Attì del XVI Convegno SIA
Società Italiana di Archeoastronomia

DIPARTIMENTO DI MATEMATICA
POLITECNICO DI MILANO
3-4 NOVEMBRE 2016

Quis dubitet hominem
coniungere caelo?

a cura di
Elio Antonello
INDICE

<table>
<thead>
<tr>
<th>Presentazione</th>
<th>p. 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elio Antonello, &lt;em&gt;Astronomia, paleoclimatologia ed evoluzione umana&lt;/em&gt;</td>
<td>3</td>
</tr>
<tr>
<td>Simone Bartolini, Federico Di Gesualdo, &lt;em&gt;Solar and cosmological symbolism and astronomical orientations of Romanesque churches in Tuscany&lt;/em&gt;</td>
<td>31</td>
</tr>
<tr>
<td>Massimo Calabresi, Paola Refice, &lt;em&gt;Lettura astronomica del cielo dipinto nel sogno di Costantino di Piero della Francesca&lt;/em&gt;</td>
<td>47</td>
</tr>
<tr>
<td>Maurizio Chirri, Michele Ceddia, Isabella Ercoles, Giorgio Manzi, &lt;em&gt;Differenze dei gradi iniziativi e delle corrispondenti influenze planetarie, nei mitrei di Santa Prisca in Roma e del Felicissimo in Ostia&lt;/em&gt;</td>
<td>57</td>
</tr>
<tr>
<td>Mario Codebò, Athanasios Fourlis, &lt;em&gt;Sirius was already white&lt;/em&gt;</td>
<td>69</td>
</tr>
<tr>
<td>Paolo Colona, &lt;em&gt;The astronomical origin of numbers' symbolism&lt;/em&gt;</td>
<td>79</td>
</tr>
<tr>
<td>Marta Conventi, Henry De Santis, &lt;em&gt;Misurare la terra secondo il cielo: il caso di Albingaunum&lt;/em&gt;</td>
<td>97</td>
</tr>
<tr>
<td>Annamaria Dallaporta, Lucio Marcato, &lt;em&gt;A proposito della cometa di Akbar&lt;/em&gt;</td>
<td>107</td>
</tr>
<tr>
<td>Giangiacomo Gandolfì, &lt;em&gt;Gli emisferi celesti della Sagrestia Vecchia a San Lorenzo e della Cappella dei Pazzi a Santa Croce: una rivalutazione astrologica. Parte I&lt;/em&gt;</td>
<td>121</td>
</tr>
</tbody>
</table>
Nicoletta Lanciano,
*Lettura critica dei metodi di Eratostene e Posidonio per stimare il meridiano terrestre, nell’opera di Cleomede* 149

Silvia Motta, Adriano Gaspani,
*An archaeoastronomical investigation on the Templar churches built in Piedmont, in the North West of Italy* 165

Andrea Orlando, Carlo Veca,
*Gli orientamenti delle tombe a pozzetto della necropoli protostorica di Thapsos (Siracusa): analisi preliminare* 177

Andrea Orlando, Orazio Palio e Maria Turco
*Analisi archeoastronomica della spirale megalitica di Balze Soprane (Bronte, CT) nell’area nord-occidentale dell’Etna* 191

Guido Rosada,
*Ut ad orientem spectet* 205

Alberto Scuderi, Vito Francesco Polcaro,
*New evidences of solstice alignments of prehistoric sites in Western Sicily* 229

Eva Spinazzè,
*Baptisteries and baptismal fonts: interpretation of the orientation of Early Christian and medieval baptisteries in Friuli (North-East of Italy). The case of Aquileia* 239

Angela Maria Zavaglia,
*Il complesso rupestre della “Madonna della Stella” di Gravina in Puglia. Ipotesi sui riferimenti archeoastronomici nei rituali dei culti precristiani* 267
The astronomical origin of numbers’ symbolism

Paolo Colona

UER, SIA, UAI, Accademia delle Stelle; infoservizi@yahoo.com

Abstract. We propose a quantitative method for measuring the cultural importance of numbers. It consists in measuring their occurrence in a specific cultural context and then normalizing the outcome for the Benford’s law. We give a provisional estimate of the “numerological signature” for the Western culture as a whole and point out that it’s possible to establish the numerological signature also for much more specific targets. We note that carrying out such a work for mythological or religious canons or single literary works from the past could guarantee a wealth of in-depth information about their origin and eventual mutual influences. We then show that the majority of the most important numbers in our culture have an astronomical derivation and we report our interpretation as to their origin: 7 from the number of the planets; 12 from the entire lunations in a solar year; 72 as 1/5 of 360, being 5 the difference between 365 and 360; 108 as the least common multiple between 12 and 27, capable to merge solar and lunar Zodiac. A note about frequent fortuitous coincidences in astronomical numerology and of a possible discovery of symbolic use of 72 and 108 in Dante’s Divina Commedia is also provided.

1. Introduction
As anyone can easily verify, numbers are not used in an even way in our life and culture: some happen to be used more frequently than others. This evident fact is mainly due to two separate causes that we see in detail: 1) Benford’s law, 2) cultural bias.

1) Benford’s law\(^1\) states that in many sets of numerical data the first digit is likely to be small. Populations of cities or lengths of rivers are more likely to start with a 1 than with a 9, and there are less with a higher figure than with a lower (see Figure 1). The Benford’s law applies to any collection of random numbers that occur naturally\(^2\), that is to say without

---

\(^1\) Discovered in March 1938 by Frank Benford (Benford 1938).
\(^2\) Apart from the usual examples of the length of the rivers (in any unit of measure) or the inhabitants of towns, also the Fibonacci numbers obey to the Benford’s Law.
human intervention, and defines the distribution of the first digits in such collections (which results to be logarithmic). Benford’s law, although just empirical and without a complete theoretical explanation, appears to be sound and reliable enough to be used to detect frauds (i.e. improper manipulation) in statistic data\(^3\) and evidences based on Benford’s law have been admitted as forensic proofs in criminal cases in the United States\(^4\).

2) With *cultural bias* we basically mean “choice”: when any number could go, one was chosen instead of others because of its cultural relevance\(^5\). Cultural bias is often the effect of the symbolism associated to the numbers: a number with a strong symbolic meaning was used preferably instead of less significant numbers.

![Graph showing Benford-like behaviour](image)

**Fig. 1.** The “Benford-like” behaviour is obvious in this bar chart: the height of the bars represents the length of the longest rivers in Mm (first on the left is the Amazon River). Shorter rivers are more numerous than longer ones just as smaller numbers are more frequent in our culture than bigger ones.

These two aspects mainly model the occurrence of numbers in our culture. Our aim is to spot the cultural selection among numbers (cultural bias) and analyse its possible causes with an emphasis on ancient cultural issues. In order to do so, we first identify usable data referring to the usage of numbers, then we apply Benford’s law for normalization, and finally recognize and discuss those numbers that stand out from the mean distribution.

---

\(^3\) Nigrini (1999).


\(^5\) Here we assume that numbers can have a symbolic meaning associated with them. This is a safe assumption since numerology and number-related religions, cults and magic, all based on the different connotations of the numbers, exist since antiquity.
2. About the collection of numbers
As said, our first aim is to quantify the usage of the numbers in our culture. To do this we should be able to count how many times each number is used. Unfortunately this implies to read any newspaper, listen to any broadcast and to examine every book (past and present), waiting to come across a number and take note of it. As this is an impossible task, we have two possibilities: 1) to use subsets (and count numbers used only in specific circumstances) or 2) to take advantage of some “natural counters”, anything that spontaneously reacts to the use of a number and can work as an indicator.

We see these possibilities in detail:

1) Defining subsets is an interesting possibility: we renounce to know the usage of numbers in a global sense and we concentrate to study it only in a definite region or period. We can also decide to limit our investigation to a semantic area (i.e. legal, scientific, religious, poetic...), epoch (archaic, Classical, Medieval…) or even to a single literary work (i.e. Bible, Veda, Homeric Poems, Kyrgyz Manas…). We didn’t choose this option because we first needed to verify if the method itself worked, but it is clear that studying the distribution of numbers in single literary works is an extremely promising research and it will be undertook in the future. Its potential is shown in the final chapter of this paper.

2) Although we can’t actually count all the numbers used in our culture, we can still conceive some shortcuts that allow us to have an estimate of the general usage of a number (and then of its importance). A good tool turned out to be Wikipedia, the well known “free online encyclopaedia”. Each number is in fact an entry of this encyclopaedia and we noticed that the length of the page depends on the usage of the number. This is obvious: the more important is an encyclopaedia entry, the longer it will be. Other indicators could be, for example, the amount of pages found by Google containing each number. But, while Wikipedia already selects the use of a number in various cultural areas, Google queries are somewhat more noisy and requires a more elaborated processing.

About the choice of using Wikipedia as a brief indicator of cultural importance of the numbers, it is useful to note that: 1) the language of Wikipedia doesn’t seem to greatly affect the results since pages are often similar copies from other languages (mainly English)\(^6\), 2) the facts that

\(^6\) Or, otherwise, the pages that we could access and treat are all written in Indo-European languages and then maybe for this reason show the same numerological signature.
71 (number)

72 (number)

Fig. 2. Wikipedia entries for numbers 71 and 72. The length of the latter mostly depends on the wide use of this number in religion.
3. Data processing
We started downloading 150\(^7\) pages of Wikipedia (one for each number between 1 and 150), then we used their digital weight (KB) to code the length of text used for each number. As expected for the Benford’s law, the smaller numbers showed to have longer pages in the encyclopaedia according to their greater use, resulting in higher bars in Figure 3.

![Figure 3](image)

**Fig. 3.** The histogram with the raw data shows its “Benford-like” behaviour. Columns represent the weight of the Wikipedia page for each number in KB.

Some numbers do peak above the overall trend (for example numbers 7 and 12): in order to determine their actual importance we normalized the data set with the Benford’s law.

The now “flat” histogram clearly shows which numbers deserved more space in the encyclopaedia, revealing their cultural importance (Figure 4). Bars don’t have errors because they derive from given digital quantities, but the result in general counts on the reliability of Wikipedia itself in assessing the utilization and cultural relevance of a number. Basically, this work has been possible because “the richer is the cultural role of a number, the bigger is the encyclopaedia’s page that refers to it”. We, for ourselves, assumed a +/−10% as an indicative value of uncertainty in case of a quantitative treatment of the data, but it’s clear that a mostly qualitative use of this histogram is quite enough for the interest of this study.

---

\(^7\) It’s just a practical limit: nothing would have changed with a wider set of pages. Moreover most of the numbers known to have a cultural relevance are lower than 150, so such a set is ideal for testing our method. The data were taken from the Italian version in early 2015.
Fig. 4. The same bar chart of Fig. 3 net of the effects of the Benford’s Law. Now the trend is flat and it’s easier to evaluate the cultural relevance of each number.

4. Evaluating the histogram
The first time the histogram appeared to us, we eagerly went to see how certain well known numbers behaved, also in order to see if the response was reasonable. All the numbers that we expected to peak stood out of the lower crowd of “anonymous” numbers, showing that the work was reliable. We see the result in detail. Among the 24 numbers\(^8\) that score highest in the graph, 7 are smaller than 10, and 7 more are related to “tens” (i.e. 40, 50, 70, 80, 99, 100, 101\(^9\)). The only small number that seems reasonable to keep for further discussion is 7, which scores highest in the histogram and far above neighbouring digits. We’ll also ignore those related to tens since their importance is probably just due to their being round numbers\(^{10}\). The nine numbers that clearly requires an explanation after this skimming are: 7, 12, 13, 23, 28, 33, 42, 72, 108\(^{11}\). All of them notoriously have a story to tell (often related to astronomy), confirming that the recognition process is effective\(^{12}\).

---

\(^8\) These are the numbers whose bar crosses the first horizontal line in the histogram, which has no a particular meaning apart from being helpful in spotting the highest results, the most interesting for our purposes.

\(^9\) “100” is so important and peculiar that it brings above the line both 99 and 101.

\(^{10}\) This doesn’t mean that a round number can’t have a story for itself (number 40, for example, is interesting), but we’ll focus on those that have no evident reason to stand fiercely above the average.

\(^{11}\) In “order of importance” (height of their bars) the numbers are: 7, 12, 42, 108, 23, 33, 28, 72, 13.

\(^{12}\) There could exist interesting numbers that yet don’t stand out in the histogram? It is possible and it would mean that their importance is subtle enough to have deceived Wikipedia’s process. Such hairsplitting entries can be identified by a more precise,
5. Discussing the numbers and their meanings
We now leave aside the foregoing discourse about data collection and turn to investigate the possible origin of the importance of each number.

A closer look at those nine numbers shows that for some of them their “fame” is recent. The Free Encyclopaedia is in fact well updated about modern themes which are popular in the web and this aspect obviously emerges in our results.

23. The obliquity of Ecliptic is the most probable astronomical meaning of twenty-three, but, totalling 20 billion web pages, two mainstream movies and several musical clip with billions of visualizations, number 23 is so widespread that enters our statistics anyway, regardless of its astronomical valence. A better comprehension of this number and its possible but uncertain relation with astronomy could come from studying the occurrence of numbers in more ancient sources.

33. Besides being the age of Jesus, thirty-three has various uses that incline to mysticism, both in the Masonry and in numerology. This number seems to be unrelated to any astronomical meaning; it’s fortune could well originate from the Gospels.

42. Forty-two got a longer entry in Wikipedia mostly because it is “the answer to the ultimate question of life, the universe and everything” in Douglas Adams’ book “The Hitchhiker’s Guide to the Galaxy”. It’s great fortune in contemporary popular culture, with quotations in games and TV series, makes number 42 peak in the histogram regardless of any possible astronomical or ancient origin, that, if exists, should be thus investigated purposely.

6. Important numbers of astronomical origin
Six of the nine numbers that display a peculiar cultural relevance borrow their fortune from astronomy.

7. Seven, the number with the highest bar, is undoubtedly the most popular number with a specific symbolic meaning. Things listed in groups
direct application of our method as proposed in paragraph 2.2 and suggested in the last chapter.

Googling “42” will plainly testify it. Also, just starting typing the query “The answer...” in Google, the phrase will be automatically completed.

As Elon Musk himself confirmed, a copy of this book is kept in the glove box of his Tesla, the car launched toward Mars by the most powerful roket Falcon Heavy of the SpaceX Corporation on 2018 Feb 6th. On the LCD display of the car is shown “don’t panic” and a towel is also kept in the car: two more quotations from the book.
of seven are countless. The importance of this number is exquisitely astronomical and derives from the number of the “planets”\textsuperscript{15}. Some relate 7 to the days of the week, that’s to say to a quarter of a lunar cycle, but, at least for its primary meaning, the planetary interpretation is more convincing. There exist in fact all over the world ancient tales about seven doors, or ladders with seven steps or trees with seven branches that lead to the sky\textsuperscript{16}. Such ladders or doors or branches can hardly be the days of the week, while are easy to identify with the classical seven “skies”, one for each planet, that link the Earth to the upper world\textsuperscript{17}.

The importance of 7 is usually said to come from early planetary observations in Mesopotamia\textsuperscript{18}, but it’s impossible to exclude that its origin could precede even by far Mesopotamian astronomy. Actually this possibility would better explain the wide spread of the motif.

A theme funded on the number seven that appear to us directly related to the planets is that of the “seven sages”, attested in many cultures: the “original” seven sages, to which the human ones are inspired, could well be the seven planets, seen as superior intelligent beings, holders of the fate\textsuperscript{19}.

12. \textit{Twelve} is the second most important number in our culture and it originates from the number of months (i.e. lunations or lunar cycles) that fit in a year. This number is sometimes depicted as a circle of stars. Each of such star represents a full moon along the Ecliptic (see the European flag). As a symbol, it has two meanings: 12 companions of the Sun (seen as an important man or god) and of the reaching of unity (one entire year) from multiplicity. We called this ancient symbol \textit{dodecasterion} and discussed its meaning in a previous work\textsuperscript{20}.

---

\textsuperscript{15} Here we of course use “planet” with its ancient meaning of “wandering star”, so that the “planets” are seven and were known since the most ancient times.

\textsuperscript{16} The theme is renowned and widely studied. In a word: “Climbing the Tree of Life is referred to symbolically in stories that tell of ascending seven layers into the sky and climbing stairs with seven steps or ladders with seven rungs. For example, the Turko-Mongol birch post is carved with seven notches and set standing symbolically at the center of the world” (Pratt 2007).

\textsuperscript{17} Later mystic ascensions to the heavens explicitly develop through the “skies” of the seven planets, as in Ibn ‘Arabi’s \textit{al-Futūḥat al-Makkiyya} or in Dante’s \textit{Divina Commedia}.

\textsuperscript{18} See Eliade (1987).

\textsuperscript{19} In India the Seven Sages (\textit{Saptarishi}) are identified with the seven stars of the Big Dipper. It is possibly a later identification. See note 44 in chap. 8.

\textsuperscript{20} Colona (2014a); see also Colona (2014b).
13. Modern triskaidekaphobia, which is the first reason why *thirteen* is high in our histogram, can be related to the interesting astronomical significance of this number, which also refers to the thirteenth Babylonian leap month (represented by a crow, a sign of misfortune) according to *Knaurs Lexicon der Symbole*.

28. *Twenty-eight* is not necessarily an “astronomical” number. 28 days are in fact the mean duration of the female cycle, and this could be enough for making 28 important. Yet the lunar cycle is very similar: the sidereal month is of 27.3 days while the synodic month is of 29.5 days, and their average equals the fertility cycle\(^{21}\). Actually, 28 can have been used as a lunar number in many cases throughout history. Among them we are inclined to count the division in 28 sectors of the dome of the Pantheon in Rome. From the length of the lunar cycle and of the year come the importance of the numbers 12 (months in a year) and 30 (days in a month).

7. **Two crucial astronomical numbers**

72. Symbolic use of *seventy-two* dates back to Egyptians and Babylonians and is well attested in many traditions\(^{22}\). The symbology of this number, often seen as the number of disciples or mates of some important figure, suggests a precise way for it to gain its importance, in analogy with number 12. It simply seems to be a further subdivision of the Zodiac by dividing each month in 6 sections of 5 days, that's to say half of a Decan\(^{23}\), and the entire year into 72 steps\(^{24}\). Secondly, its importance may derive from being 1/5 of 360, where 5 is the difference between 360 (convenient partition of the Ecliptic) and 365 (the duration of a year), an essential evidence found after the first determination of the length of the year. The

---

\(^{21}\) It’s one of the reasons why the lunar symbol is close to the female figure in our culture.

\(^{22}\) Just few examples: 72 were the conspirators that helped Seth-Typhon to kill Osiris; the mates Odysseus lost in the land of the Ciconians; the sages who translated the Bible from Hebrew into Greek; the disciples Jesus sent to spread the Gospel; the steps of the Jacob's ladder according to the Zohar; the virgins that awaits Islam martyrs in heaven; the sacred sites of Chinese Taoism, and the disciples of Confucius.

\(^{23}\) Used in Egypt since the end of III millennium BC, Decans are a division of the rotating celestial sphere in 36 subsequent parts, each of which put in relation to the Zodiac.

\(^{24}\) The connection between 5 and 72 to build up an entire year is also well known far from ancient Egypt. The traditional Japanese calendar includes 72 seasons of 5 days (called *Shichijūni Kō*) to keep in touch with the subtle and constant seasonal changes all through the year.
process must have been the following: the handy round digit closest to the actual duration of the year is 360 (upon this, the sexagesimal numeral system was developed by ancient astronomers and used in Mesopotamia\textsuperscript{25}). If we consider a year of 360 days, 5 days will miss to the count, that’s to say \textit{one per each 72 days of the year}. Ancient astronomers got this notion. It is confirmed by the Egyptian myth\textsuperscript{26} of the creation of the five “extra days”, obtained by the god Thoth that gambled with the Moon for 1/72 of her light (360/72 = 5) and won\textsuperscript{27}.

The importance of number 72 may then have flourished around II millennium b.C. or earlier depending on when a 365 days year was recognized and when the computing needs suggested the use of the round digit 360 to streamline calculations.

It is worth to spend a word about the relation between 72 and the precession of the equinoxes\textsuperscript{28}, that many scholars suppose was known in ancient times before Hipparchus\textsuperscript{29}. We also believe that it’s not correct to exclude that the notion of some effects of the precession could have been known far before Hipparchus. Though, following Hipparchus (as we know it from Ptolemy), the precession rate is said to be “less than one degree every 100 years” and not explicitly 72. Therefore the number 72 is ruled out. Under these circumstances, unless we find proof that the rate of the precession was known with its correct value in very ancient times, we must hold that the importance of number 72 is not linked to precession\textsuperscript{30}.

\textsuperscript{25} The choice was highly encouraged by practical reasons “for a magnitude of 60 units can be subdivided easily into halves, thirds, fourths, fifths, sixths, tenths, twelfths, fifteenth and thirtieths, thus affording ten possible subdivisions.” Boyer B. C., Merzbach C. U. (2010) \textit{A History of Mathematics}.
\textsuperscript{27} Thank to these 5 brand new days conquered or created by Thoth, Nut could give birth to her 5 sons and daughters: Horus, Osiris, Set, Isis, and Nephtys. This is the mythic institution of the year of 365 days instead of 365. The five extra days are called \textit{epagomenal days} and Egyptians considered them the birthdays of the five gods.
\textsuperscript{28} The equinoxes go through one degree of Ecliptic every 72 years due to precession.
\textsuperscript{29} Among them maybe the most famous is Giorgio De Santillana with his essay \textit{Hamlet’s Mill}.
\textsuperscript{30} Assuming that the spread itself of number 72 is a proof that the precession rate was well known already in second millennium is surely a suggestive theory but alas it requires independent (and strong) proofs currently missing. (Instead, that the ancients knew that 72 is a fifth of 360 doesn’t require any particular support).
(And, if it is, the importance of 72 must have occurred after the conventional division of the circle in 360°, this is a firm chronological constrain). Of great interest is the relation between 70 and 72, since there was a convergence in their qualitative, symbolic meaning. It was due to their closeness and to the importance 70 had on its own for being ten times seven. 70 and 72 are then sometimes used equivalently, with 70 approximating 72 and borrowing or sharing its connotation. For example Plutarch himself states that Thoth won one seventieth (εβδομηκοστός) of the year, and the so called Septuagint (namely “the Bible of the Seventy”) was actually drafted by seventy two translators.

108. One hundred and eight is the number with the greatest cultural relevance in Southern and Eastern Asia. Oriental religion, philosophy, mysticism and even martial arts hold this number as the most significant and sacred. It is commonly found in Hinduism, Jainism, Buddhism and Chinese astrology. Its fortune seems to start in India, presumably during second millennium B.C. or before. The reason of the fortune of 108 is to be found in the Moon, that encompasses the entire Zodiac in circa 27 days. Ancient Indian astrology divided the Ecliptic into 27 lunar mansions called nakshatra, and each nakshatra was purposely subdivided into four portions called pada (step) obtaining a total of 108 sections of the Zodiac. An alternative very suggestive hypothesis that we held true but later had to discharge is that this number became important when the discovery was made that it corresponds to the relative distance of the Sun. In the past years the Author attempted several times to measure the relative distance of the Sun in order to see if such a measurement was accessible to ancient

---

31 This hypothesis is also contrasted by the wrong figure (100 years per degree) given by Ptolemy: how could very ancient civilizations know the exact rate of the precession when the much later astronomers Hipparchus and Ptolemy missed it?
32 Number seventy appears some 50 times in the Bible (about ten more than number fourty), with this strong symbolism. In our bar chart 72 scores just slightly higher than 70.
33 If not used instead of 72, it would be a paradox since 360 is divisible by 72, but not by 70.
34 The number 108 is structural in the Vedic literature and is pervasive in any expression of ancient Indian culture. (And modern too. We can mention en passant that 108 is an Indian toll free emergency telephone number).
35 The relative distance of an object is measured by means of its size. The Sun is 108 solar diameters away from the Earth, so 108 is its relative distance. Similarly, a ball will look the same apparent size of the Sun if placed at 108 times its diameter from the observer.
observers, and succeeded within an error of very few percents using totally
trivial tools such as strings and wooden sticks. This reassured us that
skilled ancient astronomers could well determine the relative distance of
the Sun. We independently discovered this relation without knowing that it
was first published by professor Subhash Kak in 1993. We had to
abandon this interpretation because of the following reasons. The symbolic
meaning usually given to the number 108 in several Oriental religions and
disciplines: it is often considered as the number of steps or difficulties to
overcome in order to reach the spiritual goal of perfection and fulfilment.
Then the underlying concept appears to be that there are “108 times” a
solar size to pass before reaching the real Sun. This seems to support the
interpretation of 108 as the relative distance of the Sun. Yet, if the Zodiac
is divided in 108 steps, it's easy to conceive the year as a continuous
struggle toward perfection, and the yearly solar path divided in 108
sections will still fit the symbolic meaning of 108 obstacles to overcome.
The Mala itself, the Buddhist Rosary, compound of 108 grains, is a crown,
a circuit, just like the Ecliptic. And the 108 bell tolls in the Japanese
Buddhist ceremony for the new year can well be an omen for seizing the
108 opportunities brought by the new year (the next orbit of the Sun along
the Zodiac) to improve oneself.

It is very remarkable that 108, with the same connotation (number of
difficulties to outmatch) appears in Homeric Odyssey, quantifying the
suitors of Penelope, the rivals that Odysseus had to kill before he could
reveal himself to his wife and complete his nostos: the Proci were 108. In
this case, though, interpreting 108 as the divisions of the Zodiac also holds
since the numbers referring to the divisions of the Zodiac are always
expressed in the myths as the mates of an important figure (12 Apostles,
72 Disciples and so on). Then, there could properly be 108 suitors at
Penelope’s court if this number is seen as a division of the Zodiac. Lastly,
one could still argue that there must have been a reason for dividing in four
sections the 27 nakshatras, and conclude that the reason could be that it
was symbolically attractive to obtain the same number expressing the

36 Subhash Kak, *Astronomy and its Role in Vedic Culture*, in *Vistas in Astronomy*,
Volume 36, Part 1.

37 The defilements of Buddhism are 108; conventional Buddhist mala (Rosary) has
108 beads, each remembering the mortal desires of mankind.

38 For example, in Japan, at the end of the year, a bell is chimed 108 times in
Buddhist temples to welcome the new year. Each ring represents one of 108 earthly
temptations a person must overcome in order to achieve nirvana.
relative distance of the Sun. But two problems arise here: 1) we have no archaeological or historical evidence that independently indicate that such a measurement was actually obtained in ancient times; 2) there is a far more compelling reason for doing so: 108 is the Least Common Multiple between 12 and 27, that's to say 108 is the number that links the Lunar Zodiac (27 days/nakshara) with the Solar one (12 months/signs). 108 is then important for itself regardless of the knowledge of the relative distance of the Sun.

108 and its meaning must have been very popular in the region of origin and eventually spread along with Indian culture and religion. Starting from the second half of the first millennium b.C. Buddhist monks mainly conveyed in other regions and cultures (China, Japan and far East) the symbolism of 108 that also passed to Islamic nations in later centuries[^39]. It is interesting to note that the fortune of 108 seems to have leaked also into Christian culture. The Rosary, in its canonical form, has 54 beads. This must be compared to the Buddhist use of making the Rosary (called Mala) of 108 beads or of a divisor of 108[^40].

8. Dante, numerology and fortuity
We are trying to bring quantitative analysis into a field usually left to speculation and suggestion. To our surprise, the difficulty was not only that in ancient times it wasn’t usual to write why a number was important, or that the explanations given today are often assumptive. Our biggest issue actually was with *fortuity*. This study definitively demonstrates that coincidences and flukes do exist. As the reader may have noticed, in fact, three of the four most important astronomical numbers (12, 72, 108) are mutual multiple or divisors. It is so strong the enticement of arithmetic that, once it’s established that 12 is a very important number for obvious reasons, one could conclude that its multiples (12 x 6 and 12 x 9, i.e. 72 and 108) are important just because of it[^41]. Worst, one could be tempted by

[^39]: Giorgio De Santillana downright grasped the importance of 108 but couldn’t determine its origin. Along with 72 he unfortunately related 108 to the precession of the equinoxes due to arithmetic relations between the two numbers.

[^40]: Number 108 sometimes also appear in architectonic decorations of Western churches as it does for example in the magnificent façade of the cathedral of Ferrara, embellished with 54 *couples* of columns.

[^41]: If it was true, then also 48 (12 x 4) and 84 (12 x 7) should be as much common numbers in ancient literature. But this doesn’t happen: the assumption is wrong.
easy numerology and notice that the first powers of the very first numbers ($2^2 \times 3^1$, $2^3 \times 3^2$ and $2^2 \times 3^3$) give us precisely our figures: 12, 72, 108.

Fig. 5. Talking about coincidences: as incredible as it can be, 36, 72 and 108 all appear as the angular values in the five pointed stars (once the circle is divided into 360 degrees). Moreover they do so in a spree of golden ratios. (Not mentioning the relation between the pentagon and the appearances of Venus along the Ecliptic…)

However, we saw instead that 12, 72 and 108 stem each from a different astronomical observable fact and have nothing to do with each other. They are respectively linked to the ratio between orbital periods of the Earth and of the Moon, to the ratio of orbital and rotational periods of the Earth, and to the sidereal period of the Moon. All quantities totally unrelated and that ancient astronomers were aware of. So their independence and their astronomical origin are safe. Nevertheless we also find 72 and 108 along with their companion 36 (triple of 12, third of 108 and half of 72) all together in the angles of the “magical”\footnote{The five-pointed star (also known as pentagram, pentacle, pentalpha, pentangle or star pentagon) was used symbolically in ancient Greece and Babylonia and had magical roles over the centuries from Neoplatonism to Freemasonry.}\footnote{Actually this coincidence, together with their being mutual multiple or divisors and their very simple and basic arithmetical expressions, can well have contributed to their fortune and boosted the prestige of such numbers (and also of the five-pointed star!)} five points star\footnote{see Figure 5} (see Figure 5).
Many more incredible coincidences that simply exist for no reason are common in astronomical numerology and they of course get the work complicated, making a harder task to establish whether a circumstance is a fact or a fortuity without importance.

This very problem arises with Dante, too.

As we all know, Dante was an eager scholar with an incomparable culture. He packed his masterpiece the Divina Commedia with the most sophisticated scientific notions, along with sagacious codes and hidden references according to the typical medieval taste. We already saw that the importance of 108 leaked into Western culture (both Greek and Christian) and we noted that numbers 72 and 108 are related to the Sun path. There is no perceptible difficulty in admitting that Dante could be aware of the solar symbolism of 72 and 108. If so, there could be traces in his work. Phaethon is a well known solar myth and Dante mentions it three times in the Divina Commedia. The first two mentions are at the verses 72 and 108 of If IX and Pg XVII. No comment is needed of course, but there is more.

The Commedia contains 100 canti, so we can’t check if something peculiar related to the Sun happens in the inexistente “canto 108”. But we can do it with the canto 72 which begins with these verses:

\[ S’io ti fiammegio nel caldo d’amore \]
\[ di là dal modo che’n terra si vede, \]
\[ sì che del viso tuo vinco il valore \]

Such an explosion of unbearable light may well be an allusion to the shine of the Sun. The same happens at the verse 108 of the same canto:

---

44 There’s no need to list them all. We’ll just recall that seven are at the same time the planets, the days of the week (one fourth of the lunar period), and also the main stars in nearly all the most evident asterisms of the sky: Orion, Ursa Major, Corona Borealis, Pleiades.

45 See for example Paradiso, canto V, vv. 97-111 where an inverse acrostic of the first letter of each tercet reads “PESCE” (“fish”) while in the straight text Dante uses a similitude based upon the act of fishing.

46 It narrates the tragic misadventure of Phaethon, son of Apollo, who tries to drive the car of the Sun but burns the Earth with excessive heat and ends stroked by the lightning of Zeus. We have studied this myth and in a future work we’ll make clear its meaning and its odd details.

47 The 72nd canto of the Divina Commedia is Pd V (fifth of Paradiso).

48 “If I dazzle you like a flaming fire of love more than is seen on Earth so that you can’t sustain my sight”.

93
All these notable cases can be clear signs that Dante knew and used the solar connotation of numbers 72 and 108... Or they may be one more fortuitous coincidence in astronomical numerology: further studies will settle the question.

9. Conclusions

This work is compound of two distinct studies.

In the first part we presented a method for quantitatively evaluating the importance of a number in a certain cultural context. It is about counting how many times each number is used and then plot the results, bring the due normalization following the Benford’s law and analyse the outcome. We did it with general Western culture taking advantage of Wikipedia’s pages as a shortcut for estimating the use of the numbers. We also pointed out that a more exact procedure could be followed if it were possible to actually count the occurrence of the single numbers, as could be done for example narrowing the study to a single work from the ancient texts. In this case a precise “numerological fingerprint” (as much as the spectra used in astrophysics) would result for each ancient literary ambient or author, leading to a better comprehension of the background and reference culture. It would be of extreme interest then comparing the “fingerprints” of works from different epochs, geographic areas or cultural contexts. Moreover, since the cultural context affects the occurrence of numbers in a work, through the study of their numerological signature it would be possible to characterize origin and possible influences of each work.

In the second part we have been browsing the numbers that emerged from the previous processing. We discovered that six\textsuperscript{51} out of nine of the most relevant numbers in our culture draw their importance from ancient astronomical observations. This demonstrates once more that astronomy was essential for archaic civilizations and closely linked to their cultural evolution, to the point that its legacy lingers on till today, making evident

\textsuperscript{49} Actually the excessive brightness of the Sun is the major difficulty faced by the observer who tries to measure the relative distance of the Sun (as the Author can testify upon his own experience).

\textsuperscript{50} “In the bright glare that sparked from her”.

\textsuperscript{51} The four numbers with a certain astronomical origin are 7, 12, 72, 108; those \textit{sub judice} are 13, 33 and 28. Others (like 23, 40, 144 = 12\textsuperscript{2} and even more) may as well have an astronomical connotation waiting to be clarified.
(and above all it is now measurable) the contribution of astronomy to our present culture. Numbers with a certain astronomical derivation are: 7, 12, 72, 108. We discussed the observations from which they took origin (noting that 72 has nothing to do with the precession of the equinoxes), and outlined in particular the possible history and evolution of the exceptional number 108.

A note was added in which we warn of the dangers of the accidental convergences that flourish within astronomical numerology and we present a possible discovery regarding the use of the numbers 72 and 108 following their astronomical connotations in the Divina Commedia of Dante Alighieri.

Bibliografia


Colona P. (2014b) Riferimenti, simboli e numerologia astronomica nel Canzoniere di Petrarca, in Gerbertus vol. 5 and 6 p. 109-124, ISSN 2038355X.


