

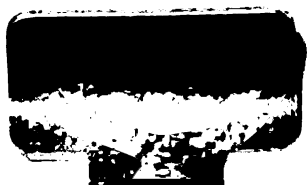
G. I. AUTEN



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THS

Thesis
Investigation of a Line
of Precise Levels
C. I. Auten G. R. Fryman
1905

THESIS



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THE S.I.C

INVESTIGATION OF A LINE OF PRECISE LEVELS

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C. I. AUTEN 1905

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G. R. FRYMAN 1905.

THESIS

The object of what is known as precise leveling is to obtain the highest possible accurate work. For this purpose special instruments are made. The one used in this work was made especially for the C. & N. Department at N. A. S. by Jones & Co., St. Louis, Mo., U. S. A. The instrument was first adjusted. In the field a large umbrella was used to shield the instrument from wind and sun. The length of the line was about 2 mi., lying between a bench on Piatt's Power House, Lansing, Mich. and one on the depot (Lake Shore) Dixondale, Mich. A spirit level was run over the entire line.

About half of the survey was made over country roads. The flat disc turning points being used. The other half was made over the C. & N. T. R. R., joints of the rails being marked and used as turning points. For the greater part of the work but one rodman was employed. However, for a considerable part of it two were used. The second time was saved and more probable accurate results obtained since the readings for any particular set up could be gotten nearer the same time. When using the railroad joints as turning points, they were marked so that in case of having to move the instrument because of passing trains, they could easily be found again. Bench marks were established about every three-quarters of a mile. If the line of the road line, if we were off any road would amount, we would have over only certain portions of the whole line. For example:

From N. E. R. III to S. N. at Logan St., the line did not check within three or four centimeters. On running it again the result fell between the first two results, so to be sure we were correct we were compelled to again run the line, this time checking to within .05 centimeters with our third line. The results were taken:

The hindrances to accurate work are: first, high or even slight wind. Second, hazy atmosphere and third, long sights and bright sun. About the entire error, if it be very much, can be laid to the wind or settling of the instrument. To prevent this get a good set up each time, and use the umbrellas. Toward noon and soon after dinner the hazy atmosphere is a great hindrance to accurate estimation. We were not bothered a great deal, however, because of the slight wind blowing nearly all the time. For long sights produce inaccurate results. 60 ft. is about the longest sight that should be taken and then the reading should be excellent; 40 ft. sights give best results. The direction of the sun we found to be a source of producing errors because of not well lighted rods.

A word about the effect of the sun on the instrument. We could see no great change in the condition of the instrument after it had been brought to the temperature of the atmosphere; this was always allowed to occur before the instrument was used. The check on the entire line was .726 dm.

Decimeter = unit

Direct Line.Back Sights.

<u>Thread Readings.</u>						Thread Dis.	Remarks
Point	1	2	3	Mean			
P.M.I.	2.50	3.25	4.00	3.250	1.50		Temp. 58°C
T.P. I.	11.75	15.30	18.70	15.250	6.95		Time 10 ³⁰ AM.
" II.	1.90	6.40	11.70	6.660	9.80		Date 4/13/05
" III.	31.00	31.50	32.00	31.500	1.00		Temp. 58°C.
" IV.	18.20	20.00	21.70	19.960	3.50		wavy atmos.
T.B.M.a.	27.90	29.80	31.50	29.730	3.60		Time 12 AM
T.P. I.	8.90	9.70	10.40	9.660	1.50		good
" II.	19.20	21.80	24.30	21.766	5.10		"
" III.	15.05	17.60	20.05	17.570	5.00		"
" IV.	18.65	20.20	21.70	20.180	3.05		"
" V.	4.15	6.25	8.30	6.230	4.15		"
" VI.	4.00	5.25	6.40	5.216	2.40		"
" VII.	2.55	3.40	4.20	3.383	1.65		"
" VIII.	5.60	5.80	6.00	5.800	.20		Time 3 ³⁰ PM.
				196.155	49.40		

Check Line.Back Sights.

<u>Thread Readings.</u>						Thread Dis.	Remarks
Point	1	2	3	Mean			
P.B.M.II.	28.00	29.60	31.15	29.583	3.15		Date 4/13/05.
T.P. I.	30.40	30.80	31.10	30.766	.70		Time 3 ³⁰ PM.
" II.	27.65	29.00	30.25	28.966	2.60		good
" III.	27.65	30.00	32.20	29.950	4.55		"
" IV.	10.50	11.50	12.50	11.500	2.00		"
" V.	20.55	23.65	26.55	23.583	6.00		"
" VI.	23.90	26.95	28.80	26.550	4.90		"
" VII.	3.0	2.65	4.45	2.630	3.65		"
T.B.M.a.	9.40	10.25	11.05	10.230	1.60		Time 6 PM
T.P. I.	3.50	4.03	4.54	4.023	1.04		good
" II.	2.28	2.65	3.00	2.643	.72		"
" III.	5.50	9.14	12.60	9.046	7.10		"
" IV.	26.18	26.95	27.70	26.976	1.52		cloudy
" V.	11.40	12.95	14.42	12.923	3.02		"
" VI.	28.34	29.80	31.45	29.863	3.11		Dark
" VII.	16.22	16.92	17.72	16.920	1.50		Time 7 ³⁰ PM
				296.152	47.16		

Decimeter = unit.

Direct Line.Fore Sight.

Point	Thread Readings.			Mean	Thread Dis.	Remarks.
	1	2	3			
T.P. I	2 6.5 5	2 7.3 0	2 8.1 0	2 7.3 2 0	1.5 5	good readings
II	1 8.7 0	2 1.8 0	2 4.8 0	2 1.7 6 6	6.1 0	Time 1 P.M.
III	2.7 0	6.0 0	9.2 0	5.9 6 6	6.5 0	"
IV	8.3 5	9.0 0	9.6 5	9.0 0 0	1.3 0	sunny.
T.B.M. a	1 3.5 0	1 5.5 0	1 7.3 0	1 5.4 3 0	3.8 0	"
T.P. I	6.4 0	8.1 0	9.8 0	8.1 0 0	3.4 0	Time 2 P.M.
II	3 0.9 0	3 7.6 0	3 2.2 0	3 1.5 6 6	1.3 0	"
III	1 6.5 0	1 9.0 0	2 1.3 0	1 8.9 3 0	4.8 0	"
IV	2 1.9 5	2 5.1 5	2 8.2 0	2 5.1 0 0	6.2 5	"
V	2 5.7 0	2 7.0 0	2 8.2 0	2 6.9 6 0	2.5 0	"
VI	1 6.1 5	1 7.9 5	1 9.6 5	1 7.9 1 5	3.5 0	"
VII	2 7.5 0	2 8.8 0	3 0.0 5	2 8.7 8 0	3.5 5	"
VIII	3 0.8 5	3 1.5 0	3 2.1 0	3 1.4 8 0	1.2 5	"
P.B.M. II	2 8.0 0	2 9.6 0	3 1.1 5	2 9.5 8 0	3.1 5	3 rd P.M.
				297.8 9 3	48.9 5	F3-B3 = 101.7

Check Line.Fore Sight.

Point	Thread Readings			Mean	Thread Dis.	Remarks
	1	2	3			
T.P. I.	6.8 0	7.1 0	7.3 5	7.0 8 3	.5 5	Reading good Time 3
II.	2.3 5	3.0 5	3.6 5	3.0 1 6	1.3 0	"
III.	2.4 0	3.4 0	4.3 0	3.3 6 6	1.9 0	"
IV.	1.2 5	2.7 0	4.1 0	2.6 8 3	2.8 5	"
V.	9.1 0	12.4 0	15.6 0	12.3 6 6	6.5 0	"
VI.	1 1.2 0	1 6.1 0	2 0.7 0	1 6.0 0 0	9.5 0	"
VII.	2 8.6 0	2 9.8 0	3 0.9 0	2 9.7 6 0	2.3 0	Time 5 ²⁰
T.B.M. a	9.4 0	1 0.2 5	1 1.0 5	1 0.2 3 0	1.6 0	"
I.	3.8 0	6.4 0	8.8 0	6.3 3 3	5.0 0	"
II.	3 1.3 0	3 1.7 5	3 2.1 8	3 1.7 4 3	.8 8	cloudy
III.	1 8.5 5	2 1.1 0	2 3.5 0	2 1.0 5 0	4.9 5	"
IV.	3.5 5	4.9 0	6.1 2	4.8 5 3	2.5 7	"
V.	1 3.2 5	1 3.7 8	1 4.2 8	1 3.7 7 0	1.0 3	"
VI.	1 3.1 0	1 5.2 5	1 7.3 0	1 5.2 1 6	4.2 0	"
VII.	2.4 0	3.0 0	3.6 8	3.0 2 6	1.2 8	"
P.B.M. I.	1 2.8 0	1 3.7 0	1 4.6 0	1 3.7 0 0	1.8 0	Time 7 ²⁰
				194.1 9 5	48.2 1	Nearly Dark
						B3-F3 = 101.957
						Error = .219

Decimeter = unit.

Direct LineBack SightsThread Readings

Point.	1	2	3	Mean	Thread Dis.	Remarks
P.B.M. II	18.60	21.20	23.65	21.150	5.05	Date 4/17 '05
T.P. I.	29.40	30.30	31.20	30.300	1.80	7 ⁴⁵ A.M.
II	29.62	30.40	31.10	30.340	1.48	Temp. 38°C
T.B.M.p.	11.02	11.75	12.35	11.706	1.33	snod.
I	6.45	8.55	10.60	8.560	4.15	good readings
II	27.95	30.35	32.65	30.316	4.10	" "
T.B.M.c	27.65	29.35	30.95	29.326	3.30	" "
I	29.45	30.60	31.70	30.583	2.25	" "
II	26.30	27.80	29.25	27.800	2.95	" "
T.B.M.e.	4.10	5.70	7.20	5.660	3.10	" "
I	13.67	14.55	15.36	14.520	1.69	" "
				240.251	31.20	

Check LineBack Sights.Thread Readings

Point	1	2	3	Mean	Thread Dis.	Remarks
P.B.M.f.	6.00	8.12	10.13	8.080	4.13	Date 5/13 '05
T.P. I	23.85	25.65	27.33	25.610	3.48	12 ³⁰ A.M.
II	2.00	3.35	4.60	3.310	2.60	warm & Sunny
III	5.60	6.28	6.95	6.270	1.35	good readings.
IV	3.25	4.50	5.62	4.460	1.37	
V	1.10	4.70	8.10	4.630	7.00	
VI	1.4	6.60	18.40	6.530	3.80	
VII	9.18	9.70	10.20	9.690	1.02	
VIII	2.20	4.95	7.50	4.880	5.30	
IX	10.48	11.42	12.32	11.400	1.84	3 ³⁰ P.M.
				94.860	31.89	

check .06

Decimeter = unit

Direct Line.Fore Sights.

Point	Thread Readings.			Mean	Thread Dis.	Remarks
	1	2	3			
T.P.I.	17.75	20.50	23.20	20.483	5.45	Date 9/14 ⁰⁵ .
II.	2.00	2.47	2.90	2.456	.90	Temp. 38°C.
T.B.M.p.	3.40	3.80	4.22	3.806	.82	7 ³⁰ .
I.	14.22	16.10	17.90	16.073	3.68	good readings
II.	5.45	8.20	10.75	8.133	5.30	
T.B.M.c.	5.00	7.90	10.65	7.850	5.65	
I	3.30	4.20	5.05	4.183	1.75	
II	3.80	4.64	5.45	4.630	1.65	
T.B.M.e.	19.20	21.70	22.20	21.700	5.00	
I	26.60	28.12	29.60	28.106	3.00	
T.B.M.f	4.62	5.55	6.40	5.520	1.78	10 ³⁰ snow.
				122.940	34.98	B.S.-F.D. = 117.311

Check Line.Fore Sights.

Point.	Thread Readings.			Mean	Thread Dis.	Remarks.
	1	2	3			
T.P. I.	2.00	3.60	5.10	3.56	3.10	Date 9/13 ⁰⁵
II	7.65	9.85	11.95	9.81	2.30	12 ³⁰ AM.
III	28.22	29.40	30.52	29.38	2.30	warm & sunny
IV	29.00	30.45	31.82	30.42	2.82	Temp 80° F
V	18.40	21.50	24.50	21.46	6.10	good readings.
VI	23.02	24.82	26.52	24.78	3.50	
VII	15.70	18.40	20.95	18.35	5.25	
VIII	30.12	30.92	31.70	30.90	1.58	
IX	27.30	28.63	29.90	28.61	2.60	
P.B.M.II.	12.70	14.90	17.00	14.86	4.30	3 ³⁰ P.M.
				212.13	33.85	F.S.-B.S. = 117.27
						Error = .04

Decimeter = unit.

Direct Line.Back Sights.Thread Readings.

Point.	1	2	3	Mean	Thread Dis.	Remarks
P.B.M.f.	1 8.1 0	1 9.4 2	2 0.6 5	1 9.3 9	2.5 5	Date May 13 '05
T.P. I	8.1 2	1 0.4 0	1 2.5 5	1 0.3 6	4.4 3	1 P.M.
II	8.9 5	1 0.7 5	1 2.4 8	1 0.7 3	3.3 3	almost wavy
III	1 2.3 5	1 3.2 0	1 3.9 9	1 3.1 8	1.6 4	" "
T.B.M.IIc.	9.8 0	1 2.2 0	1 4.5 5	1 2.1 8	4.7 5	" "
T.P. I	1 4.2 5	1 6.6 8	1 9.0 0	1 6.6 4	4.7 5	" "
II	1 5.4 5	1 8.0 0	2 0.3 2	1 7.9 3	4.8 7	good readings
III	9.9 2	1 2.3 5	1 4.7 5	1 2.3 0	4.8 3	" "
IV	1 2.5 3	1 3.3 4	1 4.1 0	1 3.3 2	1.5 7	" "
T.B.M.IIc.	9.4 8	1 1.9 0	1 4.2 0	1 1.8 6	4.7 2	" "
T.P. I	6.3 0	8.7 0	1 1.0 0	8.6 6	4.7 0	" "
II	5.4 0	7.8 0	1 0.0 5	7.7 5	4.6 5	" "
III	9.6 3	1 0.7 0	1 1.7 0	1 0.6 8	2.0 7	" "
T.B.M.IIc.	6.5 0	9.0 0	1 1.3 0	8.9 3	4.8 0	" "
T.P. I	1 3.1 0	1 5.5 6	1 7.9 0	1 5.5 2	4.8 0	" "
II	1 4.0 0	1 7.0 2	1 9.9 0	1 6.9 7	5.9 0	5:30
				206.4 0	64.5 6	
				206.30		

Check Line.Back Sights.Thread Readings.

Point.	1	2	3	Mean	Thread Dis.	Remarks
B.M. 5k.	1 2.1 2	1 4.1 0	1 5.9 5	1 4.0 6	3.8 3	Date May 20 '05
T.P. I	1 0.9 8	1 2.9 2	1 4.8 0	1 2.9 0	3.8 2	8 A.M.
II	8.8 5	1 0.8 2	1 2.7 0	1 0.7 9	3.8 5	good readings
III	1 3.4 2	1 5.3 5	1 7.2 2	1 5.3 3	3.8 0	" "
T.B.M.IIc.	1 7.4 0	1 9.4 5	2 1.2 0	1 9.3 5	3.8 0	" "
T.P. I	1 6.4 8	1 8.4 2	2 0.3 0	1 8.4 0	3.8 2	" "
II	1 5.5 0	1 7.6 3	1 9.6 3	1 7.5 8	4.1 3	" "
III	1 5.4 0	1 7.5 5	1 9.5 5	1 7.5 0	4.1 5	" "
B.M.IIc.	1 1.3 0	1 3.4 0	1 5.4 0	1 3.3 6	4.1 0	windy
T.P. I	1 3.6 0	1 5.7 0	1 7.7 0	1 5.6 6	4.1 0	" "
II	8.4 0	1 0.3 5	1 2.2 0	1 0.3 1	3.8 0	" "
III	1 0.2 8	1 2.3 5	1 4.3 5	1 2.3 2	4.0 7	" "
IV	1 2.1 8	1 4.6 0	1 6.9 0	1 4.5 6	4.7 2	" "
B.M.IIc.	1 4.4 5	1 6.5 8	1 8.5 8	1 6.5 4	4.1 3	" "
T.P. I	1 7.4 2	1 9.0 0	2 0.4 5	1 8.9 6	3.0 3	" "
II	9.1 0	1 1.1 4	1 3.0 7	1 1.1 0	3.9 7	" "
III	1 1.8 8	1 2.8 9	1 3.8 2	1 2.8 6	1.9 4	12 A.M.
				251.5 8	63.0 6	

Decimeter = unit

Direct Line.Fore Sights.

Point	Thread Readings			Mean	Thread Dis.	Remarks
	1	2	3			
T.P. I	14.00	15.40	16.70	15.37	2.70	Date 5/30/05
II	14.90	16.40	17.85	16.38	2.95	1.P.M.
III	18.40	20.78	23.02	20.73	4.62	
B.M.III.e.	14.42	15.52	16.58	15.50	2.16	
T.P. I	11.80	14.20	16.55	14.18	4.75	
II	9.18	11.65	13.93	11.59	4.77	
III	7.80	10.18	12.45	10.14	4.65	
IV	12.10	14.35	16.50	14.32	4.40	
B.M.II.e.	12.58	13.58	14.50	13.55	1.92	
T.P. I	15.70	18.20	20.52	18.14	4.82	
II	16.80	18.95	21.00	18.92	4.20	
III	17.15	19.50	21.70	19.45	4.55	
B.M.I.e.	16.20	17.25	18.25	17.23	2.05	
T.P. I	13.82	16.25	18.58	16.21	4.76	
II	10.30	12.71	15.03	12.68	4.73	F.S.-B.S. = 43.48
B.M.sh.	12.51	15.55	18.40	15.49	5.89	
				249.88	61.92	

Check Line.Fore Sights.

Point	Thread Readings			Mean	Thread Dis.	Remarks
	1	2	3			
T.P. I	12.55	14.50	16.35	14.41	3.80	Date 5/15 of
II	13.43	15.40	17.25	15.36	3.82	8 a.m.
III	9.93	11.85	13.70	11.84	3.77	readings good
B.M.I.e.	6.84	8.80	10.65	8.76	3.81	Temp. 70°F
T.P. I	5.80	7.90	9.90	7.86	4.10	
II	6.80	8.80	10.60	8.73	3.80	
III	6.45	8.55	10.55	8.52	4.10	
B.M.II.e.	10.38	12.48	14.50	12.45	4.12	
T.P. I	10.30	12.40	14.40	12.36	4.10	
II	15.35	17.50	19.50	17.45	4.15	windy
III	19.50	16.65	18.65	16.60	4.15	
IV	13.92	16.10	18.12	16.05	4.20	
B.M.III.e.	10.65	12.65	14.55	12.62	3.90	
T.P. I	9.95	12.00	14.00	11.98	4.05	
II	7.72	9.38	10.90	9.33	3.18	
III	3.90	5.40	7.35	5.38	3.95	
P.B.M.f	17.15	18.32	19.42	18.29	1.27	Temp. 75°F
				207.94	63.27	B.S.-F.S. = 43.48
				207.97		Error = .11

check 2.23

Decimeter = unit

Direct LineBack SightsThread Readings

Point	1	2	3	Mean	Thread Dis.	Remarks
B.M. sh.	10.52	11.95	13.25	11.90	2.73	Date 4/18/05. 38°F snow.
T.P. I.	10.10	11.60	13.00	11.56	2.90	
II	13.45	15.25	16.95	15.21	3.50	
III	13.65	15.38	17.00	15.34	3.35	
IV	15.70	16.61	17.40	16.57	2.20	
V	15.98	17.25	18.50	17.24	2.62	
T.B.M. Ie	14.30	16.65	18.90	16.40	4.60	
T.P. I	13.50	15.75	17.85	15.70	4.35	
II	14.50	16.80	18.78	16.76	4.28	
III	10.15	11.30	12.38	11.276	2.23	
T.B.M. Iie	4.30	6.50	8.68	6.46	4.38	
T.P. I	6.52	8.82	11.00	8.78	4.48	
II	12.23	13.25	14.21	13.23	1.98	
T.B.M. Iiie	20.15	22.43	24.65	22.41	4.40	
T.P. I	7.00	9.30	11.50	9.263	4.50	
II	8.30	10.30	12.15	10.25	3.85	
III	10.18	11.32	12.45	11.316	2.27	
T.B.M. IVe	19.55	21.65	23.65	21.616	4.10	
T.P. I	10.95	13.12	15.15	13.073	4.20	
II	10.40	11.95	13.40	11.916	3.00	
T.B.M. Vle	6.10	8.05	9.93	8.026	3.83	
T.P. I	10.80	12.62	14.43	12.623	3.63	
II	7.99	9.82	11.55	9.786	3.56	
				306.705	80.94	

Check Line Back Sights

	1	2	3	Mean	Thread Dis.	Remarks
P.B.M. III.	2.700	2.810	2.913	2.8076	2.13	Date 4/18/05 39.5°F cloudy co'
T.P. I	9.10	11.05	12.90	11.016	3.80	
II	14.40	16.65	18.80	16.616	4.40	
T.B.M. Ie.	16.15	18.15	20.02	18.106	3.77	
T.P. I	16.85	18.80	20.65	18.766	3.80	
II	27.55	29.50	31.35	29.466	3.80	
T.B.M. Ie.	17.70	19.65	21.45	19.600	3.75	
T.P. I.	16.85	18.82	20.70	18.790	3.85	
II	17.60	19.10	20.92	19.400	3.82	
III	15.62	16.12	16.60	16.133	.98	
IV	28.50	30.45	32.30	30.411	.80	
T.B.M. Iiie	18.50	20.45	22.35	20.433	3.85	
T.P. I	18.10	19.40	20.60	19.333	2.50	
II	16.25	18.28	20.20	18.243	5.95	
T.B.M. Iiie.	13.22	15.15	17.00	15.123	3.22	
T.P. I	13.42	15.53	17.54	15.496	4.12	
II	12.18	14.75	17.20	14.710	5.02	
III	6.92	9.00	10.95	8.956	4.03	
T.B.M. Ie	6.90	9.30	11.58	9.260	4.68	
T.P. I	9.94	12.50	15.02	12.486	5.08	
II	14.15	16.12	18.00	16.090	.85	
III	16.50	18.45	20.30	18.417	3.80	
				394.947	73.90	

Decimeter = unit.

Direct Line.Fore Sights.

Point	Thread Readings				Thread Dis.	Remarks
	1	2	3	Mean		
T.P. I	12.45	13.63	14.80	13.62	2.35	Date 4/15
II	11.97	13.40	14.75	13.37	2.78	Temp 38°
III	12.10	13.85	15.60	13.85	3.50	snow
IV	8.02	9.70	11.30	9.67	3.28	
V	7.52	9.00	10.24	8.92	2.72	
T.B.M. I.e.	10.00	11.31	12.51	11.27	2.51	
T.P. I	14.10	16.45	18.65	16.40	4.55	
II	13.75	16.00	18.20	15.976	4.45	
III	17.20	19.45	21.58	19.41	4.38	
T.B.M. II.e.	14.17	15.25	16.28	15.233	2.11	
T.P. I	20.10	22.25	24.28	22.210	4.18	
II	17.80	19.91	21.91	19.873	4.11	
T.B.M. III.e.	27.78	28.70	29.60	28.693	1.82	
T.P. I	16.90	19.10	21.20	19.066	4.30	
II	16.75	18.55	20.25	18.516	3.50	
III	17.45	19.40	21.25	19.366	3.80	
T.B.M. IV.e.	27.75	30.25	32.60	30.200	4.95	
T.P. I	16.65	18.80	20.75	18.733	4.10	
II	17.68	19.70	21.65	19.676	3.97	
T.B.M. V.e.	16.65	18.70	20.65	18.666	4.00	
T.P. I	14.35	16.65	18.80	16.616	4.45	
II	9.15	11.05	12.95	11.033	3.80	
P.B.M. III.	25.48	26.50	27.45	26.476	1.97	38°

Check Line. Fore Sights.

Thread Readings

406.843

79.58

Point	Thread Readings				Thread Dis.	Remarks
	1	2	3	Mean		
T.P. I.	9.68	11.42	13.07	11.390	3.39	Date 4/15/05.
II.	10.82	12.65	14.40	12.625	3.58	cold, cloudy.
T.B.M. X.e.	6.10	8.05	9.93	8.026	3.83	readings good
T.P. I	8.21	10.10	11.90	10.070	3.69	Temp. 39°
II	10.82	12.85	14.80	12.823	3.98	
T.B.M. IV.e.	19.60	21.75	23.82	21.723	4.22	
T.P. I	7.72	9.80	11.80	9.774	4.08	
II	10.75	12.10	13.40	12.083	2.65	
III	7.75	9.85	11.86	9.820	4.11	
IV	9.80	11.70	13.50	11.666	3.70	
T.B.M. III.e.	25.40	25.88	26.34	25.873	.94	Total error
T.P. I	8.35	10.32	12.20	10.29	3.85	on line = .726
II	6.90	8.95	10.85	8.90	3.85	Dip. 17° elevation
T.B.M. II.e.	7.30	8.85	10.38	8.843	3.08	= 128.408
T.P. I	9.52	11.32	13.00	11.28	3.52	
II	13.60	15.50	17.30	15.466	3.70	
III	13.00	15.10	17.12	15.073	4.12	
T.B.M. I.e.	13.52	15.00	16.44	14.986	2.92	
T.P. I	18.70	20.80	22.76	20.753	4.06	
II	15.20	17.65	19.44	17.596	4.74	B.S. - F.S. = 100.494
III	10.75	13.25	15.60	13.200	4.85	Error = .356
B.M. 24.	10.40	12.22	13.96	12.193	3.56	
				294.453	70.34	

-:DESCRIPTION OF MONUMENTS:-

- P. E. N. I. Cross cut on top of West end of stone under South-east corner of West wing of Filordale Chapel.
- P. E. N. II. North-east corner of the bridge across Grand River on South-east corner of stone under bed plate.
- P. E. N. III. Cross cut on East end of window-sill of North-west window in Platt's Power house.
- T. E. N. a. Top of red granite stone on East side of road under fence, four rods from north corner of Mr. Cogswell's orchard.
- T. E. N. b. Top of black stone on East side of road 200 ft. North George Rousch's house.
- T. E. N. f. Socket on North edge of stump on South side of Millier's road, 1/2 mi. East of corner and S. 15° E. of old barn.
- T. E. N. I c. Third joint of North rail on C. T. R. R. East of signal post on North side of track and South of red barn.
- T. E. N. II c. Second joint of North rail on C. T. R. R., West of whistle post on North side of track and first one West of Millers.
- T. E. N. III c. First joint on North rail of C. T. R. R. East of turn-out on South side of track 210 ft. West mile post (C-215).
- P. E. N. b. Joint in North rail C. T. R. R. South of auction house 7/4 miles West of Turkey Creek.

ROOM USE ONLY

Oct 19 '38

~~MAY 31 1961~~

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