



THESIS

A Hydrographic Survey of the  
Bushkill Creek, at Easton, Pa.

BY

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Class of 1913

243  
b.

Lafayette College  
Department of Civil Engineering

Course in Surveying

Thesis

Notes

OF

Bushkill Creek Hydr. Survey

Party No.

1

Book No.

1

M. S. Evans

G. H. Bannerman

1913

Party

EASTON, PA.

- INDEX. -

Profile of section of stream at Cemetery  
bridge at Easton, Pa. Pages 2-3

Gage Heights at Cemetery bridge for  
Months of Jan. Pages 4, 5, 12, 13, 14, 15,  
20, 21

Current Meter observations at Cemetery bridge  
for various dates Pages 6, 7, 8, 9, 16, 17, 18,  
19

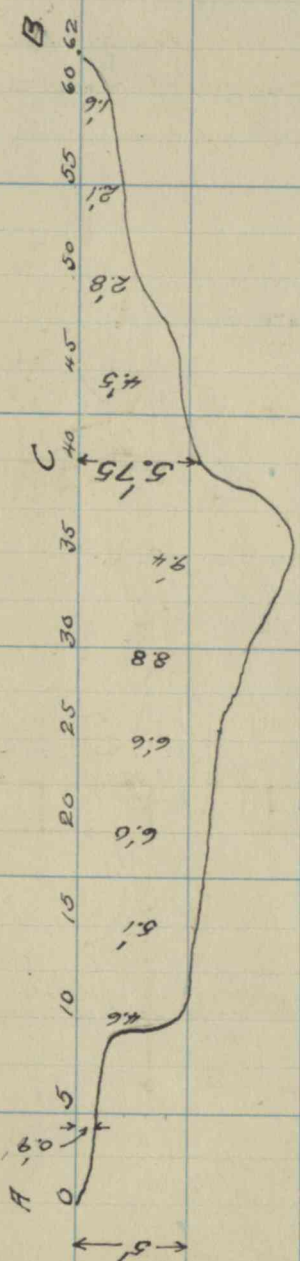
Rating Table - Price Current Meter  
Pages 10-11

2. Soundings - Bushkill Creek

Span of Bridge 62.0 A to B

Profile of creek bottom, depth at C being 5.75

← 5' →



← 5' →

Thesis Work, Begun Jan. 7 1913<sup>(3)</sup>

Evans  
Bannerman.

Observations for stream height are made at Point C, viz. a file mark on stanchion 22' from cemetery side of bridge.

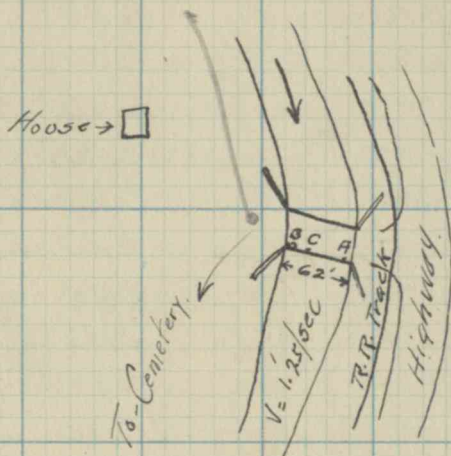
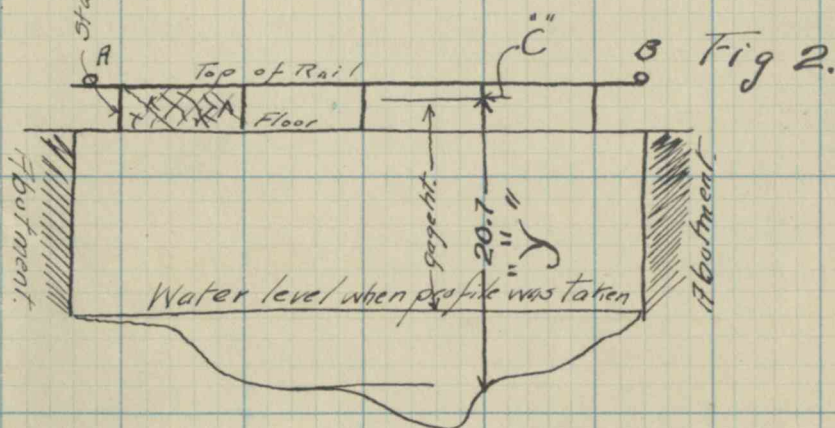


Fig. 1



# 4 Gage heights, measured from

Date	Dist. to water Surf.	Height $\bar{Y}$	Actual Water Depth at point C	Time	Weather
Jan. 1913		20.7			
7	14.95	"	5.76	11 AM.	Misty
8	14.375	"	6.325	1:15 PM	Raining.
9	14.390		* 6.310	12:45 PM	Clear-Cold
10	14.690		6.010	9:40 AM	Cloudy
11	14.540		6.160	9:45 AM	Misty
	14.500		6.20	10:45 AM	slight rain in mean time
	14.500		6.20	2:00 P.	Cloudy
	14.500		6.20	3:00 P	Cloudy
Sunday 12	14.300		6.40	2:00 P	Cloudy
	14.250		6.45	3:00 P	Cloudy <sup>High</sup> Wind
13	14.810		5.89	12:45 P	Clear
14	14.940		5.76	1:45 P	Clear
15	14.83		5.87	9:30 A	Clear
16	14.93		5.77	1:15 P	Cloudy
17	14.58		6.12	12:45 P	Cloudy
18	14.78		5.92	1:30 P	Raining
Sunday 19	14.58		6.12	1:45 P	Clear
20	15.00		<del>5.70</del> 5.97 ✓	1:15 P	Clear
21	14.81		5.89	1:30 P	Clear <sup>High</sup> Wind
22	15.00		5.70	1:30 P	Clear Cold
23	15.06		5.64	1:00 P	Heavy Show
24	14.79		5.91	2:30 P	Cloudy
25	14.87		5.83	10:00 A	Clear

Gage Heights cont'd on Page 12

point "C" on cemetery bridge. 1913<sup>5</sup>

Bushkill Hydrographic Survey { Evans  
Bannerman.

Temp.

All gage heights will be taken when possible, which will probably be during Jan. Feb. March and perhaps May from the cemetery bridge. The depth from "C" to bottom of stream at this point is 20.7'. When the water becomes so low here as to make readings probably inaccurate the station will be moved up to the R.R. bridge at the quarry above the Rope walk.

40°  
40°  
38°  
32°  
42°  
44°  
44°  
45°  
40°  
38°  
36° \* Delaware has backed water up over dam at Main and Allshouse mill.

36°  
30°  
47° \* Night before readings of Jan 11, were taken occurred a warm light rain extending well on towards morning. Rained again at 4:30 and until 8 P.M. Rained night of Jan 11 and from 10 to 12 AM Jan 12.

58°  
58°  
53-51° Slight rain in early morning of 16th.

49°  
35° High wind Rain night before 17, beginning at 9 P.M. Heavy thunder shower on afternoon of the 18th for abt. 1 hour 5-6, P.M. Stream cloudy on 19th.

36°  
36°  
48° Rain on 23'd began @ 10 A.M. and lasted until

39°

# 6 Current Meter Observations.

No	Dist. from A	Revs per 50 Sec.			Mean R's	R's/Sec.	Vel Ft/Sec.
		1st run	2d. Run	Depth.			
0	0	0	0		Still water.	✓	
1	5'	0	0		Still water	✓	
2	10'	3	5	2'	4.0 0.08	0.490	
					No surf current		
	10'	2	4	bottom	3.0	0.06	0.404
3	15'	7	9	Surf	8.0	0.16	0.834
		12	10	2'	11.0	0.22	1.091
		8	7	bottom	7.5	0.15	0.791
4	20'	16	18	Surf	17.0	0.34	1.604
		12	11	2'	11.5	0.23	1.134
		6	6	bottom	6.0	0.12	0.662
5	25'	11	12	Surf.	11.5	0.23	1.134
		14	14	2'	14.0	0.28	1.346
		12	12	4'	12.0	0.24	1.176
		7	9	bottom	8.0	0.16	0.834
6	30'	9	8	Surf.	8.5	0.17	0.877
		11	9	2'	10.0	0.20	1.006
		11	12	4'	11.5	0.23	1.134
		9	8	6'	8.5	0.17	0.877
		3	3	bottom	3.0	0.06	0.404
7	35'	8	8	Surf	8.0	0.16	0.834
		8	9	2'	8.5	0.17	0.877
		10	11	4'	10.5	0.21	1.049
		9	9	6'	9.0	0.18	0.920
		3	3	bottom	3.0	0.06	0.404



of Bushkill at Cemetery Bridge Easton Pa.

Jan. 14, 1913. Evans  
Bannerman

Depth at pt. C. 5.76

Time 1:15 - 5: P.M

Date Jan 14, '13

Weather Clear

Condition of Stream,

Fairly clear water

Temperature, 36° - 28°

Temp 28° for Float Measurements.

Section	Dist. Travelled by Float	Time	Surf Vel.
1			None
2	17.75	32"	0.554
9	17.75	<del>23"</del> 28"	<del>0.771</del> 0.633
10	17.75	36"	0.493
11	17.75	47"	0.377
12	17.75	65"	0.263

Velocities entered on  
opposite page from table  
for meter given on page 10

## 8 Current meter work cont'd

Revs/50 secs.

No	Dist. from H	1st Run	2d Run	Depth	Mean R's	R's/sec	Vel ft/sec
8	40	5	4	Surf	4.5	0.09	0.335
		3	4	2'	3.5	0.07	0.447
		3	4	4'	3.5	0.06	0.404
		3	3	bottom	3.0	0.06	0.404
9	45			Surf	No readings		
10	50						0.493
11	55						0.377
12	60						0.263
Wall.	62						—

Jan 14 1913.

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Thesis. { Ewans  
Bannerman.  
1913

could be obtained with meter on  
9, 10, 11, 12. 30 floats were used to  
determine surface velocity. From  
these the mean velocity can be  
obtained.

Velocities entered on opposite  
page from table for meter as  
given on page 10.

# 10 Rating Table "Price Current Meter"

Revs per Sec	Velocity Ft./sec.	R.P.S	Vel/Ft sec
.05	0.362	0.31	1.474
.06	0.404	0.32	1.517
.07	0.447	0.33	1.561
.08	0.490	0.34	1.604
.09	0.535	0.35	1.647
.10	0.576	0.36	1.690
.11	0.619	0.37	1.733
.12	0.662	0.38	1.777
.13	0.705	0.39	1.820
.14	0.748	0.40	1.863
.15	0.791	0.41	1.905
.16	0.834	0.42	1.948
.17	0.877	0.43	1.990
.18	0.920	0.44	2.032
.19	0.963	0.45	2.075
.20	1.006	0.46	2.117
.21	1.049	0.47	2.159
.22	1.091	0.48	2.201
.23	1.134	0.49	2.244
.24	1.176	0.50	2.286
.25	1.219	0.51	2.328
.26	1.261	0.52	2.369
.27	1.304	0.53	2.411
.28	1.346	0.54	2.452
.29	1.389	0.55	2.494
.30	1.431	0.56	2.535

R.P.S Vel ft/sec

0.57 2.577

0.58 2.618

0.59 2.680

0.60 2.701

0.61 2.743

0.62 2.784

0.63 2.826

0.64 2.867

0.65 2.909

0.66 2.950

0.67 2.992

0.68 3.033

0.69 3.075

0.70 3.116

0.71 3.157

0.72 3.198

0.73 3.239

0.74 3.280

0.75 3.322

0.76 3.363

0.77 3.404

0.78 3.445

0.79 3.486

0.80 3.527

0.81 3.567

0.82 3.608

12

## Gage Heights Cont'd

Date	Gage to Surf.	Ht. "Y"	Actual Depth "C"	Time	Weather
Jan 26	14 67	20.7	6 03	2:15 <sup>P</sup>	Clear
27	14 58		6 12	2:15 <sup>P</sup>	Cloudy
28	14 56		6 14	2:15 <sup>P</sup>	Clear
29	14 79		5 91	3:00 <sup>P</sup>	Cloudy
30	14 82		5 88	1:00 <sup>P</sup>	Clear
<sup>31</sup> Feb 1	<sup>14 86</sup> 14 90		<sup>5 84</sup> 5 80	<sup>1:00<sup>P</sup> clear</sup> 4:15 <sup>P</sup>	Clear
Sunday 2	14 87		5 83	1:30 <sup>P</sup>	Clear
3	14 89		5 81	1:30 <sup>P</sup>	Snowing
4	14 96		5 74	1:30 <sup>P</sup>	Clear
5	15 17		5 53	2:30 <sup>P</sup>	Clear
6	15 04		5 66	12:30 <sup>P</sup>	Clear <sup>High</sup> Windy
7	15 54		5 16	12:30 <sup>P</sup>	Clear <sup>Windy</sup>
8	15 08		5 62	1:30 <sup>P</sup>	Clear
Sunday 9	14 83		5 87	2:30 <sup>P</sup>	Clear
10	14 92		5 78	1:00 <sup>P</sup>	Clear
11	15 04		5 66	2:00 <sup>P</sup>	Snowing,
12	15 17		5 53	2:00 <sup>P</sup>	Clear
13	15 25		5 45	4:00 <sup>P</sup>	Clear
14	14 95		5 75	1:00 <sup>P</sup>	Clear
15	15 04		5 66	12:30 <sup>P</sup>	Clear
Sunday 16	14 92		5 78	1:30 <sup>P</sup>	Cloudy
17	15 00		5 70	1:30 <sup>P</sup>	Cloudy
18	14 92		5 78	9:30 <sup>A</sup>	Clear <sup>High Wind</sup>
19	14 97		5 73	1:00 <sup>P</sup>	Clear
20	15 04		5 66	1:30 <sup>P</sup>	Cloudy
21	15 08		5 62	11:30 <sup>P</sup>	cloudy

From page 4.

13

Temp

58°

38°

45°

38°

60°

50°

42°

31°

46°

43°

25°

28°

36°

40°

37°

39°

30°

28°

26°

51°

45°

50°

43°

28°

34°

50°

54°

Rain on morning - Jan. 27

3" of snow.

Water clearest since beginning <sup>of work</sup>

Light snow - morning of 17<sup>th</sup>.

14

## Gage Heights Cont'd

Date	Dist to Surf.	Ht "y."	Actual Depth	Time	Weather
Feb 22 Sunday	Di 14.94	20.7	5.76	1:00 <sup>P</sup>	Rain
23	14.80		5.90	12:30	Clear
24	14.96		5.74	12:30	Clear
25	15.04		5.66	12:30	Clear
26	15.00		5.70	12:30	Cloudy
27	14.74		5.96	4:30	Rain
28	14.78		5.92	4:30	Clear
Mar 1	14.75		5.95	1:00	High Wind Clear
2	14.62		6.08	4:30	Clear
3	14.71		5.99	4:30	Clear
4	14.95		5.75	1:30	Clear
5	14.96		5.74	9:30 <sup>A</sup>	Clear
6	15.04		5.66	1:30	Snow High W.
7	15.20		5.50	12:30	Clear
8 Sunday	15.14		5.56	12:30	Clear
9	15.11		5.59	1:00	Clear
10	15.00		5.70	4:00	Clear
11	14.90		5.80	4:00	Clear
12	15.10		5.600	4:30	rain
13	14.10		6.60	4:00	rain
14	13.00		7.70	4:00	Clear
15	14.08		6.62	1:30	rain
Sunday 16	14.00		6.70	1:30	cloudy
17	14.42		6.28	1:30	Clear
18	14.96		5.74	1:30	Clear
19	14.95		5.95	1:30	Clear windy

see page 20.



from page 13

Temp

48°

52°

49°

54°

36°

42°

50°

44°

40°

48°

52°

54°

40°

30°

36°

55°

57°

54°

56°

61°

66°

68°

50°

44°

50°

62°

Slight rain during day.

Heavy Rains

Heavy Rains.

16

## Current Meter Observations

No	Dist from Ft.	Revs per 50 Sec.			Mean TR's	R's/sec	Vel. Ft/sec.
		1st run	2d Run	Depth			
0	0	11	10	Surf.	10.5	0.21	1.049
		13	13	bottom.	13	0.26	1.261
1	5'	16	18	Surf.	17	0.34	1.604
		16	18	Bottom	17	0.34	1.604
2	10'	29	27	Surf.	28	0.56	2.535
		25	27	2'	26	0.52	2.369
		19	17	Bottom	18	0.36	1.690
3	15'	38	40	Surf.	39	0.78	3.445
		38	42	2'	40	0.80	3.529
		37	35	4'	36	0.72	3.198
		34	34	6' Bottom	34	0.68	3.033
4	20'	44	46	Surf.	45	0.90	3.931
		39	41	2'	40	0.80	3.529
		27	29	4'	28	0.56	2.535
		27	25	6' bottom	26	0.52	2.369
5	25'	38	39	Surf.	38.5	0.77	3.404
		38	40	2'	39	0.78	3.445
		39	41	4'	40	0.80	3.529
		35	37	6'	36	0.72	3.198
6	30'	33	31	Bottom	32	0.64	2.867
		32	30	Surf.	31	0.62	2.784
		36	34	2'	35	0.70	3.116
		37	39	4'	38	0.76	3.363
		39	37	6'	38	0.76	3.363
		35	33	8"	34	0.68	3.033
		23	21	Bottom	22	0.44	2.032

at Cemetery Bridge.

17

Depth @ C 1.00 = 6. March 16 '13

Depth @ C\* 6.62

Time 2-4 P.M.

Cloudy and  
rain in early  
part of observation.

Temp. 68°

Stream rose  
3" during time  
of observations  
due to milks  
probably.

18

## Current Meter Observations

No	Dist from A	1 <sup>st</sup> run	2 <sup>d</sup> run	Depth	Mean RS	RS/sec	Vel/ft/sec
7	35	32	30	Surf.	31	0.62	2.784
		32	34	2'	33	0.66	2.950
		36	34	4'	35	0.70	3.116
		36'	34'	6'	35	0.70	3.116
		33'	31	8'	32	0.64	2.867
		24	26	bottom	25	0.50	2.286
8	40	27	25	Surf.	26	0.52	2.369
		21	19	2'	20	0.40	1.868
		29	31	4'	30	0.60	2.701
		25	27	6'	26	0.52	2.369
		19	17	bottom	18	0.36	1.690
		26	24	Surf.	25	0.50	2.286
9	45	13	11	2'	12	0.24	1.176
		7	9	4' bot.	8	0.16	0.834
		24	22	Surf.	23	0.46	2.117
10	50	16	18	bottom	17	0.34	1.604
		17	14	Surf.	15.5	0.31	1.474
11	55	11	9	bottom	10	0.20	1.006
		0	-	Surf.	0	0	0
12	60	0	-	Surf.	0	0	0

Cont'd from p. 16

19

# Gage Heights Cont'd

Date	Dist To Surf	Ht "Y"	Actual Depth	Time	Weather
20 March	14.16	20.7	6.54	10 AM	Rain High Wind
21	14.25		6.45	2:00 P	Cloudy High Wind
22	14.41		6.29	2:00 P	Clear
Sunday 23	14.58		6.12	1:00 P	Clear High Wind
24	14.75		5.95	3:30 P	Cloudy High Wind
25	14.83		5.87	4:00	Cloudy
26	14.33		6.47	5:00 P	Rain
27	10.25		10.45	3:00 P	Rain
	13.33		7.37	10:30 A	Windy
28	13.58		7.12	5 P	Clear
29	13.91		6.79	8:00 A	Clear
Sunday 30	13.90		6.80	11:00 A	Rain
31	14.33		6.37	11:00 A	Cloudy-Rain
April 1	14.58		6.12	3:00 P	Clear Wind
2	14.75		5.95	4:30 P	Clear wind
3	14.75		5.95	7:00 P	Cloudy
4	14.75		5.95	7:00 P	Cloudy Wind
5	14.75		5.95	2:00 P	Clear High Wind
Sunday 6	14.58		6.12	3:00 P	Cloudy Wind
7	14.87		5.83	6:30 P	Clear
8	14.91		5.79	6:30 P	Clear
9	14.91		5.79	9:00 A	Clear
10	15.00		5.70	9:15 A	Clear windy
11	14.83		5.87	2:45 P	Rain. (saw)
<del>12</del>	14.54		6.16	4:45 P	Rain
<del>11</del>	14.08		6.62	8:05 P	Raining.
<del>11/2</del>	13.75		6.95	8:40 A	Cloudy
	14.01		6.69	3:45 P	Raining light

From page 14-15

Temp in Remarks

58°

68°

48°

46°

Velocity with float when creek was at highest point was 11 per sec.

66°

70°

Rain morning and evening.

65°

64°-40° Heavy rain from 6-10 A.M & 11<sup>P</sup> to 3:30<sup>P</sup>A.

40°-47° Back water from Delaware up to the second dam, (above Bushkill Street.

34°

52°

60°

Rain at Noon.

56°

60°

51°

75°

68°

Heavy shower night of 4th.

68°

68°

64°

60°

62°

Set peg here as measured after night. Heavy Showers thru out day beginning 14 night before at apt. 11 and continuing intermittent thru out night & next day. Rate of rising - from 2:45 to 4:45 = .145' / hr = 1.74' / hr. From 4:45 to 5:05 = 0.135' / hr = 1.62" / hr. Max ht. probably not ascertained as mills start work at 6 A.M. Rain all night.

Trusses 13' C-C

Sidewalk 5'

Ht. of Railing 3' 6" (0-1) (1-2) (2-3)

Dist. C-C Stanchions 9' 4 1/2" 11' 0" 11' 0" (3-4) (4-5) 5-End  
11' 0" 11' 0" 8' 8 1/2"

Ht 11' 6" of bridge chord

Rail length = 11' 66' Total

all combined

20.74 25 21.45

12) 10.75 (89  
76  
---  
315  
96  
---  
1680  
834  
---  
770

7 1/2

25

1091  
49  
---  
77) .0400 (05

63  
5  
---  
415  
8) 30  
---  
37

77  
49

822  
291  
---  
086  
-3

12) 9.37 (78  
84  
---  
97

6) 39 (63  
113  
---  
6189.086 ) .300 (1

60  
819.3 ) .086 (28  
6  
---  
140  
28  
---  
42

81

1493 1/2



47

Approx. vel. =  $\frac{100}{20} = 5'$

$$\begin{array}{r}
 28 \overline{) 14.75} \quad (630 \\
 \underline{168} \\
 95 \\
 \underline{84} \\
 110
 \end{array}$$

$$\begin{array}{r}
 47 \overline{) 1775} \quad (37 \\
 \underline{1411} \\
 365 \\
 \underline{329} \\
 360
 \end{array}$$

$$\begin{array}{r}
 10292 \\
 \underline{10661} \\
 10661
 \end{array}$$

Per

Per

$$\begin{array}{r}
 12 \overline{) 7.0} \quad (58 \\
 \underline{60} \\
 100
 \end{array}$$

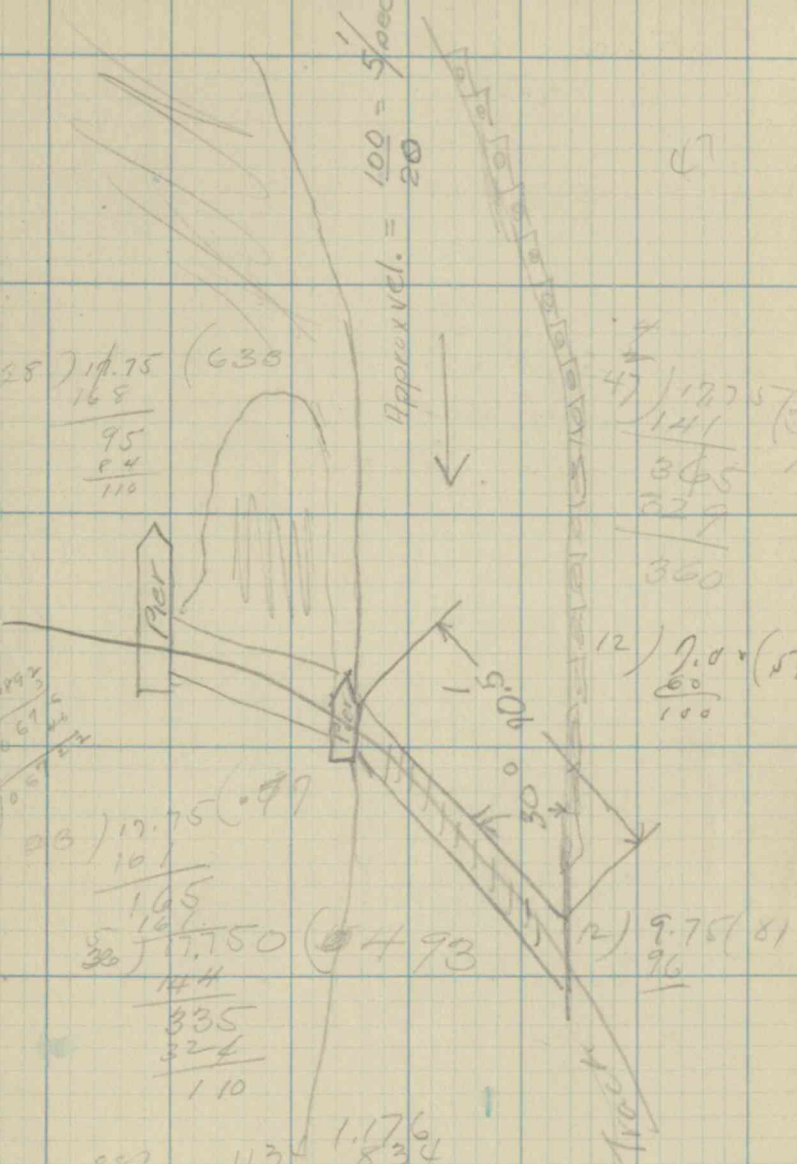
$$\begin{array}{r}
 26 \overline{) 17.75} \quad (67 \\
 \underline{101} \\
 165 \\
 \underline{156} \\
 95
 \end{array}$$

$$\begin{array}{r}
 30 \overline{) 17.750} \quad (493 \\
 \underline{144} \\
 335 \\
 \underline{324} \\
 110
 \end{array}$$

$$\begin{array}{r}
 12 \overline{) 9.75} \quad (81 \\
 \underline{96} \\
 \phantom{00}
 \end{array}$$

$$\begin{array}{r}
 887 \quad 1130 \quad 1.176 \\
 \underline{662} \quad \underline{662} \quad \underline{.834} \\
 .225 \quad 472 \quad 3.42 \\
 \underline{472} \quad \underline{1888} \quad \underline{.47} \\
 3620
 \end{array}$$

$$\begin{array}{r}
 .043 \\
 \underline{.312} \\
 .0430
 \end{array}$$

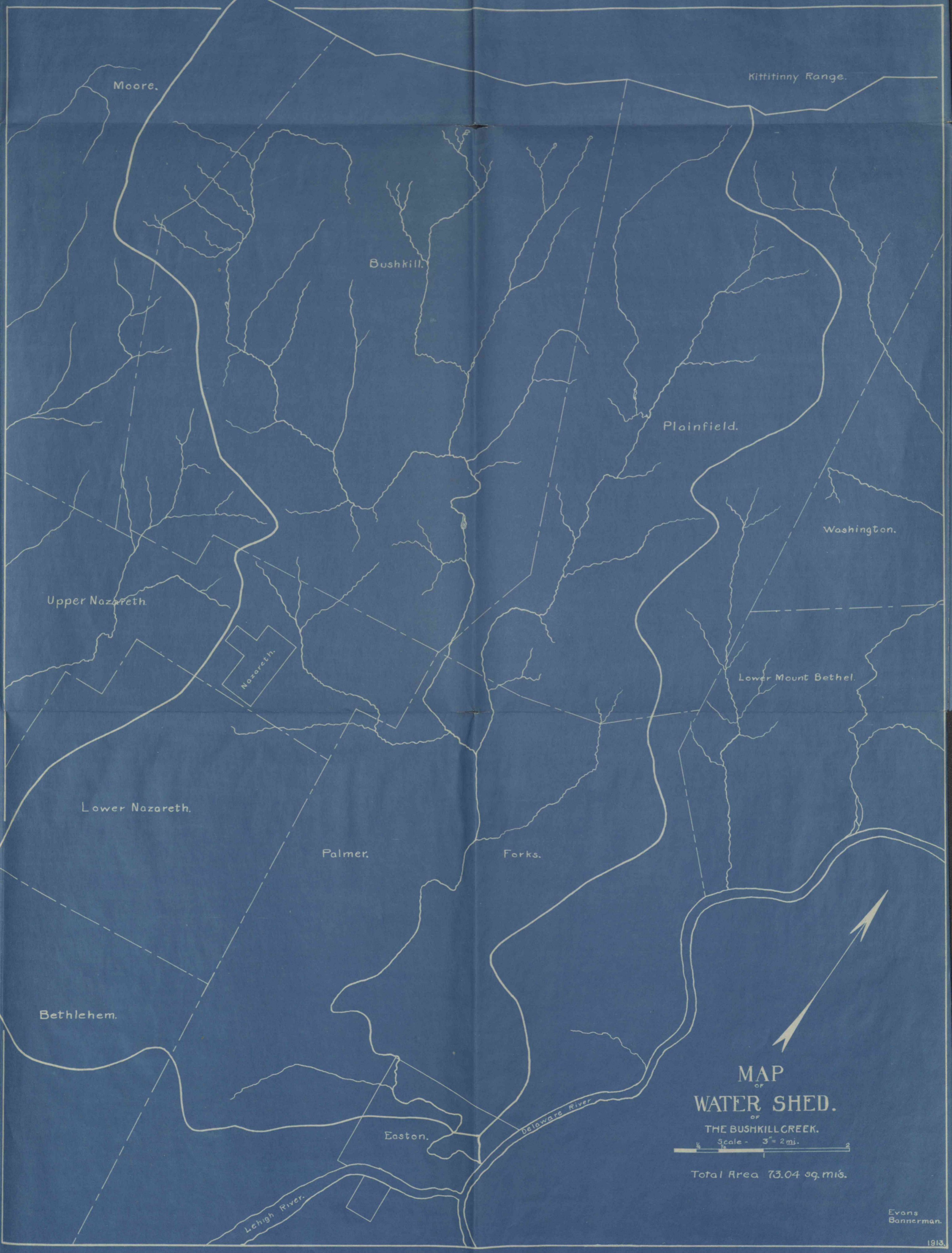


$4 \frac{1}{2}$   $6.5$  (54)  $20.7$   $\frac{1}{8}$   $5 \frac{1}{2}$   $1.12$   
 $3.5$   $6.0$   $15.1$   $56.62$   $14.5$   $14.1125$   
 $2.6$   $11.5$   $14.8$   $8.5$   $14.9$   $11.25$  (94)  
 $7.1$   $10.5$   $14.9$   $14.9$   $14.58$   $14.9$   $14.94$   
 $10.5$   $6.6$   $12$   $6$   $5$   $6.12$   $20.70$   
 $9.0$   $23.8$   $15$   $7.9$   $24.3$   $14.1.9$   $20.65$   $14.89$   
 $4.0$   $1.0$   $9.5$   $9.4$   $12$   $7$   $58$   $20.75$   
 $1.0$   $15.0$   $11$   $16.5$   $14.9$   $20.7$   $15.3$   $1.50$   $8.90$   
 $0$   $10.5$   $9.35$   $1.6$   $14.42$   $5.4$   $0.42$   $34.7$   
 $10.5$   $11.85$   $11.85$   $9.55$   $14.95$   $5.75$

$96$   $515$   $12$   $11.125$  (98)  $5.4$   $12$   $7$  (5)  $65$   $177.5$  (263)  
 $96$   $11.85$   $10.8$   $32$   $14.95$   $130$   
 $8.9$   $20.70$   $475$   
 $9.45$   $5.4$   $14.79$   $450$   
 $5.9$  Same place @  $3.30$   
 $14.375$   $14.275$

$12$   $3.62$  (3)  $13$   $32$   $17.75$  (55)  
 $12$   $10.5$  (8)  $20.7$   $24.700$   $160$   
 $9.0$   $14.69$   $14.750$   $195$   
 $9.0$   $6.01$   $5.950$   $160$   
 $12$   $9.75$  (8)  $12$   $15$  (06)  $83$   
 $15$   $1.625$   $72$

$12$   $8.25$  (6)  $12$   $10$   $110$   
 $20.70$   $662$   $10.5$   $666$   $12$   $55$  (46)  $50$   
 $20.7$   $14.78$   $4.08$   $587$   $70$   $100$   
 $5.92$   $10.5$   $.29$   $4$   $5$



Moore.

Kittitiny Range.

Bushkill.

Plainfield.

Washington.

Upper Nazareth.

Nazareth.

Lower Mount Bethel.

Lower Nazareth.

Palmer.

Forks.

Bethlehem.

Easton.

Delaware River

Lehigh River.

MAP  
OF  
WATER SHED.

OF  
THE BUSHKILL CREEK.

Scale - 3" = 2 mi.

Total Area 73.04 sq. mls.

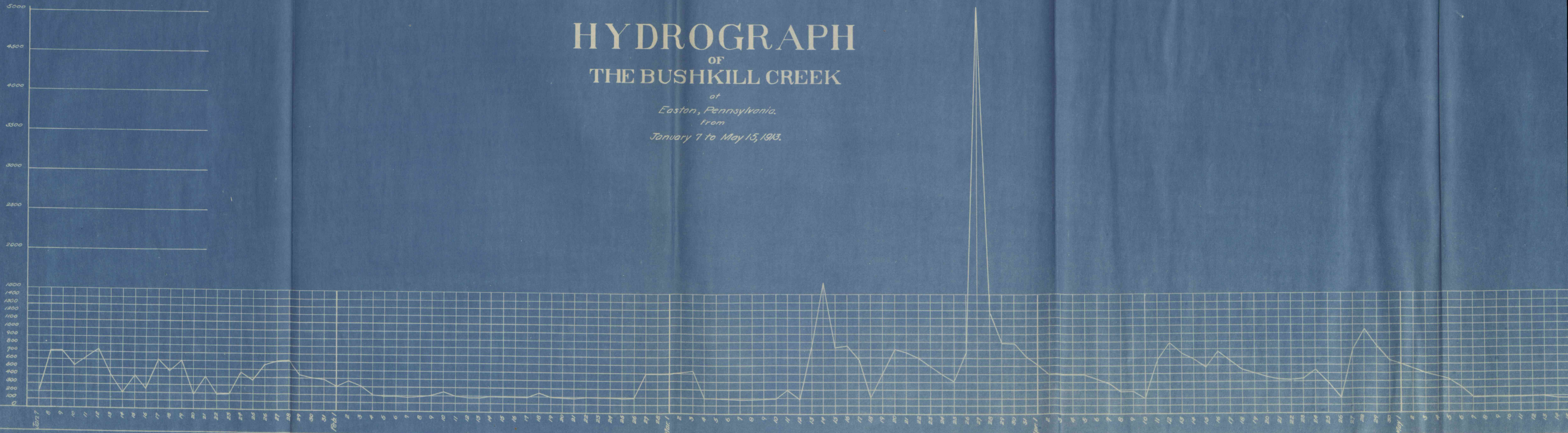
Evans  
Bannerman.

# HYDROGRAPH

OF  
THE BUSHKILL CREEK

at  
Easton, Pennsylvania.  
from  
January 7 to May 15, 1913.

Discharge in Cubic Feet per Second.



U. S. DEPARTMENT OF AGRICULTURE, WEATHER BUREAU.

Station, Phillipsburg, N. J.

Data Daily Precipitations, 1913. (Inches)

19 13	January	February	March	April	May	June	July	August	September	October	November	December
1		.22		.10								
2												
3	.68	.48		.01								
4	T	.08										
5	T		.04	.50								
6	.01											
7	.29		.08	T								
8	.53											
9												
10												
11	.27	.09	.68	.29								
12	.32		.04	.136								
13			T	.20								
14			.102	.11								
15			.11	.03								
16	.08		.42	.57								
17	.29	.02	T	.09								
18	.33											
19				T								
20			.103									
21	.19	T	.35									
22		.29	.02									
23	.27	.13										
24	.03		T	T								
25	.02											
26		T	.29									
27	.21	.41	.188									
28		.57	.131	.230								
29	.06			.31								
30	T		T	.15								
31			.01									
Sums....	3.60	2.29	7.28	6.02								
Means....												

T indicates amount too small to measure.