

Art of π : Mathematical History and Literary Inspiration

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Abstract

The symbol π as a denotation for the constant ratio of a circle's circumference to its diameter appears in the 17th century. In addition to mathematical applications, this number has been an inspiration to artists and poets for a long time. In this paper I present several texts, including poems by M. Keith, a number of Russian poets and myself, that represent a wide range of poetic possibilities inspired by the number π and its mathematical properties.

Introduction

As it is well known, the number π is the ratio of a circle's circumference to its diameter. The name possibly originated from the Greek word 'periphēria' – 'edge', 'arc', while the first appearance of the letter π in this sense was in William Oughtred's *Clavis mathematicae* (1631). Afterwards it was mentioned in William Jones' *Synopsis Palmariorum Matheseos* (1706), and after Leonard Euler's famous *Introductio in analysi infinitiorum* (1748) the name became widespread among the mathematical community [12].

There are several approximations of π used in mathematical calculations with the most popular being the decimal: 3.14159265358979323846264338... and the rational: 22/7, 333/106, 355/113, 52163/16604. In addition there is an approximation in a numerical system based on 60 as 3:8:30 ($3 + 8/60 + 30/60^2$), used since Ptolemy's *Almagest* (circa 148 a.d.); and a series discovered by Leibnitz in 1673:

$$\pi / 4 = 1 - 1/3 + 2/5 - 1/7 + 1/9 - 1/11 + \dots$$

and its general case described by James Gregory:

$$\arctg x = x - x^3/3 + x^5/5 - x^7/7 + x^9/9 - x^{11}/11 + \dots, \text{ where } |x| \leq 1.$$

Mathematicians, physicists and engineers use number π for calculations, while artists and poets use it for inspiration. In 2009 I started collecting art works inspired by the number π for the Antipodes Association [8]. First I thought these works were simple amusements, but Noam D. Elkies performing *Allegro a la J.S. Bach and C.M. von Weber* at the Bridges 2010 gave me an incentive to search for more developed works. In his musical piece, Elkies encodes the first 244 decimals of the number π by the musical notes: every fourth note of the right-hand part corresponds by tone to a digit of the number π in sequence. My collection of art works inspired by the number π was presented at the Antipodes Festival-2011 with 112 works in literature, visual arts, musical and craft categories, and has been continually enriched since then. In the present paper I review some literary works from this collection demonstrating various approaches to present the number π in literature.

Literary Works Inspired by the Number π

The literary exploration of the number π includes several enumerations in accordance with the decimal approximation of the number π : number of letters in the words of the text, number of syllables, and even number of lines in a strophe of a poem; other methods include emphasizing of the first letters of the words, mnemonic writing based on various π approximations, visual and phonetic exploration of π and meditations on transcendency. Most of the literary texts in the collection are in Russian (presented here in my translations into English). Few non-Russian texts include a poem by Wisława Szymborska (in Polish); a sonnet by Jacques Bens (in French) whose works I will present later, and several poems by Michael Keith (in English). All these non-Russian authors refer to the decimal approximation of the number π , though in different aspects.

Keith virtuosity explores the most popular method of writing inspired by π : enumerating the number of letters in a word for a mnemonic phrase. An example of this writing is the phrase “How I want a drink, alcoholic of course, after the heavy lectures involving quantum mechanics” attributed to the astronomer Sir James Jeans [5]. Michael Keith proposed the name ‘Pilish’ for the artificial version of English that follows this technique [6]. Keith’s poem *Bemused* is written for the first 218 digits of π (3.14159265358979323846...):

For a time I stood, relishing my autumn night.
Amy hated wordless nighttime walking intensely
and so had strutted home dourly.
”I’m rather cold,” she had muttered, “and so... goodbye”.

Welcoming night surrounded me; lukewarm droplets fell.
I continued walking. I passed gentlemen
and derelicts wandering the streets alone.
I considered their fortunes, my misfortune. <...>

Keith finds the constraint writing enormously liberating, “suggesting new ideas or ways of expressing things that would otherwise not occur to the writer” [7], the concept correlating with that of Oulipo, whose writing techniques Keith appreciates and follows. An important principle of constraint writing noticed by Oulipo’s member Jacques Roubaud is that “a text written under some restriction speaks of this restriction” [10], and Keith includes the ‘Pilish’ literary technique into the plot of the story: his *Cadaeic Cadenza* is a short story of 3835 words where the narrator discovers that all books in the world have suddenly been transformed into ‘Pilish’, with excerpts from the famous texts included into the story. Another collection by Mike Keith, *Not A Wake*, consists of ten sections, each written in a different style: a free-verse poem; five short stories; 97 haiku; two intertwined poems; a surrealist poem in 14 stanzas; a movie screenplay and so on. The number of letters of the words of this collection, including auxiliary ones such as character names in a play, titles of poems and illustrations, crossword clues and others, present a continuous line of the digits of the number π . To my knowledge, it is the most prolonged and literary significant example of writing under this restriction.

Writing in ‘Pilish’ is possible and realized as well in languages other than English, which is well demonstrated in a number of Russian texts included in the collection [8]. Moscow mathematician and poet Sergey Fedin created the short text *Числовое (Numberword)* [4] using ‘Pilish’ in Russian, having developed this method independently of Keith. Fedin’s short text was written as a homage to Raymond Queneau, the co-founder of Oulipo, and his book *Exercices de style* where the same banal story about a young man with a long neck is told in 99 styles. In the collection of texts *Занимательная риторика Раймона Кено (Amusing rhetoric of Raymond Queneau)*, [4]) the same plot is retold in more than a hundred different styles, including the methods of writing inspired by π .

Enumeration of the number of letters is not the only method of writing devoted to the number π . Close, though more exotic technique is enumerating the number of syllables. This is realized by contemporary Russian poet Alexey Vernitsky [8], who counts syllables of the lines of the poem by the digits of the number π (3-1-4-1-5):

Троица –	Trinity
Бог,	Is God,
И в квадрате –	And its square
Бог.	Is God.
Цветок яблони	Apple blossom
Благословен дружным кругом муз.	Is blessed by the united circle of Muses,
Опять	Once more
Падают снежинки.	Snowflakes are falling.

He also follows Oulipo’s rule about correlation of content and method of writing: the image created in each line of the poem corresponds to the number presented in this line: trinity for three, God for one, squaring for four and so on, with the image of a circle for the complete poem.

It is also possible to count larger elements of the text. Jacques Bens, a member of Oulipo group, uses the same decimals in his three ‘irrational sonnets’ where they define the number of lines in strophes: 3-1-4-1-5 [2]. The rhymes in Bens’s sonnets follow the scheme AAb C bAAb C CdCCd with the ending of the fourth line as a refrain. The total number of lines in five strophes, including refrains, is $14 = 3 + 1 + 4 + 1 + 5$, the same as in a traditional sonnet.

Another type of writing inspired by the number π is emphasizing the first letters of the words. This includes the method invented by Fedin for his short text *Акрологос* (*Acrologos*) [4]. Fedin makes the first letters of the words correspond to the first letters of the digits of the number π : *T* (for *три*, three) – *O* (for *один*, one) – *Ч* (for *четыре*, four) – *O* (for *один*, one) – *П* (for *пять*, five) – *Д* (for *девять*, nine), and so on. To distinguish the numbers *два* (two) and *девять* (nine) both starting with the same letter *д* (d), Fedin chose to start in the first case with double letters *дв* (dv):

	Типчик		Jerk
Омнибус.	Человечек	осыпает	An omnibus. A young man curses a jam of
проклятьями	давку	двуногих.	his bipod neighbours. His neck sticks up as a
позорно торчит	подобно	веревке.	rope. Doors have been closed. The shadow
Двери	сомкнулись.	Длинношеего	of the long-necked guy multiplies. Fiddling
Теребя	воротник	человечку	a coarse collar of his friend, he whispers
двусмысленно	шепчет	что-то	something ambiguous into his ear.
	товарищ.		

Russian poet Boris Grinberg proposed another method correlating the digits of the number π to the successive letters of the alphabet: *в* (the third letter of the Russian alphabet) for 3, *а* (the first letter) for 1, *г* (the fourth letter) for 4, and so on, and wrote a poem with fixed first and last letters of the words: “*в...а г...а д...з б...е д...в д...ж з...ё з...в б...в ж...г*” strictly following the self-invented restriction:

Ворона	голосила	джаз	белуге,	A crow	loudly	sang	jazz	to a	hausen
дятлов	долбёж,	зверьё	заглушив,	having	drowned	out the	voices	of the	other
браконьеров-	жадюг...			woodpeckers’	drilling,	greedy	poachers...		

A poem sounds surrealistic and can be easily memorized, though it could be difficult to recognize and to reconstruct the number π from the sequence of the first and last letters of the poem’s words.

Memorizing techniques explored by Sergey Bobrov are considerably easier. In one poem Bobrov [3] explores the digital approach to the number π in the way known today as ‘poetry in numbers’:

Гордый Рим трубил победу Над твердыней Сиракуз. Но трудами Архимеда Много больше я горжусь. Надо нынче нам заняться, Оказать старинке честь, Чтобы нам не ошибаться, Чтоб окружность верно счесть. Надо только постараться И запомнить все как есть: Три – четырнадцать – пятнадцать – Девяносто два и шесть!	Rome proudly blew the horns Celebrating victory over Syracuse, But I am more proud For the works of Archimedes. We should think about it now To honor the old days, For not making mistakes In calculating the circle. We should try hard To remember it as it is: Three – fourteen – fifteen – Ninety two and six!
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Here the decimals of the number π are represented by one- and two-digit numbers providing the reading in four-foot trochee: “три – четырнадцать – пятнадцать – девяносто два и шесть” (3 – 14 – 15 – 92 – 6) which can be easily memorized and thus indeed helps to remember the first digits of the number π .

Sergey Bobrov was a remarkable figure of the twentieth century’s Russian culture: born in 1889 in Moscow, he became a poet, a critic, a translator, a mathematician and a philologist. In the 1910s he was one of the leaders of Russian futurism, an organizer and an active member of *Центрифуга* (*Centrifuge*) poetic group, together with Boris Pasternak and Nikolay Aseev. As a philologist he contributed to the study of Alexander Pushkin’s poetry and theory of translation. But he did not write only academic articles: in 1918 he published a literary hoax attributing it to Pushkin, and disclosed his own authorship only after the most influential specialist recognized the poem as a Pushkin original. In the 1930s Bobrov was arrested and exiled to Kokshetau (Kazakhstan). Later he abandoned attempts to publish his poetry, though never ceased writing. He became a popularizer of mathematics for children, wrote a number of books, including noticeably popular *Волшебный двурог* (*Magical two-horned creature*) where the cited above poem was published. In the 1960s Bobrov returned to literary studies and together with mathematician Andrey Kolmogorov worked on mathematical theory of prosody.

Bobrov’s approaches to mathematical writing were original and inspiring. In contrast to all texts presented above which were based on the decimal approximation of the number π , in the next poem Bobrov follows the Archimedes fractions’ approach [3]:

Двадцать две совы скучали На больших сухих суках. Двадцать две совы мечтали О семи больших мышах. О мышах довольно юрких, В аккуратных серых шкурках. Слюни капали с усов У огромных серых сов. Вот как жили-поживали Эти совы на суках – Д в а д ц а т ь две совы мечтали О с е м и б о л ь ш и х м ы ш а х.	Twenty two owls were bored Sitting on thick deadwoods. Twenty two owls were dreaming About seven huge mice. About quick-moving mice Who wear neat grey skins. Big grey owls’ mouths Were watering. That was how they lived, These owls on deadwoods: Twenty two owls were dreaming About seven huge mice.
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Bobrov’s goal was to present mathematics to children in the most amusing and inspiring way, so that by reading stories and memorizing funny poems children became mathematical-friendly.

For contemporary poet A. Vlasov exploration of the number π goes far beyond mathematics to pure art. Starting from π , Vlasov writes a palindrome tongue-twister and enriches it by visual representation:



In this short text the author uses the drawing of one figure of π in various rotations. The letter n (p) is given by the original position, the letter y (u) is obtained by a 90 degree rotation, the letter k (k) is obtained by a - 90 degree rotation, and the letter u (e) is the result of a 180 degree rotation. Vlasov combines these letters in a comic phrase divided into lines: *К у н у н у к / к у к / у / к у н у н у к* (*buy a bunch / of cues / and / a stack of pikes*). In addition, each line is a palindrome, as the order of letters is the same from the beginning to the end and vice versa.

Vlasov's tongue-twister can be considered as a literary joke, though other poets are serious about the number π , seeing in it a concept that unifies mathematics and poetry, so poetical exploration of the number π leads to meditation on transcendency. In Vladimir Druk's poem the number π makes the author meditate on the space and time continuum:

мне по душе пространство π где шестерня времен скрипит и где в раздумье морщит лоб периодическая дробь где всем законам вопреки я дважды вышел из реки взглянул на небо свысока и вдаль ушел издалека.	I enjoy the space of π where a gear of time squeaks where a periodic fraction knits its brow deep in thought where against all rules I have gone twice out from the river looked down to the sky and went far away from afar
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Due to the number π the image of a circle appears in the poem so the lyrical hero closes his trajectory transforming in into out, up into down, the end into beginning.

I also wrote several texts based on several properties of π for this collection: first, a comic text exploring phonetic representation of π so that the syllable nu (π) is included into each word of the text. Another one of my poems is written under a more complicated constraint: the focus is on the first letters of the words; the letters $a, й, у, э$ (1st, 11th, 21st and 31st letters of the Russian alphabet) correspond to digit 1 in the decimal approximation of number π ; the letters $б, к, ф, ю$ (2nd, 12th, 22nd and 32nd letters of the Russian alphabet) correspond to 2, the letters $в, л, х, я$ (3rd, 13th, 23rd and 33rd letters) to 3, and so on. The author can choose any word starting with these letters when writing a text. The result is a quasi-surrealistic text in an intersection of arbitrariness and restrictions:

Я хта, у меньшаясь, м едлительным у тконосом ч итает зарисовку ф арватера. О хочие до х леба н адоедливые р ыбы скользят п од з елёной в олной б ез л ишних р ывков. Г нев, о богиня – о стынь. <...>	A yacht, shrinking like a slow platypus, reads a sketch of the fairway. Irksome fishes are hungry for bread, they glide unjerkily under green waves. O goddess, the anger, chill out. <...>
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My third poem is a series of 15 hokku-like poems where the author meditates on life interweaving different aspects of the number π into poems: 3, 22/7, length of circumference, volume of sphere and others:

Кружусь по кругу, Хоровод знаков перед глазами. Остановлюсь на трёх.	As I am spinning round, A ring of signs turns in front of my eyes. Best to stop at three.
Сначала было легко, Но налились соком арбузы, И я не могу определить их объём.	It was easy in the beginning, But watermelons ripen full of juice. I cannot describe their fullness.

Собери вместе семерых девушек,
Выдай им двадцать две ленты.
Их страдания и не приближаются к моим.

Call seven young girls together,
Give them twenty-two ribbons.
Their suffering would not come close to mine.

Небо чертят гусиные стаи:
Три птицы, одна, четыре, еще одна, пять.
Взгляда не подниму от тетради.

A flock of geese crosses the autumn sky:
Three birds, another one, four more, one again, five...
I will not raise eyes from the book.

Conclusion

The presented texts demonstrate several methods of literary representation of the number π , not less numerous and beautiful than the mathematical representations. As can be seen, some texts go far beyond the original goal of memorizing the decimal representation of the number π , and writing inspired by the number π becomes an independent style of art, in particular, poetry. More examples of literary representations of π , together with visual art, musical and crafts works, can be found on the Antipodes web-site [8]. The texts of the collection are mostly in Russian, though there is a wide range of texts in English, French and other languages (as [1], [9] and many others), so the collection will hopefully grow. My experience of collecting these works has demonstrated that the number π , in literature as well as in mathematics, is inexhaustible, and can be continued infinitely. In the words of Polish poet Wisława Szymborska [11], who starts the poem *Liczba Pi* (*Number Pi*, [9]) by listing these decimals as unpredictable random numbers, then making a connection between this infinite series and personal events and emotions:

<...> a także ziemia i niebo przeminą,
ale nie liczba Pi, co to to nie,
ona wciąż swoje niezłe jeszcze pięć,
nie byle jakie osiem,
nieostatnie siedem,
przynaglając, ach, przynaglając gnuśną wieczność
do trwania.

<...> heaven and earth will certainly come to the end,
but not the number Pi, not it,
It goes on and on five,
and away eight,
without stopping seven,
urging, oh, urging the sluggish eternity
further and further.

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