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Preliminary report

ENHANCED ACCURACY OF THE BELGRADE ZENITH TELESCOPE'S INCLINATION AFTER SETTING UP THERMAL INSULATION FOR ITS TALCOTT LEVELS

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SUMMARY: It has been found that the accuracy of the inclination determination of the Belgrade Zenith Telescope was substantially enhanced after thermal insulation has been provided for its Talcott levels. Juxtaposed are results of the inclination determination in 1967 and 1970, the former preceding and the latter following the setting up of the thermal insulation.

1. INTRODUCTION

In view of the contemplated modernization of our Zenith Telescope (ASCANIA, A=110mm) it was necessary first to acquire accurate picture of this instrument's current potentialities. This implied testings and checkings, one of them being performed on the instrument's Talcott levels, on which report is presented in this paper.

A particular circumstance contributed to this study having an added interest: in 1969 the Talcott levels of our ZT were thermally insulated (Milovanović et al., 1981). Hence a comparison of the results yielded by these levels, such as they were delivered by their manufacturer ASCANIA many decades ago, with the results obtained with the same levels now thermally insulated, promised results out of the ordinary. As sample years chosen were 1967 and 1970, the one preceding and the other following the installing of the thermal insulation. The number of measurings both in 1967 and 1970, amounting to 830 and 1020, resp., was sufficient for the conclusions to be reliable.

2. METHODS AND RESULTS

The accuracy of the ZT's inclination has been approached proceeding from the differences $\Delta\beta$ of the inclination β_U, furnished by the upper, and β_L, furnished by the lower level, i.e. $\Delta\beta=\beta_U-\beta_L$. As is well known, each one of the star pairs observed involves a $\Delta\beta$ value. Account is thereby taken of whether the star pair has been observed in the EW or WE sequence, i.e. whether the first star in the pair has been observed at the clamp E and the second at the clamp W, or vice versa. In other words, whether the reversal order of the instrument with a certain star pair has been EW or WE. The number of observations performed in 1967 with the EW reversals is 423, that of WE reversals being 407. In 1970 the situation is the following: 546 with EW and 474 with WE reversals.

Another aspect determining the data treatment is connected with the observers. There have been two observers in 1967: R. Grujić (RG), and M. Djokić (MD). In 1970 a third observer had joined them: V. Milovanović (VM). The calculations have in the first place been executed according to observers, i.e. the individual observer has been held as the bearer of the results. Still, the final step consisted in combining the results of both observers in 1967 and of all three of them in 1970 as the difference between the observers proved marginal.

Two versions of the data treatment have been carried out:

a) All of the measurements have been used in the calculations;

b) The measurements whose risk, according to the Student-Fisher criterion, exceeded 0.05%, were discarded.

Results of what is laid down above, i.e. what both versions a) and b) yielded, are summarized in Table 1 for 1967 and in Table 2 for 1970. The results delivered by the version a) appear in the upper halves and those by the version b) in the lower halves of Tables 1 and 2.

Table 1. Mean values $\overline{\Delta\beta}$ of the inclination differences associated with the EW and WE reversals, their error $\epsilon_{\overline{\Delta\beta}}$, n-number of measurements, according to observers (RG, MD, see above). Data for 1967.

	RG			MD			RG,MD		
	$\overline{\Delta\beta}$	$\epsilon_{\overline{\Delta\beta}}$	n	$\overline{\Delta\beta}$	$\epsilon_{\overline{\Delta\beta}}$	n	$\overline{\Delta\beta}$	$\epsilon_{\overline{\Delta\beta}}$	n
EW	-".007	±".005	192	+".009	±".005	231	+".002	±".003	423
WE	+.008	±.005	193	+.020	±.005	214	+.014	±.004	407
E-W	-.015			-.011			-.012		
	After rejecting								
EW	-.003	±.004	186	+.003	±.004	214	.000	±.003	398
WE	+.003	±.004	182	+.016	±.004	201	+.010	±.003	388
E-W	-.006			-.013			-.010		

Table 2. Mean values $\overline{\Delta\beta}$ of the inclination differences associated with the EW and WE reversals, their error $\epsilon_{\overline{\Delta\beta}}$, n-number of measurements, according to observers (RG, MD, and VM, see above). Data for 1970.

	RG			MD			VM			RG,MD,VM		
	$\overline{\Delta\beta}$	$\epsilon_{\overline{\Delta\beta}}$	n	$\overline{\Delta\beta}$	$\epsilon_{\overline{\Delta\beta}}$	n	$\overline{\Delta\beta}$	$\epsilon_{\overline{\Delta\beta}}$	n	$\overline{\Delta\beta}$	$\epsilon_{\overline{\Delta\beta}}$	n
EW	-".007	±".003	192	-".003	±".003	172	+".001	±".003	182	-".003	±".002	546
WE	-.001	±.002	165	-.002	±.004	166	-.002	±.003	153	-.002	±.003	474
E-W	-.006			-.001			+.003			-.001		
	After rejecting											
EW	-.006	±.002	179	-.002	±.002	124	+.001	±.002	177	-.002	±.002	480
WE	-.001	±.002	155	-.003	±.002	114	-.003	±.002	156	-.002	±.002	425
E-W	-.005			+.001			+.004			.000		

From the comparison of the $\overline{\Delta\beta}$ values in Table 2 with their counterparts in Table 1 it clearly follows that they are substantially lower, about an order of magnitude. This cannot be taken otherwise than to be a convincing proof of what remarkable effects have been achieved by protecting Talcott levels with, evidently adequate, thermal insulation.

We went a step further in elucidating the question here considered. Keeping in mind the well known fact that in astronomical levels the temperature effects are the strongest, we submitted data listed in Table 1 and Table 2 to a scrutiny with a view of establishing exactly those effects in our inclination measurings. The relation used was:

$$\Delta\beta = a + b(T - T_0)\,, \qquad (1)$$

where $\Delta\beta$ is, as before, the inclination difference, a and b are the unknown constants, T - temperature of the instrument and T_0 - mean value of the temperature.

Results of data processing according to Eq. 1 are shown in Table 3 for 1967 and in Table 4 for 1970. Here too, two versions of calculations were performed: a) All of the measurements are used and

b) Rejected are measurements whose risk, according to the Student-Fisher criterion, was in excess of 0.05%. Version a) data appear in the upper halves and those of the version b) in the lower halves of Tables 3 and 4.

Table 3. Constants a and b (Eq. 1) according to observers (RG and MD, see above) and instrument reversals EW and WE. r - correlation coefficient. Data for 1967.

	RG				MD			
	a	b	T_0	r	a	b	T_0	r
EW	+.04286	+.01144	11.144	-.432	+.22400	+.00576	14.255	-.394
	±.19922	±.01917			±.15310	±.02524		
WE	+.63402	+.03106		+.203	+.11801	-.01318		-.365
	±.42481	±.04343			±.09302	±.02066		
	After rejecting							
EW	+.17043	-.00499	11.025	+.073	+.02590	+.01353	13.091	-.574
	±.11149	±.01527			±.14133	±.02624		
WE	-.00280	+.01566		+.117	+.05661	+.00425		-.436
	±.10038	±.01626			±.07484	±.01314		

Table 4. Constants a and b (Eq. 1) according to observers (RG, MD and VM, see above) and instrument reversals EW and WE. r - correlation coefficient. Data for 1970.

	RG				MD				VM			
	a	b	T_0	r	a	b	T_0	r	a	b	T_0	r
EW	-.00766	-.00010	10.530	-.005	-.02221	+.00115	10.296	+.368	+.00529	-.00020	10.292	-.087
	±.00596	±.00047			±.00807	±.00059			±.00638	±.00046		
WE	+.00378	-.00086		-.338	+.00413	-.00036		-.153	-.00535	+.00037		+.165
	±.00612	±.00048			±.00642	±.00047			±.00623	±.00045		
	After rejecting											
EW	-.00931	+.00022	9.530	+.141	-.01285	+.00050	10.000	+.284	+.00239	-.00037	10.281	-.210
	±.00395	±.00031			±.00475	±.00035			±.00480	±.00035		
WE	-.00267	-.00013		-.071	-.00539	+.00010		+.058	-.00067	+.00011		+.041
	±.00455	±.00035			±.00439	±.00032			±.00477	±.00034		

We realize from Table 4 how the temperature coefficients b there in are negligibly small as compared with the ones in Table 3. This is an independent proof that the temperature effects on Talcott levels, after putting them under thermal insulation, have thoroughly been weakened. Therewith is explained, to a large measure, the mechanism through which the temperature factor affects both the inclination of the instrument and the resulting latitude values (Teleki and Grujić, 1982; Grujić and Teleki, 1987). Namely, the latitude values before, and those after, Talcott levels have been thermally insulated, have displayed the same qualitative difference as the one stated with the inclination values. The difference between the observers, as already related, are insignificant.

4. CONCLUSION

The installing of the thermal insulation for the Talcott levels of the Belgrade Zenith Telescope in 1969 has brought about a thorough diminishing of the temperature effects on the inclination determination. Accordingly, the accuracy of the inclination determination has correspondingly been enhanced, remaining within a few thousands of second of arc. These results make us more confident to go ahead with the contemplated modernization of our ZT.

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УВЕЋАЊЕ ТАЧНОСТИ НАГИБА ЗЕНИТ-ТЕЛЕСКОПА У БЕОГРАДУ НАКОН ПОСТАВЉАЊА ТЕМПЕРАТУРСКЕ ЗАШТИТЕ ТАЛКОТОВИХ ЛИБЕЛА

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Претходно саопштење

Аутори су истраживали утицај Талкотових либела на добијене географске ширине Зенит телескопа у Београду из мерења за 1967. и 1970. годину користећи разлике у нагибу инструмента одређене Талкотовим либелама. Утицај температуре на тачност добијених латитуда је значајно мањи 1970. године, након што је извршена температурска заштита Талкотових либела и читавог инструмента, него 1967. године, када те заштите није било.