TALLINNA TEHNIKAÜLIKOOLI TOIMETUSED
PUBLICATIONS FROM THE TECHNICAL UNIVERSITY OF ESTONIA
AT TALLINN
Series A № 12 (July 1940)

Recomputation of the Estonian Latitude Determinations

BY

R. LIVLÄNDER

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K. Mattieseni trükikoda o.-ü., Tartu, 1940.

In my paper "Longitude and Latitude Determinations in Estonia from 1930 to 1933" (*P. T. T. A. 1.*)* I gave longitudes for 23 and latitudes for 24 first-order triangulation points in Estonia. The latitudes, determined according to the Talcott method, were based on the old Boss system [1]). In the meantime a new Boss catalogue [2]), containing modern star positions, has been published. Thus it became desirable to convert the latitudes into the new Boss system. As expected, better results were obtained by using the new system. There occurs, besides, a systematic difference between the two catalogues, and the latitudes in the new system are, on an average, by $+0''.16$ larger than the latitudes in the old system. The new declinations were computed by Mr. K. Kruusmaa, to whom the author desires to express his thanks.

Together with the re-computation a few errors in *P. T. T. A. 1.* were also corrected. Thus at several field-points, where one zenith star was observed in two positions of the instrument, r, the correction for refraction, and partly also c, the correction for the curvature of the parallel, were omitted. The correction for the curvature of the parallel is $+0''.59$ for the stars Nos. 4790, 4688, 5412, and $+0''.57$ for the star No. 6260 (the numbers are given in the old system). The first three stars were observed on July 16 to 27, 1930, August 5 and 6, 1931, June 9 and 13, 1933; the last star was observed on July 23 and 24, 1933. All these observations must be corrected by the abovenamed quantities. The correction for refraction is $+0''.13$ for No. 4790, and $-0''.06$ for No. 4688 at Tallinn in July 1930; $-0''.08$ for No. 5412 at Tahkuna in 1931; $-0''.08$ for

*) Abbreviation used: *Publications from the Tallinn Institute of Technology Series A No 1 = P. T. T. A. 1.*

[1]) Lewis Boss. Preliminary General Catalogue of 6188 stars etc. Washington 1910.

[2]) Benjamin Boss. General Catalogue of 33 342 Stars for the Epoch 1950. Washington 1937.

No. 4790 at Kloostri in 1932; $+0''.02$ for No. 4790 at Keila in 1932; $-0''.11$ for No. 4688 at Pakri in 1932; $-0''.04$ for No. 4790 at Nabala in 1933; —0.05 for No. 4688 at Jõelähtme in 1933; $+0''.12$ for No. 6260 at Essemäe in 1933. The observations of all the above-mentioned stars should be taken with the weight 0.5. On page 101 (*P. T. T. A. 1.*), the value m for the star No. 4614 is not correct, the correct m being $+5'\,22''.22$.

In the following tables all the author's latitude determinations from 1930 to 1933 are given in the new Boss system (Benjamin Boss 1937). The mean latitude value for a field-point is deduced as an arithmetic mean (weighted mean, if necessary) from all the observed pairs; its mean error is derived from the internal agreement of the individual pairs (not nights).

The mean error of the latitude of a field-point is, on an average, $\pm 0''.10_4$. In the old Boss system this error was $\pm 0''.12_4$, the new system giving thus considerably better results. This error containing observation errors as well as declination errors, it is evident that better results are due to smaller declination errors in the new Boss system. When briefly examining the nature of the errors in *P. T. T. A.* 1. on page 18, in 1937, I came to the conclusion that of the error $\pm 0''.12_4$ a little less than $\pm 0''.09$ is owing to the observations, whereas the remaining part must be due to declination errors. If we ascribe $\pm 0''.08_5$ to errors of observation, $\pm 0''.09$ is left over for declination errors in the old Boss system. With, on an average, 13 Talcott pairs observed at a field-point, we get

$$\text{about } \pm 0''.09 \times \sqrt{13} = \text{about } \pm\, 0''.30$$

for the declination error of one pair in the old Boss system.

At a field-point, 13 Talcott pairs were, on an average, observed; the number of observations at a field-point was, however, 19 on two nights. Thus a number of pairs was repeated on both nights; there were, on an average, 6 pairs observed on both nights, and 3.5 pairs different for the two nights. When computing the mean error for one pair from the internal agreement of the pairs o n o n e n i g h t, we find for its value in the new Boss system,

on an average, $\pm 0''.44_5$. This quantity contains observation errors as well as declination errors. When dividing this value by the square root of the number of observations at one point, we get $\pm 0''.44_5 : \sqrt{19} = \pm 0''.10_1$, which is somewhat less than $\pm 0''.10_4$, the value deduced from all the observations on two (or more) nights. Considering, however, that the number of pairs at a point was, on an average, only 13, we must take into account that the part of the declination errors in the total error $\pm 0''.44_5$ must be divided by $\sqrt{13}$ instead of by $\sqrt{19}$. Thus we can say that the error $\pm 0''.10_4$, deduced from the internal agreement of all the pairs on two (or sometimes more) nights is practically the same as the error deduced from the internal agreement of the pairs on one night. We must, therefore, conclude that the observations do not contain systematic "one night" errors. From the observations no conclusion can, however, be drawn with regard to long periodic systematic errors. There is, of course, no doubt that the real value for the mean error of a field-point must be larger than $\pm 0''.10_4$.

If we compute the error for a field-point not from the internal agreement of the pairs but from the internal agreement of the nights, we find for it in the new Boss system, on an average, the value $\pm 0''.09_8$ (in the old Boss system this quantity would be $\pm 0''.09_2$). This value cannot but be less than $\pm 0''.10_4$, most of the pairs being the same on the two nights (6 pairs out of 9.5 common for both nights). Taking into account all that was said above, we may conclude that

1) the mean error for the latitude of a field-point, $\pm 0''.10_4$, was deduced from the internal agreement of the pairs in the new Boss system. The latitudes of the field-points contain no short period (of a few days) systematic errors;

2) from the above-mentioned quantity, the observation error is between $\pm 0''.08_5$ and $\pm 0''.09_5$, the error of declinations between $\pm 0''.04$ and $\pm 0''.06$;

3) the pure observation error of one pair is between $\pm 0''.37$ and $\pm 0''.41$ (from $\pm 0''.08_5 \cdot \sqrt{19}$ to $\pm 0''.09_5 \cdot \sqrt{19}$). The mean error of declinations for one pair in the new Boss system is between $\pm 0''.14$ and $\pm 0''.20$ (from $\pm 0''.04 \cdot \sqrt{13}$ to $\pm 0''.06 \cdot \sqrt{13}$). The new Boss system is considerably better than the old.

The following table gives the latitude determinations. In the table we denote by

$*$ — the number of the stars composing a pair in the old Boss Catalogue (Lewis Boss 1910). In exceptional cases the numbers are from Ambronn's catalogue (Ambronn, Sternverzeichnis 1907), and are then always specially marked;

φ_p — the value of the latitude, deduced in the new Boss system (Benjamin Boss 1937);

℄ — the effect of short period nutation terms.

The table contains no other observation data; these may be found, if required, in *P. T. T. A. 1.*

Ruhnu, 1930. 6. 3.

$*$	φ_p
	$57^\circ\,48'$
3847,3893	$3''.16$
4890,3977	$2''.32$ [1])
4890,4949	$2''.95$ [2])
4004,4021	$2''.79$
4162,4186	$2''.61$
4162,4213	$2''.52$
4432,4458	$3''.07$
	$2''.77$
℄	$-0''.10$
	$57^\circ\,48'\,02''.67$

Ruhnu, 1930. 6. 4.

$*$	φ_p
	$57^\circ\,48'$
3847,3893	$3''.68$
3911,3930	$2''.39$
4890,3977	$3''.36$ [1])
4890,4949	$3''.49$ [2])
4004,4021	$3''.33$
4162,4186	$3''.03$
4162,4213	$3''.43$
4327,4332	$3''.26$
4432,4458	$3''.11$
4470,4494	$3''.31$
4591,4584	$3''.08$
4671,4707	$2''.91$
4730,4787	$3''.83$
	$3''.25$
℄	$-0''.11$
	$57^\circ\,48'\,03''.14$

Abruka, 1930. 6. 7.

$*$	φ_p
	$58^\circ\,08'$
3656,3666	$24''.43$
599,3770	$24''.25$
3853,3893	$23''.48$
4035,4057	$23''.74$
4151,4161	$24''.41$
4510,4591	$25''.13$
	$24''.24$
℄	$0''.00$
	$58^\circ\,08'\,24''.24$

Mean (Ruhnu, 1930): $57^\circ\,48'\,02''.98 \pm 0''.09$.

[1]) Ambronn 4890. [2]) Ambronn 4949.

Abruka, 1930. 6. 8.

✳	φ_p
	58° 08′
3656,3666	24.13″
599,3770	23.60
3853,3893	24.02
4035,4057	24.41
4151,4161	24.57
4382,5523	23.50 [1])
4510,4591	24.52
4602,4639	24.36
4603,4639	24.28
1758,4820	23.89
	24.13
	℄ +0.03
	58° 08′ 24.16″

Abruka, 1930. 6. 9.

✳	φ_p
	58° 08′
3656,3666	24.24″
	58° 08′ 24.24″

Sõrve, 1930. 6. 19.

✳	φ_p
	57° 54′
3853,3893	35.79″ [2])
3911,3930	37.36
4890,4949	37.57 [3])
4021,4085	36.58
4162,4186	38.24
4327,4332	37.30
4470,4494	37.99
4510,4591	37.37
4603,4639	37.37
4602,4639	37.45
4671,4707	37.61
4799,4829	38.08
4948,4994	37.65
4948,5014	37.46
	37.48
	℄ —0.08
	57° 54′ 37.40″

Mean (Abruka, 1930): 58° 08′ 24.19″ ± 0.10″

Sõrve, 1930. 6. 20

✳	φ_p
	57° 54′
3911,3930	37.26″
4890,4949	38,26 [4])
4021,4085	36.95
4162,4186	37.92
4327,4332	37.11
4470,4494	37.34
4510,4591	36.67
4603,4639	36.49
4602,4639	36.60
4671,4707	37.05
4799,4829	37.21
	37.17
	℄ —0.05
	57° 54′ 37.12″

Viidumäe, 1930. 6. 26.

✳	φ_p
	58° 18′
830,4081	25.68″
4184,4223	25.81
4382,5523	26.47 [5])
4591,4542	26.63
1758,4820	26.70
1758,4858	25.30
4948,5005	25.98
5200,5234	27.73
	26.29
	℄ +0.10
	58° 18′ 26.39″

Viidumäe, 1930. 6. 27.

✳	φ_p
	58° 18′
830,4081	25.87″
4121,4161	25.52
4184,4223	26.71
4382,5523	26.51 [5])
4591,4542	26.76
1758,4820	27.19
1758,4858	25.59
4948,5005	25.38
5200,5234	27.66
	26.35
	℄ +0.08
	58° 18′ 26.43″

Mean (Viidumäe, 1930): 58° 18′ 26.41″ ± 0.18″

Mean (Sõrve, 1930): 57° 54′ 37.27″ ± 0.11″

[1]) Ambronn 5523. [2]) Weight 0.5. [3]) Ambronn 4890, 4949.
[4]) Ambronn 4890, 4949. [5]) Ambronn 5523.

Tallinn, 1930.7. 16.

✳	φ
	59° 26′
4591,5764	16.57[1])
4790,4790	18.18[2])
4923,4948	18.06
5218,6624	18.25[3])
5412,5453	17.31
[4]) ,5535	18.40
5481,5535	18.39
5593,5614	17.97
	17.87
	ℭ —0.09
	59° 26′ 17.78

Tallinn, 1930. 7. 22.

✳	φ_p
	59° 26′
4591,5764	17.61[1])
4790,4790	17.97[2])
4923,4948	17.89
5218,6624	17.52[3])
5412,5453	17.82
[4]) ,5535	17.88
5593,5614	17.02
	17.65
	ℭ +0.05
	59° 26′ 17.70

Tallinn, 1930. 7. 24.

✳	φ_p
	59° 26′
4591,5764	17.63[1])
4923,4948	17.34
5218,6624	17.27[3])
5412,5453	17.13
[4]) ,5535	18.03
5481,5535	18.17
5593,5614	17.37
5639,5678	17.03
5685,5721	17.08
	17.45
	ℭ +0.09
	59° 26′ 17.54

Tallinn, 1930. 7. 27.

✳	φ_p
	59° 26′
4591,5764	18.16[5])
4688,4688	17.06[6])
4790,4790	18.12[6])
4833,4894	17.27
4923,4948	17.72
5014,5057	16.80
5153,5183	17.52
5218,6624	17.52[7])
5412,5453	17.03
5481,5535	18.52
5593,5614	17.08
	17.52
	ℭ 0.00
	59° 26′ 17.52

Mean (Tallinn, 1931): 59° 26′ 17.62±0.08

[1]) Ambronn 5764.
[2]) Weight 0,5.
[3]) Ambronn 6624.
[4]) Hels. 12048.
[5]) Ambronn 5764.
[6]) Weight 0,5.
[7]) Ambronn 6624.

Tallinn, 1931. 5. 27.

✳	φ_p
	59° 26′
	″
3744,3809	17.52
3945,3949	17.75
3945,3982	17.82
4021,4047	18.05
4161,4223	17.12
1235,4400	16.89
4591,5764	17.61 [1]
	17.54
	€ —0.03
	59° 26′ 17.51

Tallinn, 1931. 5. 28.

✳	φ_p
	59° 26′
	″
3597,3626	17.60
3744,3809	16.77
3945,3982	17.89
3949,3982	17.92
4021,4047	17.58
4161,4223	17.26
1235,4400	17.56
4591,5764	17.37 [1]
	17.49
	€ 0.00
	59° 26′ 17.49

Tallinn, 1931. 5. 30.

✳	φ_p
	59° 26′
	″
3597,3626	17.35
3744,3809	17.13
3945,3982	17.97
3949,3982	17.91
4021,4047	17.20
4161,4223	17.11
1235,4400	17.05
4591,5764	16.92 [1]
	17.33
	€ +0.06
	59° 26′ 17.39

Tallinn, 1931. 5. 31.

✳	φ_p
	59° 26′
	″
3597,3626	17.55

Mean (Tallinn, 1931): 59° 26′ 17.46 ± 0.07.

Undva, 1931. 6. 19.

✳	φ_p
	58° 29′
	″
3958,4004	31.09 [2]
4121,4161	29.38
4184,4223	30.27
4234,4255	29.83
4255,4293	30.14
4381,5564	29.54 [3]
4458,4470	30.30
4460,4470	30.16
4591,4582	29.55
4661,4724	29.60
4724,4749	29.95
4790,4822	29.83
1871,4960	30.00
	29.93
	€ 0.00
	58° 29′ 29.93

Undva, 1931. 6. 20.

✳	φ_p
	58° 29′
	″
4121,4161	29.78
4184,4223	29.98
4234,4255	30.10
4293,4255	30.07
4458,4470	30.33
4460,4470	30.32
4591,4582	29.75
4661,4724	29.72
4724,4749	29.82
4790,4822	29.80
	29.97
	€ — 0.06
	58° 29′ 29.91

Mean (Undva, 1931): 58° 29′ 29.92 ± 0.07.

Ohtja, 1931. 6. 23.

✳	φ_p
	58° 25′
	″
4121,4161	37.69
4184,4223	38.21
4234,4255	37.95
4255,4293	38.37
4381,5564	37.62 [3]
4458,4470	38.40
4460,4470	38.35
4591,4582	37.96
4661,4724	38.28
4724,4749	38.20
4788,4805	38.59
1871,4960	37.73
	38.11
	€ — 0.09
	58° 25′ 38.02

[1]) Ambronn 5764. [2]) Weight 0,5. [3]) Ambronn 5564.

Ohtja, 1931. 6. 24.

✳	φ_p
	58° 25′
	″
4121,4161	37.71
4184,4223	38.42
4234,4255	37.91
4255,4293	38.53
4381,5564	38.30 [1])
4458,4470	38.65
4460,4470	38.69
	38.32
	℄ — 0.05
	58° 25′ 38.27

Mean (Ohtja, 1931):
58° 25′ 38.11 ± 0.08

Meiuste, 1931. 7. 2.

✳	φ_p
	58° 35′
	″
1124,4311	35.18
4381,5564	34.76 [1])
4458,4470	36.35
4460,4470	36.34
4535,4602	35.46
4535,4603	35.43
4661,4724	35.51
4724,4749	36.07
4790,4822	35.87
4863,4930	36.05
4948,4988	35.91
5075,5149	35.08
5165,5218	36.44
	35.73
	℄ +0.02
	58° 35′ 35.75

Meiuste, 1931. 7. 4.

✳	φ_p
	58° 35′
	″
1124,4311	35.61
4381,5564	36.02 [1])
4458,4470	36.01
4460,4470	36.04
4591,4582	35.53
4661,4724	36.02
4724,4747	35.82
4790,4822	35.75
4948,4988	35.75
5075,5149	35.64
5165,5218	36.30
	35.86
	℄ —0.05
	58° 35′ 35.81

Mean (Meiuste, 1931): 58° 35′ 35.78″±0.08

Määltse 1931. 7. 12.

✳	φ_p
	58° 50′
	″
4535,4603	52.26
Määltse, 1931. 1. 7. 13	
4354,4382	51.85
4391,5564	52.28 [1])
4535,4603	51.18
4686,4711	51.08
4730,4745	51.07
4782,4814	51.29
4842,4909	50.63
4948,4980	51.74
5149,5163	51.98
5199,5205	51.60
5234,5271	52.26
	51.60
	℄ +0.03
	58° 50′ 51.63

Määltse, 1931. 7. 15.

✳	φ_p
	58° 50′
	″
4842,4909	49.13 [2])
4948,4980	51.41
5149,5163	52.00
	51.19
	℄ +0.08
	58° 50′ 51.27

Määltse, 1931. 7. 20.

✳	φ_p
	58° 50′
	″
4535,4603	51.86
4686,4711	51.85
4730,4745	51.62
4782,4814	51.45
	51.70
	℄ —0.11
	58° 50′ 51.59

Mean (Määltse, 1931): 58° 50′ 51.57″±0.14.

[1]) Ambronn 5564.
[2]) Weight 0,5.

Tahkuna, 1931. 8. 5.

✳	φ_p
	59° 05′
4730,4745	28.40
4782,4814	29.00
4842,4909	29.00
5013,5026	28.94
5165,5191	28.94
5218,5270	29.16
5333,5362	29.16
5412,5412	28.11 [1])
5453,5481	27.36
5453, [2])	29.01
5565,5608	29.26
5639,5687	28.65
5716,5764	28.36
	28.80
℄	—0.08
	59° 05′ 28.72

Tahkuna, 1931. 8. 6.

✳	φ_p
	59° 05′
4730,4745	28.69
4787,4829	29.51
4829,4869	28.14
5013,5026	28.51
5165,5191	28.44
5234,5251	28.89
5412,5412	27.98 [1])
5447,5488	29.39
5565,5608	28.88
5667,5727	28.98
	28.78
℄	—0.06
	59° 05′ 28.72

Kõpu, 1931. 8. 10.

✳	φ_p
	58° 54′
5149,5163	57.12
5199,5205	56.89
5234,5271	57.12
5321,5344	56.99
5453,5481	55.78
5565,5608	56.31
5661,5734	56.13
5784,5806	55.87
5843,5896	56.40
5896,5931	56.44
	56.50
℄	+0.06
	58° 54′ 56.56

Mean (Tahkuna, 1931): 59° 05′ 28.72″±0.09″.

Kõpu, 1931. 8. 11.

✳	φ_p
	58° 54′
4842,4909	56.06
4948,4980	56.13
5149,5163	57.23
5784,5806	56.39
	56.45
℄	+0.08
	58° 54′ 56.53

Kõpu, 1931. 8. 15.

✳	φ_p
	58° 54′
5565,5608	56.38
5818,5833	56.84
Kõpu, 1931. 8. 16.	
4730,4745	56.12
	56.44
℄	—0.04
	58° 54′ 56.40

Mean (Kõpu, 1931): 58° 54′ 56.53″±0.11″.

[1]) Weight 0.5.
[2]) Hels. 12048.

Veski, 1932. 6. 4.

*	φ_p
	59° 10′
3856,3930	46.06″
3979,4035	45.44
4056,4079	44.59
4181,4220	44.56
4327,4358	45.51
4382,4458	44.97
4382,4460	45.14
4479,4504	45.21
4479,4505	45.26
4609,4623	45.15
4671,4688	45.45
4727,4765	45.30
4829,4869	45.65
	45.25
	Ⓒ +0.10
	59° 10′ 45.35″

Veski, 1932. 6. 6.

*	φ_p
	59° 10′
3833,3841	45.59″
3856,3930	45.68
3979,4035	45.44
4056,4079	45.06
4479,4504	45.64
4671,4688	45.76
	45.53
	Ⓒ +0.07
	59° 10′ 45.60″

Mean (Veski, 1932):
59° 10′ 45.43″ ± 0.09″.

Kloostri, 1932. 6. 9.

*	φ_p
	59° 13′
4181,4220	12.25″
4327,4358	13.27
4382,4458	12.88
4382,4460	13.16
4479,4504	13.08
4479,4505	12.96
4609,4623	12.49
4671,4688	12.58
4727,4765	12.82
4790,4790	12.36 [1])
4829,4869	12.54
	12.78
	Ⓒ —0.05
	59° 13′ 12.73″

Kloostri, 1932. 6. 10.

*	φ_p
	59° 13′
3856,3930	11.27″ [1])
3979,4035	11.63
4056,4079	12.07
4181,4220	12.20
4327,4358	12.33
4382,4458	12.15
4382,4460	12.22
4479,4504	12.97
4609,4623	12.48
4671,4688	13.18
4727,4765	12.41
4790,4790	12.50 [1])
4829,4869	12.84
	12.33
	Ⓒ —0.08
	59° 13′ 12.25″

Keila, 1932. 6. 23.

*	φ_p
	59° 19′
4021,4047	20.30″
4090,4159	20.60
4181,4220	21.43
4293,4364	21.40
4470,4531	22.08
4609,4623	21.49
1673,4761	21.91
4790,4790	20.96 [1])
4829,4869	21.57
4923,4948	20.59
	21.25
	Ⓒ —0.08
	59° 19′ 21.17″

Keila, 1932. 6. 26.

*	φ_p
	59° 19′
4021,4047	20.17″
4090,4159	19.83
4181,4220	20.10
4293,4364	19.41
4484,4539	20.12
4609,4623	20.98
4727,4765	21.04
4790,4790	20.91 [1])
4829,4869	21.05
4923,4948	20.60
5020,5083	20.61
	20.42
	Ⓒ —0.08
	59° 19′ 20.34″

Mean (Keila, 1932): 59° 19′ 20.73″ ± 0.15″.

Mean (Kloostri, 1932): 59° 13′ 12.48″ ± 0.10″.

[1]) Weight 0.5.

Pakri, 1932. 6. 27.

*	φ_p
	59° 23′
	″
4293,4364	15.44
1235,4400	14.82
4484,4539	16.15
4602,4614	15.21
4603,4614	15.23
4688,4688	15.02 [1])
4763,4822	15.29
4923,4948	14.97
	15.28
ℭ	—0.06
	59° 23′ 15.22

Pakri, 1932. 7. 3.

*	φ_p
	59° 23′
	″
4293,4364	15.24
1235.4400	14.92
4470,4531	15.39
4609,4623	15.67
4688,4688	15.03 [1])
4763,4822	15.61
4923,4948	15.01
5153,5183	14.64
5218,6624	14.98 [2])
	15.17
ℭ	+0.10
	59° 23′ 15.27

Pakri, 1932. 7. 5.

*	φ_p
	59° 23′
	″
1235,4400	14.86
4484,4539	15.18
	15.02
ℭ	0.00
	59° 23′ 15.02

Mean (Pakri, 1932): 59° 23′ 15.22″±0.08″.

Osmussaare, 1932. 7. 14.

*	φ_p
	59° 18′
	″
4484,4539	11.31
4609,4623	12.09
4727,4765	12.11
4790,4790	12.29 [1])
4829,4869	12.75
4923,4948	11.68
5020,5083	13.12
5191,5225	12.86
5236,5293	12.95
5236,5308	13.18
5388,5433	12.33
	12.43
ℭ	+0.08
	59° 18′ 12.51

Osmussaare, 1932. 7. 16.

*	φ_p
	59° 18′
	″
4470,4531	12.18
4609,4623	12.22
1673,4761	12.72
4790,4790	12.27 [1])
4829,4869	12.62
4923,4948	12.04
5020,5083	13.04
5153,5183	11.97
5218,6624	12.00 [2])
5290,5365	12.99
5388,5433	12.17
	12.39
ℭ	+0.11
	59° 18′ 12.50

Vormsi, 1932. 7. 26.

*	φ_p
	59° 01′
	″
4782,4814	43.05
4842,4909	42.68
4948,4980	43.55
5013,5026	43.49
5165,5191	42.98
5234,5251	44.20
5276,5346	42.44
5346,5394	43.14
5447,5488	43.29
5565,5608	43.46
	43.23
ℭ	—0.04
	59° 01′ 43.19

Mean (Osmussaare, 1932): 59° 18′ 12.50″±0.11

[1]) Weight 0,5

[2]) Ambronn 6624.

Vormsi, 1932. 7. 27.

✳	φ_p
	59° 01′
	″
4634,4653	44.08
4730,4745	43.50
4825,4846	43.33
4948,4980	43.69
5165,5191	43.10
	43.54
	℄ +0.02
	59° 01′ 43.56″

Vormsi, 1932. 7. 29.

✳	φ_p
	59° 01′
	″
4479,4504	42.88
4634,4653	43.66
4686,4711	43.86
4730,4745	43.49
4787,4829	43.51
	43.48
	℄ +0.10
	59° 01′ 43.58″

Tallinn, 1932. 8. 12/13.

✳	φ_p
	59° 26′
	″
5721,5756	17.62
5810,5827	17.95
5848,5887	17.92
7442,5955	18.57[1])
5987,6001	18.10
6044,6080	17.67
	17.97
	℄ +0.07
	59° 26′ 18.04″

Mean (Vormsi, 1932): 59° 01′ 43.38″ ± 0.10″.

Tallinn, 1932. 8. 13.

✳	φ_p
	59° 26′
	″
4923,4948	17.81
5057,5137	16.97
5153,5183	17.61
5208,5293	17.18
5208,5308	17.35
5412,5453	18.21
5593,5614	18.69
5639,5678	17.05
5721,5756	17.31
5810,5827	18.27
5848,5887	17.96
5955,6016	18.05
5969,6016	18.55
	17.77
	℄ +0.12
	59° 26′ 17.89″

Nabala, 1933. 6. 9.

✳	φ_p
	59° 15′
	″
3856,3930	41.15[2])
4021,4047	41.20
4112,4160	41.22
4181,4220	41.33
4240,4317	41.21
4479,4504	41.44
4479,4505	41.31
4602,4614	40.37[2])
4603,4614	40.35[2])
4727,4765	41.21
4790,4790	41.27[3])
4829,4869	41.65
	41.22
	℄ + 0.09
	59° 15′ 41.31″

Nabala, 1933. 6. 10.

✳	φ_p
	59° 15′
	″
3856,3930	40.63
3945,3982	41.28
3949,3982	41.55
4042,4079	41.46
4056,4079	41.33
4112,4160	41.05
4181,4220	41.44
4479,4504	41.66
4479,4505	41.67
	41.34
	℄ +0.01
	59° 15′ 41.35″

Mean (Tallinn, 1932): 59° 26′ 17.94″ ± 0.12″.

Mean (Nabala, 1933): 59° 15′ 41.33″ ± 0.07″

[1]) Ambronn 7442.
[2]) Weight 0.5, too faint.
[3]) Weight 0,5.

Jõelähtme, 1933. 6. 12.

✳	φ_p
	59° 26′
3958,4949	51.20[1])
3958,3977	51.33
4021,4047	51.65
4161,4223	52.01
4270,4317	51.99
1235,4400	50.98
4470,4531	52.54
4609,4623	51.44
4763,4822	51.41
	51.62
ℰ	—0.03
	59° 26′ 51.59

Jõelähtme, 1933. 6. 13.

✳	φ_p
	59° 26′
3945,3982	52.52
3949,3982	51.68
4021,4047	51.42
4161,4223	52.65
4270,4317	51.93
1235,4400	51.27
4464,4511	52.42
4591,5764	51.65[2])
4609,4623	51.55
4688,4688	51.41[3])
	51.87
ℰ	—0.10
	59° 26′ 51.77

Keri, 1933. 6. 22.

✳	φ_p
	59° 41′
4160,4214	55.05
4322,4354	54.22
4368,5523	55.54[4])
4483,4511	54.36
4602,4661	54.72
4603,4661	54.72
4707,4730	54.88
4788,4814	54.93
4911,4958	53.91
5011,5057	55.16
5014,5057	55.13
	54.78
ℰ	+0.10
	59° 41′ 54.88

Mean (Jõelähtme, 1933): 59° 26′ 51.68 ± 0.11.

Keri, 1933. 6. 27.

✳	φ_p
	59° 41′
4368,5523	55.80[4])
4483,4511	54.60
4602,4661	54.29
4603,4661	53.90
4707,4730	54.83
4788,4814	55.43
	54.81
ℰ	—0.07
	59° 41′ 54.74

Mean (Keri, 1933):
59° 41′ 54.83 ± 0.13

Naissaare, 1933. 7. 1.

✳	φ_p
	59° 36′
4270,4317	14.07
4368,5523	13.61[4])
	13.84
ℰ	—0.03
	59° 36′ 13.81

Naissaare, 1933. 7. 2.

✳	φ_p
	59° 36′
4270,4317	14.19
1235,4400	14.36
4464,4511	14.35
4602,4661	13.63
4603,4661	13.55
4707,4730	13.62
4788,4814	14.08
4869,4890	14.37
4909,4988	14.24
5014,5057	13.79
5097,5165	13.90
5218,6624	14.75[5])
5249,5308	13.94
	14.06
	—0.04
	59° 36′ 14.02

[1]) Ambronn 4949.
[2]) Ambronn 5764.
[3]) Weight 0.5.
[4]) Ambronn 5523.
[5]) Ambronn 6624.

Naissaare, 1933. 7. 3.

✳	φ_p
	59° 36′
	″
1235,4400	14.25
4464,4511	13.49
4909,4988	14.46
5011,5057	14.46
5014,5057	14.17
5097,5165	14.55
	14.23
℄	0.00
	59° 36′ 14.23

Mean (Naissaare, 1933):
59° 36′ 14.06 ± 0.08

Suurupi, 1933. 7. 11.

✳	φ_p
	59° 27′
	″
1235,4400	53.71
4464,4511	53.03
4602,4614	53.60
4603,4614	53.67
4788,4814	52.98
4833,4894	53.17
4923,4948	53.96
5014,5057	53.12
5057,5137	53.33
5153,5183	53.65
5218,6624	53.85 [1]
5249,5312	53.53
5412,5453	54.27
	53.53
℄	—0.07
	59° 27′ 53.46

Suurupi, 1933. 7. 13/14.

✳	φ_p
	59° 27′
	″
4869,4890	52.61
4923,4948	54.04
5014,5057	52.04
5218,6624	53.69 [1]
5250,5270	53.29
	53.13
℄	—0.08
	59° 27′ 53.05

Mean (Suurupi, 1933):
59° 27′ 53.35 ± 0.13.

Essemäe, 1933. 7. 23.

✳	φ_p
	57° 38′
4554,4589	19.72
4620,4672	20.53
4730,4787	19.45
6260,6260	20.29 [2]
5031,5079	19.05 [3]
5265,5333	20.13
5453,5472	19.95
5532,5543	19.58
5567,5603	20.67
	19.88
℄	+0.02
	57° 38′ 19.90

Essemäe, 1933. 7. 24.

✳	φ_p
	57° 38′
	″
6260,6260	20.68 [4]
5009,5031	20.48
5048,5079	20.69
5265,5333	19.94
5453,5472	19.93
5532,5543	19.56 [5]
	20.23
℄	—0.01
	57° 38′ 20.22

Essemäe, 1933. 7. 25.

✳	φ_p
	57° 38′
	″
4554,4589	19.25
4620,4672	20.47
5153,5200	19.61
	19.77
℄	—0.08
	57° 38′ 19.69

Mean (Essemäe, 1933): 57° 38′ 19.96 ± 0.12.

[1]) Ambronn 6624.
[2]) Ambronn 6260; weight 0.5, too faint.
[3]) Weight 0.5, too faint.
[4]) Ambronn 6260; weight 0.5.
[5]) Weight 0.5, clouds.

Antsla, 1933. 8. 9/10.

*	φ_p
	57° 48′
	″
5394,5412	47.89
5447,5480	48.00
5565,5593	47.95
5650,5664	47.66
5734,5792	48.32
5827,5856	47.81
5891,5942	47.23
	47.84
	Ⓒ —0.05
	57° 48′ 47.79″

Antsla, 1933. 8. 11.

*	φ_p
	57° 48′
4890,4910	47.51
4948,4994	47.35
4948,5014	47.35
5031,5079	47.77
5130,5162	48.45
5194,5218	47.94
5394,5412	47.91
5478,5525	47.96
5495,5525	48.72
5565,5593	47.97
5667,5714	48.21
	47.92
	Ⓒ —0.07
	57° 48′ 47.85″

Mean (Antsla, 1933): 57° 48′ 47.83″ ± 0.09.

The following table gives the final latitudes. In the table we indicate by

φ_p — the value of the latitude determined for the astronomical pier, with ist mean error;

$\Delta\varphi$ — the reduction to the mean position of the terrestrial pole;

$\varphi = \varphi_p + \Delta\varphi$; For Tallinn φ was deduced as the weighted mean of the determinations in 1930, 1931, and 1932, the weights being according to the number of nights, i. e., 4, 3, and 2.

r — the reduction from the astronomical pier to the geodetic centre. For triangulation towers this reduction is given to the sub-surface mark (s), for lighthouses (l) and churches (ch), however, to the geodetic observation point (pier). At Tallinn r is given from the astronomical pier (in the medieval Landskrona tower) to the geodetic observation point in the Tallinn Lutheran Cathedral (Tallinna Toomkirik).

φ_r — the final latitude of the geodetic centre.

The final latitudes given in this table should replace the latitudes of the table printed in *P.T.T.A.1.* pp. 109 to 110.

Final Latitudes.

Name	φ_p	$\Delta\varphi$	φ	r	$\varphi r = \varphi + r$
Tallinn 1930.	59° 26′ 17.62 ± 0.08	—0.08	59° 26′ 17.54	+2.60 *ch*	59° 26′ 20.14
Tallinn 1931.	17.46 ± 0.07	+0.08	17.54	„	20.14
Tallinn 1932.	17.94 ± 0.12	0.00	17.94	„	20.54
Weighted mean for Tallinn			**59° 26′ 17.63 ± 0.12**	+ 2.60 *ch*	**59° 26′ 20.23**
Ruhnu	57° 48′ 2.98 ± 0.09	+ 0.03	**57° 48′ 3.01**	+ 2.33 *l*	**57° 48′ 5.34**
Abruka	58 8 24.19 ± 0.10	+ 0.02	**58 8 24.21**	+ 0.45 *s*	**58 8 24.66**
Sõrve	57 54 37.27 ± 0.11	0.00	**57 54 37.27**	— 1.88 *l*	**57 54 35.39**
Viidumäe	58 18 26.41 ± 0.18	— 0.01	**58 18 26.40**	+ 1.59 *s*	**58 18 27.99**
Undva	58 29 29.92 ± 0.07	0.00	**58 29 29.92**	+ 1.72 *s*	**58 29 31.64**
Ohtja	58 25 38.11 ± 0.08	0.00	**58 25 38.11**	+ 2.90 *s*	**58 25 41.01**
Meiuste	58 35 35.78 ± 0.08	— 0.02	**58 35 35.76**	+ 17.34 *s*	**58 35 53.10**
Määltse	58 50 51.57 ± 0.14	— 0.07	**58 50 51.50**	— 0.58 *s*	**58 50 50.92**
Tahkuna	59 5 28.72 ± 0.09	— 0.11	**59 5 28.61**	+ 3.23 *l*	**59 5 31.84**
Kõpu	58 54 56.53 ± 0.11	— 0.12	**58 54 56.41**	+ 2.09 *l*	**58 54 58.50**
Veski	59 10 45.43 ± 0.09	+ 0.13	**59 10 45.56**	+ 1.26 *s*	**59 10 46.82**
Kloostri	59 13 12.48 ± 0.10	+ 0.13	**59 13 12.61**	+ 0.21 *s*	**59 13 12.82**
Keila	59 19 20.73 ± 0.15	+ 0 10	**59 19 20.83**	— 0.03 *s*	**59 19 20.80**
Pakri	59 23 15.22 ± 0.08	+ 0.10	**59 23 15.32**	+ 2.62 *l*	**59 23 17.94**
Osmussaare	59 18 12.50 ± 0.11	+ 0.03	**59 18 12.53**	— 1.02 *l*	**59 18 11.51**
Vormsi	59 1 43.38 ± 0.10	+ 0.02	**59 1 43.40**	— 1.88 *l*	**59 1 41.52**
Nabala	59 15 41.33 ± 0.07	+ 0.14	**59 15 41.47**	— 0.76 *s*	**59 15 40.71**

Jõelähtme	59 26 51.68 ± 0.11	+ 0.14	**59 26 51.82**	— 0.37 *ch*	**59 26 51.45**
Keri	59 41 54.83 ± 0.13	+ 0.13	**59 41 54.96**	— 0.72 *l*	**59 41 54.24**
Naissaare	59 36 14.06 ± 0.08	+ 0.12	**59 36 14.18**	+ 1.22 *l*	**59 36 15.40**
Suurupi	59 27 53.35 ± 0.13	+ 0.09	**59 27 53.44**	+ 0.35 *l*	**59 27 53.79**
Essemäe	57 38 19.96 ± 0.12	+ 0.08	**57 38 20.04**	— 0.11 *s*	**57 38 19.93**
Antsla	57 48 47.83 ± 0.09	+ 0.04	**57 48 47.87**	— 0.08 *s*	**57 48 47.79**