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**Sundials from Cluj County,
Romania**

**Cluj-Napoca
2020**

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Cover: The medieval sundial on St. Mary's Catholic Church in Cluj-Napoca, Romania.

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Contents

Preface	5
Measuring time by the sun	7
The first sundials	10
Old sundials in Cluj-Napoca	15
Old sundials near Cluj-Napoca	23
Some new sundials	32
Can you tell the time?	38
Pseudo sundials and other local curiosities	43

Appendices

<i>Regarding the orientation of some Cluj churches</i>	51
<i>Traces of an old sundial on St. Michael's Church in Cluj -Napoca</i>	55
<i>Sulița - the spear: an old Romanian unit of time measurement</i>	58
<i>A practical method for constructing a sundial</i>	67

Preface

Cluj County is an administrative division in Transylvania (northwestern Romania) with a population of approximately 700,000 inhabitants. Romanians and Hungarians have lived here together for many centuries with different customs but sharing a common cultural heritage and human values.

The largest city in this area is also generally referred to as Cluj but was renamed Cluj-Napoca in 1974. The added name is a tribute to the ancient settlement of Napoca –



*Map of Cluj County and the places mentioned in this book.
Based on Cluj County Spacial Plan.*



mentioned by Ptolemy, the geographer of antiquity – which was set up here as a Roman town under the rule of Emperor Hadrian in 124 AD. Ancient Cluj had enjoyed certain military and administrative prominence but was reduced to the status of a rural settlement after the Roman withdrawal of 271 AD. Bordering fertile agricultural areas in the east, and favourably located near the mountains to the west, the city slowly recovered. By the middle of the 14th century, the craftsmen of Cluj made their first attempt to organize into guilds. Defended by strong walls and bastions, medieval Cluj consolidated trade with distant markets like Vienna, Germany, the Low Countries, and Venice. An impressive gothic stone church dedicated to St. Michael was erected in the large main square. Lay architecture gradually followed suit. Despite the many Renaissance, Baroque and modern buildings, contemporary Cluj still manages to retain some of its medieval charm.

Besides the city on the banks of the Someșul Mic River many other destinations are waiting to be explored. Whether you stroll through the quaint villages of Țara Călatei or admire nature's raw beauty in the Turzii Gorges, be sure to watch the shadows move on the sundials of Cluj. They are a special category of cultural heritage. In Romania, there are about 200 sundials in various conditions, mostly in Transylvania. Around Cluj, there are about 20. You will find many of them on churches. To plot their exact locations just scan the QR codes inside this book.

Enjoy *Varza à la Cluj* and a blond *Ursus* beer at ease, as Transylvanians do.

For us, time flows differently.

Dan-George Uza
Cluj-Napoca, October 2020

Measuring time by the sun

From very long ago until a not-so-distant past, people assessed time subjectively, by the length of the shadow of their own body or the position of the sun relative to the buildings or objects around them: when the sun rode over the barn or stood on top of the poplar tree they knew it was noon. The progress of the sun in the sky was sometimes counted using spears, clubs, trees, even people. For example, when the sun was at three spears it was about 10 o'clock.

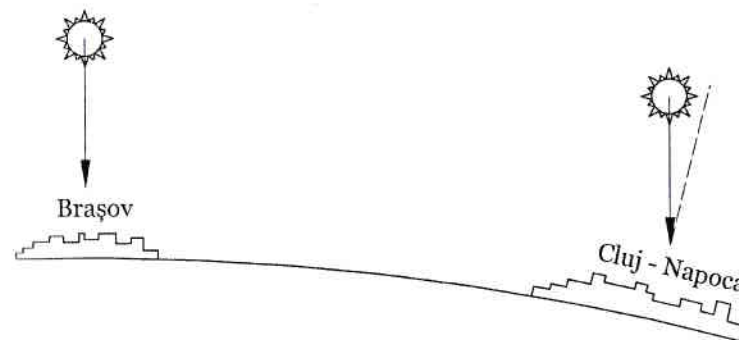
The sun rises from the east and glides across the sky while climbing to its maximum southern height at noon and then descends as it moves towards the west. This apparent solar journey, therefore, involves three significant stages: *sunrise*, *noon* (or *solar culmination*), and *sunset*. Sunrise occurs when the first rays of the rising sun are seen above the visible horizon. Sunset occurs when the last rays of the setting sun are seen above the visible horizon. Noon is the middle of the day, the time of the greatest height of the sun above the horizon (solar culmination). The sun is then said to *transit* or *cross the meridian*. But which meridian? That depends on your location.

You've probably heard it by now: The earth really is round. To fix certain geographical positions the globe was divided into a grid. Parallel circles run horizontally north or south of the equator (for measuring *latitude*) while great circles called meridians connect the north and south poles (for measuring *longitude*) and run vertically east and west from the London borough of Greenwich. In astronomy and navigation, these imaginary curves also project up into the sky producing some fundamental positional marks called coordinates. Just as the terrestrial equator is projected on the celestial vault and forms the *celestial equator*, so the

meridian passing through the observer's position can be projected into the sky forming the *celestial meridian* of that particular location. The city of Cluj-Napoca stands on the parallel of 46.8° north latitude and the meridian of 23.6° east longitude. Were it not an imaginary concept, the celestial equator would appear as an arc of a circle stretching in the sky from east to west and rising at a height of $90^\circ - 46.8^\circ = 43.2^\circ$ above the southern horizon. The celestial meridian would be an arc of a circle passing from north to south above our heads in a plane perpendicular to the horizon dividing the celestial vault into two halves. Morning would correspond to the solar journey in the eastern half of the sky and afternoon to solar journey in the western half. On the ground, the celestial meridian projects a line from south to north also called a meridian.

Meet you at noon! Okay, but at what precise time? In common language, we often assume that noon occurs at 12 o'clock but the exact time of solar noon depends on our geographical location. Solar noon occurs later in Braşov than in Constanţa and in Cluj later still. For westerly regions, the sun's crossing of the local meridian is delayed by a certain amount. As we head west each degree of longitude delays the passing of the sun by 4 minutes (or a full 360° in 24 hours). Time on a sundial in Cluj-Napoca will differ slightly from one in Braşov because each one measures *the true solar time* of its own meridian. The gap in solar time between Cluj-Napoca and Braşov is about 8 minutes - between the Cluj districts of Mărăşti and Mănăştur only a few seconds.

Modern clocks display the same time everywhere across the country – we call this *standard time*. When our common clocks tell us it is 12 o'clock (or 1 pm during summer) we should know that it's actually *average (or mean) solar noon* on the meridian of 30° east longitude – the



Solar noon occurs later in Cluj-Napoca than in Braşov.

prime meridian of our time zone (Eastern European Time). Solar noon is then delayed by 4 minutes for each degree of longitude travelled further west. In the case of Cluj-Napoca, this longitude gap amounts to $30^\circ - 23.5^\circ$ (the longitude of Cluj) = 6.5° . Each degree of longitude corresponds to 4 minutes of time. Therefore 6.5° of longitude corresponds to 26 minutes of time. This means that true solar noon in Cluj-Napoca occurs on average 26 minutes later: at 12:26 pm, or 1:26 pm while on *Daylight Saving Time* (or *DST*).

Note that in the above I was using the word *average*. This is because noon is also observed at slightly different times during the year due to the sun not moving at a uniform rate across the sky. It's farthest ahead of the annual average on 3 November (+16.5 minutes, the sun is "fast", i.e. noon comes earlier) while farthest behind on 11 February (-14.2 minutes, the sun is "slow", i.e. noon comes later). Four times a year – around 15 April, 13 June, 1 September, and 25 December – true solar time coincides with the annual average or mean sun time and thus also with the uniform rate which our modern clocks tick. If this looks like gibberish to you don't worry – just enjoy the ride! You will understand better when we get to the Botanical Gardens of Cluj-Napoca.

Humans invented the sundial to better measure time according to the sun. On a clear day, an object's shadow reflects the motion of the sun, being always opposite to it. Consequently, shadows can be used to measure time like the hands of a clock.

A sundial consists of a projecting object (usually a rod also called *gnomon* or *stylus*) and a surface marked by lines or figures onto which the shadow falls, indicating the hour (the *dial face*). This surface can be set up in different planes (horizontal, vertical, oblique, etc.). When the shadow points to one of the time markers on the dial face, we say that its hour has arrived. However, sundial time does not generally correspond to that of our common clocks: solar time is based on the local position of the sun, while modern clock or watch time is a standardized concept and consistent throughout the country.

The first sundials discovered in Romania date back to antiquity (I-IV centuries BC), the oldest of them being unearthed in the Greek colony of Histria on the Black Sea coast (near present-day Constanța). On these ancient sundials, the rod was a vertical or horizontal metal bar and time was read by the location of the shadow tip (and not its direction). All ancient dials were typically spherical, cylindrical, or conical in shape, and they divided daylight into 12 equal time sectors which were commonly not numbered on the dial face – these were the so-called *seasonal* or *temporary hours*. Time started flowing during the first hour of the day with the rising of the sun while ending at sunset with the twelfth hour. Jesus Himself bears witness to this in John 11: 9: “*Are there not twelve hours in the day?*” In Romanian, we sometimes warn against delaying an action to a later moment by referring to



A stone fragment of the oldest sundial discovered in Romania (I-IV centuries BC). Photograph by George Nica, courtesy of the National Museum of Romanian History in Bucharest (no. 18757).



The fourth temporary hour near summer solstice on an ancient sundial replica constructed from polystyrene foam.

the twelfth hour: *Don't get things done at the twelfth hour!* (You may be more accustomed to the English variant of using the eleventh hour). This certainly does not refer to 12 o'clock, but to the last moment of the ancient day – the last rays of daylight.

Dividing an hour into smaller time intervals was not a widespread practice back then. It appears somewhat clumsy to antique authors: for example, the Roman scholar Marcus Tullius Cicero (106-43 BC) speaks of *articulus temporis* – “a finger of time” referring probably to half an hour. The lack of a more dedicated terminology underlines the fact that our ancestors did not care so much about these rather short time intervals. Nevertheless, the concept was familiar to astronomers who worked with subdivisions of *equinoctial* (or *equal*) hours having a constant duration throughout the year. It is interesting to note, however, that the half-hour

entered the consciousness of the masses early enough to be found in apocalyptic Christian literature: “*And when he had opened the seventh seal, there was silence in heaven about the space of half an hour.*” (Revelation 8: 1).

Although temporary hours were spaced equally apart on sundials, their duration varied greatly during the year as the length of daylight increased or decreased with the seasons. Even so, they continued to be used up to the Middle Ages when mechanical clocks became popular.

The oldest sundial of Cluj County was unearthed in 2006 in the village of Florești and is now kept at the National Museum of History of Transylvania in Cluj-Napoca. Unfortunately, it's not currently on display. This sundial bears witness to the transition from antiquity to the early Middle Ages when the curved dials became flat and the hours started to be read according to the direction of the shadow and not according to the shadow tip. Such sundials were used in Catholic monasteries for measuring the canonical hours of prayer, hence their name: *canonical sundials*.

Christians and Muslims followed the historic tradition of reciting prayers at certain moments of the day: *Prime* or Early Morning Prayer during the first temporary hour, *Terce* or Mid-Morning Prayer during the third temporary hour, *Sext* or Midday Prayer during the sixth temporary hour, *None* or Mid-Afternoon Prayer during the ninth temporary hour, *Vespers* or Evening Prayer by the twelfth temporary hour (the times of canonical prayers varied of course by the seasons). A sundial like this was placed in a vertical position and had a perpendicular metal rod, with radial markings etched on the dial face. Its divisions were much less precise than our modern hours because they were rather meant to indicate certain stages in the sun's daily path relating to prayer times. Often their hours were not even numbered.