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## **Temporal Harmony: Integrating Circadian Rhythm, Byzantine Timekeeping, and Eastern Orthodox Monastic Practices**

### Abstract

The purpose of this paper is to investigate the connection between Eastern Orthodox monastic daily life, circadian rhythms, and Byzantine Timekeeping customs. The intention is to present how monastics manage their daily routine, which consists of worship, obedience, and rest, while navigating the quantitative progression of time (Chronos) and the qualitative (opportune) moments of divine presence (Kairos). The study uses a multidisciplinary approach to investigate how a monastic schedule, influenced by Byzantine Timekeeping, aligns with natural light and dark cycles. It received valuable data and insights from the fields of neuroscience, chronobiology, and theology. It also notes how artificial lighting affects circadian rhythms and sleep patterns, comparing these effects to those of using natural light sources like candlelight.

Keywords: Circadian Rhythms, Byzantine Timekeeping, Eastern Orthodox Monastic Practices, Chronos and Kairos, Artificial vs. Natural Lighting, Liturgical Schedules

### Introduction

For generations, monastics in the Eastern Orthodox tradition have linked their daily routines with the passage of time. They follow a set schedule for prayers, work, and rest, guided by the concepts of Kairos and Chronos, which represent different aspects of time. Kairos focuses on the quality of moments, while Chronos measures the quantity of time. This structured approach to timekeeping forms the backbone of monastic life, seamlessly integrating best spiritual practices in their daily activities.

This paper delves into the intricate relationship between circadian rhythm,<sup>1</sup> Byzantine Timekeeping,<sup>2</sup> and the daily lives of Eastern Orthodox monastics in a cenobitic setting. Drawing insights from fields such as neuroscience, chronobiology, and theology, our investigation aims at bringing to light how monastics navigate between the measured progression of time (Chronos) and the qualitative experiences of divine presence within the rhythm of their daily lives (Kairos).

Historically, monastic communities have followed, and most still do, a very disciplined schedule, meticulously divided between periods of prayer, work, and rest. The adoption of Byzantine Timekeeping practices, where the day and night are divided into twelve hours each, reflects a nuanced understanding of time that aligns with natural light-dark cycles. This division allows monastics to synchronize their daily and nightly activities with the flow of daylight, bringing a sense of a deeply balanced and rich harmony between their spiritual practices and the natural world.

Moreover, the adaptation of prayer schedules to seasonal variations, various geographical locations and different climates underscores the dynamic nature of monastic life. As the duration of daylight and night fluctuates throughout the year, monastics adjust their routines to maintain the balance between labor, contemplation, and rest, being deeply aware that they are acknowledging the cyclical rhythms of the created world. Through these adaptations, monastic communities not only affirm the interconnectedness of temporal and spiritual realities, but they embrace both the

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<sup>1</sup> “Circadian rhythms are the physical, mental, and behavioral changes an organism experiences over a 24-hour cycle. Light and dark have the biggest influence on circadian rhythms, but food intake, stress, physical activity, social environment, and temperature also affect them.” <https://www.nigms.nih.gov/education/fact-sheets/Pages/circadian-rhythms.aspx>, accessed on 4/25/2024.

<sup>2</sup> A unique method of timekeeping which was adopted, further developed, and used in the Byzantine Empire. Today it still survives in certain Eastern Orthodox monasteries, as well in some countries as a secondary timekeeping method.

structured progression of time and the opportune moments of Divine encounter. All of that within the walls of their monastery—true microcosm.

### Part 1: Historical Sleep Patterns and Circadian Rhythms

Before the widespread adoption of electricity, following the industrial revolution, historical evidence suggests that segmented or biphasic sleep patterns were common in various societies. The concept of “first sleep”, followed by a period of wakefulness, full alertness, then a “second sleep”, was prevalent in European and equatorial societies.<sup>3</sup> This biphasic sleep pattern, with a break in between two sleep periods, was considered “normal” before the advent of artificial lighting.<sup>4</sup> The absence of electric or artificial lighting allowed for more flexibility in sleep-wake patterns while some cultures incorporating noontime napping as part of their segmented sleep routines.<sup>5</sup>

Furthermore, research also indicates that the introduction of electricity and the subsequent availability of round-the-clock lighting have contributed to changes in sleep behaviors. The modern era, in which we live, is characterized by constant artificial lighting, and has led to a loss of the natural split-sleep pattern observed in preindustrial societies.<sup>6</sup> Studies have also shown that access to electricity can disrupt circadian rhythm, potentially leading to increased sleep deficiency.<sup>7</sup> The presence of electric lighting has been and still is, as we experience ourselves daily,

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<sup>3</sup> Cf. Nunn, C. L., Samson, D. R., & Krystal, A. D. (2016). Shining evolutionary light on human sleep and sleep disorders. *Evolution, Medicine, and Public Health*, 2016(1), pp. 227-243.

<sup>4</sup> Cf. Samson, D. R., Crittenden, A. N., Mabulla, I. A., Mabulla, A., & Nunn, C. L. (2017). Hadza sleep biology: evidence for flexible sleep-wake patterns in hunter-gatherers. *American Journal of Physical Anthropology*, 162(3), pp. 573-582.

<sup>5</sup> Ibid.

<sup>6</sup> Cf. Gooneratne, N. S. and Vitiello, M. V. (2014). Sleep in older adults. *Clinics in Geriatric Medicine*, 30(3), pp. 591-627.

<sup>7</sup> Cf. Knutson, K. L. (2013). Sleep duration, quality, and timing and their associations with age in a community without electricity in Haiti. *American Journal of Human Biology*, 26(1), pp. 80-86.

an interruption to our normal sleep schedules. From reading lights in the evening, to phones, blue light exposure, etc.

According to multiple studies, there is a significant correlation between exposure to artificial light, including electronic devices (i.e., phones, e-readers, tablets) and artificial outdoor lighting, and its impact on sleep patterns and circadian rhythms. Research has shown that exposure to short wavelength enriched light emitted by electronic devices mentioned above, can negatively affect sleep, circadian rhythm, and alertness following sleep completion the next day.<sup>8</sup> Artificial light exposure has been experimentally demonstrated to produce alerting effects, suppress melatonin,<sup>9</sup> and phase-shift the biological clock, leading to disruptions in sleep patterns.<sup>10</sup>

In monasteries, at least the ones which are somewhat more ascetic and stricter in observing the Typicon, you will find (almost) no artificial lighting in the church during services of Vespers, Compline, Midnight Office, and Matins (which are traditionally held from sundown to sunrise).<sup>11</sup> On the contrary, you will find candles and candlelight. Unlike electrical light, which is uncomfortable and difficult to look at, candlelight is very warm and gentle, and it fits properly with the spiritual significance and character of the nightly services.

Natural light, produced by a burning candle or a lampada, with its warm and somewhat dim, non-striking illumination,<sup>12</sup> has been traditionally used as a source of light in the evening and

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<sup>8</sup> Cf. Chang, A. M., Aeschbach, D., Duffy, J. F., & Czeisler, C. A. (2014). Evening use of light-emitting e-readers negatively affects sleep, circadian timing, and next-morning alertness. *Proceedings of the National Academy of Sciences*, 112(4), pp. 1232-1237.

<sup>9</sup> Melatonin is a hormone produced by the pineal gland (tiny organ near the center of the brain). Melatonin helps control the body's sleep cycle, and is an antioxidant. <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/melatonin>, accessed on 5/15/2024.

<sup>10</sup> Ibid.

<sup>11</sup> The only observable exception would be a small chandelier with artificial light over the chanters' stand.

<sup>12</sup> This is also true of the sunlight, for a brief period after the sunrise, and at sunset, because of its low angle/position on the horizon. At these two moments in the day, because of the specific position of the sun, the atmosphere acts as a filter that scatters shorter wavelengths of light (blue and violet) while not having proportional effect on the longer

nighttime hours, as mentioned above. While research specifically regarding candlelight is limited, studies on natural light exposure and its effects on sleep patterns and circadian rhythms provide insights into the potential impact of candle light on sleep quality. Exposure to natural light, including the warm glow of candlelight, can have a calming effect on the body and mind, promoting relaxation and signaling the onset of the evening and night rest period. Natural light exposure, particularly in the evening, has been associated with the regulation of circadian rhythms and the synchronization of the internal biological clock to the external environment.<sup>13</sup>

The use of natural light sources, such as candlelight, in the evening may help mimic the gradual decrease in light intensity that occurs in nature as the day transitions into night. This gradual decrease in light exposure can and does signal the body to initiate the production of melatonin, a hormone that regulates sleep-wake cycles, and prepares us for restful sleep.<sup>14 15</sup> By the same logic, it may serve the opposite role of slowly and gently permitting adjustment to light intensity as the day is about to break after long nightly services.<sup>16</sup>

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wavelengths (red and yellow). This effect is especially pronounced when the sun is low on the horizon, reducing the overall intensity and making the sunlight appear redder and dimmer. Looking at a candle, similar spectral composition can be observed, in that light produced by a candle consists of longer wavelengths (red and yellow). For further reading see: McNesby, K. L., & Dever, J. A. (2000). The Science of Candle Flames. *American Scientist*, 88(5), pp. 404-410, and: Young, A. T. (1982). Rayleigh Scattering. *Physics Today*, 35(1), pp. 42-48.

<sup>13</sup> Cf. Wright, K. P., McHill, A. W., Birks, B. R., Griffin, B. R., Rusterholz, T., & Chinoy, E. D. (2013). Entrainment of the human circadian clock to the natural light-dark cycle. *Current Biology*, 23(16), pp. 1554-1558.

<sup>14</sup> Cf. Zee, P. C., Attarian, H., & Videnović, A. (2013). Circadian rhythm abnormalities. *CONTINUUM: Lifelong Learning in Neurology*, 19(1), pp. 132-147.

<sup>15</sup> What also may contribute to the production of melatonin is practicing intentional silence before going to sleep. By keeping intentional silence, the mind is calmed down, and stress levels are reduced. Observing a quiet and peaceful environment (externally and internally) before bedtime signals to the body that it's time to wind down and prepare for sleep. We find evidence of this in the pre-Nikonian Great Horologion, at the end of the Great Compline, where the first portion of instructions clearly state that following the service, "monks will retreat to their cells in complete silence [...] fall asleep, so that they can rise for the church rule." In current practice, we find several options among various editions: some will include Prayer of Forgiveness combined with a litany at the very end of the Compline, and some will simply include Prayers Before Sleep.

For an example of the instructions from the pre-Nikonian reform period, see: Часослов. Вильно, 1772 г., репринтное издание [1652 г.], p. 29., [http://www.churchslavonic.net/5\\_public/chasoslov/Chasoslov\\_Vilno\\_1772g.pdf](http://www.churchslavonic.net/5_public/chasoslov/Chasoslov_Vilno_1772g.pdf), accessed on 5/27/2024.

<sup>16</sup> In the Eastern Orthodox tradition, the service of Matins, often (in monastic setting almost exclusively) celebrated just before or at daybreak, holds special significance, particularly on days which have the polyeleos rank. During the

The circadian rhythm, which governs the body's internal clock and regulates various physiological processes, such as awake and sleep times, among others, plays a crucial role in our daily lives, and even more so in the lives of cenobitic monasteries. Monastic communities have been studied to better understand how their circadian rhythms adapt to unique sleep patterns influenced by very specific schedules of services throughout the day and night. The studies have shed light on how the circadian core body temperature rhythm and sleep adapt in response to split sleep schedules. The same study also suggests that the human clock adapts to and even anticipates nocturnal awakening, which is significant to the continuation of our study.<sup>17</sup>

In conclusion to the first part of this paper, we can say biphasic sleep, observed in various cultures, allowed for flexibility, and even incorporated midday naps.<sup>18</sup> However, with the introduction of artificial lighting, and with the widespread adoption of electricity, a change occurred. Modern(ized) lifestyles, characterized by constant exposure to artificial light from devices and indoor lighting, have disrupted traditional sleep patterns and circadian rhythms.<sup>19</sup> Furthermore, studies on monastic communities in particular shed light on how unique sleep schedules influence circadian rhythm, and emphasize the body's remarkable ability to adapt to

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service, beeswax candles on a large chandelier in the center of the nave are lit and gently swing during the chanting of the psalms (Pss. 134, 135). The gentle interplay of candlelight and the movement of the chandelier causes the gold leaf halos of the saints depicted in the frescoes to glow and radiate, an effect which is impossible to replicate with artificial lighting. This creates an captivating visual effect where the saints' halos appear to come to life, leading to the feeling of the awakening and movement of the entire church building, echoing the words of the Christ, recorded in the Gospel of Luke: "And he answered and said unto them, I tell you that, if these should hold their peace, the stones would immediately cry out" (Lk 19:40), and of prophet Habakkuk: "For the stone shall cry out of the wall, and the beam out of the timber shall answer it" (Habakkuk 2:11). This "gentle light" of the candles and their movement fills the entire space with a sense of life, marking not only the dawn of a new day but also the mystical unity of heaven and earth, the divine and the human.

<sup>17</sup> Cf. Arnulf, I., Brion, A., & Pottier, M. (2011). Ring the bell for matins: circadian adaptation to split sleep by cloistered monks and nuns. *Chronobiology International*, 28(10), pp. 930-941.

<sup>18</sup> A period of afternoon *siesta* in Italy, Spain, and other Mediterranean countries.

<sup>19</sup> Tangentially related, but worth mentioning are also the studies which observed soldiers' sleeping patterns and circadian rhythms in both peace (training) and combat (war) situations. What the studies discovered was that soldiers would adapt their sleep patterns by taking "strategic naps" in order to ensure continuous vigilance and mission readiness. For further reading and research see Rosekind, MR et al. Alertness management: strategic naps in operational settings. *Journal of Sleep Research*, vol. 4, S2 (1995), pp. 62-66.

night awakenings for liturgical services and prayer. This underscores the importance of considering the role of light, both artificial and natural, in shaping our sleep patterns and overall well-being, and provides strong suggestions regarding the type of illumination that would be most appropriate for monastic settings, if not in wider parish usage.

## Part 2: Byzantine Timekeeping and its Influence on Monastic Daily Life

Before embarking any further on our journey, there is one question that needs answering first. That question is: what is time? Time is a fundamental concept of the created world, a created reality, as old (or as new) as the universe itself. It encompasses the measurement of temporal intervals, the sequencing of events, and the perception of duration. It is simultaneously linear (events unfold sequentially, with each moment following the one before it in a “straight line”, from past to present to future) and cyclic (as we can observe it on a calendar, with patterns of recurrences and repetitions).

The movements of celestial bodies, such as stars, constellations, planets, have long been used to measure and define time. Ancient civilizations, such as Egyptians and Mayans, observed the cycles of the sun, moon, and other stars to create calendars and understand the passage of time, as measured in days, months, and years. These observations of rhythms of celestial entities provided a very reliable foundation for agriculture, different rituals, as well as for social events. For example, the ancient Egyptians developed a calendar based on the annual flooding of the Nile,<sup>20</sup> while the Mayans created a complex system of interlocking calendars that could predict

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<sup>20</sup> For further reading, see: The Oxford Handbook of Egyptology. Oxford University Press, 2020.

astronomical events with a high degree of accuracy.<sup>21</sup> In essence, the heavens served as a cosmic clock, guiding human life and activities.

Time, as mentioned above, is a created reality, as depicted in the biblical account of Genesis. According to this narrative, God established the foundations of time by separating light from darkness and instituting the cycles of day and night. This divine “orchestration” emphasizes the concept of time as an ordered and purposeful construct, integral to the very basic structure of the universe, the cosmos. Unlike the eternal God, time in this context is a finite, measurable dimension that governs the temporal existence of creation. This distinction between the Creator and the created order highlights the unique nature of time.

Byzantine Timekeeping, a distinctive system further developed during the Byzantine Empire from past traditions, is characterized by its method of measuring hours, as well as its ecclesiastical or liturgical applications. This system of timekeeping divided the day and night into 12-hour halves, distinctly wherein the length of hour varies according to daily calculation based on the exact time of sunset and sunrise.<sup>22</sup> The Egyptians had initially developed the concept of dividing daylight and nighttime into 12 hours each, an idea which the Romans later adopted, developed, and adapted. In the Byzantine system, the day began precisely at sundown, marking 00:00 hours, and this timing was meticulously observed to align with the natural rhythm of the day-night cycle.<sup>23</sup>

Therefore, unlike our modern, fixed 60-minute hour, a Byzantine hour is free of that constraint and varies daily. During longer summer days, daytime hours were longer than nighttime

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<sup>21</sup> For further reading, see: *The Mayan and Other Ancient Calendars*. Geoff Stray. Bloomsbury Pub Plc USA, 2007.

<sup>22</sup> For mathematical calculations and practical examples, see Appendix 1.

<sup>23</sup> Byzantine clockface (with liturgical annotations) is provided in Appendix 2.



hours, and conversely, during wintertime, nighttime hours were longer. This method, influenced by earlier Greek practices, was adapted to suit the liturgical needs of the Orthodox Church. It became integral to monastic life, dictating the schedule of liturgical services, rest, and daily routines.<sup>24</sup> In retrospect, the origins of this unique type of timekeeping, traced back to the blending of Egyptian, Roman, and Greek astronomical knowledge, reflect positively on the Empire's ability to integrate elements of various cultures into one cohesive whole.

Byzantine Timekeeping was, and still is, essential for the Eastern Orthodox Church and her liturgical services, as it provides a structured daily framework for a monastic community. The system's division of day and night into variable-length hours allows for precise timing of services and other activities that are aligned with the natural rhythms of light and darkness. Monasteries and churches relied on this timekeeping method to organize the complete liturgical schedule, ensuring that these occurred at the appropriate times each day.<sup>25</sup> This synchronization with the natural environment not only reinforces the spiritual discipline of the monastics, but it also fosters a sense of natural order and regularity. Byzantine Timekeeping emphasizes the integration of human life with the divine order, reflecting a worldview where temporal activities were in close

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<sup>24</sup> For a proposed schedule of liturgical services, in accordance with the Byzantine Timekeeping calculations, see Appendix 3.

<sup>25</sup> In relation to Byzantine Timekeeping and the division of night and daytime into twelve uneven hours, it is worth noting that manuscripts and older (not current) editions of the Menaion often contained information regarding the duration of day and night at the beginning of the book (for each month). Interestingly, this information was also transferred (by copying) to certain other liturgical books, such as the *Sticherologion*, a type of liturgical (music) book used in the Eastern Orthodox Church that contains the texts for the stichera. For instance, the Slavic *Sticherarium* manuscript I was researching includes information at the beginning of the month of December: the number of days, and the respective durations of day and night: "Month of December, which is also said to be cold (one), has 31 days. Day has 9 hours, and night 15" (p. 59r). See: *Sticherarium Palaeoslavicum Petropolitanum. Codex Palaeoslavicus no. 34.7.6. Bibliothecae Academiae Scientiarum Rossicae*, edited by Dr. Nicolas Schidlovsky, Munksgaard, 2000.

Source: <https://ia601702.us.archive.org/2/items/Monumenta-Musicae-Byzantinae/MMB%2012%20Sticherarium%20Paleoslavicum%20Petropolitanum.pdf>, accessed on 5/11/2024.

Further research into when the above-mentioned practice of including the duration of day and night in Menaion and other liturgical books (such as the above-mentioned *Sticherarium*) changed (as the information is not provided in modern translations and editions in English language, however it can still be found in some modern Greek editions) is needed.

harmony with one's spiritual life. Interestingly, today, the same timekeeping model is held by several monasteries on Mount Athos, such as St. Panteleimon Monastery, and similar timekeeping system is used in Ethiopia, where the Ethiopian Orthodox Tewahedo Church adheres to a timekeeping tradition that aligns closely with the ancient Byzantine model. This continuity highlights the enduring influence of Byzantine practices on contemporary liturgical life in certain regions.

In philosophical and theological discussions, time is often categorized into two distinct concepts: *Kairos* (καιρός) and *Chronos* (χρόνος). Chronos refers to chronological or sequential time, the linear progression measured by clocks and calendars. It encompasses the **quantitative** aspect of time, where moments follow one another in a fixed order. Kairos, however, denotes a **qualitative** dimension of time, characterized by the right/opportune/appropriate moment. It is a time of significance and opportunity, a blessed moment.<sup>26 27</sup>

Eastern Orthodox services, especially at the monasteries where a full-fledged Typicon is observed, are traditionally longer during the night and morning and grow shorter as the day progresses, in part due to both spiritual, as well as practical considerations. One of the key reasons

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<sup>26</sup> Just before the beginning of the Divine Liturgy, a deacon, asking blessing from the priest, will say/exclaim: "It is time for the Lord to act. Master, bless." Furthermore, if we take a look at the third chapter of the Book of Ecclesiastes, English translation reads the following: "To everything there is a season, and a time for every matter under the heaven: ...". The wording here, as translated is not accurate, because it uses word "time", in the sense of chronos. However, if we look at the Septuagint translation, we see the following: "ΤΟΙΣ πᾶσι χρόνος καὶ καιρὸς τῷ παντὶ πράγματι ὑπὸ τὸν οὐρανόν. 2 καιρὸς τοῦ τεκεῖν καὶ καιρὸς τοῦ ἀποθανεῖν, καιρὸς τοῦ φυτεῦσαι καὶ καιρὸς τοῦ ἐκτίλαι τὸ πεφυτευμένον, ...". It's about a moment, and that moment has "divine perfection" in it; it is not forced, it simply IS.

<sup>27</sup> Eternity, on the other hand, is conceived and understood as an above-the-time reality, transcending the limitations of temporal existence. Unlike time, which is marked by succession, change and cycles, eternity is a state of perpetual presence, where past, present, and future are unified. This concept is central not only to the Eastern Orthodox, but to many religious and philosophical traditions, where it often represents the ultimate reality or the divine nature. In Orthodoxy, eternity is associated with God's existence not bound by finity and time, contrasting the finite and transient nature of the created world. This perspective truly does put into perspective the understanding of ultimate destiny and purpose of human life, which brings us to eschatological perspective which emphasizes the directional and end-goal-oriented nature of time, moving not towards a place, but a state. The anticipation of eschaton shapes our practices and beliefs, offering hope, but also a warning. Time is not an endless cycle but a purposeful journey towards a divinely-ordained conclusion. Or a beginning. Or simply put: the divine NOW.

for this is the monastic origin of many of the liturgical practices, where the early hours of the “day”<sup>28</sup> were seen as especially conducive to prayer, listening, and contemplation. The night and morning hours, beginning with the Compline, followed by sleep, and continuing with Midnight Office, which is again followed by sleep/rest, and again continued with Matins<sup>29</sup> and the Divine Liturgy,<sup>30</sup> are considered “prime time” for engaging in extended liturgical services, readings, listening, reflecting the tranquility and renewal that follows sleep. These early hours are viewed as spiritually significant,<sup>31</sup> symbolizing the expectation of Christ the Bridegroom, but also of His Resurrection.

From a practical standpoint, the human attention span and cognitive function do tend to be sharper in the morning after rest, which may have contributed to the tradition of holding longer, more involved services during these times. Our fathers knew this millennia ago, yet we still somehow manage to re-discover or re-invent it and claim it as our own. It’s a tradition as old as monastic life, if not older, and we inherit it, but do not fully appreciate or treasure or practice it. This understanding aligns with the one saying that individuals are more focused and receptive after a night’s sleep, making the morning hours ideal for intensive spiritual labor and conscious and active (physical and mental/noetic) participation in liturgical services. Throughout the day, monastics typically engage in various obediences, activities which lead to both physical and mental fatigue, causing for shorter, more practically bearable services as the day progresses.

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<sup>28</sup> Meaning just after midnight in contemporary understanding of time.

<sup>29</sup> Greek name for Matins is ὄρθρος, which, in translation, means the time just after rising (standing up) from sleep, at or around the break of dawn (sunrise). This further supports the theory of the biphasic sleep pattern.

<sup>30</sup> In most monasteries, Hours (I-III-VI) will usually precede the daily celebration of Divine Liturgy, however, an argument can be made for those to be placed at their appropriate and corresponding time of the day.

<sup>31</sup> “Behold, the Bridegroom comes at midnight, and blessed is the servant whom He shall find watching; and again, unworthy is the servant whom He shall find heedless. Beware, therefore, O my soul, do not be weighed down with sleep, lest you be given up to death and lest you be shut out of the Kingdom. But rouse yourself crying: Holy, Holy, Holy, are You, O our God! Through the Theotokos have mercy on us!” *Troparion* following the *Alleluia* at the Matins of the first three days of the Passion Week (“The Bridegroom Matins”).

Furthermore, the rhythm of longer liturgical services in the early hours followed by shorter ones throughout the day supports a balanced approach to spiritual and daily life of obedience and labor.<sup>32</sup> This structure allows monastics to dedicate substantial time to communal worship at the start of the day while accommodating the practical needs and responsibilities that arise as the day unfolds. This thoughtful arrangement ensures that liturgical, communal worship, remains a central part of daily life without overwhelming the practical aspects of obedience and labor.<sup>33</sup> So, the pattern of service lengths in the Eastern Orthodox tradition is both a reflection of spiritual priorities and a pragmatic and practical response to human nature and daily rhythms.

Monastics, who almost exclusively rely on either the ringing of the church bells or some other traditional methods of sound that announces either the beginning of liturgical services or the wake-up call/time, experience a unique liberty from the need to constantly, if not obsessively, check the time. This “liberation” offers significant benefits for their physical, mental, as well as

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<sup>32</sup> The duration of services also changes in synchrony with seasons and cycles of the (Church) calendar and the time of the year. For example, during the season of Great Lent, kathismata are added to the Hours, as well as to Matins, etc. Also, certain times of the year (winter vs. summer) have added or lessened number of the kathismata in the Matins (3 in wintertime when night is longer, and 2 in the summertime when night is shorter).

<sup>33</sup> Another important aspect of monastic life, whether during day or night, is the Prayer Rule (also known as the cell or kellia rule). The Prayer Rule each monastic receives differs, according to the judgment of one’s spiritual father and his assessment of one monk/nun’s spiritual state and readiness. It typically encompasses several various prayer rope intercessions or prayers (Jesus Prayer, prayer to a specific saint, or to the guardian angel) accompanied by different types and numbers of prostrations, along with assigned Psalter and other Scripture readings (e.g. a pericope from the Gospels and a section from Acts of the Apostles or the Epistles). Furthermore, a specific time for when the Prayer Rule is supposed to take place during the day or night is not prescribed in modern practice, as the emphasis is more on the regularity and consistency of the prayer rule rather than a specific time of day. There is evidence, however, such as the pre-Nikonian Great Horologion, which clearly states that following the Great Compline monks are to retreat to their kellias in complete silence, do the prayer rule and fall asleep, so that they could rise for church rule. See footnote 12 above for more detail and source text. More extensive research is needed regarding this specific text from the Horologion and how it changed since the Nikonian reform. In addition to all this, it is worth mentioning that here also existed an ancient monastic practice called the Twelve Nightly Prayers (as well as Twelve Diurnal Prayers, for a total of Twenty-four). These prayers were relatively short and involved the recitation of a prescribed set of psalms followed by prayers and/or hymnography throughout the night (or day, for Twelve Diurnal Prayers) to encourage ceaseless prayer (and vigil). Now, whether this was part of every monk or nun’s prayer rule, as we understand it today, is not completely clear and warrants further research. The topic of nightly and diurnal prayers is currently being researched by Aleksandr Andreev (University of Oslo) and Hieromonk Dalmat Yudin (Moscow Theological Academy). For further reading and research see: Andreev, A. Prayers in the Byzantine 24-Psalms Horologion: Patristic Sources, Liturgical Function. [Paper delivered at the Ninth International Congress of the Society of Oriental Liturgy, May 26–31, 2024, Catholic University of America, Washington, DC]

spiritual well-being. Freed from the constraints of constant clock-watching, depending on the ring of the bell, monastics immerse themselves fully in the present moment, attuned to the rhythms of obedience, prayer, and rest, as set by the monastery's schedule. This absolute immersion into the moment of things, rendering linear time almost useless, enables them to attune their current activity (prayer, work, rest) with their natural biological rhythms, reducing stress and promoting a sense of inner peace, to the extent possible. Moreover, by surrendering the need for constant monitoring of time, monastics develop, and are encouraged to cultivate, a deeper awareness of the timeless nature of spiritual life, where the eternal present transcends the constraints of past and future.

### Conclusion

In conclusion, the relations and interplay between the human circadian rhythms, Byzantine Timekeeping, and the daily schedules of Eastern Orthodox monastics reveals a beautiful, rich harmony between temporal and spiritual realities. Monastics, by aligning structured time divisions with natural light-dark cycles, immerse themselves in a well-rounded rhythm that reflects both the quantitative progression of Chronos and the qualitative moments of Kairos. The adaptation of the Typicon, liturgical and prayer schedules to seasonal variations emphasizes the dynamic nature of monastic life, where the flow of daylight and darkness guides the rhythm of communal worship and daily activities.

Through historical and scientific exploration, we “brought into light” the impact of artificial lighting on sleep patterns and circadian rhythms, which highlighted the importance of natural light sources, such as candlelight, in maintaining harmony with the body's natural rhythms.

The use of natural light promotes gentleness, silence,<sup>34</sup> regulates circadian rhythms, and fosters a sense of connection with the divine order of things.

Furthermore, Byzantine Timekeeping provides structure to monastic life, integrating all activities with the natural flow of day and night. The division of time into variable-length hours ensures precise timing of liturgical services, and brings a sense of spiritual discipline and order within a monastic community/monastery. The tradition of longer liturgical services in the early hours, followed by shorter ones throughout the day, reflects a balanced approach to spiritual and practical aspects of monastic life. Most notable, however, is the liberation from constant clock-watching, allowing monastics to immerse themselves fully in the present moment, in synchrony with the rhythm of obedience, prayer, and much needed rest.

In essence, the integration of circadian rhythms, Byzantine Timekeeping, and monastic Typicon reveals a profound truth: that the harmony between temporal and spiritual realities is not only achievable but essential for all-around monastic well-being. As we continue to explore this rich harmony, we are reminded of timeless wisdom that transcends the constraints of past and future, guiding us toward a fuller understanding of our place within the cosmos. One can hope that this paper was a prayerful illumination.

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<sup>34</sup> “O gladsome Light of the holy glory of the Immortal Father, the Heavenly, the Holy, the Blessed, O Jesus Christ, ...” From the hymn “O gladsome Light”, chanted/read daily at the Eastern Orthodox service of Vespers. This service, performed at sundown, also marks the beginning of the new day.

Appendix 1

**Byzantine time – practical calculation examples  
WINTER**

Sunset: 4:30pm (16:30)

Sunrise: 7:00am (07:00)

Nighttime: 4:30 PM to 7:00 AM = 14 hours 30 minutes = 870 minutes

Daylight: 7:00 AM to 4:30 PM = 9 hours 30 minutes = 570 minutes

Nighttime Hour:  $\frac{870}{12} = 72.5$  minutes

Daytime Hour:  $\frac{570}{12} = 47.5$  minutes

**Civilian Time                      Byzantine Time**

4:30 PM                      00:00 ☽

5:42 PM                      01:00

6:54 PM                      02:00

8:06 PM                      03:00

9:18 PM                      04:00

10:30 PM                      05:00

11:42 PM                      06:00

12:54 AM                      07:00

2:06 AM                      08:00

3:18 AM                      09:00

4:30 AM                      10:00

5:42 AM                      11:00

6:54 AM                      12:00

7:00 AM                      00:00 ☀

7:47 AM                      01:00

8:35 AM                      02:00

9:22 AM                      03:00

10:10 AM                      04:00

10:57 AM                      05:00

11:45 AM                      06:00

12:32 PM                      07:00

1:20 PM                      08:00

2:07 PM                      09:00

2:55 PM                      10:00

3:42 PM                      11:00

4:30 PM                      12:00

## SUMMER

Sunset: 8:30pm (20:30)

Sunrise: 5:30am (05:30)

Nighttime: 8:30 PM to 5:30 AM = 9 hours = 540 minutes

Daylight: 5:30 AM to 8:30 PM = 15 hours = 900 minutes

Nighttime Hour:  $\frac{540}{12} = 45$  minutes

Daytime Hour:  $\frac{900}{12} = 75$  minutes

### Civilian Time

### Byzantine Time

8:30 PM 00:00 ☾

9:15 PM 01:00

10:00 PM 02:00

10:45 PM 03:00

11:30 PM 04:00

12:15 AM 05:00

1:00 AM 06:00

1:45 AM 07:00

2:30 AM 08:00

3:15 AM 09:00

4:00 AM 10:00

4:45 AM 11:00

5:30 AM 12:00

5:30 AM 00:00 ☀

6:45 AM 01:00

8:00 AM 02:00

9:15 AM 03:00

10:30 AM 04:00

11:45 AM 05:00

1:00 PM 06:00

2:15 PM 07:00

3:30 PM 08:00

4:45 PM 09:00

6:00 PM 10:00

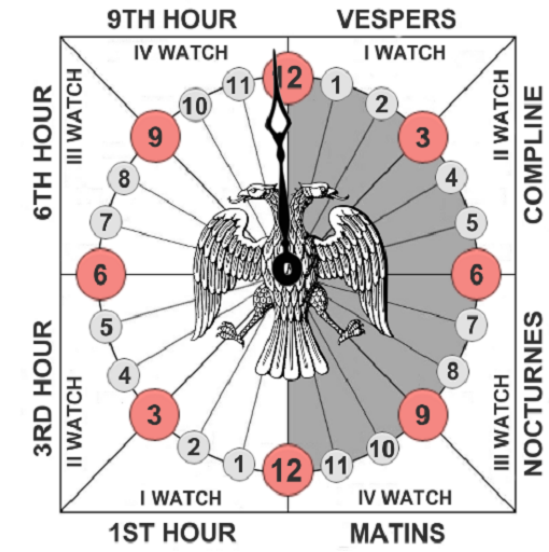
7:15 PM 11:00

8:30 PM 12:00



## Appendix 2

### Example of the Byzantine Clockface with liturgical annotations



This infographic is used with the author's<sup>35</sup> permission exclusively for this academic paper.

In calculations of byzantine and civilian times for the services in Appendix 3, this infographic was used as a guide (e.g., Compline should fall sometime between the 3<sup>rd</sup> and 6<sup>th</sup> hour of the night, during the 2<sup>nd</sup> watch, etc.). All calculations provided are a close approximation, since the actual time(s) will slightly adjust daily, with exact sunset and sunrise times.

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<sup>35</sup> The Byzantine Timepiece.

### Appendix 3

#### **Sample of the daily liturgical services schedule**

##### **WINTER**

<b>Service</b>	<b>Byzantine Time</b>	<b>Civilian Time</b>	
Vespers	Near 00:00 of night	4:00pm	(~4:00pm)
Compline	03:00 of night	8:07pm	(~8:00pm)
Midnight Office	06:00 of night	11:45pm	(~11:45pm)
Matins *	11:00 of night	5:07am	(~5:00am)
1st Hour	00:00 of day	7:00am	(~7:00am)
Divine Liturgy	00:12 of day	7:10am	(~7:15am)
3rd Hour **	03:00 of day	8:35am	(~8:30am)
6th Hour **	06:00 of day	10:57am	(~11:00am)
9th Hour	09:00 of day	1:20pm	(~1:15pm)

##### **SUMMER**

<b>Service</b>	<b>Byzantine Time</b>	<b>Civilian Time</b>	
Vespers	Near 00:00 of night	8:00pm	(~8:00pm)
Compline	03:00 of night	10:45pm	(~10:45pm)
Midnight Office	06:00 of night	1:00am	(~1:00am)
Matins *	10:00 of night	4:00am	(~4:00am)
1st Hour	00:00 of day	5:30am	(~5:30am)
Divine Liturgy	00:13 of day	5:40am	(~5:45am)
3rd Hour **	03:00 of day	8:00am	(~8:00am)
6th Hour **	06:00 of day	11:45am	(~11:45am)
9th Hour	09:00 of day	3:30pm	(~3:30pm)

\* Variations within specific service timeframe are permissible, even encouraged, in creating a well-balanced schedule (e.g. if there is a need to group any two adjacent services closer together for a valid reason, or certain specific need).

\*\* For the 3<sup>rd</sup> and 6<sup>th</sup> Hours, in order to not disrupt the obedience schedule, it may be blessed by the abbot/abbess to have these services performed by a hieromonk and a reader (monastic), without the presence of the brotherhood. Bells should still announce the services.

*N. B.* Monastic Prayer Rule, as mentioned previously, is not fixed to a specific time of day or night in contemporary practice, hence it is not included in the sample schedule provided here.