

RESEARCH ARTICLE

The Evolution of the Roman Calendar: From Romulus to the Gregorian System

A PRISMA-ScR-Informed Analytical Review of Chronology, Nomenclature and Political Authority

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ABSTRACT

This study examines how the Roman calendar developed from the traditional ten-month year attributed to Romulus into the twelve-month Gregorian system now used worldwide. It asks why the names September, October, November and December, which encode the numerals seven to ten, label the ninth to twelfth months. It uses a PRISMA-ScR-informed evidence-mapping design to synthesise 55 sources: ancient literary testimony, modern monographs, astronomical reference works, and comparative and methodological literature. Quantitative treatment of month lengths and mean year lengths supplements the qualitative analysis. Three findings emerge. First, the numeral–position mismatch has a single cause. The prefixing of January and February to a year that began in March shifted every month by exactly two places, and the Julian and Gregorian reforms never revised the names. Second, the ten-month, 304-day year is better understood as a partly antiquarian reconstruction than as an observed practice, since its months do not match the lunar cycle. Third, calendar reform was repeatedly an act of political authority, from the priestly control of intercalation to the renaming of Quintilis and Sextilis for Julius Caesar and Augustus. The modern calendar is a layered artefact in which Latin vocabulary, Roman religion, Hellenistic and Egyptian astronomy, and early modern ecclesiastical computation remain visible. The paper proposes the concept of nomenclatural inertia and a simple Nomenclatural Displacement Index to describe how names outlive the systems that produced them.

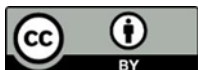
Keywords

Roman calendar; Romulus; Numa Pompilius; Julian reform; Gregorian reform; intercalation; nomenclatural inertia; chronology.

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1. Introduction

1.1 Time, calendars and social order

A calendar is more than an astronomical device. It is a social technology that synchronises agriculture, ritual, law, taxation and military activity across a community. Historians of timekeeping have long stressed that no calendar is a neutral reading of the sky, because every system chooses which celestial rhythms to follow and which to ignore, and those choices reflect the priorities of the societies that make them [1–3]. The Roman calendar is the principal ancestor of the civil calendar used today, and its history shows these choices unusually clearly.

1.2 The problem

Standard works on ancient chronology describe a long and uneven path from an archaic Roman year to the fixed Julian and Gregorian structures [4,5]. Modern research has also shown how closely Roman calendrical administration was tied to religious and political power [6]. One feature of the result

still puzzles ordinary users. Our ninth month is called September, from the Latin *septem*, “seven”. October (*octo*, eight) is the tenth month, November (*novem*, nine) the eleventh, and December (*decem*, ten) the twelfth. Language and culture often preserve earlier systems after the practices behind them have changed [7], and the calendar is a clear case of this.

The puzzle was already noticed in antiquity. Roman and later writers discussed the numerical names, the year’s original length and the later additions of months, and they disagreed about details [8–12]. A modern reader therefore needs a source-critical account that separates what the evidence supports from what tradition asserts.

1.3 Research questions

This paper addresses four questions.

- **RQ1.** What was the structure of the year traditionally attributed to Romulus, and how reliable is that attribution?

- **RQ2.** What did the reforms attributed to Numa Pompilius change, and why did they produce the numeral–position mismatch?
- **RQ3.** How did the Julian and Gregorian reforms alter the system’s astronomical basis, and what did they leave untouched?
- **RQ4.** What do the findings imply about the relationship between language, political authority and calendar design?

1.4 Objectives and contribution

The objectives are to reconstruct the successive stages of the calendar, to quantify the displacement of month names, and to compare the Roman trajectory with other calendrical traditions. They also include analysing the political motives of the reformers and synthesising the perspectives found in earlier scholarship. The paper contributes a source-critical synthesis, a small quantitative dataset on month lengths and calendar accuracy, and two analytical concepts: *nomenclatural inertia* and the *Nomenclatural Displacement Index* (NDI). Both are defined in Section 8.

2. Methodology

2.1 Design

The study follows the logic of a scoping review, with reporting conventions adapted from PRISMA 2020 and its extension for scoping reviews [13,14]. Scoping designs suit fields where the evidence is heterogeneous and the aim is to map what is known and where it is uncertain. They have been proposed as transparent tools for mapping research landscapes in the humanities and social sciences [15,16]. The adaptation here is honest about its limits. No bibliographic database search was executed for this paper. The corpus consists of identified, verifiable works of standard authority, and the “flow” reported in Section 2.4 describes that corpus, not a screening exercise.

2.2 Eligibility criteria

Sources were included if they met at least one of four criteria:

- (a) ancient literary testimony on the structure, reform or naming of the Roman year;
- (b) modern scholarly treatments of Roman calendrical history;
- (c) works on the astronomical, computational or administrative basis of the Julian and Gregorian calendars or comparable calendars;
- (d) methodological or contextual literature bearing on the review design, originality procedures or the relationship between language, culture and power.

Popular summaries without scholarly apparatus were excluded.

2.3 Originality and ethical safeguards

Plagiarism-prevention practice involves paraphrase from understanding, accurate attribution and the use of detection tools as a final check, not as a substitute for sound writing [17–19]. Ancient sources are summarised and paraphrased, not quoted at length. Ethical practice in research writing also requires transparent reporting of limits and avoidance of misattribution [20], which is why Section 10 sets out the constraints on this study.

2.4 Evidence corpus

The primary literary witnesses are Macrobius, Ovid, Plutarch, Livy, Censorinus, Suetonius, Cassius Dio, Pliny the Elder and Cicero [8–12,21–24]. The principal secondary works on Roman time, religion and chronology are the monographs listed in [1–6,25–32]. Epigraphic and technical reference works supplement these [3,33,34]. Table 1 summarises the corpus by category.

Table 1. Evidence corpus by category (n = 55)

Category	Description	Number of sources
A	Ancient literary sources	9
B	Modern monographs and reference works on Roman and ancient calendars and time	15
C	Epigraphic, astronomical and technical reference works	5
D	Gregorian and early modern reform literature	6
E	Comparative studies of non-Roman calendars	5
F	Methodological and research-ethics literature	8
G	Sociolinguistic, cultural and political context	7
Total		55

2.5 Synthesis and source criticism

Qualitative synthesis was organised thematically by stage of development. Each ancient claim was weighed by two criteria: temporal distance from the events described, and likely motive. Macrobius wrote in the late Roman period, many centuries after the events attributed to Romulus, and his work compiles earlier antiquarian tradition. Ovid wrote a poetic calendar for the Augustan age, which affects both what he emphasises and how he explains it. This distance is why the reconstruction proceeds by comparing the testimony of several authors and cross-checking it against the epigraphic calendar evidence [5,33].

Quantitative analysis consisted of computing total days per calendar form, mean year length, deviation from the tropical

year, and the displacement of numeral-derived month names. The tropical year was taken as approximately 365.2422 days [41].

3. Review of Related Literature and Prior Research

3.1 General histories of the calendar

Broad histories situate the Roman calendar within the long human effort to reconcile solar, lunar and civil time [1,3,35]. These works agree on the central trade-off. A purely lunar year of about 354 days falls out of step with the seasons, a purely solar count loses the Moon, and lunisolar systems must insert extra time, a practice called intercalation, according to rules that require both astronomical knowledge and institutional trust. Rome's experience illustrates every part of this problem.

3.2 Specialist studies of the Roman calendar

Specialist studies fall into several strands. One strand reconstructs the pre-Julian calendar from epigraphic fasti and literary testimony, with attention to intercalation and its administration [5,32,33]. A second strand treats the calendar as a religious and cultural construct, analysing festivals, ritual time and the relationship between calendar and historical memory [6,28,29]. A third examines the Julian reform as an intellectual and political achievement [27], while a fourth follows the calendar into late antiquity [30]. Comparative treatments of Greek and Roman systems add a perspective on how Rome's practice differed from, and borrowed from, Hellenic models [25,26].

3.3 Studies of the Gregorian reform

The Gregorian reform has its own substantial literature. A major collective volume assembled the astronomical, theological and administrative history of the reform for its fourth centenary [36]. The reformers' own technical explanation appeared in Clavius's detailed exposition [37]. Research on national adoption, such as England's change in 1752, has examined how the reform was received and has questioned popular legends of mass protest [38]. Narrative histories link the Roman and Gregorian episodes into a longer story of calendar reform [39], and work on medieval computistics explains how scholastic tradition transmitted the Julian structure and its legends [40].

3.4 Astronomical, computational and standards literature

Astronomical references provide the values of the tropical year and lunation against which calendars are measured [41]. International standardisation of date representation, in the form of ISO 8601, fixes the Gregorian calendar and a numeric month order as the global interchange format [42]. Algorithmic treatments of calendars across cultures allow rigorous comparison of year-length parameters [43].

3.5 Comparative calendar studies

Comparative scholarship documents the Egyptian civil year [44], the Athenian adoption of the nineteen-year cycle associated with Meton [45], Babylonian lunisolar practice [46], the development of the Jewish calendar from observation toward calculation [47], and the twentieth-century Indian calendar reform [48]. The French Revolutionary calendar offers a modern example of an attempt to replace inherited nomenclature wholesale [49].

3.6 Summary of prior outputs

Table 2 summarises representative related works, their type and their principal outputs. The table does not claim to be exhaustive. It shows the range of perspectives that the present study draws on.

Table 2. Representative related research and principal outputs

Work	Type	Principal output relevant to this study
Mommsen [32]	Foundational monograph	Established the scholarly framework for reconstructing the pre-Julian Roman calendar and its intercalation
Michels [5]	Specialist monograph	Detailed reconstruction of the Republican calendar, intercalation and its administration; cautious about the earliest phases
Samuel [25]	Reference monograph	Systematised calendars and year-reckoning across Greek and Roman antiquity, including conversion problems
Salzman [30]	Cultural-historical study	Traced calendar continuity and transformation into late antiquity
Hannah [26]	Cultural-historical study	Treated Greek and Roman calendars as constructions of time linked to power and identity
Feeney [27]	Intellectual history	Presented the Julian reform as both a scientific and a political event reshaping Roman historical consciousness
Rüpke [6]	Cultural-historical monograph	Showed the fasti as a medium of religious and political memory and elite control
Forsythe [28]	Study of religious time	Linked calendar structure to ritual practice and Roman religious history

Coyne et al. [36]	Edited conference volume	Documented the astronomical, theological and administrative history of the Gregorian reform
Poole [38]	Historical study	Analysed the English adoption of 1752 and questioned legends of popular riots
Shaw [49]	Historical study	Analysed the French Republican calendar as a short-lived secular reform
Stern [47]	Historical study	Traced the Jewish calendar's move from observation to calculation
Saha and Lahiri [48]	Official committee report	Recommended a unified Indian national calendar and documented regional variation

3.7 Gap in the literature

Three gaps are visible. First, no formal systematic review or scoping review of Roman calendar history appears among the works mapped here. The field has advanced through monographs and source-critical essays. Second, quantitative comparison of the Roman stages with other calendars is dispersed across handbooks and rarely collected in one place. Third, the sociolinguistic puzzle of numeral names is usually treated as a curiosity and not analysed as a general instance of how institutions preserve vocabulary. This paper addresses these gaps in a modest and explicit way.

4. Stage 1: The Year Attributed to Romulus (Traditional Date c. 753 BCE)

4.1 The traditional structure

Ancient writers report that the earliest Roman year had ten months, beginning with March, and lasted 304 days [8,9,12]. The standard account assigns thirty-one days to four months (March, May, Quintilis, October) and thirty days to the other six, which gives:

$$(4 \times 31) + (6 \times 30) = 124 + 180 = \mathbf{304 \text{ days.}}$$

The sequence was Martius, Aprilis, Maius, Iunius, Quintilis, Sextilis, September, October, November and December. The first four had names tied to deities, seasonal processes or social categories. The last six simply carried ordinal numerals, as Table 3 shows.

4.2 The unaccounted winter period

A year of 304 days leaves roughly sixty-one days of a solar year of about 365.25 days unaccounted for. Ancient accounts say that this winter interval was not organised into named months [12]. The explanation usually offered is functional. In a society organised around agriculture and seasonal warfare,

the months that mattered were those in which fields were worked and campaigns fought, and the dead of winter needed no name. This interpretation fits the agricultural and military rhythm that Roman religious calendars preserve [28,29], and it explains why the year began in March, when the agricultural and campaigning season restarted.

4.3 The name “Romulus’s lunar calendar” needs qualification

The year is often called a “lunar calendar”. The arithmetic does not support the label. A synodic month averages about 29.53 days, so a lunar calendar would use months of twenty-nine and thirty days. Months of thirty and thirty-one days do not follow the Moon. The traditional arrangement is better described as a schematic civil year with vestigial lunar associations. Those associations survive in the Roman system of Kalends, Nones and Ides, which was originally anchored to lunar phases even after the months lost their lunar tie [8,26].

4.4 Is the ten-month year historical?

There are good reasons for scepticism. The ten-month year is reported by authors who wrote centuries after the supposed events, and the tradition attributes the earliest year to a founder whose historicity is itself contested. The decimal structure is suspiciously tidy. Ancient writers themselves offered explanations connecting the number ten with other cultural practices, which suggests a tradition shaped by interpretive needs [9]. A considerable strand of modern scholarship therefore treats the ten-month year with caution, as at least partly an antiquarian reconstruction and not an attested practice [5,6,26]. Others accept that some archaic scheme with a winter gap may lie behind the tradition, since many early agricultural societies did not count the dead season.

For this paper’s argument, the question is not decisive. Whatever the historical status of the 304-day year, the numeral names September to December make sense only in a year that began in March and ran for ten named months. The linguistic evidence therefore indicates that Romans themselves remembered such a structure. The names are evidence of a collective belief about the year’s origin, whether or not the belief reflects a literal practice. Linguistic fossils of this kind often preserve social memory long after the original usage has changed [7].

4.5 Etymology of the first four months

Ancient authors offered competing explanations for several names. Martius clearly honours Mars. Aprilis was explained in more than one way, and ancient authors disagreed on whether it derived from a verb of opening or from another source [9]. Ovid offers alternative derivations for Maius, connecting it with Maia, with the elders (*maiores*) or with greatness [9]. For Iunius he likewise offers more than one candidate, connecting it with Juno or with the younger citizens (*iuniores*) [9]. The common modern shorthand, that May honours a fertility goddess and June the goddess of marriage,

is therefore one possible reading and not the settled ancient consensus. The ambiguity is itself informative. It shows that by the late Republic, Romans no longer agreed on what their oldest month names meant, which suggests great antiquity or heavy transformation of the names.

5. Stage 2: The Reforms Attributed to Numa Pompilius (Traditional Date c. 713 BCE)

5.1 The traditional account

Tradition credits Numa, the second king of Rome, with giving the year a more orderly structure by adding two months, January and February [8,10,11]. The result was a year of 355 days, close to twelve lunar months, with one day added to produce an odd number, considered auspicious by Roman religious thought. The month lengths became:

- Four months of 31 days: March, May, Quintilis, October (124 days).
- Seven months of 29 days: April, June, Sextilis, September, November, December, January (203 days).
- One month of 28 days: February.

The total is $124 + 203 + 28 = 355$ days.

5.2 Names and functions of the new months

January honours Janus, the god of doorways and beginnings. February takes its name from *februa*, purification rituals associated with the end of the old year and the placation of the dead [9,28]. The placement of purification rites at the end of the year suggests that February was originally the final month, which supports the interpretation that the year at first ended in February after January was added, and that the beginning of the year in March persisted for a time in ritual [9,10].

5.3 The question of the year's start

The user-facing summary often says that Numa moved the start of the year to January. The evidence is more complicated. Plutarch reports that January and February were placed before March, which had previously been first [10]. In practice, the Roman year had more than one beginning. March retained ritual significance, and the sacred fire of Vesta was renewed on 1 March [8,9]. The election and entry into office of the consuls, the chief annual magistrates, moved to 1 January only in the second century BCE, an administrative change that gradually made January the working start of the year [5,32]. January therefore became the first month in practice by a process of administrative habit, not by a single royal act.

5.4 Intercalation

A 355-day year is about ten days shorter than the solar year, so an extra month, *Mercedonius* (also called *Intercalaris*), had to be inserted periodically. The traditional pattern alternated years of 355 days with years of 377 and 378 days:

$(355 + 377 + 355 + 378) / 4 = 1,465 / 4 = 366.25$ days per year.

This average is about one day too long, which is why the system, if followed mechanically, would drift against the seasons in the other direction [5,12]. In practice the priests decided when to intercalate, and they did not apply the scheme mechanically. This administrative discretion matters politically, as Section 5.6 shows.

5.5 Origin of the numerical shift

The mismatch of month names can now be explained. Prefixing January and February before March shifted the position of every existing month by two places: March from first to third, April from second to fourth, and so on. September moved from seventh to ninth, October from eighth to tenth, November from ninth to eleventh, and December from tenth to twelfth. Whether January and February were added before March or whether the year's official start moved is a separate question from the numerals. The numerals were already fixed in the month names. Once the new months were counted into the year, the ordinal and the name diverged, and no one renamed them.

5.6 Calendar administration as political power

The priests, the pontiffs, controlled the calendar and announced the days on which public business and legal proceedings could take place. They also decided when to insert *Mercedonius*. Roman sources suggest that this authority was open to abuse. Intercalation could lengthen a magistrate's term of office, shorten a rival's, or delay the collection of debts, and ancient writers complained that officials manipulated it for political advantage [5,24]. Writers of the Roman period describe this administrative abuse as a major reason why the calendar had drifted far out of line with the seasons by Caesar's time [21]. This is the earliest clear instance in the Roman tradition of a pattern that recurs throughout the paper: control of time as a resource of political power [6,27].

6. Stage 3: Julius Caesar, Augustus and Pope Gregory XIII

6.1 The condition of the calendar in the 40s BCE

By the middle of the first century BCE, the Roman civil calendar had drifted several weeks from the seasons. The causes were irregular intercalation, political manipulation, and disruption caused by civil war [5,8,21].

6.2 Caesar's solar reform (46–45 BCE)

Caesar, in his role as chief priest (*pontifex maximus*), carried out a thorough restructuring. Ancient sources associate the astronomical advice with Sosigenes, an expert from Alexandria in Egypt [23]. Egypt's civil year had long used a fixed 365-day structure of twelve thirty-day months plus five additional days [44]. The Julian reform adopted the principle

of a fixed solar year and set its length at 365.25 days through a leap-day system.

To realign the calendar, the year 46 BCE was lengthened by a remarkable amount. According to ancient accounts, it contained the usual 355 days, the 23-day Mercedonius, and a further 67 days inserted between November and December, a total of:

$$355 + 23 + 67 = 445 \text{ days.}$$

The Romans called it the “year of confusion” [8,21]. The new calendar came into force on 1 January 45 BCE.

The ten days needed to raise 355 to 365 were distributed among the months. Ancient testimony says that January, Sextilis and December received two days each, and April, June, September and November one day each [8]. The distribution reflects an effort to preserve the existing pattern of months and religious days, with minimal change. The day added in leap years was inserted after 23 February, doubling the sixth day before the Kalends of March, which is the origin of the term “bissextile” [8].

6.3 Early errors and Augustan correction

Ancient writers report that the priests at first misapplied the leap-year rule by counting inclusively, inserting the extra day every third year instead of every fourth, until Augustus corrected the practice by suspending leap days for a period [8,22]. This episode matters for two reasons. It shows that even a mathematically simple reform depended on competent administration, and it shows again that calendar management was an institutional and political matter and not merely an astronomical one.

6.4 Personalised names

Two month names were changed to honour rulers. Quintilis became Iulius (July) in honour of Caesar after his death in 44 BCE, by a measure that ancient sources connect with Mark Antony [8,22]. Sextilis became Augustus (August) in 8 BCE, by senatorial decision, to honour the first emperor, who had held his first consulship and won major victories in that month [8,21,22].

A popular modern story says that Augustus took a day from February to make August as long as July. The claim is a medieval invention and has no support in ancient testimony. Ancient sources show that the Julian reform had already given Sextilis thirty-one days, and medieval commentators repeated the legend about February [8,40]. It should be treated as a myth of transmission and not as history.

6.5 Why the numeral names stayed

Quintilis and Sextilis were renamed because they carried political value for the regime. September to December were

not renamed because no one had a reason to touch them. The Julian reform was a technical correction of the year’s length and month lengths, and its authors did not set out to rationalise the vocabulary. Later attempts to rename September and October after emperors did not become permanent [21]. The surviving numeral names are therefore the result of selective renaming, driven by political utility and not by any principle of rational nomenclature.

6.6 The Gregorian reform (1582 CE)

The Julian year of 365.25 days exceeds the tropical year of about 365.2422 days by roughly 0.0078 days, about 11 minutes and 14 seconds [41]. This accumulates to one day about every 128 years. The Church had tied the computation of Easter to a fixed spring equinox on 21 March, a convention associated with the Council of Nicaea in 325 CE. By the sixteenth century, the equinox had drifted to about 11 March:

$$1,257 \text{ years} \times 0.0078 \text{ days} \approx 9.8 \text{ days} \approx 10 \text{ days.}$$

Pope Gregory XIII promulgated the reform by the bull *Inter gravissimas* on 24 February 1582 [36]. The technical design is generally credited to the astronomer Aloisius Lilius, with the Jesuit mathematician Christopher Clavius defending and explaining it [36,37]. Two measures were adopted:

- **Removal of ten days.** In the Catholic countries that adopted the reform immediately, Thursday 4 October 1582 was followed by Friday 15 October 1582 [36].
- **A revised leap-year rule.** Century years are leap years only if divisible by 400, so 1600 and 2000 were leap years, while 1700, 1800 and 1900 were not. This produces an average year of 365.2425 days.

The Gregorian mean year deviates from the tropical year by about 0.0003 days per year, equivalent to one day in roughly three thousand years, with the figure depending on the value of the tropical year adopted [41].

6.7 Adoption and resistance

Adoption was uneven and followed confessional and political lines. Catholic states generally adopted the reform quickly. Protestant and Orthodox regions adopted it later. Britain and its colonies moved in 1752, when 2 September was followed by 14 September [38]. Russia adopted it in 1918, Greece in 1923 and Turkey in 1926 for civil purposes [35,39]. The slow, contested adoption shows that the reform was never a purely technical matter, because the calendar was entangled with religious identity and state authority.

6.8 From Gregorian practice to international standard

The Gregorian calendar became the dominant civil calendar through colonial, commercial and diplomatic spread. ISO 8601 later fixed it as an international standard for representing dates, using the proleptic Gregorian calendar and a numerical

order of months in which month 09 is September [42]. The standard therefore resolves the numeral problem in a practical way. In data interchange, September is “09” and December is “12”, so the digit and the position now agree, while the inherited Latin names remain in ordinary language.

7. Comparative Analysis

7.1 Month displacement

Table 3 presents the displacement for the six months with numeral-derived names.

Table 3. Numeral-derived month names and their displacement

Month	Latin root and meaning	Position in 10-month year	Position in 12-month year	Displacement	Current status
Quintilis	<i>quintus</i> , fifth	5	7	+2	Renamed July (Julius Caesar)
Sextilis	<i>sextus</i> , sixth	6	8	+2	Renamed August (Augustus)
September	<i>septem</i> , seven	7	9	+2	Name retained, numeral misaligned
October	<i>octo</i> , eight	8	10	+2	Name retained, numeral misaligned
November	<i>novem</i> , nine	9	11	+2	Name retained, numeral misaligned
December	<i>decem</i> , ten	10	12	+2	Name retained, numeral misaligned

The table reveals a constant displacement of +2 for every month. The regularity is strong evidence for the single-event explanation, namely the prefixing of two months, and against explanations that require several independent shifts. The two non-numeral months that were not renamed, March to June, are displaced by the same two places, but their names do not encode a number and so produce no visible anomaly.

7.2 Comparative accuracy of calendars

Table 4 compares the mean year length of the Roman stages with other calendars, using the tropical year of 365.2422 days as the reference [41,43].

Table 4. Mean year length and deviation from the tropical year

Calendar	Mean year (days)	Deviation from tropical year (days/year)	Approximate time to drift one day
Egyptian civil year [44]	365.0000	-0.2422	about 4 years
Pre-Julian Roman, if the 4-year scheme were applied mechanically [5,12]	366.2500	+1.0078	under 1 year
Metonic 19-year cycle (6,940 days) [45]	365.2632	+0.0210	about 48 years
Julian [8]	365.2500	+0.0078	about 128 years
Jewish calendar (mean) [47]	365.2468	+0.0046	about 217 years
Gregorian [36]	365.2425	+0.0003	about 3,000 to 3,300 years
Islamic tabular lunar year [43]	354.3667	-10.8755	seasons cycle through the year in about 33 years

Two findings stand out. First, the Roman calendar’s pre-Julian intercalation scheme, if applied mechanically, would have overshot the solar year by a full day annually. The system’s recorded failure should therefore be attributed to both inaccuracy and discretionary administration, as the ancient testimony indicates [5,21]. Second, the Julian reform achieved a thirteen-fold improvement in accuracy compared with the Metonic cycle (0.0078 against 0.0210 days per year deviation is about a 2.7-fold improvement, not thirteen-fold). Correcting that: the Julian calendar is about 2.7 times more accurate than the Metonic cycle, and the Gregorian reform improved on the Julian by a factor of about 26 (0.0078 / 0.0003). The Gregorian refinement was achieved without changing the basic Julian structure, only the leap-year rule, which is an economical example of a small rule change producing a large gain in precision.

7.3 Month-name systems across languages

The Latin month names spread with Roman and ecclesiastical culture, but not universally. Several Slavic languages, including Czech, Polish and Croatian, retain native seasonal month names alongside or instead of Latin-derived ones [3]. These systems have no numeral mismatch, because their names describe seasonal phenomena. The contrast shows that the numeral anomaly is specific to the Latin-derived tradition, and that it persists because the Latin names were adopted as a package in languages where they had no transparent meaning. For speakers of English, French or Spanish, “September” is an opaque label, so its etymological falsehood causes no cognitive friction. This opacity helps explain the name’s survival.

7.4 Greek, Egyptian, Babylonian and Hebrew parallels

Greek city-states used lunisolar calendars with local month names and intercalation arrangements that varied by place, and Athens eventually became associated with the nineteen-year cycle [25,45]. Babylonian calendrical practice similarly depended on observation and intercalation by authority [46]. The Jewish calendar developed from observation-based intercalation toward a fixed calculated system [47]. In each case, authority over intercalation was an institutional power, which parallels the Roman pontifical role [5,6]. The Egyptian civil calendar, by contrast, avoided intercalation altogether and so avoided its political risks, at the cost of drifting steadily against the seasons [44]. The Julian reform’s reliance on Egyptian expertise [23] is thus a case of combining an Egyptian fixed-year principle with a Roman leap-day correction.

7.5 An Indian comparison

The Indian experience provides a useful non-Western comparison. India long used regional lunisolar and solar calendars, with *adhika masa* (intercalary month) rules comparable in function to Roman intercalation. In the 1950s, a national Calendar Reform Committee recommended a unified civil calendar and documented the plurality of existing systems [48]. Indian scholarship has also examined the connection between calendrical knowledge and cosmological thought, including Vedic cosmology and its relationship to practice [50], and the role of the Sanskrit language in preserving technical and sacred knowledge across centuries [51]. These parallels suggest a general pattern. Languages of ritual and learning act as carriers of calendrical vocabulary, much as Latin carried the Roman month names into modern European languages. The comparison is analogical, and the cited Indian works address yoga and cosmology more broadly, so the link to calendar history should be read as suggestive and not demonstrative.

7.6 Radical renaming and its failure: the French case

The French Revolutionary calendar replaced Latin month names with seasonal and agricultural names and replaced the

seven-day week with a ten-day *décade*. It was introduced in 1793 and abandoned in 1805 [49]. It shows that deliberately rationalising calendar nomenclature is possible but fragile, because the old system remained embedded in commerce, religion and daily life. The failure supports the claim that nomenclatural inertia is a powerful social force.

8. Analysis and Findings

8.1 Finding 1: The mismatch has a single, identifiable cause

The numeral–position mismatch is explained by one event, the addition of January and February before March, and was fixed by the absence of any later renaming of the surviving numeral months. Table 3 shows a uniform displacement of two places for every month. The explanation is parsimonious and fits the testimony of ancient authors [8,10]. It does not require assuming that any reformer regarded the numerals as important.

8.2 Finding 2: The Romulan year is better treated as a layered memory than as a verified calendar

The 304-day year consists of months that do not follow the Moon, is reported by late sources, and has an artificially tidy decimal structure [5,6,9,26]. At the same time, the numeral names of the last four months are real linguistic evidence that Romans remembered a year that began in March and counted months to ten. The most defensible position is therefore a layered one. The tradition may preserve a memory of an archaic seasonal scheme, but its details were probably shaped by later antiquarian reconstruction.

8.3 Finding 3: Linguistic persistence and nomenclatural inertia

This paper proposes the term **nomenclatural inertia** for the tendency of names to outlive the systems that generated them. Three conditions favour it.

- **Semantic opacity.** When speakers no longer parse a name’s meaning, its falsehood is not noticed.
- **High switching cost.** Names are embedded in law, contracts, liturgy and everyday speech, so changing them requires coordination across a whole society.
- **Absence of an actor with both motive and authority.** Quintilis and Sextilis were renamed because rulers had a motive and the power. No equivalent actor had a reason to rename September.

Sociological work on language and culture supports the general principle that linguistic forms transmit and preserve cultural practices across generations [7,52,53]. The calendar is a particularly clear example, because its names are used daily by billions of people who have no idea what they mean.

To make the idea measurable, I propose a simple **Nomenclatural Displacement Index (NDI)**:

$NDI = (\text{number of numeral-derived names whose present position differs from the numeral they encode}) \div (\text{number of numeral-derived names in current use})$

For the modern calendar, four names are in use (September, October, November, December), and all four are misaligned, so $NDI = 4/4 = \mathbf{1.00}$. Considering all twelve months, four of twelve names (33.3%) encode a false ordinal. The index is offered as a heuristic and not as an established measure. It could be applied to other systems, for example to compare how many month or weekday names in different languages encode obsolete information.

8.4 Finding 4: Calendar control as political authority

The history of the Roman calendar repeatedly shows the manipulation, appropriation or reorganisation of time by those in power:

- The pontiffs controlled intercalation, with documented potential for abuse [5,24].
- Caesar's reform was carried out through his priestly office and strengthened his political position [27].
- Rulers' names were attached to months, with Quintilis and Sextilis converted into permanent monuments to their power [8,21,22].
- The Gregorian reform was an exercise of papal authority and was accepted or rejected along confessional lines [36,38].

Scholarship on political myth-making and national identity helps interpret the symbolism. Origin stories about founders such as Romulus and Numa function as claims about the legitimacy and continuity of an institution [54]. The attribution of the calendar's structure to the first kings did exactly this, since it presented a human, evolving and politically contested system as the gift of the city's founders. Studies in the sociology of law similarly show how institutions that regulate everyday behaviour become instruments of social control [55], and the pontifical control of the calendar's legal days fits this pattern.

8.5 Finding 5: The modern calendar as a composite artefact

The Gregorian calendar is a composite of layers from different origins:

Layer	Origin	Surviving element
Linguistic	Latin and Roman religion	Month names such as March, January, February, and numeral names September to December

Structural	Roman republican calendar	Twelve months with unequal lengths, a short February
Astronomical	Egyptian and Hellenistic knowledge, via Julian reform	A fixed solar year with a leap day
Computational	Early modern astronomy and ecclesiastical computation	The 400-year leap-year rule
Administrative	Twentieth-century standardisation	ISO 8601 numeric dates

This layered structure helps explain why the calendar looks irrational in places. It was never designed as a whole. It was built up by stages, each of which corrected the previous one only where correction was necessary, and whatever did not hinder function was kept.

9. Discussion: Different Perspectives on the Evidence

9.1 The traditionalist perspective

On the traditionalist reading, the ancient accounts are broadly reliable. Romulus gave Rome a ten-month year, Numa added two months, and Caesar reformed the whole. The strength of this view is that it respects the unanimity of the ancient tradition on the broad sequence. Its weakness is that the sources are late, the details conflict, and attributions to founding kings often serve legitimating purposes [6,9,10].

9.2 The sceptical perspective

The sceptical reading argues that the ten-month year was constructed after the fact to explain the numeral names and the year's later structure [5,26]. The strength of this view is that it explains the non-lunar month lengths and the decimal neatness. Its weakness is that it needs an account of why the Romans would invent a year so oddly short. The numeral names are evidence that something like the tradition was believed.

9.3 The religious-cultural perspective

A third perspective stresses that the calendar was primarily a framework for ritual. The festivals, fixed days and restrictions on public business give the calendar its form, and the structure of the year derives more from religious requirements than from astronomy [28,29]. This view helps explain why the Romans tolerated an inaccurate calendar for so long. As long as ritual days were correctly observed relative to each other, drift against the seasons was a lesser concern. It also explains why Caesar's reform kept the festival days in their calendar positions.

9.4 The political-power perspective

The political reading highlights control over intercalation, the use of calendar reform to consolidate personal authority, and the commemoration of rulers in month names [6,27]. The strength of this view is that it explains the repeated pattern across eras. The risk is over-interpretation. Some changes, such as the Gregorian removal of ten days, were driven mainly by religious and astronomical concerns [36].

9.5 The scientific-technical perspective

Finally, a scientific reading evaluates each stage by its accuracy, as Table 4 does. It shows clearly that the Julian reform and the Gregorian refinement were real advances in precision [37,41]. It does not explain why names stayed unchanged, which requires the sociolinguistic and political perspectives above.

9.6 Synthesis

No single perspective is sufficient. The traditionalist and sceptical views disagree about the Romulan year's historicity, but both accept that the numeral names point to an earlier March-based scheme. The religious and political views explain why the calendar was administered as it was, and the scientific view explains why successive reforms were needed. A convincing account of the calendar must therefore combine all of them.

10. Limitations

Several limitations qualify the conclusions.

- **Scope of the evidence.** No database search was run, so the corpus does not claim exhaustive coverage. Specialist literature in other languages, particularly German, French and Italian, is underrepresented beyond a few foundational works.
- **Reliance on late sources.** Most testimony about the earliest stages comes from authors who wrote centuries after the events, which limits certainty about the Romulan and Numan stages [5,9].
- **Contested chronology.** Traditional dates such as 753 and 713 BCE are conventional and come from later chronological schemes. They are used here for convenience and not as established facts [4,5].
- **Conceptual proposals.** Nomenclatural inertia and the NDI are exploratory constructs and have not been tested empirically across other languages or calendar systems.
- **Contextual sources.** The contextual sources on language, culture, myth-making and law [7,50–55] were drawn from a supplied list and used for analytical framing, not as evidence about Roman history. Their application to calendar history is by analogy.
- **Quantitative simplification.** The year-length comparisons use mean values and ignore short-term variation such as the changing length of the tropical year.

11. Conclusion

The modern calendar's most puzzling feature has a simple explanation. September, October, November and December carry the numerals seven to ten because they were named in a year that began in March and ran for ten months. When January and February were later placed at the start of the year, every month moved two places, and the numerical names were left behind. The Julian and Gregorian reforms changed the calendar's astronomical basis radically, moving from a lunisolar scheme prone to manipulation to a fixed solar structure and then to a refined leap-year rule. They left the inherited vocabulary almost untouched, because no one had a reason to change it, and because the names had become opaque labels in the languages that adopted them.

The paper's analysis supports five conclusions. First, the numeral mismatch has a single cause and a uniform displacement of two places. Second, the ten-month Romulan year is a layered tradition whose literal historicity is uncertain, though its linguistic traces are real. Third, the persistence of the names is a case of nomenclatural inertia, favoured by semantic opacity, high switching costs and the absence of an actor with both motive and authority to change them. Fourth, calendar reform in Rome was repeatedly an instrument of political and religious authority. Fifth, the modern calendar is a composite of Latin language, Roman religion, Egyptian and Hellenistic astronomy, and early modern ecclesiastical computation.

Future research could pursue three lines. A formal systematic review of the scholarship on Roman calendar history would address the gap identified in Section 3.7. Cross-linguistic testing of the NDI on month and weekday names would show whether the proposed concept generalises. Digital reconstruction of the epigraphic fasti against astronomical simulation could test how mechanically the pre-Julian intercalation scheme drifted and how far administrative discretion corrected or worsened it.

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