ILLYRICA ANTIQUA

IN HONOREM DUJE RENDIĆ-MIOČEVIĆ

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE
ŠIBENIK 12th–15th SEPTEMBER 2013

Department of Archaeology
Faculty of Humanities and Social Sciences, University of Zagreb

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IMPRESSUM

NAKLADNIK / PUBLISHER

Odsjek za arheologiju Filozofskog fakulteta Sveučilišta u Zagrebu /
Department of Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb

ZA NAKLADNIKA / REPRESENTING PUBLISHER

Željko Holjevac

UREDNIK / EDITOR

Dino Demicheli

RECENZENTI / REVIEWERS

Boris Olujić i Marko Dizdar

OBLIKOVANJE I PRIPREMA ZA TISAK / DESIGN & DTP

Srećko Škrinjarić

TISAK / PRESS

Tiskara Zelina d.d

NAKLADA / PRINT RUN

300 primjeraka / copies

Izdavanje knjige financijski su poduprli Ministarstvo znanosti i obrazovanja Republike Hrvatske
i Zaklada Hrvatske akademije znanosti i umjetnosti.

MINISTARSTVO ZNANOSTI
I OBRAZOVANJA REPUBLIKE HRVATSKE

ZAKLADA HRVATSKE AKADEMIJE
ZNANOSTI I UMJETNOSTI

ISBN: 978-953-175-657-0

CIP zapis dostupan u računalnome katalogu Nacionalne i sveučilišne knjižnice u Zagrebu
pod brojem 000966461.

NASLOVNICA / FRONT COVER

Nadgrobna ara Kvinta Rutilija Ticijana i Kvinta Rutilija Prokula / Funerary altar of Q. Rutilius Titianus and Q. Rutilius Proculus, Muzej grada Šibenika / Šibenik City Museum
Urna vojničkog tribuna / The urn of a military tribune, Muzej grada Šibenika / Šibenik City Museum

STRAŽNJA KORICA / BACK COVER

Titul Aplina Bardurija, Pladomenovog sina / Titulus of Aplis Bardurius, son of Pladomenus
Muzej grada Šibenika / Šibenik City Museum

FOTOGRAF / PHOTOGRAPHER

Tomislav Šmider

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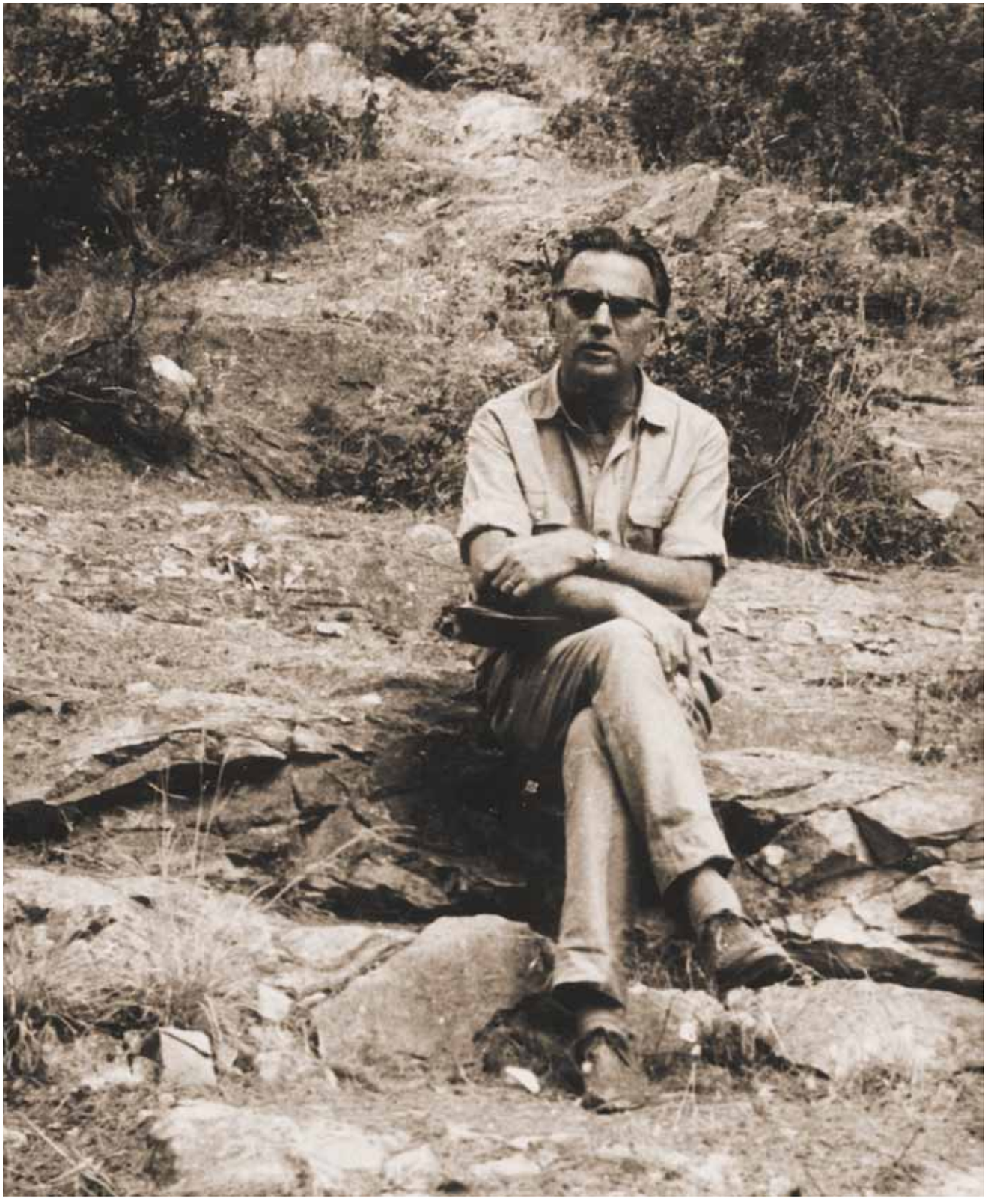
Zagreb 2017.



Duje Rendić-Miočević

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Hrvoje Manenica

TWO SUNDIALS FROM NARONA

Original scientific paper
UDC 681.11:902.2(497.5 Vid)"652"
DOI 10.17234/IllyricaAntiqua.2.15

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In this paper, the author presents a brief overview of how time is measured with the help of shadows from the sun and the development of sundials from the very beginning in Babylon, through Egypt and Greece to the Roman Empire. Similar examples of ancient sundials which have been found in Croatia and neighbouring Bosnia and Hercegovina to date, are also mentioned. The analysis of the two sundials from Narona includes their description, the interpretation of the preserved text, as well as their place and how they were used.

Keywords: *Time, sundial, latitude, Narona, necropolis*

In the Archaeological Museum Narona, two Roman sundials are kept. One is exhibited as part of the permanent exhibition, while the other is kept in the Museum's storeroom. As so far nothing about them has been written, they will be presented in this paper. A paper with a similar theme has been written by Mladen Nikolanci from where the inspiration for the title of this work originates (Nikolanci 1975).

Time is constantly present around us and has followed the world from its creation. The passage of time has always interested Man, just as he always wanted to know the reason for the passage of time. From the earliest beginnings of civilisation, Man has tried to measure time and to determine the exact time in which he lives. Modern man has no such problem in determining time, as he has at his disposal many gadgets and appliances wherever he turns, which can precisely give the exact time to the smallest part of a second. However, until recently this was not the case. In this paper an attempt to explain the way time was measured in ancient times with the aid of sunlight, that is sundials, will be made.

THE DIVISION OF DAY AND NIGHT

Man very early recognised the passing of time. He followed the passage of day and night and the seasons. During this period, Man was only able to measure time on the basis of night and day or year, or as the American Indians, following the cycle of the moon. It is not known when Man began counting the hours in the day, nor the way in which it was done, but it is certain that one of the first methods was the observation of shadows as the day progressed; it was obvious that the shadows changed their direction and length. Morning shadows are long and extend towards the west, and towards the middle of the day, that is midday, the shadows change and extend towards the north.[1] Towards the evening the shadows again extend in the direction of the east. Part of the day, that is the time of day, can be assumed by the length of the shadow, that is its direction (Albert E Waugh 1973: 1).

[1] In the southern hemisphere, the shadow at midday is towards the south.

Most probably, in the beginning, the day was divided into three parts, morning, afternoon and night according to the three events marked everyday- sunrise, midday and sunset. These three changes were obvious and served as a distinct way of measuring time in the very beginning. In everyday life, there existed a similarity between the sundial and Man, that is the length of the human shadow at various times of the day served as the orientation for determining time. The height of an adult is always the same, so that by the length of the shadow of an adult person mealtimes could be calculated. It is not known how effective this method was in practice. Through the year, the length of shadows would vary depending on the season, that is the position of the Earth towards the Sun. Because of this, it is certain that people using this method to measure time, influenced their bio-rhythm, given that the length of the day varied through the year, therefore the time of their food consumption would change (Hannah 2008: 746-747).

ASTRONOMY AND THE MEASUREMENT OF TIME

In order to ascertain the precise measurement of time with the aid of shadows, that is sundials, many things had to be discovered, understood and finally accepted. From the beginning Man noticed the daily and yearly changes, but did not always understand why these natural things happened and why they repeated. In order to divide time into equal cycles which were constant and repeated each year, it was first necessary to understand our part of Space, that is the Solar System and the Earth's movement within this system (Gibbs 1976: 7-12.).

Greek mathematicians and astronomers had studied the sky and heavenly bodies even before 7th century BC, but any noticeable progress in astronomy did not follow until 5th century BC, and after. Pythagoras of Samos worked in the second half of 6th century BC, defining the Earth as a round heavenly body found in Space surrounded by other heavenly bodies. They followed the sunrise and sunset and determined the position of the ecliptic.[2] In the first half of the 4th century BC, Eudoxus of Knidos, constructed the movement of the Sun, Moon and the then-known five planets, which according to him orbited around the Earth. Therefore, the Earth was in the centre of the system, that is together with the rest of the then - known heavenly bodies, making up a geocentric system. Somewhere around the year 250. BC, Aristarchus of Samos was the first to place the Sun in the centre of the system and to present what is known as the heliocentric system. Aristarchus' heliocentric hypothesis at that time was not generally accepted (Gibbs 1976: 8-9).

Concerning the Sun and the measurement of time using sunlight, two types of discovered sundials can take credit for this. The *hemicyclium* (hemispherical) type, (carved into a stone block) and the so-called *Planes dial* which was constructed as a flat stone with a gnomon, which could be used horizontally or vertically, hanging on the wall of the house (Grimal et al 1983: 63).

In the ancient world, these were all astrological advances which lead to knowledge about Space, the Solar System, the Earth and the Earth's rotation. These are the parameters which have gradually brought about the exact measurement of time and its division into years, days, hours etc. which we use today.

The sundials of the ancient world enabled measurement of time throughout the entire year. It was the Egyptians who first divided day and night into 12 parts that is hours. However, there was a problem. Given that the length of the day or night depended on the season of the year, so the length of the hour depended on the position of the Earth. It was only during the summer and winter equinoxes that the hour was equal during the whole day and night. This was called ''the equinoctial dial'' which is the timepiece used today, hence it is the same during the whole year comprising 60 minutes, that is 3600 seconds.

The clocks that we use today came into use during the Middle Ages thanks to the discovery of sand and mechanical timepieces. During ancient times, the equinox timepiece was known to astronomers, but it was not possible to give the exact time using sundials. Sundials which could determine hours in the day, most probably were discovered during the Greek period. The earliest locations where they were found were Delos and Pompeii (Grimal et al 1983:63-68).

THE FIRST SUNDIALS

Most probably the first sundials were constructed in the ancient Babylonian civilisation from where the ancient Greeks adopted them, somewhere around the year 500. BC. This fact can be connected to the Greek philosopher, mathematician and astronomer Anaximander. He was the first in Greece to construct and show the gno-

[2] The apparent annual path of the Sun.

mon, the dial of the sundial (shadow meter), and put it in Sparta (Hannah: 2008: 746). Herodotus (2.109.3) gives us details from the 5th century BC, where he says that the Greeks took the knowledge of the sundial from the Babylonians (Gibbs 1976: 6). At the end of the 5th century BC it seems that sunlight, that is the shadow to measure time, was very widely used.

Vitruvius, the Roman architect and builder was a contemporary of Julius Caesar, and gives interesting facts about sundials, primarily about its origins and inventors (Vitruvius 1999: 185). He states how the half - circled sundial, hollowed into a square shaped stone and cut to half its height, was invented by Berossus of Chaldea.[3] This fact which Vitruvius gives us about Berossus, supports the facts which Herodotus gives (2.109.3) that the Greeks took the measurement of time using the sun from Mesopotamia, that is from the Babylonians. In addition, he lists the type of sundials and astrologers who invented them. In order to make sundials of a defined size and use, it was first necessary to calculate the geographical latitude where the sundial would be used. Vitruvius continued to mention the Hemicyclium (Hemispherical) or Scaphe dial. This name referred to the sundial of the hemispherical shape, that is the half - sphere (Gibbs 1976: 60).

SUNDIALS

Depending on how time was measured using shadows from the sun, the Greeks and Romans in ancient times used several types of sundial. Today, it is thought that the oldest surviving Greek sundial to the present day is from the island of Delos, where a total of 25 sundials have been discovered. In Pompeii, for example 35 sundials were found, so that from the examples of these two locations we can see the availability and popularity of these gadgets in the Greek and Roman period (Hannah 2008: 748).

On the basis of these discovered examples it seems that the main and most popular types of sundial among the Greeks and Romans were the hemicyclium (hemispherical), cylindrical, conical and flat sundials. The hardest to construct but also the most widely used were the hemicyclium sundials, given that they required the carving of a half - sphere hollow (hemispherical) from one stone block. This procedure needed great skill, as an equal absolutely perfect half - sphere had to be achieved. Its popularity lay in the fact that it was the simplest way of showing the time of day, the reason being that its shape silhouetted the celestial heaven. The gnomon (shadow meter) that is the dial, was situated above the hollow of the sphere outlining with its shadow the time of day onto the surface of the dial (Gibbs 1976: 12).

Variations of this type of sundial are also conical dials, which in effect are made up from a quarter of a sphere on which the shadow from the gnomon is cast and which is found in the centre. In the middle meridian there is the so - called noon line which indicates the time by projecting a shadow on the convex part of the dial. In the spherical part of the dial, carved lines form the coordinate network of the dial, the part where the gnomon is situated. On each side of the noon line there are five other meridians. These eleven meridians form twelve spaces which indicate the twelve parts of the day. Conical sundials were very well represented in the ancient world, and quite often the very base of the sundial with a sphere part, was decorated with various motifs or inscriptions (Gibbs 1976: 31). The two sundials from Narona which will be dealt with in this paper belong to this type. There were also sundials which had nine lines, that is eight spaces, which indicated eight hours of the day. By today's measuring, that would be a time period from 8am to 4pm, and Roman from II. to X. daily hours. The lines which indicated hours in Roman times were numbered, and the Greeks used the letters of the alphabet instead of numbers. There is a possibility that the signs on some sundials were painted on and consequently have not been preserved to date (Nikolanci 1975: 170-174).

In Roman times, sundials were already in use in the 3century BC. All citizens used them and they could be found in public places such as forums, market places and public buildings. The popularity and wide use of these sundials in the Roman Empire in the early part of II. century, was noted in an anecdote relating to the Emperor Trajan. It says that this sundial can also be made from a human face, *''if you turn the nose in the direction of the sun, and open the mouth wide, you will show the passer-by the exact time''* (Hannah 2008: 748).

The measurement of time in Rome was very important. There was a service for this which was carried out by the *accensus*. Every day his task was to announce the third, sixth and ninth hour of the day. It is interesting that several sundials marked by these hours have been preserved for us today (Warre Cornish 1898: 2).

[3] According to Vitruvius, Berossus was contemporary of Alexander the Great, a priest from Babylon, founder of the astrological school on Kos, and he wrote in the Greek language.

Fig. 1. The locations on which the sundials were found in Narona (photo M. Marušić)

The precision of the sundial could be achieved by the exact choice of its position, that is, such a sundial should be produced for a specific place of geographical latitude. This can be seen during the Solstice when the shadow of the gnomon (shadow meter) should correspond to the defined geographical latitude where the sundial is placed. Thus, there is a case which is recorded by Pliny (Plin. *Nat. Hist.*7.213) with the first sundial which was brought to Rome from Catana on Sicily where it was confiscated in the year 263. BC. In Rome it did not give the exact time, but Romans used it for 99 years without realising that this sundial had been made for a different geographical latitude which was located south of Rome, so that for the duration of all that long period they had wrongly read the time from it. In the year 164. BC, another sundial was made which was adjusted to the geographical latitude which corresponded to the city of Rome (Gibbs 1973: 10; Grimal et al 1983: 68).

There are also similar cases from the Roman Empire. For example, on some sundials from Pompeii, which were also incorrect, they were not precise, as obviously, the sundial was not produced to indicate the exact part of the day in that place. In such cases, there were discrepancies in the measurement of time, but still it was possible to orientate rather precisely. Romans, according to Vitruvius relinquished the task of making sundials to architects who did not always have enough astronomic knowledge, and many Roman sundials came about by copying the Greek ones. Copying was one of the reasons why some of the Roman sundials were not precise enough, as they were simply made for a different geographical latitude. On the other hand, for example on Delos in Greece, sundials have been found which show the exact time, indicating that they were made on Delos (Tadić 1990: 152).

From the Roman province of Dalmatia several sundials originate. Thus, in Salona two were found, a copy of one of them from the first half of the 20th century decorates the lapidarium of the Archaeological Museum in Split (Nikolanci 1975: 170). Sharon L. Gibbs also mentions two sundials from Pula, which are kept in the Archaeological Museum of Istria (Gibbs 1976; 206) and one from the Archaeological Museum in Zagreb which Josip Brunšmid has written about at the beginning of the 20th century (Brunšmid 1904-1911: 113-114). It is the sundial which is in the lapidarium of the Archaeological Museum in Zagreb and originates from Josipdol where it was probably brought from Čakovec (Gibbs 1975: 178). One sundial is also kept in the storeroom of the Archaeological Museum in Zadar and was found while excavating the Roman necropolis on Relja in 1989.[4] There is a record of yet another sundial from Kaštel Sućurac which also belonged to the conical type (Delić 1996). From neighbouring Bosnia and Hercegovinia, the *Diluntum* (Stolac) sundial is known (Tadić 1990: 147-154).

Fig. 2. Sundial from Narona (inv.no. 28) photo Toni Glučina

SUNDIALS FROM NARONA

During the setting up of the permanent exhibition of the Archaeological Museum Narona, just before its final completion, a very well preserved Roman sundial (inventory number: 796) was included in the exhibits. However, during the first audit of the museum's material in 2009. one more sundial was discovered. Today this sundial is kept in the storeroom of the museum under the inventory number 28.

The sundial (inventory number 28) was found sometime at the beginning of the 20th century under the ruins of the Church of the Blessed Lady, which was later demolished at the beginning of the 20th century, in order to build a larger church which is today called the Church of Our Lady of the Snows situated on the hilltop in Vid. This sundial was found by a local man from Vid, Ivan Ereš (son of the late Grga Ereš) who gave it to the priest at that time, Father Serafin Puratić. The biggest preserved height of this sundial is 19 cm, the width is 19.2 cm and the diameter of the base is 17 cm. It weighs about 6 kilograms. It is made of limestone and not entirely preserved. The base is round, and towards the upper part where the crown, that is the sphere part of the dial can be found, and where the lines and gnomon (shadow meter) are located, it is wider. This upper part which forms the crown is broken off. Vertically the sundial is also broken, approximately in the middle. On the front side, there is a Latin inscription, which is not completely preserved; the preserved part reads:

L(ucius) Lusius C(ai) f (ilius) Nic[--] or *Nig[---]*
Q(uintus) Herennius Eup[----]
f(aciendum) c(uraverunt)[5]

The remains of the damaged inscription can be explained in the following way:

Lucius Lusius Nic[--] or Nig[--], son of Gaius and Q. Hernnius Eup[--] or Eud[---] commissioned the making of the dial. That is, these two ordered and paid for the making of this sundial. What is missing on this inscription, are parts of their names, that is, neither of them have their cognomen completely preserved. The Lusius' cognomen begins with *Nic- or Nig-,* and there are many possibilities for the restoration. The possibility that the last preserved letter could have been *g*, so in that case his name could be read as *Nig(er)* or *Nig(rinus).* Names with *Nig-* are also common, in this case it is more likely that the variant is with *Nig-* rather than *Nic-*, as

[4] On this occasion we mention the sundial from Relja with the permission of the excavator Smiljan Glušević Phd. who will publish this.

[5] Here I would like to thank my colleague Dr. sc. Dino Demicheli from the Department of Archaeology University of Zagreb, who helped me translate and explained the inscriptions.

Fig. 3. Sundial from Narona (inv.no. 796), photo Toni Glučina

names with *Nic-* are mainly Greek, and here the person in question is someone with Roman citizenship which his father certainly had, so that it is probably less likely that his father would have a Greek name. Concerning the cognomen of the other person *Quintus Herennius*, it seems that after *Eu* there is another letter, at first glance it looks like a *p* or *d*, so his name could be *Eupor, Euplus, Euprepes or Eudoxius* or some other. As far as dating goes, according to the letters it could be dated to the first half of the first century.

This sundial belongs to the conical sundials, and probably had, like others at this time, nine cut vertical lines on the spherical part, of which only four are preserved. This sundial can be dated roughly to the Roman Naronitan period of prosperity in the 1st century.

The other sundial from Narona is exhibited within the permanent exhibition of the Archaeological Museum Narona, under the inventory number 796. The sundial has already been mentioned in literature but without detailed analysis (Marin 2003: 13). It is 33 cm in height, 20 cm wide and 15 cm in depth and weighs 10 kilograms. It is made of limestone and also belongs to the conical type of sundial. It was found not far from the city walls of Narona, during the construction of a school playground in 1990. It was found by a local resident of Vid, Ante Bukovac - Dumba, and the museum succeeded in purchasing it. At the place where the sundial was found was one of the Naronitan necropolis, and during the construction of the playground, according to local witnesses, many other grave accessories were found. Today, in the same place, the remains of a necropolis are visible. Next to the playground in the rock, there is a carved tomb and further on towards the north - west there is an urn carved in the rock and a rectangular podium for the tomb stele, also carved in the rock. Unfortunately, during this construction work, rescue excavations were not carried out, so that we do not have either the documentation or the preserved archaeological findings.

The sundial was carved in one piece of limestone, the spherical part of the dial has been well preserved and only a minor part of the left side is missing. All eleven lines are visible which denote the twelve daily hours, among which was the central one, the noon line, above which was a gnomon (shadow meter) which has not been preserved. A small rectangular hole can be clearly seen in which the gnomon would be inserted. The base of the sundial is rectangular and the steps to it are decorated and in its central part, the dial is decorated with two half - moon lines which are in juxtaposition. This sundial can also be dated to the development of Narona as an important urban centre, at the beginning of the 1st century.

Both sundials from Narona were found not far from the city walls, the explanation for which can be found in two assumptions. The first one is the fact that the whole area of the Neretva Valley was of great economic importance for Narona and there were probably many commercial objects of the type of *Villae Rusticae.* One such object was located immediately outside the city walls nearby where the sundial under inventory number 796 was found. Therefore, these sundials might have been part of the decoration of the outside of some of the Naronitan villas, and afterwards reached the places where they were found, in its immediate vicinity.

The second fact is that both sundials were found outside the city walls, in the area where Naronitan necropolis were located. The first sundial (inv.no.28) was found in the ruins of the former Church of Our Blessed Lady and the church was built on the top of a hill where at one time there were city gates from which the road lead to the north - west in the direction of *Bigeste* (Humac near Ljubuški), and next to it there was a necropolis. The place where the second sundial was found (inv.no. 796) was also a necropolis located near the city walls, and where in ancient times a road went towards the south, that is in the direction of the mouth of the River Neretva. The supposed area of the direction of the ancient road is today marshland so its route and remains, for now, are not possible to precisely locate.

Since in Roman times sundials were liked very much, especially this type which are small portable sundials, there is a possibility that these two Naronitan sundials were part of a decoration on a Roman grave, maybe even as part of the burial goods? Situations similar to this one can be found on the necropolis of ancient *Iader* (Zadar) in the suburb of Relja where one portable sundial was also found, and which as we have already mentioned, should be presented in the future. It is interesting that both Naronitan sundials were found outside the residential and public part of Narona, although in their function they should be connected with such places. Of course, finally only archaeological excavations of the above - mentioned necropolis remain, in order to obtain a possible answer to these and many other questions, which generally exist around the topography of Narona.

SAŽETAK

DVA SUNČANA SATA IZ NARONE

Vrijeme je nešto što okružuje čovjeka kao konstanta oduvijek i ono je prisutno stalno i svugdje. Sunčeva svijetlost je od vremena prvih civilizacija služila za računanje vremena uz pomoć sjene. U članku se donosi kratak pregled razvoja sunčanih satova i njihova tipologija, kao i razvoj astronomije, odnosno nove spoznaje o sunčanom sustavu i Zemlji.

U članku se opisuju dva manja sunčana sata koja su pronađena kao slučajni nalazi neposredno izvan bedema antičke Narone. Jedan od satova gotovo je u potpunosti sačuvan i uvršten je u stalni postav Arheološkog muzeja Narona. Drugi sat je fragmentiran s djelomično sačuvanim natpisom, a prepoznat je u mnoštvu kamenog materijala u muzejskoj čuvaonici prilikom prve revizije građe Arheološkog muzeja Narona. Navode se i analogije sa sličnim pronađenim sunčanim satovima kod nas i u susjednoj BiH.

Ključne riječi: vrijeme, sunčani sat, Narona, zemljopisna širina, nekropola

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