhere on a line passing through it from the observers eye. There is nothing to show whether it is near or far except such inference, so far as they may afford from a knowledge of its size / its focus or by stereoscopic effect, or ~~even~~ in so-called aerial perspective. But when the perspective ~~includes~~ relates to a horse standing on the ground there is an important addition to these data. The animal stands with his forelegs near together & similarly with his hind legs. Consequently by ~~doing~~ making a dot between each pair and then drawing a line through the dots we obtain the line of intersection with the ground of an imaginary plane that passes vertically through the spine of the animal. The ~~measure~~ a vertical ~~drawn~~ height of the withers or ~~above~~ that down to this line, is a datum whence which ~~this paper~~ we can easily deal by the methods ~~shortly~~ to be described

(over)

Similarly as we know ~~generally~~ approximately the shape of ~~the~~ a horse, as the relation roughly of the thickness to the length of its body we can approximately and with not inconsiderable accuracy ~~draw~~ determine the points where perpendiculars ~~to the~~ from various parts of ~~the~~ body other than along the ridge of his back would meet the ground. ~~meet the ground~~

In this way the problem of determining the various measures of a horse from those ~~meas~~ of his photograph, is accomplished.

The corrections for perspective are large. Thus if the height at the withers be (15 hands), ~~a~~ 60 inches, and if he is standing about 240 inches (20 feet) from the camera, ~~a difference~~ of ~~this position of any part a difference of only~~ 12 inches (whether nearer or further) in his position, ~~forwards or backwards~~ (the effect is approximately the same) will ~~make~~ cause a perspective increase or diminution in the apparent height of its back of its amount that is ~~of one inch~~. ~~It will also~~ the requisite correction will be as large as 1 inch.

It may seem practically impossible to attain to a respectable degree of accuracy of measurement under such delicate conditions as these but the problem is by no means so difficult as it looks at first sight, so the reader is asked to suspend his judgement until he has read further. The error due to the process (which has already been described) of dotting points, is certainly less than 1 inch under ordinary conditions, because the hoofs of a standing horse ~~are nearly in juxtaposed~~ are often in actual contact & never unless he straddles in an ungainly way are more than one hoof's breadth asunder that is about 4 or 5 inches. It is easy to judge such small intervals with fair accuracy, even ~~though~~ when one or both of its limits ~~may~~ are partly hidden from view, and their positions have to be inferred.

Racing Illustrated

reduced to Ht of withers = 100

No	Page	Name	Height of withers	Chest	Croup	Length	Withers	Chest	Croup	Length
1	5	Melanion	66.5	30.7	66.9	71.1	100	46.2	100.0	107.0
	10	Glencairn (a hunter)	87.0	41.3	84.0	92.0	100	47.5	96.6	105.7 [illegible]
2	22	Sir Visto	102.0	47.5	101.2	97.6	100	46.6	99.5	95.7
	29	Avilion	104.8	47.7	107.0	108.5	100	45.5	102.0	103.5
	~~30~~	~~Camelot~~								
3	39	Grey Leg	81.2	38.0	80.0	80.5	100	46.8	98.5	99.2
	41	Le Var	102.0	47.3	99.2	101.2	100	46.4	97.3	99.2
4	57	Isinglass	93.5	43.2	95.7	95.8	100	46.2	102.7	102.7
	62	The Lombard	109.0	51.0	105.0	107.5	100	46.8	96.5	99.4
18	293	Solaro	87.0	38.5	85.0	81.0	100	44.3	97.8	93.2
	295	Bushy Park	84.8	39.0	86.7	84.0	100	46.0	102.3	99.1
	301	Laoens	85.0	40.0	84.5	80.8	100	47.1	99.6	95.1
	305	Orlota	83.7	36.8	80.5	78.0	100	44.0	96.2	93.2
	304	Galkottia	81.8	37.0	80.4	79.0	100	45.3	98.3	96.6
	307	Speedwell	86.0	40.5	89.9	86.2	100	47.1	104.9	100.5
	308	Santa Maura	85.3	39.1	83.9	83.0	100	45.8	98.3	97.2
		Shotover (1)	59.4	29.5	59.0	63.9	100	49.7	99.3	107.6
		(2)	48.1	24.2	47.2	50.0	100	50.3	98.1	108.0
		Broxton	66.5	30.5	67.6	68.2	100	45.2	101.7	102.5
		Donovan	64.8	30.6	64.1	64.1	100	46.4	98.9	98.9
		Orme	65.0	29.4	63.2	64.8	100	45.3	97.3	99.7
		Bend Or	65.1	29.8	64.4	67.7	100	45.8	98.8	104.0
							Range	44.0 – 50.3	96.2 – 104.9	93.2 – 107.0
								6.3	8.7	13.8
							62:100	3.9	5.4	8.6
							or	4	5½	8½

(wider apart)

From separate photographs bought at Spooner, 379, Strand WC.

a	Height of a given point in space
b	Its horizontal distance from screen
c_1	Horizontal distance of camera from the right hand scale
c_2	" " " " " left " "
d	Horizontal distance of camera from screen
h	Height of camera
α_1	Perspective enlargement of upper end of $\underline{a}$, as projected on screen
α_2	" " lower " " " "
β_1	Perspective shortening of the side scale b on the right, as projected on screen
β_2	" " " left, " "

$$\alpha_1 = \frac{b(a-h)}{d-b} \quad , \quad \alpha_2 = \frac{bh}{d-b}$$

(I) $\alpha_1 + \alpha_2 = \frac{ba}{d-b}$ which is independent of h, the height of the camera.

(II) $d = (c_1+\beta_1)\frac{b}{\beta_1} = (c_2+\beta_2)\frac{b}{\beta_2}$

whence $d = b\,\frac{\beta_1+\beta_2+S}{\beta_1+\beta_2}$ which is independent of the ratios of c_1 to c_2, that is of the lateral position of the camera between the side scales.

$$\beta_1 = \frac{c_1 b}{d-b} \quad , \quad \beta_2 = \frac{c_2 b}{d-b} \quad \text{whence} \quad \beta_1+\beta_2 = \frac{Sb}{d-b}$$

which is independent of the ratio of c_1 to c_2

if $\beta_1 = \beta_2$ then either of them $= \frac{b\frac{S}{2}}{d-b}$

$$\frac{d}{d-l} = \frac{S+\beta_1+\beta_2}{S} \qquad d = \frac{l(S+\beta_1+\beta_2)}{\beta_1+\beta_2}$$

Let $a = 5$ feet $= 60''$, $d = 20$ feet $= 240''$ $\frac{1}{2}s = 5'' = 60''$

Foreshortened Scale Stride for various values of b

$$B = \frac{b \times 60}{d - b} \qquad \frac{B}{b} = \frac{60}{d-b}$$

$b = 20$	$\frac{60}{220} = \frac{6}{22} =$	0.27×1.53	$= .41$
$b = 25$	$\frac{60}{215} =$	0.28×1.59	$= .45$
$b = 30$	$\frac{60}{210} =$	0.29×1.68	$= .49$
$b = 35$	$\frac{60}{205} =$	0.29×1.75	$= .51$
$b = 40$	$\frac{60}{200}$	0.30×1.85	$= .54$

say ½ on ~~inside~~ provided scale corresponds to average correction of 1½ or 1¾ a
due to error in position of 5 inches between $b = 20$ & $b = 40$

not strictly correct if should be

					$\times \frac{1}{25}$ to photo reduction
$b = 22.5$	$d - b = 217.5$	$\frac{b}{d-b}$	0.277×1.53	.424	.017
27.5	212.5	.283	$\times 1.59$	.450	.018
32.5	207.5	.290	$\times 1.68$	.487	.019
37.5	202.5	.297	$\times 1.75$	.520	.021
42.5	197.5	.305	$\times 1.85$	.564	.023

So 0.02 (= $\frac{1}{50}$) inch in a photo ($\frac{1}{25}$ of nat size) is needed
to show a diff^{ce} of position that requires a correction = 1.5 inch

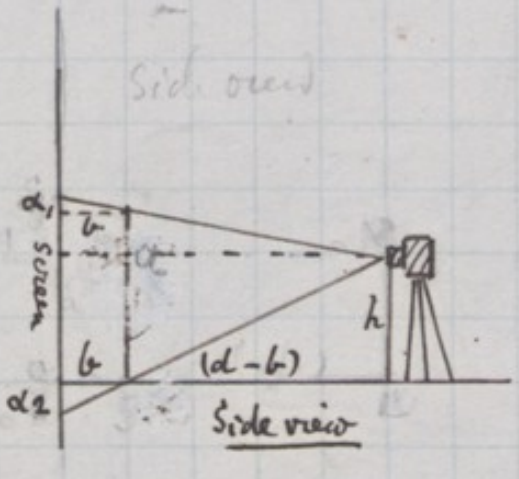
? is this done in the right way
it is the value of B that is wanted, not $B \times \frac{B}{b}$

$h = 5$ $h^2 = 25$

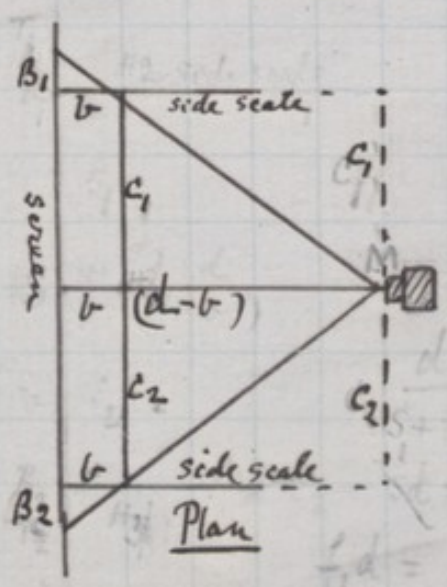
$\frac{25}{19}$

Enlarged effect $\alpha = 1$

$z \left(\frac{h}{d-1}\right)$



Side view



Plan

$d = \frac{r(s+t_1)}{t_1}$

f 30

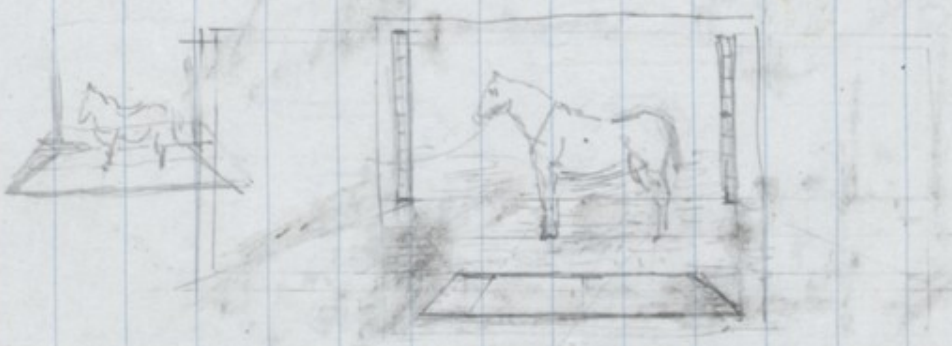
f = focal length in feet in inches

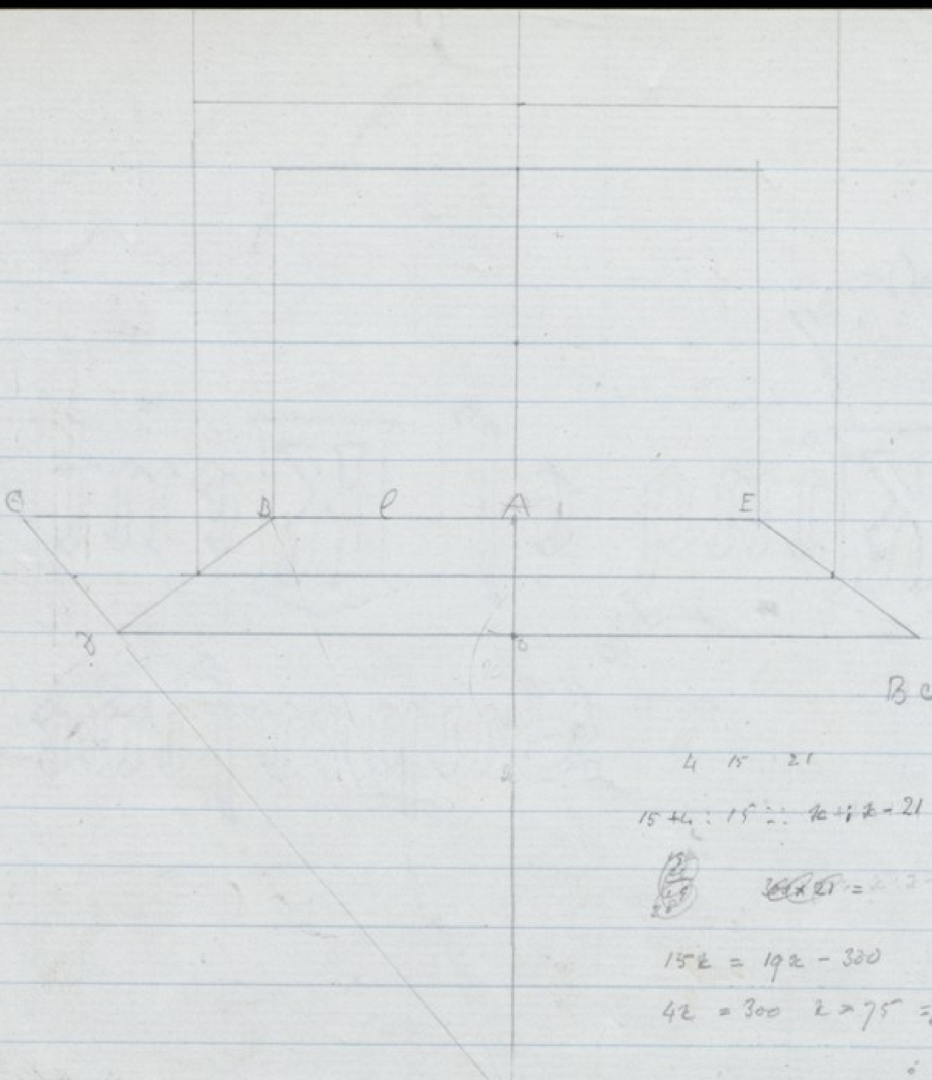
f : 35 :: 1 : 25 f = 35/25 = 1.4 feet

f : 35×12 :: 1 : 25 f' = 16.8 inches

25/420 (16.8
25
170
150
200

f. 30v





BC : 2AB :: AC : z(=AO)
=BD=
[illegible]

4 15 21

15+4 : 15 :: z : z − 21

~~[illegible]~~ × 21 = [illegible]

15z = 19z − 300

4z = 300 z = 75 = 6ft 3

15 21 . 4

f. 31v