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MILUTIN MILANKOVIĆ AND THE REFORM OF THE JULIAN CALENDAR IN 1923

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Abstract: At the Orthodox Church Ecumenical Congress of 1923 in Constantinople one of the important questions discussed was the Julian Calendar reform. In the delegation of the Serbian Orthodox Church was the accomplished Serbian geophysicist and astronomer Milutin Milanković (1879–1958), who played a critical role in the proceedings, and whose proposition for calendar reform was adopted. The issues relating to that proposal are discussed here, along with a short history of Milutin Milanković and his work.

Key words: History of astronomy, Milutin Milanković, calendar reform, Julian Calendar, Orthodox Church

1 INTRODUCTION

Patriarch Meletios IV (1922–1923), head of the Orthodox Churches, convened an Ecumenical Congress in Constantinople in May 1923, where one of the principal topics of discussion was the reform of the Julian Calendar. In the Serbian delegation were Gavrilo Dožić and Milutin Milanković. At the time, Dožić was the Metropolitan of Crna Gora and Primorje (Montenegro and the Littoral), and later became Patriarch of the Serbian Orthodox Church. Milutin Milanković (Figure 1) had been a very successful civil engineer before accepting the Chair of Applied Mathematics at the University in Belgrade in 1909. From this point on, Milanković applied himself to the study of climatic change due to thermal heating by solar radiation. He developed an astronomical theory for the evolution of planetary climates and explained the phenomenon of the Earth's Ice Ages and polar motion. One of his contributions was his analysis of the Earth's period of rotation, which resulted in his proposal at the Congress in Constantinople to reform the Julian Calendar.

We will first present Milutin Milanković's principal scientific results, before discussing the reform of the Julian Calendar at the Congress in Constantinople of 1923 and his contribution to it.

2 MILUTIN MILANKOVIĆ

Milutin Milanković, who was born in Dalj on 28 May 1879 and died in Belgrade on 12 December 1958, is best known for his ground-breaking work on the causal relationship of solar heating to the phenomena of the Ice Ages. He graduated from the Vienna University of Technology with a degree in civil engineering (1902) and a Ph.D. in technical sciences (1904), and remained there for five years designing dams, bridges and viaducts. In 1909, he was offered the Chair in Applied Mathematics at Belgrade University, and he relocated to Serbia where he taught mechanical and theoretical physics and celestial mechanics.

Milanković began occupying himself with the astronomical origins of planetary climate changes and the mathematical theory of climate. In 1912, he published *A Contribution to the Mathematical Theory of Climate*; in 1913, *On the Application of the Mathematical Theory of Warmth Transmission to the Problems of Cosmic Physics*; and in 1916, *Investigation on the Climate of Mars.*

Figure 1: Milutin Milanković, 1879–1958 (after Pantić, 2001: 171).

In his *Mathematical Theory of the Thermal Phenomena Caused by the Solar Radiation* Milanković (1920) developed a theory based on the principles of celestial mechanics and theoretical physics which explained the distribution of solar radiation throughout interplanetary space and over the planetary surfaces. He indicated also the connection between the insolation (i.e. incoming solar radiation) and the temperature of the planetary layers, and he determined

daily, annual and secular changes in the insolation. In 1926 he published the research paper titled "Investigation in the thermic constitution of the planetary atmospheres." In all of these works he devoted particular attention to the climate of Mars, establishing beyond doubt the mean annual temperature on the planet's surface to be about -17^{o} C.

In his foremost work, *Kanon der Erdbestrahlung und seine Anwendung auf das Eiszeitenproblem* (*The Canon of the Earth's Insolation and its Application to the Ice Ages Problem*) which was published in 1941, Milanković collected the results of his 28 previously-published researches and assembled them in one monograph. He added new analyses and supplements, including numerous applications of his theory, demonstrating that long-period cyclical changes in the Earth's climate and the occurrence of Ice Ages were associated with the following causes:

(1) Changes in the Earth's axis of inclination between 22^{o} and 24.5^{o} with a 41,000-year period, as a result of which the insolation at any particular point on the Earth's surface also undergoes change.
(2) Changes in the eccentricity of the Earth's orbit around the Sun, with a 100,000-year period, bringing about changes in the Earth's distance from the Sun, which in turn give rise to changes in the duration of the seasons.
(3) Polar precession, causing the point of the winter solstice to be shifted along the Sun's annual apparent path, affecting the duration of the seasons with a period of 22,000 years.

In order to solve the problem of the occurrence of the Ice Ages in Europe during the Quaternary Period, in 1932 Milanković arrived at his famous differential equation of the Earth's polar motion (Milanković, 1933). He found that some 300 million years ago, the Earth's North Pole was in the Pacific Ocean at $+20^{o}$ latitude and 168^{o} E longitude. At present, the North Pole is moving towards its equilibrium point in Siberia, near the location where the Pechora River flows into the Arctic Ocean. Today we know that this is a consequence of the movement of the continental plates.

Milanković paid considerable attention to the history of science. In his *Memories, Experiences, Insights* (Milanković, 1997) he points out that: "Any science may be comprehended in its fullness only after one gets acquainted with its origins and its gradual development." He then describes how for him the history of science became the most magnificent part of the entire history of humanity. In his book *Techniques during the Remote Centuries*, Milanković (1955) states with regret that "While the works on the world history might fill a large library, the most important works on the history of Mathematics, Astronomy and Physics might be well stored in any personal library."

Milutin Milanković was the Vice-president of the Serbian Academy of Sciences and Arts and from 1948 to 1951 Director of the Belgrade Astronomical Observatory. To honor his scientific achievements in astronomy, a crater on the far side of the Moon (coordinates $+170^{o}$, $+77^{o}$) was given his name at the 14th I.A.U. General Assembly in Brighton in 1970. His name was also given to a crater on Mars (coordinates $+147^{o}$, $+55^{o}$) at the 15th I.A.U. General Assembly in Sydney in 1973. In 1982, a minor planet discovered in 1930 by Milorad Protić and Pero Djurković and provisionally designated 1936 GA, received its permanent name, 1605 Milanković (Dimitrijević, 2002).

3 CALENDAR REFORM AND THE PANORTHODOX CONGRESS IN CONSTANTINOPLE IN 1923

At the First Council of Nicea (A.D. 325), the Christian Church adopted the Julian calendar, introduced by Julius Caesar in 47 B.C. In this calendar, leap years occur every fourth year, provided the numerals of that year are divisible by four. Although this system was a very good approximation to the natural cycle, its year was over eleven minutes longer than the tropical year. By the sixteenth century, the accumulated time difference reached ten days.

On 24 February 1582, Pope Gregorius XIII commanded the introduction of the following reforms: (i) the accumulated discrepancy would be eliminated by making the day after 4 October the 15^{th} of October 1582; (ii) the only secular leap years would be those where the number of the centuries is divisible by four.

The Eastern Orthodox Churches, not wanting to follow the dictates of the Catholic Church, chose to retain the Julian calendar. By the twentieth century, the discrepancy between the two calendars had grown to thirteen days.

At the Ecumenical Congress of Orthodox Churches of 1923 in Constantinople, one of the important questions was the reform of the Julian calendar, and representatives of the Serbian and Romanian Orthodox Churches submitted two elaborate propositions (a detailed description of the calendar reform and of the Pan Orthodox Congress in Constantinople is given in Milanković, 1923; 1995; 1997; see, also, Dimitrijević, 2002 and Dimitrijević and Theodossiou, 2002). The Serbian delegation came to the Congress with a proposition for calendar reform authored by Maksim Trpković. He proposed the intercalation rule that the secular years in centuries which when divided by 9 have remainders of 0 or 4 will be leap years. In such a way seven days will be omitted from nine centuries, so that the calendar will be closer to the tropical year than the Gregorian calendar, and the vernal equinox will always fall on 21 March or very close to it.

The Romanian delegation consisted of Archimandrite Julius Scriban and Senator Dragici. They came with the following proposal for calendar reform: each year is to have 364 days (exactly 52 weeks) so that every date has a fixed day in the week. March, June, September and December have 31 days, and the other months 30 days. An additional week is added every five years between 31 June and 1 July, whose number of days corrects the difference with the tropical year. The first day of Easter is fixed at 29 April, and all other holidays become fixed. Senator Dragici presented the unsigned proposition to the Congress as his, but he told Milanković that the author was actually Baron Bedeus from Sibiu. The Baron was not an Orthodox Christian, so it was inappropriate that his name should appear on the proposal.

A scientific commission comprising Milutin Milankovic, Senator Dragici and Archimandrite Scriban was formed to examine the two proposals, but both were ultimately rejected by the Congress. What they found objectionable in the proposition of the Serbian dele-

gation was that the year 2000 would not be a leap year, as in the Gregorian calendar, and only after 77 years would a difference of one day appear between the Gregorian and the New Rectified Julian calendars. The general opinion of the participants was that the better solution was to retain the Julian calendar as it was and only delete thirteen days, in order to bring it into line with the Gregorian calendar. In this way, a one-day difference would appear after 177 years, in the year 2100.

Milutin Milanković was then given the task of developing a new proposal for calendar reform. He concluded that the wish of the majority of participants was that the calendar of the Eastern Orthodox Church should not be identical to the Gregorian calendar, but that the two should parallel one another as far as possible. Consequently, instead of trying to fix the date of the vernal equinox at 21 March, as in Trpković's proposal**,** he tried to obtain the longest possible consonance of the two calendars. Finally, he developed a new intercalation rule: that secular years are leap years only provided that the number of centuries they belong to when divided by 9 yields the remainder 2 or 6. In this way he obtained a calendar that was more precise than the Gregorian one but consistent with it up to 2800 (i.e. for 877 years from the time of the Ecumenical Congress in Constantinople). The result was that the years 2100, 2200, 2300, 2500, 2600 and 2700 are ordinary years according to both calendars. The years 2000 and 2400 are leap years according to the Gregorian calendar since 2000 and 2400 can be evenly divided by four, and according to Milanković's New Rectified Julian calendar as well because when 2000 is divided by 9 the remainder is 2 and for 2400 the remainder is 6. The year 2800 is a leap year according to the Gregorian calendar since 28 can be evenly divided by 4, but according to the New Rectified Julian calendar it is an ordinary year since when 28 is divided by 9 the remainder is 1. One should take into account the fact that the New Rectified Julian calendar of the Orthodox Church will be in better agreement with nature than with the Gregorian calendar: a disagreement of just one day between the New Rectified Julian calendar and the tropical year will only accumulate after almost 30,000 years!

Milanković presented his new proposal to the Congress at its 23 May 1923 session. This new proposition by the Serbian Orthodox Church was signed by him and by Gavrilo Dožić. In his historic speech to the Congress, Milanković told the delegates that if they only decided to delete thirteen days from the Julian calendar, the Orthodox Church would be in an inferior position in any future discussion on the calendar question. On the other hand, with the proposition of the Serbian delegation, the Orthodox Church would have the most precise and most scientific calendar in the Christian world, so it could confidently enter into any negotiations on the calendar question with Western Churches. Milanković underlined also that with such a decision, the Orthodox Church would not be accepting the calendar of the Roman Catholic Church, but would be adopting a better one.

Also attending the Congress was Anthimos Metropolitan from Viziys, who proposed to determine the exact date of Easter by astronomical methods, with help from observatories and universities in Athens, Belgrade, Bucharest and Pulkovo.

Figure 2: Conclusion or Concentrasion of the all Orthodox Congress in Constantinople in 1923. In the centre is the head of all Orthodox Churches, Patriarch Meletios IV. Milutin Milanković is sitting on the extreme right, and beside him is the Metropolitan of Montenegro and Coast Gavrilo Dožić. The signature across the photo is of Patriarch Meletios IV (after Milanković, 1995).

The date of Christian Easter had originally been linked to that of the Jewish Passover because it was generally thought that the Last Supper was a Passover meal. The synod of Nicea, however, decided to separate these holidays and determined that Easter would take place on the first Sunday after the full Moon that follows the spring equinox (which occurred on 21 March at that time). Calculations using whole numbers and different calendars resulted in differences between the two holidays of up to four weeks. The proposed calendar reform would also result in different dates, in spite of the fact that the calendars paralleled one another.

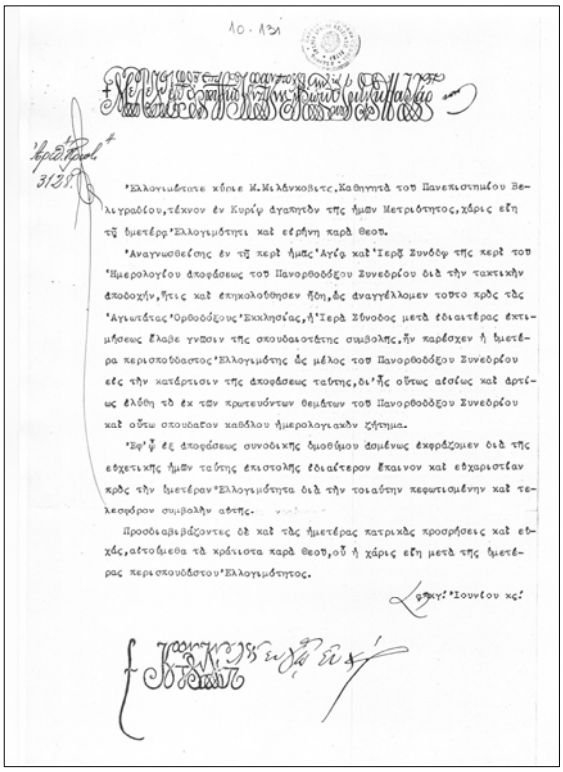

Figure 3: The letter from his beatitude Ecumenical Partriarch Meletios IV to Milutin Milanković (courtesy: Archive of the Serbian Academy of Sciences and Arts, 10.131/III – 101).

Milutin Milanković completed the final version of the calendar reform, which was then adopted by the Congress. The relevant document was signed on 8 June 1923, just prior to the conclusion of the Congress, by Patriarch Meletios IV, Kalinikos (Metropolitan of Kyzikos), Alexander (Archbishop of North America), Gavrilo Dožić (Metropolitan of Montenegro and Littoral), Vasilios (Metropolitan of Nicaea), Jakub (Metropolitan of Durachion), Archimandrite Julius Scriban, and Professors E. Antoniadis and Milutin Milanković. The Congress was especially grateful to Milanković for his valued and very substantial input, and on 26 June 1923 Patriarch Meletios IV sent him a heartfelt letter of thanks. This is reproduced here in Figure 3, and an English translation is provided in Appendix 1.

The date of the official inception of the New Julian calendar was originally scheduled for 1 October 1923, but it was subsequently changed to 14 October. This was the date when the calendar reform would be introduced in the Ecumenical Patriarchate and in the Greek Churches, but without the part concerning the Easter determination, where the old Julian calculation was retained. Today, Patriarchates of Constantinople, Alexandria and Antioch, Churches of Greece, Cyprus, Romania, Poland, Finland and most recently, Bulgaria (in 1968) and the Orthodox Church in America (on 1 September 1983; see e.g. http://www.holy-trinity.org/modern/calen2.html) use the 'New', 'Revised' or 'Rectified' Julian calendar. On the other hand, the Patriarchate of Jerusalem, and the Churches of Russia and Serbia, along with the monasteries on Mt. Athos, all continue to adhere to the old Julian calendar (see http://www.yalchicago.org/paschacalculation.html).

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APPENDIX 1: TRANSLATION OF THE LETTER OF THANKS TO PROFESSOR MILANKOVIĆ (REPRODUCED IN FIGURE 3)

The most learned gentleman M. Milanković, professor of the Belgrade University dear in Lord, child of humbleness, let boon be with your Eruditeness and peace from God.

Since the decision of the Pan-Orthodox Conference on the calendar question is proclaimed in our holy and sacerdotal Synode in order to be correctly adopted, as we communicate to the most serenes Orthodox Churches, honorable Synode with particular respect noting your very precious advice, with which your high Eruditeness contributed, as a member of the Pan-Orthodox Conference, to the formulation of the decision with which it so luckily and favourably solved one of the leading subjects of the Pan-Othodox Conference and the important calendar question.

In that name, with this our synodal decision, we cordially express by this our prayering-letter exceptional laudation and thanksgiving to your high Eruditeness for your enlightened and useful advice.

Addressing to you our paternal laudations and blessings we pray that God's boon always be with your extraordinary Eruditeness.

26 June 1923
By Mercy of God
Archbishop of Constantinople-New Rome and Patriarch
Meletios IV

It is important to note that this letter was written in the old ceremonial Greek language, Katarevusa, and in translating it we tried to preserve the ceremonial and archaic spirit of the original terminology. Consequently, several unusual words which are not widely used are included. For example, the word "boon" is a wish usually granted by a god to a person or group of people (thus "… a spanking breeze is a boon to sailors."). Meanwhile, the term "your Eruditeness" is analogous to "your Highness", in that the Patriarch wanted to express his admiration to Milanković for his knowledge and his erudition.

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Petros Z. Mantarakis received a BS in astronomy from the California Institute of Technology, and an MS in astronomy from the University of Arizona. He worked in industry for thirty years, where he attained the level of President of several companies. He has 20 patents, and has published two books and numerous articles. He lives in Los Angeles (California), where he continues to write and do consulting work.