

What Is a Mathematical Ode?

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Abstract This chapter introduces a new poetic form based on the Fibonacci sequence—the mathematical ode. Beginning with the motivation for the search for such a poetic form, the chapter proceeds to examples and information about the three known types of odes. It then presents the new poetic form and a poem written by the author that makes use of it. The final section of the paper includes afterthoughts and a few open questions.

1 The Challenge

One morning in the winter of 2017 as I booted my computer, I saw displayed on the screen an arresting image: a photograph of two strange looking birds perched on a branch. On the right-hand side of the image appeared the following caption [3]:

Two hoatzins, perched in Brazil

We're still waiting for the poet who dares to write an ode to the hoatzin, a bird that earns its other common name stinkbird. Native to the Amazon mangrove swamps and the Orinoco Delta, the hoatzin has a digestive system more like a cow's than a bird's. It digests the leaves it eats with a gut full of enzymes that ferment the food, and that fermentation gives off an unpleasant odor. Surely there's some poetic inspiration there.

Intrigued, I googled the bird's name to find more about it. What I found fired my imagination and connected to various feelings and events that were happening in my life at that time, a perfect recipe for inspiring a poem. As far as poetic form—the ode—my knowledge was limited to the few examples of odes written by several of my favorite poets.

According to the Merriam Webster Dictionary [12], in addition to its metaphorical value as “something that shows respect for or celebrates the worth or influence of another,” an ode is “a lyric poem usually marked by exaltation of feelings and style,

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Turn wheresoe'er I may,
By night or day,
The things which I have seen I now can see no more.

Ancient Greek lyric poets, such as Sappho, wrote odes of a different nature than Pindar's. Those were called monodies, were sung by individuals, and explored more personal subjects. Sappho's monodies followed the three-section pattern of Pindar, and within it included four-line stanzas (three 11-syllable lines and a final 5-syllable line) with a strict meter based on the nature of the ancient Greek language.

Horatian odes are named after the Roman poet Horace (first century CE). Horace's odes explored intimate feelings and scenes of daily life and were meant for quiet reading rather than public performance. His odes did not make use of Pindar's three-section pattern, they consisted of any number of four-line stanzas which shared the same meter, rhyme scheme, and line length, often in the Sapphic stanza tradition. Horatian odes typically use a regular, recurrent stanza pattern and are meditative and informal in tone. An example of such a Horatian ode is John Keats' "Ode to a Nightingale" [8]. This ode has eight stanzas of ten lines each and the meter of each line in the stanza, except the eighth, is iambic pentameter. The eighth line is written in iambic trimeter. This means that all but the eighth line of each stanza is 10 syllables long and the eighth line is 6 syllables long, with alternating stressed and unstressed syllables. Here is the fourth stanza from this poem:

Away! away! for I will fly to thee,
Not charioted by Bacchus and his pards,
But on the viewless wings of Poesy,
 Though the dull brain perplexes and retards:
Already with thee! tender is the night,
 And haply the Queen-Moon is on her throne,
 Cluster'd around by all her starry Fays;
 But here there is no light,
Save what from heaven is with the breezes blown
 Through verdurous glooms and winding mossy ways.

Irregular odes use a wide variety of structural possibilities, while retaining the tone and often also the thematic elements of the classical odes. Traditionally, structural restrictions of irregular odes employed classical prosodic constraints, like the sonnet-like restrictions used by Keats in "Ode to a Grecian Urn" [9]. With the introduction of free verse by Walt Whitman in the nineteenth century, poets began writing irregular odes in free verse, employing innovative structural restrictions, and celebrating unconventional subjects. The odes of Pablo Neruda [13, 14] are examples of the later kind of irregular odes. These luminous and musical odes in free verse glorify the everyday experience and objects. Their structure is visual rather than numerical. Neruda invented a new form, a sinuous flow of words—brief lines that leave more empty space than print on the page. As Margaret Sayers Peden says in the introduction to her translation of Neruda's odes [13], "Neruda transported the physical contours of Chile to the printed page. The jagged length of the land bounded by mountains and sea was filled with his words." With this bold move,

Neruda made the ode form his own. Here is the opening stanza of Neruda's "Ode to the Hummingbird," beautifully translated by Maria Jacketti [2, 14]:

The hummingbird
 in flight
 is a water-spark,
 an incandescent drop
 of American
 fire,
 the jungle's
 flaming résumé,
 a heavenly,
 precise
 rainbow:
 the hummingbird is
 an arc,
 a golden
 thread,
 a green
 bonfire!

I had written my poem in free verse. Neruda's approach to structuring his free verse odes inspired me to look for a mathematical form that will fit the poem naturally, without requiring any major editing, as well as give it its musicality. Nevertheless, I aimed to retain an echo of the classical ode's traditional structural elements: syllable counting, the appearance of the number 3 (in honor of Pindar's three-section pattern), and that of the number 4 (in honor of Horace and Sappho's four-line stanzas). There was a mathematical structure that satisfied all my requirements, namely a certain segment of the Fibonacci sequence.

The Fibonacci sequence is the sequence made up of the following numbers, called Fibonacci numbers:

$$1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 \dots$$

Starting from the number 2 in the third position, each number in this sequence is constructed by adding the previous two Fibonacci numbers. The first appearance of the sequence in Western mathematics literature was in 1202, in the book, *Liber Abaci* [4], written by the Italian mathematician Leonardo Fibonacci. In *Liber Abaci*, the Fibonacci sequence was produced by the pairing of rabbits and represented the ideal growth of a rabbit population over time. A Fibonacci poem follows the Fibonacci sequence to any length in its count of syllables per line, or words per line, or lines per stanza, or any other countable thing connected with the poem. More information on the use of the Fibonacci sequence in modern poetry and examples of Fibonacci poems are found in [5, 6, 7, 17].

The proposed mathematical ode structure is a Fibonacci poem whose line lengths follow the Fibonacci sequence from the first Fibonacci number, 1, to the 12th Fibonacci number, 144. The poem has 12 lines. Each of the first eight lines of the poem occupies only one typed line on the page and, therefore, the first eight lines of the poem can be grouped into two quatrains. Each of the remaining four lines of

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the poem occupies more than one typed line on the page. Those lines may be seen as one final four-line unit, completing a three-section pattern. The resulting poem, “Ode to a hoatzin,” is included in the next section.

3 The Poem

My mathematical ode to a hoatzin presented in this section uses the ode structure proposed in the previous section.

Ode to a hoatzin

In 2015, genetic research indicated that the hoatzin is the last surviving member of a bird line that branched off in its own direction 64 million years ago, shortly after the extinction event that killed the non-avian dinosaurs.

— <https://en.wikipedia.org/wiki/Hoatzin>

Wild
bird
from the
dense mangroves

of the Amazon
and the Orinoco basins:
Brazil, Colombia, Venezuela; national
bird of Guyana, *the land of many waters*; fiery plumage lighting up the
screen!

you whistle, groan, hiss and grunt, make fluttering noises as you spread
your wings. Enzymes in your digestive system ferment the leaves you
peck so

delicately from the thicket, into a foul-smelling mixture. Your nickname
is *stink-bird*, but what a sight! Spiky crest quivers in the air like a
golden crown; your genus, *Opisthocomus*, most appropriately means

long hair behind. You rarely fly, yet the span of your extended wings
staggers: wide open like an exotic crimson fan, it sweeps the humid air.
How the wet forest must love its creatures to grant them their striking
colors and astonishing details: small claws on two wing digits of your
newly hatched chicks enable them to climb to safety before they learn
to fly;

earning another nickname: *reptile-bird*. Maroon eyes in bright-blue face
between vibrating branches of tangled vegetation, warm rain soaking your
features, drenching your body to the core. A breath from the deep past?
A sign from the future? Defies classification! And you aged well like my
imagination. Everything is in the head, I know, guiding the body trying to
keep it from rebelling again. Someone dared me this morning to write an ode
to a hoatzin. With names like these, even if you were ugly, it would be a
pleasure. Away! away! for I will fly to you.

4 Concluding Remarks

I will end this chapter with a few afterthoughts and questions that arose from the introduction of the mathematical ode form.

Although odes are usually not very long, their length is left to the discretion of the poet. The 12-line Fibonacci poem structure is a good fit for my own ode, but I wondered if a longer Fibonacci poem can accommodate odes of longer lengths. It is clear that the three-section partition, each section consisting of one four-line stanza, cannot be repeated. One repetition of this pattern will make the last line of a poem have a syllable count equal to the 24th Fibonacci number, which is 46,368. Without relaxing some of the requirements, it would only be possible to extend the length of the mathematical ode by adding four-line stanzas to the third section of the poem. How many four-lines stanzas? This will need to take into account the resulting length of the last line and its effect on the poem's musicality.

The Fibonacci sequence is intriguing, not only because it exhibits an attractive numerical pattern but also because it makes frequent appearance in natural settings. For example, the Fibonacci numbers are associated with orderly arrangements in spirals exhibited by certain plants, such as the sunflower seed arrangements in the flower's central disk or the spiral at the base of a pinecone. The Fibonacci sequence is also related to a visual aesthetic principle, the so-called golden ratio or divine proportion, known as Φ [5].

It seems that the Fibonacci sequence is also naturally connected to poetic structure. The Fibonacci sequence first appeared in ancient Indian mathematics in connection with Sanskrit prosody. In the Sanskrit tradition of prosody, there was interest in enumerating rhythmic patterns created by the pairing of long and short syllables. Enumerating the different patterns resulted in the Fibonacci sequence [10]. More recently, the natural link between the Fibonacci sequence and poetic structure was observed in connection with the definition of a Fib, by Gregory K. Pincus. A Fib is a six-line poem of 20 syllables with the lines' syllable count following the first six numbers of the Fibonacci sequence: 1, 1, 2, 3, 5, and 8. Pincus' definition and Fibs, appearing in his blog in 2006 [15], attracted immediate and widespread public attention. Here is one of Pincus' original Fibs:

One
Small,
Precise,
Poetic,
Spiraling mixture:
Math plus poetry yields the Fib.

The blog's Fib entry alone received hundreds of comments, many of them in Fib form. Pincus' blog entry revived the interest of the poetry community in the use of the Fibonacci sequence. Delightfully, like the proverbial Fibonacci rabbits, the Fibonacci poems are multiplying in online and print journals unchecked. 2006 had seen the establishment of a journal dedicated to this form of poetry, *The Fib Review* [17], and 2022 saw the publication of *Poetry in the Glade: Bridges 2021 Fib Collection* [7].

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The Fib, with its brevity and precision, is the haiku of mathematical structure, just like the 12-line Fibonacci poem is a good fit for the mathematical ode form. It would be interesting to explore the possibilities for other poetic structures inherent in the Fibonacci sequence. Are there any other Fibonacci sequence segments corresponding to classical poetic forms?

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