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OLD SUNDIALS IN SERBIAN LANDS

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Abstract. By this paper we attempt to provide an insight into the history of gnomonics in Serbian lands. A survay, rather discontinuous, is presented of not numerous sundials in these regions dating back to diverse epochs.

1. INTRODUCTION

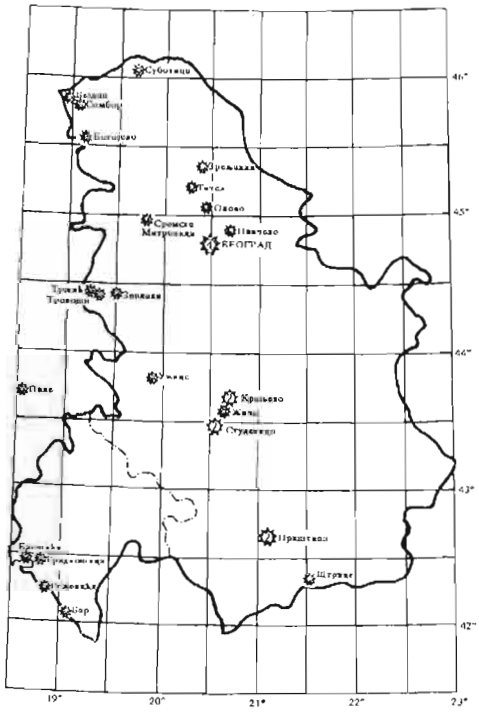

Fig. 1. The preliminary map of stationary sundials in Serbian lands.

The sundials are attractive segment in the scientific and cultural heritage of every people. They are the object of interest of researches of various branches, who treat them from different aspects: according to historical periods, according to their construction, according to their belonging to clock systems within the framework of regional entities of various size. The most general is their division into *portative* and *stationary* sundials. As a rule first studied were portative sundials, from a stylistic viewpoint as work of applied art. This is the case with us too (Han, 1966). Unlike the portative sundials, most of which are stored in museums. The stationary sundials have first to be spotted. The last decades of the present century are noted for systematic researches in, and cataloguing of, the stationary sundials in a number of European countries.

Currently we do not dispose of sufficient data, such that would allow us to form any dependable idea of the sundials, extant or that have existed in the

area of Serbia and Serbian lands. Their history can only fragmentary be reconstructed from the scarce specimens which have been preserved to our days and from fragments in the literature which, directly or indirectly, point to their existence. Table 1 is but a maigre framework for further researches in the history of gnomostics with us.

In what follows presented shortly will be our most interesting specimens of sundials, whereby we saw to it to avoid any repetition of what has already been written (Tadić, 1997).

2. CHRONOLOGICAL OVERVIEW OF OUR OLD SUNDIALS

The most ancient and most valuable found in our lands, is certainly the Roman sundial detected in 1981 at Sremska Mitrovica among the ruins of the Roman town Sirmium (Figs 2a, b).

Here we have to deal with an impressive sculptor composition consisting of marble, life-size, figures with a spherically carved sundial on their shoulders. Two of the figures – Atlantes and Heracles = recognizable at first glance, are no rarity in the antique sundials. The third figure might be Heracles' (half) tween brother Iphicles (Milošević, 1985) or Heracles' father Zeus (Tadić, 1988). The latter version is possibly nearer the truth: Atlantes – as the one holding the heavans – Heracles as the ruler of the Zodiac and a custodian of heavens Zeus – as the ruler of the heavens and finally the triade's crown, sundial – as infinitely diminished and reversed model of the same heavens.

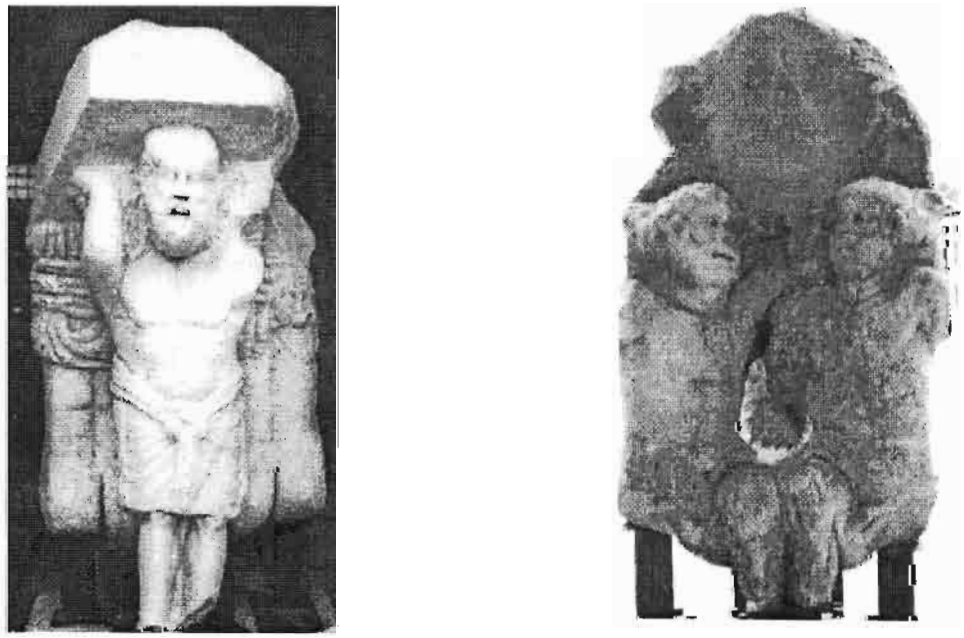

Fig. 2. Sculptor compositions: a) Atlantes and b) Heracles and Zeus (Iphicles?) with Sirmium's sundials on their shoulders.

Table 1. Sketch of chronology of gnomonics in Serbian lands.

Year or Century	Data relevant to the history of gnomonics with Serbs
7th c	Roman sundial in Sirmium - Sremska Mitrovica
1208	The earliest record of the Serbian word "Časovnik" (clock) in Hilandar typicon by St. Sava
1183-1196	Mediaeval sundial in Bogorodica (Our Lady) church in Studenica monastery
13th-15th c	A number of exact time specifications according to temporal hourly systems in the ancient Serbian records, epitaphs, genealogies and annals.
1404	The first ever mechanical clock in Russia at the Prince Court in Moscow, constructed by Serbian monk Lazar.
16th c	Data in the so-called "Bogišić manuscript" on the length of man's shadow in feet, according to months and temporal hours.
1746	Proceedings from an exact analysis by Rudjer Bošković (1711-1787) the Dubrovnikan J. L. Zuzorić published in Venice a treatise on the ancient Roman sundials of Beros type.
1828	Mural sundial in Zemun
1831	Mural sundial in Pančevo
1843-1852	Pictured mural sundial in Sombor, a work of the monk Jovan (Julian) Čokor (1810-1871).
1896	Mural sundial on the building of the German consulate in Belgrade.
1902	Prof. Milan Nedeljković published the book "Determination of time by means of sundials".
1931-1932	Prof. Vojislav Mišković (1892-1976) published an article "On sundials" in two parts.
1932	A horizontal sundial inside the Astronomical Observatory's grounds was constructed according to a design by prof. V. Mišković.
1934	Mural sundial (metal on brick) of the Orthodox boarding school in Belgrade, work of the architect Aleksandar Deroko (1894-1988).
1938	A second mural sundial of the same technique by architect A. Deroko on the Bishope's residence in Žiča Monastery.

The sundial is broken, less than half of the spherically carved base, with five hour lines which close the sectors for the 5th, 6th, 7th and 8th temporal hours. The celestial equator's projection cuts into halves the hour lines, an indication of the sundial having been adjusted to the altitude of the celestial pole above Sremska Mitrovica's horizon ($\varphi = 45°$).

The triad with the sundial was dug out at the locality of an old Roman cemetery from the end of the First and the beginning of the Second centuries. Most probably it

was within the structure of a mausoleum of some wealthy Sirmium's citizen (similar to Trimalhion in Petronyis Sotiricon).

Our only preserved sundial (Fig. 3a) is the one on the Bogorodica (Our Lady) church of Studenica monastery (Tadić, 1987). It is carved on the left pilistre next to the doorway of the south church vestibule, at about 4 m height. The semi-circle-shaped hour plate of 21 cm radius, is divided into 12 equal hour sectors. The sectors are numerated in Byzantine fashion by letters A, B, Γ, Д, E, S, З, H. There is missing the last quadrant of the sundial, the one with the denotations Θ, I, IA, IB. There is no gnomon either, which must have been fixed perpendicularly on the wall, in the centre of the semi-circle shaped hour plate of the sundial (Fig. 3b).

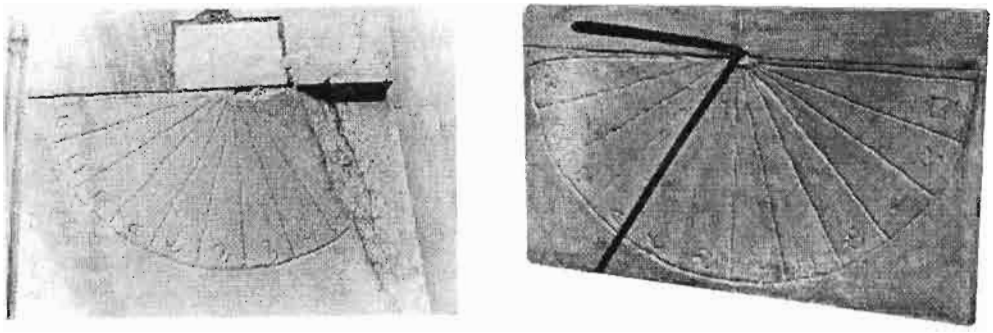

Fig. 3.

This kind of sundials with differing numbers of hour sectors (12, 8, 6, ...) have been manufactured on a massive scale in the Middle Ages. One may say that they were one of the peculiarities of that period. Strictly speaking these were not the sundials in the exact meaning of the word since their shadow did not conform with the temporal hour system then in force. On the other hand these improvised devices have by themselves, through their geometrically ordered dials, dictated a particular division of the day which, considering its duration of several centuries, might be taken as a particular hour system visual-temporal hour system.

The shape of the letters-numerals of the Studenica sundial suggests its being as old as the church itself, and this was built between 1183 and 1196.

No other medieval sundials have been preserved in the areas of Serbia and Serbian lands. Nevertheless their existence is indicated by numerous exact hour specifications in the medieval Serbian manuscripts. For fixing the first and the sixth – otherwise often mentioned – day's hours no sundial was necessary, they having been linked with the sunrise and the noon. But the mentioning of the ninth, third, fifth and seventh hour does not leave any doubt as to their existence. For example the hour of death of the Serbian king Dragutin (1282, at the ninth hour), the second Serbian patriarch Sava (1375, at the third hour), the emperor Lazar (1389, at the sixth or seventh hour), the despot Stefan (1427, at five hours by day).

The piece of information from the annals to the effect that the first mechanical clock in Russia was installed at the Prince's court in 1404 and that it was a work of the Serbian monk Lazar clearly betokens a tradition in Serbs of the clock workmanship. The medieval Serbian clock workmanship is atteszed to also by two sundials of "Studenica design" found on Hungarian territory. One of these is at the locality Rackeve (Serbian Kovin) on the wall of the Orthodox church whose foundations were laid by Serbs (Bartha, 1995). A similar one is on the Orthodox church in the village Grabocen (Bartha ....?). In their nortward mass migrations before Turks the Serbs carried with themselves in their memories also the Bysantine "recipe" of sundial making.

Preserved from the 16th century is the so-called "Bogišić" manuscript, containing data on the length of man's shadow in feet according to months, for each temporal hour (Novaković, 1884). These shadow lenths were determined for the fifth antique "climate", i.e. for the longest – 15 hours – of day-time (or according to Ptolemy, by the latitude $\varphi = 40°56'$).

Proceeding chronologically by leaps one should mention that Rudjer Bošković (1711-1787) was sporadically occupied with gnomonics too and that, to take an example, the Dubrovnikan J. L. Zuzorić (Zuzzeri) in 1746 published a treatment concerning the old sundial found among the ruins of an antique villa on the Rome's hill Tuscal, relying on a previous Bošković's analysis of this topic.

Of the sundials originating in the 19th century, of which we possess knowledge, particularly interesting is the mural sundial in Zemun from the year 1828 (Fig. 4a, b). Its polos has metalic footing and a two-part arc support adjustable to any wall irrespective of the wall's position. This simultaneously indicates that the Zemun gnomoner was not lacking orders, i.e. that this was not the only sundial he made.

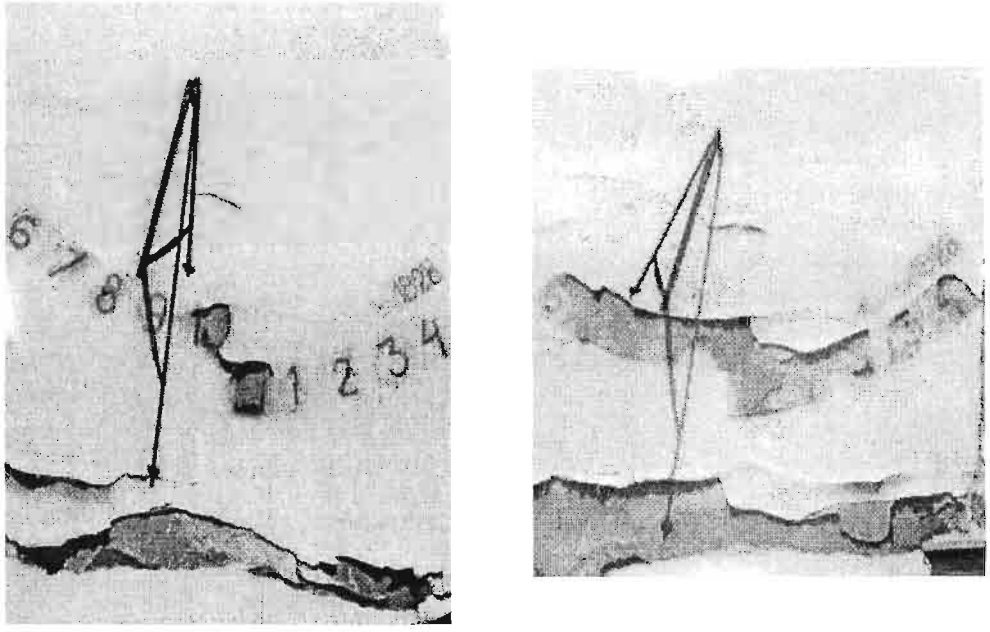

Fig. 4. a) The mural sundial in Zemun (1987), b) the mural sundial in Zemun (1997).

More important for the history of gnomonics (and astronomy) in Serbs is the pictured mural sundial in Sombor (Fig. 5a), made by the Serbian monk Jovan (Julian) Čokor (1810-1871) (Fig. 5b), between 1843 and 1852, while he was a professor and director of the local Serbian Teachers School (Jovanović, 1985). This sundial occupies an outstanding place – not thanks to its pictoral composition nor to its sarcastic motif – but because its hot-tempered author is considered the first amateur-astronomer with Serbs.

Fig. 5. a) The pictured mural sundial in Sombor. b) Jovan (Julian) Čokor.

The year 1887 saw the founding of the Astronomical and Meteorological Observatory in Belgrade. Its first director was Milan Nedeljković (1857-1950), a professor of astronomy and meteorology at the Grand School (University). Prof. Nedeljković published in 1902 the book "time determination with the aid of sundials". Nedeljković's book contains detailed instructions concerning the construction of the sundials, which were to serve in testing the accuracy of the clocks at the meteorological stations. The matter is in fact of gnomon and the determination of the true noon with it. This is but the first step in the construction of the sundial properly speking, something Nedeljković stated succinctly in the Supplement to the text, page VII, where he points out that when going over to the true sundial one is to draw hour lines by observing the gnomon's top "as the top of a fictive lever, inclined by the angle equal to the local latitude".

Nedeljković's successor, the second director of the Belgrade Observatory, professor Vojislav V. Mišković (1892-1976) published in "Godišnjak Našeg Neba" (Almanac of Our Sky) for 1932 an article "On sundials", to put it into effect next year by constructing within the newly built Observatory on Veliki Vračar a horizontal sundial (Fig. 6). This is the only sundial known to have been constructed by a professional astronomer. The sundial is located on the Observatory's meridian, midway between the pavilions of the Large and Small refractors. The stone plate (50 × 50 cm) is still there. No polos is there as the sundial is on a busy path, in particular by night.

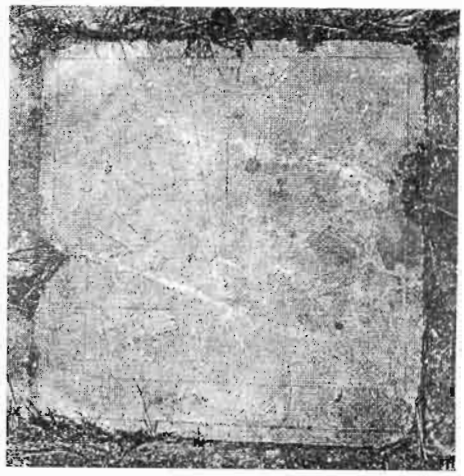

Fig. 6. The horizontal sundial on Astronomical Observatory.

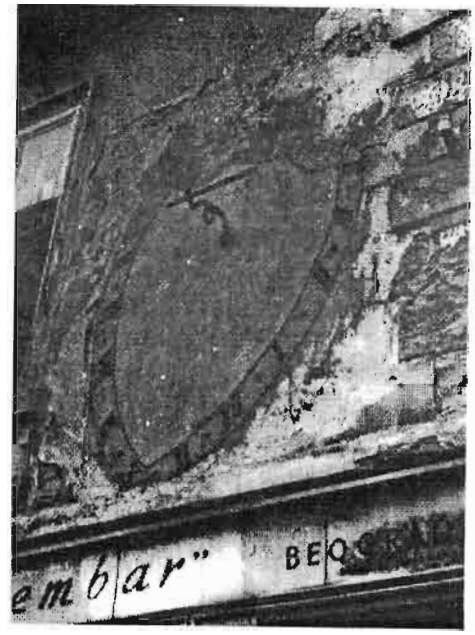

Fig. 7. The mural sundial in Pančevo.

In the following issue of the same almanac Mišković published the continuation of the article in which he gave instructions for making vertical sundials of all orientations. The two writings of profs. Nedeljković and Mišković are significant because in them we find defined, for the first time with us, the basic notions of the gnomonics.

In considering by inertia as "old" all the sundials before the Second World War let us conclude this presentation by mentioning the mural sundial on the Orthodox boarding school in Belgrade (1934) and the mural sundial on the Bishope's residence in Žiča monastery (1938) constructed by our eminent architect Aleksandar Deroko (1894-1948).

3. CONCLUSION

The medieval hour determination tradition was established in Serbian lands – Studenica sundial marking its beginning and the monk Lazar's Moscow clock its culmination. All this was interrupted by the Turk invasion. Under the Turkish rule the Serbs, with their "hands on sward" were cut off from the normal communications, thus from the general progress that meanwhile was making great strides in Europe. This is in part some explanation of why there is an obvious scarcity of sundials in Serbian lands. But this very circumstance imposes an obligation for their systematic protection.

References

Dadić, Ž.: 1963, Ivan Luka Zuzorić i problemi povijesti astronomije, Dubrovnik, VI, No 1-2, Dubrovnik, pp. 55-57.

Han, V.: 1966, Džepni i putni sunčani satovi iz zbirke Muzeja primenjene umetnosti. Zbornik Muzeja primenjene umetnosti, 9-10, Beograd, pp. 65-80.

Jovanović, D.B.: 1985, Život i rad Jovana (Julijana) Čokora, Zbornik radova VII nacionalne konferencije astronoma Jugoslavije, Beograd, pp. 99-102.

Milošević, P.: 1985, Sunčani sat iz Sirmijuma, Starinar XXXVI, Beograd.

Novaković, S.: 1884, Odlomci srednjovjekovne kosmografije i geografije, Starine, JAZU, knj. XVII, Zagreb, pp. 53-54.

Tadić, M.: 1987, Studenički sunčanici, Bagdala, Kruševac.

Tadić, M.: 1988, Sirmijumska trijada sa sunčanikom, Vasiona, XXXVI, 1988/1.

Tadić, M.: 1997, Nacrt za katalog naših sunčanika, Publikacije Astronomske opservatorije u Beogradu, Sv. 46, Beograd, pp. 31-41.