



The Sacred Number 108

by Newcomb Greenleaf

Hindus count 108 Upanishads
Tibetan and Indian malas
 string together 108 prayer beads
The collected words of the Buddha
 the Kanjyur of Tibet
 fill 108 volumes
9-1-1 in the USA becomes 1-0-8 in India
Why 108?

As maverick algorist mathematician and
vajrayana Buddhist practitioner
I take two routes to 108
first to its emptiness, to sunyata
Like all objects
108 is empty through three dependencies
on conventional designation
on parts and internal structure
on greater wholes of which it is a part
CVIII is empty of independent existence

Our sacred number goes by many names
many conventional designations
one hundred eight
gya gye
CVIII
hundert acht
108
cientos ocho
1101100
cem oito
cent huit
and countless more

Does 108 exist independent
of all naming?
It's a matter of opinion
You may agree with Martin Gardner
and most mathematicians that
when two dinosaurs met two dinosaurs
there were four dinosaurs
though there was no one there to count
(unless dinosaurs could count)
Algorist maverick I agree only that
when two imagined dinosaurs
meet two more of same
I've got four dinosaurs on my mind
As Nagarjuna might put it
There is no mathematics without mathematicians
There are no mathematicians without mathematics

A mindful trip around a mala from 1 to 108
never skips 37
so 108 depends on 37
has no existence that is separate from 37
37 is a part of 108 that can be taken away
 $108 - 37 = 71$
108 depends on 37 and all its parts

108 sits loyally between 107 and 109
If removed from its neighbors
108 loses its identity
dies and is no more

108 depends on both 107 and 109
Count beyond 108 and 109
to millions billions trillions
and their followers

Gaze into the infinite expanses
of modern mathematics
in which our number is now found
including the *Sacred Explosion*
which we will set off below

These three dependencies
on convention
on parts
on greater wholes wider contexts
establish the emptiness of 108
108 is not separate from
the context of being a number
and that context keeps changing

Vajrayana Buddhist practice
cooked 108 into my psyche
Inspired by Chögyam Trungpa Rinpoche
meek perky outrageous inscrutable
crazy wisdom Tibetan yogi
with 108 bead mala I counted endless
humbling prostrations
cleansing purifications
sweeping generousities
melting openings of the heart

Each circular journey of mind and fingers
summons **108** to embodied life
in a sacred setting

108 is a number
infinitely created and caressed
infinitely pondered and blessed
by fingers and minds
of millennia of vajrayanists
soaked in good intentions and holy spirit

The beautiful symmetry of **108**
catches a mathematician's eye

In **Euclid's *Elements*** we learn
every positive whole number
carries a special structure
its prime factorization

Now **108** arises from first primes 2 and 3:

$$108 = 2 \cdot 54 = 2 \cdot 2 \cdot 27 = 2 \cdot 2 \cdot 3 \cdot 3 \cdot 3$$
$$108 = 2^2 \cdot 3^3$$

Holding to the symmetry
exponent = base
suggests a sequence that grows
faster than any exponential sequence

The *Sacred Explosion*
inspired by our sacred number
Watch it grow super-exponentially

Start the *Sacred Explosion* with

1

multiply by the prime 2 raised to power 2

$$2^2 = 4$$

then multiply by the prime 3 raised to power 3

$$2^2 \cdot 3^3 = \mathbf{108}$$

multiply by the prime 5 to the 5th

$$2^2 \cdot 3^3 \cdot 5^5 = 337,500$$

by 7 to the 7th

$$2^2 \cdot 3^3 \cdot 5^5 \cdot 7^7 = 277,945,762,500$$

a bit less than three hundred billion

by 11 to the 11th

79,301,169,838,123,235,887,500

around eighty sextillion

a number with 23 digits

by 13 to the 13th

a number with 38 digits

and so it explodes

Another look at the start of the *Sacred Explosion*:

1 is unique

4 is cozy

108 is human

three hundred thousand is personal finance

three hundred billion is global finance

eighty sextillion is astronomical

38 digits transcends reference

we've only looked at the first seven terms

barely started

108 is the human anchor of the *Sacred Explosion*

Our Python-enabled window

on numerical vastness

might cause *Euclid* to faint

with surprise and envy

Despite his deep math understanding

even *Euclid* could barely calculate

Computation was hard

labor intensive

just try doing arithmetic with Roman numerals

no notation for really big numbers

no zero

no negative numbers

Euclid also had class issues

geometry was aristocratic and sacred

while arithmetic

was for shopkeepers

And he knew nothing of sunyata

A millennium after *Euclid*
India saw a great mathematical revolution
emptiness-inspired
zero brought in from the cold
just as sunyata pointed to no thing
so zero could be a number that counted nothing
“zero” and “sunya” are cognate
With zero came numerals
we call Hindu-Arabic
naming our sacred number 108
enabling efficient algorithms for
adding subtracting multiplying dividing
On the other side of zero
negative numbers came into being

Brahmagupta stands tall at the center of this flowering
creator/liberator of zero and negative numbers
an astronomer for whom math was a sacred tool
wrote his great thesis around 630

Brahma Sphuta Siddhanta

(The True Doctrine of Brahma)

in a classical poetic form used for sacred verse
all words no formulas no new symbols
no x y or z but colors for variables
subtract the square of red from green
positive numbers were “assets”
negatives were “debts”

There was justice for *all* numbers
assets debts zero
all full members of the club of numbers
all subject to universal karmic laws
the product of two debts is always an asset

Zero flanked by assets and debts
as sunyata lies between affirmation and denial
The *Brahma Sphuta Siddhanta* circulated widely
reaching Baghdad in less than two centuries
translated into Arabic
into the hands of *al-Khwārizmī*

Muhammad ibn Mūsā al-Khwārizmī

Persian “man from Khorezm”
astronomer-mathematician-geographer
at the Caliph’s House of Wisdom in Baghdad
improved the Hindu algorithms for arithmetic
The word “algorithm” comes from Algoritmi
al-Khwarizmi Latinized
the central concept of computer science
of which he is now a patron saint
His 830 text on arithmetic and higher math
made it to Europe
translated into Latin before 1125
Only the Latin translation survives

European adoption was slow and controversial

Abacists moved beads on wires
worked faster with fewer errors
Algorists used Algoritmi’s methods
left a checkable paper trail
but in a foreign notation

Enter *Fibonacci* in Pisa

merchant *and* mathematician
European father of modern math
learned the secrets of Arab merchants
including arithmetic in the service of money
wrote about it in

Liber Abaci (Book of Computation, 1202, Pisa)

brought numerals and algorithms
into local culture
by linking them with *money*
a cornucopia of complex problems
buying horses and melting coins
finding purses and lending money
even breeding rabbits

For families moving from farms to towns
breeding rabbits was serious business

He is remembered today for that problem
in which the rabbit population grows as
0 1 1 2 3 5 8 13 21 34 55 89 144 ...
each the sum of the prior two
a sequence now called *Fibonacci*
A sequence in which the ratios become golden
linking our Pisan merchant to the pentagram
a universal sacred symbol
in which all ten triangles are golden
Indian mathematical musicians
counting rhythmic patterns
of single notes and double notes
found the Fibonacci sequence over a millenium earlier

Long after astronomers and merchants
adopted Hindu-Arabic numerals
Roman numerals remained in common use
108 was a notational device used for computation
CVIII was the real thing
put on headstones and cornerstones
But money talks and now
108 is the number itself
while CVIII will be applied to
the Super Bowl in the year 2074

Number-enabled darkness now
casts a shadow even over **108**
The Brahma Sphuta Siddhanta
is sacred verse
Liber Abaci
is all about money
Math and weaponry developed together
from cannonballs to the atomic bomb
In math classrooms we have
anxiety loathing
racism sexism
more fear than love
Math-enabled technology
math-supported materialism
lie at the core of our environmental crisis

Let us pray:

Sacred number 108
empty by convention and context
beautiful by symmetry
holy and powerful through practice
Please shine a warm light of love and wisdom
onto the often cold and gray
world of numbers
Pacify
enrich
magnetize
and when necessary
destroy

Feel free to recite the prayer 108 times.

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An earlier and much shorter version of this poem,  
with the title *The Emptiness of 108*,  
appeared in a gorgeous volume of art:

*Catherine Eaton Skinner: 108*

Radius Books, Santa Fe, 2016.

Skinner asked me to write an essay,  
and it insisted in coming out in poetic form.

Skinner's work inspired me to create the 108-art  
that appears before the poem.

It pictures the six integral rectangles with area 108:

1 by 108, 2 by 54, 3 by 36, 4 by 27, 6 by 18, 9 by 12.

In homage to the *sangaku*, the wooden panels  
on which geometric diagrams were painted  
in Japanese Temple Geometry

(which I prefer to call "Zen Geometry"),

I like to place geometric patterns,

here the six rectangles,

on photos of trees and tree bark.

The bark in this image is birch.

The geometry was done with GeoGebra  
and the graphics with GIMP.