



Universiteit
Leiden
The Netherlands

Determination of absolute declinations and latitude by observations at the meridian circle and the zenith telescope

Sanders, C.

Citation

Sanders, C. (1931). Determination of absolute declinations and latitude by observations at the meridian circle and the zenith telescope. *Bulletin Of The Astronomical Institutes Of The Netherlands*, 6, 123. Retrieved from <https://hdl.handle.net/1887/6174>

Version: Not Applicable (or Unknown)

License: [Leiden University Non-exclusive license](#)

Downloaded from: <https://hdl.handle.net/1887/6174>

Note: To cite this publication please use the final published version (if applicable).

BULLETIN OF THE ASTRONOMICAL INSTITUTES OF THE NETHERLANDS.

1931 July 1

Volume VI.

No. 219.

COMMUNICATIONS FROM THE OBSERVATORY AT LEIDEN.

Determination of absolute declinations and latitude by observations at the meridian circle and the zenith telescope, by *C. Sanders*.

1. *The method.*

The method has been fully explained in *B. A. N.* 162, where also a few preliminary observations were given. In *B. A. N.* 181, p. 138 a few more results as to the mean errors to be expected have been communicated. Since then the observations have been continued until 1930 May 12. In all 298 pairs were observed on 66 nights with the meridian circle and 235 pairs on 58 nights with the zenith telescope. These numbers do not include the pairs of which the North star was observed in only one culmination. In all 31 north stars in both culminations with the corresponding south stars, are available for the final results. The average number of meridian circle observations for each pair is 4.2 for the upper and 4 for the lower culmination, the corresponding numbers for the zenith-telescope being 3.4 and 3.2. The observers at the meridian circle were Messrs J. J. RAIMOND Jr. (2 nights only), D. GAYKEMA and J. M. KRIEST during the first half, joined by Mr. G. VAN HERK during the second half of the work, the microscopes being read by themselves or by Messrs MEKKING and L. GAYKEMA. The observer at the zenith telescope was C. SANDERS. Only one circle was read in each position of the instrument viz: circle A in the position clamp West, and circle B in the position clamp East.

The four measured arcs are denoted by A, B, C, D, then:

Measured at the zenith-telescope = $z_N - z_S$:

A: North star in upper culmination,
B: " " " lower " "

Measured at the meridian circle = $z_N + z_S$:

C: North star in upper culmination,
D: " " " lower " "

If we denote by δ_N , δ_S and δ_A the declinations of the north star, the star in the zone $\delta + 23^\circ$ to $+ 32^\circ$,

which is observed with the north star in upper culmination, and the equatorial star which is observed with the north star in lower culmination, then we have:

$$\begin{aligned} A &= \delta_N + \delta_S - 2\varphi, & C &= \delta_N - \delta_S, \\ B &= 180^\circ - \delta_N + \delta_A - 2\varphi, & D &= 180^\circ - \delta_N - \delta_A. \end{aligned}$$

2. *The reductions.*

The meridian circle arcs C and D, were corrected for division errors, run, flexure and refraction. For the run of the microscopes only a few regular observations were available. As however two divisions were read in each of the two microscopes V and VII, the run correction has been derived from the whole of the available material. A fairly gradual increase of its value being noticeable, it was found convenient to use separate values for different intervals as follows:

1929 May	+ 0".08 (neglected)
June to Sept.	+ 0.16
October	+ 0.22
November	+ 0.38
1930 Jan to Feb. 20	+ 0.52
Feb. 20—Feb. 28	+ 0.99
March—April	+ 1.76

for a 5' interval.

The flexure corrections have not been redetermined during the course of this work. Values previously found were adopted (*Leiden Annals*, X, I, page 87) ¹⁾.

The refraction has been computed from the tables of Albrecht. For the temperature correction the value of the thermometer readings $\frac{1}{2}(H + F)$ has been used, H being the uncorrected reading of the outside, and F that of the inside thermometer, a comparison with a thermometer Z, suspended in the slit, having shown that the temperature in the slit was equal to half the sum of the uncorrected readings of H and F. This procedure was adopted because the thermometer Z

¹⁾ Also in *Leiden Annals* XIII, part 4, page 18.

got broken in the course of the work. The thus corrected arcs were then reduced to the beginning of the year and to 1930.0.

The zenith telescope arcs A and B were corrected for the curvature of the parallel, for the inequalities of the screw, for level and for differential refraction. They were also reduced to 1930.0.

From the whole of the thus corrected material the following mean errors were derived:

zenith telescope arc A $\pm 0''38$
 " " " B $\pm 0''45$
 meridian circle " C $\pm 0''78$
 " " " D $\pm 1''14$

These mean errors enable us to compute the mean error of each of the individual results.

3. The results.

The results are given in the following table:

TABLE I.

Greenw. and Boss	North Star		Lei—Boss	Boss	Zone + 28°		Lei—Boss	Boss	Equatorial Star		Lei—Boss	52°9' φ m. e.
	δ 1930.0	m. e.			δ 1930.0	m. e.			δ 1930.0	m. e.		
2397	76° 33' 42" 90	\pm 24	+ 06	106	27° 53' 38" 14	\pm 43	+ 33	3132	+ 0° 55' 11" 72	\pm 85	+ 93	20° 14' \pm 24
37												
4007	72 17 32.68	\pm 13		241	31 48 27.57	\pm 47	+ 1.02	3375	- 3 26 4.12	\pm 49	+ 1.58	20.06 \pm 13
1892	78 0 18.55	\pm 12	+ .17	3224	26 14 4.52	\pm 47	+ .68	3388	- 3 17 12.85	\pm 49	+ .53	
3182				3231	26 29 12.86	\pm 47	+ 1.70	6123	+ 2 32 28.89	\pm 58	+ .79	20.17 \pm 12
4014	72 30 35.93	\pm 16		3251	26 17 58.89	\pm 56	- 1.51					
1174	81 4 27.84	\pm 15		248	31 38 21.67	\pm 42	+ 2.33	3375	- 3 26 3.53	\pm 68	+ 2.17	20.46 \pm 16
3379	74 26 30.26	\pm 15	+ .71	434	23 14 6.62	\pm 38	+ 1.22	3388	- 3 17 11.91	\pm 68	+ 1.47	
3809				441	23 15 20.42	\pm 38	+ 1.40	3462	+ 5 31 17.71	\pm 68	+ .69	20.17 \pm 15
4244	72 45 17.17	\pm 25	+ .59	3729	30 2 54.77	\pm 47	+ .94	612	- 0 59 32.05	\pm 49	+ 1.63	20.18 \pm 15
3488				3570	31 32 14.89	\pm 51	+ .22	722	- 1 27 23.87	\pm 59	+ .48	
1923	78 48 33.57	\pm 18		3635	25 25 21.49	\pm 37	+ .85	290	- 2 52 4.79	\pm 85	+ 1.50	20.33 \pm 25
2086	77 28 48.91	\pm 21	+ .25	751	26 49 10.21	\pm 59	+ 1.57	622	+ 2 56 31.71	\pm 54	+ 1.88	20.08 \pm 18
721				865	23 43 54.76	\pm 50	+ 1.80	3895	+ 2 1 45.48	\pm 116	+ 1.27	20.40 \pm 21
1201	80 30 35.71	\pm 22	- .10	4176	32 29 44.18	\pm 59	+ 1.46	3939	+ 2 5 4.07	\pm 84	+ 1.49	
914				4742	31 51 25.67	\pm 32	+ 1.09	4026	+ 4 41 14.91	\pm 70	+ 1.14	20.08 \pm 22
4791	71 32 27.31	\pm 22		1693	29 2 45.47	\pm 41	+ .49	1024	- 3 54 21.35	\pm 61	+ .45	20.23 \pm 22
4339	72 42 10.49	\pm 19	+ .04	1722	29 2 30.03	\pm 41	+ .21	1599	- 2 54 47.65	\pm 69	+ 1.26	20.18 \pm 19
4672				4867	28 31 3.41	\pm 35	+ 1.66	4719	- 0 22 10.86	\pm 45	+ .48	19.81 \pm 12
2881	75 19 57.36	\pm 12		4872	32 23 26.21	\pm 38	+ 1.68	1848	- 0 11 5.95	\pm 53	+ .02	20.14 \pm 14
3058	75 41 41.26	\pm 14	- .04	2232	28 7 31.17	\pm 44	+ .62	1873	- 0 2 18.16	\pm 53	+ 1.00	
4838				5235	31 57 48.06	\pm 43	+ .65	1999	- 3 57 10.89	\pm 85	+ 1.69	20.40 \pm 24
4853	71 57 58.03	\pm 24		5319	32 3 27.32	\pm 43	+ 1.23	5090	+ 0 5 22.35	\pm 69	+ .32	19.86 \pm 21
2521	75 58 24.26	\pm 21	+ .33	2338	30 57 8.84	\pm 43	+ .85	2227	- 3 31 22.38	\pm 83	+ 1.45	20.27 \pm 17
2174				4629	24 24 57.09	\pm 50	+ .55	5242	- 2 19 59.58	\pm 46	+ .13	19.84 \pm 17
4394	72 17 41.02	\pm 17	+ .71	2364	33 32 52.86	\pm 43	+ .44	1514	+ 4 9 51.40	\pm 70	+ 1.45	20.26 \pm 22
5280				2409	32 41 30.87	\pm 50	+ 1.50	5406	- 5 0 5.16	\pm 51	+ 1.22	20.22 \pm 17
3710	73 25 7.13	\pm 17		5522	23 19 52.95	\pm 37	+ 1.35	5503	- 3 51 27.11	\pm 70	+ 1.32	20.46 \pm 22
1656	79 59 49.27	\pm 22	+ .64	5673	26 19 57.49	\pm 43	+ .67	2589	+ 4 57 59.17	\pm 60	+ 1.47	20.20 \pm 18
4603				2727	29 2 0.74	\pm 43	+ 1.00	2623	+ 2 6 36.77	\pm 60	+ 1.01	19.93 \pm 19
4661	70 55 29.21	\pm 17		1780	25 27 53.01	\pm 43	+ .29	5559	- 0 22 5.36	\pm 54	+ 1.26	20.14 \pm 19
4665	71 38 54.79	\pm 22		5805	32 12 50.38	\pm 43	+ .86	4953	+ 2 58 25.53	\pm 85	- .15	19.50 \pm 25
1394	80 56 17.16	\pm 18		5806	32 12 50.38	\pm 43	+ .86	2760	- 3 43 10.94	\pm 54	+ .66	19.76 \pm 19
2353	77 54 29.45	\pm 19		5806	32 12 50.69	\pm 43	+ 1.17	2760	- 3 43 10.90	\pm 54	+ .70	19.67 \pm 19
2924	75 5 46.97	\pm 19	- .08	2839	27 53 26.05	\pm 41	+ .54	5908	+ 0 41 30.00	\pm 53	+ .91	20.08 \pm 13
2668				2852	26 41 38.18	\pm 48	+ 1.17	5924	+ 0 35 20.76	\pm 53	+ 1.17	
1836	78 51 59.62	\pm 25		6023	32 0 3.24	\pm 38	+ .37	5959	+ 1 44 48.63	\pm 42	+ 1.64	20.51 \pm 17
4913	72 1 44.88	\pm 19		6094	28 58 25.12	\pm 46	+ .05	2982	- 3 16 6.70	\pm 69	+ .92	20.18 \pm 21
4915	71 59 46.95	\pm 19	+ 1.02					3058	- 0 26 13.68	\pm 85	+ .46	19.77 \pm 24
5716												
2560	76 21 59.56	\pm 13										
2202	77 27 37.35	\pm 17										
4457	72 31 39.34	\pm 21										
3541	75 9 15.58	\pm 24	+ .27									
6129												
	Mean	O—B	+ .33 \pm .10		Mean	O—B	+ .90 \pm .08		Mean	O—B	+ 1.05 \pm .11	20.11 \pm .04

The numbers in the first column are from the Greenwich 2nd 9 year Catalogue part II, 1900 and from Boss' P. G. C. When a star has two numbers the upper is the Greenwich and the lower the Boss number. The mean errors have been computed from the mean errors of one measure of the different arcs given above. The average mean error of one latitude and of the declination of a north star is $\pm ".19$. The average mean errors of the South stars are for the zone $+ 28^\circ \pm ".44$ and for the equator $\pm ".65$. The mean error of one latitude computed from the differences of the individual values with their mean comes out larger, viz: $\pm ".25$. For the north stars only corrections to the declinations of Boss are given. The proper motions in the Greenwich catalogue are so uncertain that corrections to the declinations at an epoch differing thirty years from that of the catalogue would be of no value. The corrections found for the individual south stars to the declinations of the P. G. C. are very large. The mean errors however are also large, and a much greater number of observations would be necessary for a reliable determination of the individual declinations. At the same time it is evident that there must be large systematic errors. The latitude here found is much higher than the generally adopted value $19^\circ.80$. It is however identical with the latitude which resulted from the discussion by Dr. HINS of the zenith distances measured in the years 1863–1868, published in *B. A. N.* 174 (cf. also *B. A. N.* 181, page 138).

It was tried to determine corrections $\Delta\varphi$, m and b to the adopted latitude, refraction and flexure. Owing however to the sum of refractions and zenith distances in all combinations of north stars in upper and lower culmination with the corresponding south stars being nearly constant, the equations of condition are nearly all identical and no satisfactory results could be derived. The mean errors of the corrections found exceeded the corrections themselves. It would, therefore, perhaps be advisable to adopt the results as they stand, without any further attempt at correction. However one circumstance still requires attention. The correction for flexure was applied for the two positions, clamp East and clamp West by the adopted formulae. It might be that the difference in flexure between these two positions is different now from what it was when the determination on which these formulae depend was made. In fact a comparison of the results of both circles gave

for the arcs C : circle A—circle B $+ ".59 \pm ".15$ (m. e.)
 $z = 24^\circ$
 " " " D: " — " $+ ".91 \pm ".20$
 $z = 52^\circ$

If we assume a correction to the difference of the

flexure for the two positions of the instrument, or the two circles, of the form $2b \sin 24^\circ = + ".59$ and $2b \sin 52^\circ = + ".91$, then with $b = + ".63$ we find $+ ".51$ and $+ ".98$ respectively agreeing with the above values within the limits of error. This correction is much larger than the difference between circle A and circle B according to the adopted formulae. It is to be noted that, on the other hand, the difference between the circles A and B as found from the ordinary meridian observations of the stars of the selected areas agrees within the limits of its uncertainty with the old formulae (see *Leiden Annals*, XV, 3, p. 12).

This supplementary flexure, $+ ".63 \sin z$, has been applied to all the arcs measured with circle B (clamp East) which amounts to reducing all observations to circle A (clamp West). With equal right we might, of course, have reduced the observations to circle B (clamp East). In that case, however, the latitude would have become still greater, as also the declination corrections. The values of φ now become as follows:

Grw.	φ	Grw.	φ	Grw.	φ	Grw.	φ
2397	20"06	2086	20"40	4394	19"93	1836	19"50
4407	19'95	1201	19'98	3710	19'81	4913	19'58
1892	20'05	4791	20'10	1656	20'08	4915	19'49
4014	20'35	4339	19'87	4661	20'06	2560	19'92
1174	20'05	2881	19'67	4665	20'37	2202	20'37
3379	20'01	3058	19'99	1394	20'08	4457	19'90
4244	20'20	4853	20'36	2353	19'80	3541	19'61
1923	19'96	2521	19'68	2924	20'06		

The mean becomes $\varphi = 52^\circ 9' 19''.98$.

A solution was now made introducing as unknowns the corrections $\Delta\varphi$ to the latitude ($19^\circ.80$) and $0.01 m$, k to the constant of refraction k . A least squares solution of the equations of condition gave

$$\Delta\varphi = + 0''.098 \pm ".98 \text{ and } m = + 0.152 \pm 1.93$$

The mean errors are still larger than the corrections and no great confidence can be placed in their reality but in any case this seems an acceptable result. I have therefore corrected the observations of circle B (clamp East) by applying the supplementary flexure $+ ".63 \sin z$ and all the observations by a correction to the refraction amounting to 0.152% of its value. The results are given in Table 2.

TABLE 2.

Number		φ	O—Boss		Number Boss	O—Boss (+ 28°)		Number Boss	O—Boss (equator)	
Grw.	Boss		Leiden	Berl.-Bab. 25		Leiden	Berl.-Bab. 25		Leiden	Berl.-Bab. 25
		52°9'								
2397	37	19°99'	+ "10	— "10	106	— "02		3132	+ "68	
4007		19°87'						3375	+ 1'25	+ 1'21
1892	3182	19°95'	+ '02	+ '29	241	+ '59		3388	+ '20	+ '38
					3224	+ '49	+ '62	6123	+ '25	+ '59
					3231	+ '47				
4014		20°28'			3251	— 1'74	+ '40			
					248	+ 1'87	+ 1'44	3375	+ 1'85	+ 1'21
1174		19°98'			434	+ '74		3388	+ 1'15	+ '38
					441	+ '92	+ '62	3462	+ '40	
3379	3809	19°96'	+ '52	+ '54				612	+ '91	
					3729	+ '68	+ '67	722	— '08	+ '05
4244	3488	20°12'	+ '42	+ '13	3570	— '01		290	+ '90	
1923		19°88'			3635	+ '58	+ '54	622	+ 1'37	+ '22
2086	721	20°33'	+ '21					3895	+ 1'10	+ '84
					751	+ 1'45		3939	+ 1'32	
1201	914	19°91'	— '02		865	+ 1'38		4026	+ '87	
4791		20°02'			4176	+ 1'22	+ '71	1024	— '16	+ '08
4339	4672	19°79'	— '22	+ '36	4742	+ '56		1599	+ '23	
2881		19°59'			1693	+ '18		4719	— '07	
					1722	— '10				
3058	4838	19°92'	+ '04		4867	+ 1'21	+ 1'00	1848	— '37	— '30
								1873	+ '56	
4853		20°27'			4872	+ 1'44		1999	+ 1'42	
2521	2174	19°60'	+ '18	+ '10	2232	+ '26		5090	— '34	
4394	5280	19°85'	+ '48	+ '74	5235	+ '04		2227	+ '38	
					5319	+ '62	+ '89			
3710		19°74'			2338	+ '66	+ 1'04	5242	— '10	
1656	4603	20°02'	+ '63	+ '40	4629	+ '06	+ '68	1514	+ '95	+ 1'27
4661		19°98'			2364	+ '07		5406	+ '64	+ '30
4665		20°29'			2409	+ 1'30		5503	+ '85	+ '40
1394		20°01'			5522	+ '90		2589	+ 1'09	+ '87
2353		19°73'			5673	+ '29		2623	+ '58	
2924	2668	19°98'	+ '04		2727	+ '74		5595	+ '89	
1836		19°43'			1780	+ '17		4953	— '32	+ '31
4913		19°49'			5806	+ '52	+ '49	2760	— '05	+ 1'15
4915	5716	19°41'	+ '83	+ '54	5806	+ '82		2760	0	
2560		19°85'						5908	+ '45	
					2839	+ '05		5924	+ '71	
2202		20°29'			2852	+ '73		5959	+ 1'20	+ '63
4457		19°83'			6023	— '05	+ '78	2982	— '05	+ '70
3541	6129	19°54'	+ '13		6094	+ '29		3058	— '12	+ '92
		$\varphi = 19^{\circ}90'$								
		14 Boss stars mean	+ "24	(+ "07)	mean	+ "55	(+ "62)	mean	+ "55	(+ "57)
		9 » » Berl.-Bab. 25 and Leiden }	+ '33	+ '33						

The differences O—Boss under "mean" in parentheses were taken from the table on page 42 of *Veröffentlichungen der Universitätssternwarte zu Berlin-Babelsberg*, Bd VII, Heft 4 (COURVOISIER).

It appears that the declination corrections, reduced to the system of circle A, and with the corrected refractions, agree well with those of COURVOISIER, especially for the equator and for the north stars. The difference O—B for the north stars however, should not be regarded as a systematic difference, the number of stars (14) being too small. This is shown clearly, by comparison with the Berlin-Babelsberg

results. The 9 stars in common with Berl.-Bab. give, both for Leiden and for Berl.-Bab., O—B = + "33, but the systematic difference Berl.-Babelsberg—Boss for the zone + 70° to + 80° is only + "07 (table on pag. 42, column 8 of *Berl.-Bab.*, Bd VII, Heft 4). A comparison with the Greenwich 2nd 9 y. Catalogue is useless owing to the number of stars for which no reliable proper motion is available, which is about 50%.

From the Talcott observations we can derive a value of the latitude for the upper and lower culminations separately, using the Boss declinations. We find

$$\begin{aligned}\varphi_{l.c} &= 19^{\circ}76 \\ \varphi_{u.c} &= 19^{\circ}51\end{aligned}$$

$$\text{The difference} = +''25 = \Delta\delta_N + \frac{1}{2}\Delta\delta_S - \frac{1}{2}\Delta\delta_A$$

This gives a correction $+''25$ to the north stars, in agreement with the result of Table 2, the corrections to the south stars being equal. Further we have $\frac{1}{2}(\varphi_{l.c} + \varphi_{u.c}) = 19^{\circ}64$, which depends only on the declinations of the south stars (Boss). Adding the correction found $\pm''55/2$ we find $19^{\circ}92$, in agreement with the value found directly, which is, however, only a check on the accuracy of the numerical work.

There is, of course, no a priori reason to reduce to circle A rather than to circle B, consequently the systematic corrections to the declinations derived here are still very uncertain, the difference between the results of Table 1 and Table 2 being an indication of the range of uncertainty. All we can conclude is that these systematic corrections are real and may be of the order of say $1''$ of arc, as has just recently been shown again by DNEPROVSKY (*Comptes rendus de l'Academie des Sciences de l'U. R. S. S.*, 1929 Dec. 19).

In conclusion I want to thank Professor DE SITTE for his kind advice in the preparation of this work and Dr. HINS for some valuable suggestions.

4. Postscript.

After the above was written the preliminary values of the variation of latitude at Greenwich in 1930, kindly communicated by the Astronomer Royal, came

to hand. Those for 1929 having already been published in *Monthly Notices*, vol. XC No. 5, March 1930, page 561, it now became possible to correct the zenith telescope observations for the variation of latitude. The individual corrections to each measured arc $z_A - z_S$ were interpolated from the smooth curve. It was, of course, impossible to take into account the difference in phase between Greenwich and Leiden which, however, may be considered negligible. The mean corrections thus obtained were applied to the values of the arcs A and B reduced to 1930.0, from which corrected values of the latitude and declinations were derived.

The latitudes of page 125 now become as follows:

Grw.	φ	Grw.	φ	Grw.	φ	Grw.	φ
2397	20 ^o 09	2086	20 ^o 45	4394	19 ^o 99	1836	19 ^o 58
4407	19 ^o 99	1201	20 ^o 03	3710	19 ^o 86	4913	19 ^o 68
1892	20 ^o 09	4791	20 ^o 15	1656	20 ^o 14	4915	19 ^o 59
4014	20 ^o 43	4339	19 ^o 94	4661	20 ^o 11	2560	20 ^o 02
1174	20 ^o 13	2881	19 ^o 73	4665	20 ^o 43	2202	20 ^o 46
3379	20 ^o 09	3058	20 ^o 07	1394	20 ^o 15	4457	19 ^o 98
4244	20 ^o 26	4853	20 ^o 42	2353	19 ^o 91	3541	19 ^o 69
1923	20 ^o 04	2521	19 ^o 73	2924	20 ^o 16		

The mean value being $\varphi = 20^{\circ}05$

A new solution was now made involving $\Delta\varphi$ and m , as before, which gave $\Delta\varphi = +''16 \pm ''96$ and $m = +.165 \pm 1.89$. The mean errors are only very slightly reduced. The refraction correction comes out materially the same as before: the small difference of $.013\%$ would not affect the results.

The following table shows the final results.

TABLE 2, corrected for latitude variation.

Number		φ	O—Boss		Number Boss	O—Boss (+28°)		Number Boss	O—Boss (equator)	
Grw.	Boss		Leiden	Berl.-Bab. 25		Leiden	Berl.-Bab. 25		Leiden	Berl.-Bab. 25
		52 ^o 9'								
2397	37	20 ^o 02	+''04	-''10	106	-''08		3132	+''74	
4007		19 ^o 91				+''53		3375	+1'31	+1'21
1892	3182	19 ^o 99	+''10	+''29	241	+''57	+''62	3388	+''26	+''38
					3224	+''55		6123	+''17	+''59
4014		20 ^o 36			3251	-1'66	+''40			
					248	+1'76	+1'44	3375	+1'96	+1'21
1174		20 ^o 06			434	+''63		3388	+1'26	+''38
					441	+''81	+''62	3462	+''51	
3379	3809	20 ^o 04	+''63	+''54				612	+''80	
					3729	+''79	+''67	722	-''19	+''05
4244	3488	20 ^o 18	+''52	+''13	3570	+''09		290	+''80	
1923		19 ^o 96			3635	+''69	+''54	622	+1'26	+''22