

Meaning and reception of the Gregorian Reformation of the Calendar

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Abstract The Gregorian reformation is drafted in historical, religious, astronomical and computational senses: its reception in the World analyzed.

Sommario La riforma gregoriana è inquadrata in senso storico, religioso, astronomico e computazionale, con il suo recepimento nel mondo.

Introduction: Roman calendars from Numa to Julius Cesar

In a society the time had to be ruled, and the king had this duty. The Roman society, as many ancient ones, rooted his feasts in astronomical events considering them as religious.¹

The first roman calendar is attributed to the 2nd king, the priest Numa Pompilio.² Based upon a 365 days year it suffer the problem that the tropical year is not an exact multiple of the mean solar day, and the solution was made by the arbitrary introduction of leap days or months each time it was needed.

Julius Cesar issued in 46 B. C. the approximation of 4 tropical years with 1461 days, by the regular introduction in the bissextile year of the 24 of February, then called *dies bis-sexta a calendibus Martii* (bis=repeated 6th day before March 1=*calendae*). This reformation was supported by the astronomical studies made by Sosigenes in Alexandria of Egypt, and subjected to a progressive shift between civil and astronomical calendar of 3 days each 400 years, reset and fixed by Pope Gregorius XIII.

- 1 The foundation of Rome on April, 21 was associated to the celebration of the feast of Pales, name related to Palilicium, latin name of Aldebaran, the eye of the Taurus constellation. The observation of birds coming from a given direction of the sky from a selected area (sancta=saint, in latin, means selected) was the way to decide who and where Rome was to rise. Romulus won vs Remus, and the Palatine hill (hill of Pales) won vs the Aventine. The sacred area was aligned (astronomically) with the cardinal points N, S, E, W, giving fully the early meaning of *pomerium*, the sacred borders of the Urbs, Rome.
- 2 The dates of the seven kings of Rome have been object of several debates, as well as their real existence: their role is out of discussion.

The Christian religious problem of Easter determination

The feast of Easter first is Jewish and after Christ's Death and Resurrection become the foundation feast of Christian religion. The Jewish adopted a lunisolar calendar, and Easter is the full Moon of spring, Christians followed this tradition, making the Sunday as sacred day, because of the Resurrection occurred in. In the early four Christian centuries there was some fluctuation in the Easter computus for different communities, and pope Damasus wanted to fix it in order to have the same date for all Christians. The necessity of computing in advance the dates of Easter gave origin to various algorithms, like the Octaëteris, based upon the approximation of the lunar year with 354 days, or the lunar month of 29.5 days. This was developed again in Alexandria and issued by the pope³ Demetrius in 214. Ancient Greek astronomers already measured 29.53 days for the mean lunar month, but the calendars based on this value would require several centuries to equal integer number of days, of tropical years and of lunar months. Therefore in the Catholic Church an algorithm to compute the full Moon of spring and the following Sunday was to be standardized, and various *Paschales Computi* limited to five times 19 years, the Greek Metonic cycle (19 Julian years=235 mean lunar months) of Hippolytus (222), or Dionysius Exiguus (532).

The standardization of the Computus by Gregorius XIII

Easter is linked to the spring's Moon as in the tradition and as in Nicea Council of 325 this was solved by fixing Spring to 21 March and Easter from 22nd on; after it was necessary to have spring equinox always near the 21st March, and this implied the reset of 10 days of the Julian calendar and the introduction

3 In the Catholic Church the name pope nowadays is associated to the bishop of Rome, originally also of Alexandria and other important cities.

of the periodical correction each centennial year not multiple of 400. This part of the reformation affected also the civil life, from the State of the Church, to Italy, and to the European Countries. It was a careful reformation from the astronomical point of view, but the political issues of having the pope as new ruler of the civil time were not simple for Countries then separated from the Catholic Church (Ortodoxes since 1054, Protestant since 1517, Anglican since 1536).

Reception of the Gregorian Calendar

The table shows the states or regions and the years in which they adopted the reformation, and the reasons of the delay.

Year ^{Vignati} ^{**Cappelli}	State or Region*	Reason
1582 (1583**)	FRANCE	Religious
1582/ X	ITALY	Religious
1582/ XII	SAVOY	Religious
1582/ XII	LUXEMBOURG	Religious
1582/ X	HOLLAND catholic side	Religious
1582/ X	PORTUGAL and possessions	Religious
1582/ X	SPAIN and possessions	Religious
1583 (1584**)	AUSTRIA	Religious
1583	BAYERN and TIROLO	Religious
1583 (1584**)	SWISS catholic side	Religious
1584	BOEMIA and MORAVIA	Religious
1586 (1582**1585**)	POLAND	Religious
1587	HUNGARY	Religious
1590	TRANSYLVANIA	Religious
1610	PRUSSIA	Religious
1648 (1584**)	ALSACE (Catholic side)	Religious
1682	STRASBOURG	Religious
1700	DENMARK	Religious
1700	GERMANY protestant side	Religious
1700	FAROE ISLANDS	Religious
1700	NORWAY	Religious
1700	HOLLAND protestant side	Religious
1622**	SWISS canton Vallese	Religious

1700 (1701**)	SWISS protestant cantons	Religious
1724	SWISS canton San Gallo	Religious
1752	ENGLAND & IRELAND**	Religious
1752	USA (English possession)	Religious
1753	FINLAND	Political
1753	SWEDEN	Political
1760	LORRAINE	Religious
1811 (1724**)	SWISS canton Grigioni	Religious
1867	ALASKA	Political
1873	JAPAN	Political
1875	EGYPT	Religious
1896	KOREA	Political
1912	CHINA	Political
1912	ALBANIA	Political
1915	LETTONIA and LITUANIA	Political
1916 (1917**)	BULGARIA	Political
1918	RUSSIA and ESTONIA	Political
1919	JUGOSLAVIA	Political
1919	ROMANIA	Political
1924	IRAN	Political
1924 (1923**)	GREECE	Religious
1927	TURKEY	Religious

* some names are old, or no more existant.

Conclusions simplifying the algorithm for Easter is not the reason of the proposal to fix Easter to the second Sunday of April, but in view of religious unification of Christians.

References

- G. Giudice, http://www.dpgi.unina.it/giudice/Calendar/Inter_Gravissimas.html
A. Carandini, *La fondazione di Roma*, Laterza, Bari, 2013.
C. Sigismondi, *Algoritmi per il calcolo dell'epatta della Luna*, Gerb 9,109 2016
A. Vignati, *L'introduzione del Calendario Gregoriano*, APRA, 2016.
M.S. Dimitrievic, *Milankovic european astronomer*, AN 323, 570 (2002)
A. A. Mosshammer, *The Easter Computus and the Origins of the Christian Era*, Oxford, 2008; C. Piazzino, www.kerylos.org/calendario_romano.htm
A. Cappelli, *Cronologia, cronografia e calendario perpetuo*, Hoepli, 1969
L. Holford-Strevens, *The History of Time: Short Introduction*, Oxford, 2005