## Chapter 3: Conic sections and other geometric forms

I used to loathe coordinate geometry at school, mainly because we had to calculate, plot and draw the graphs by hand. My geometry notebooks were full of wobbly parabolas and ellipses that staggered uncertainly from point to point rather than flowing in one smooth, continuous curve.

It took me a while to appreciate the beauty of these shapes and their geometric companions. The parabola and ellipse form part of a class of curves known as conics, which were studied extensively by the Greek mathematician Apollonius of Perga (c. 262 BC - 190 BC). Apollonius – described by his contemporaries as 'the Great Geometer' – wrote a series of books on conics, seven of which survive either in the original Greek or in 9th century Arabic translations. Facts about the life of Apollonius are sparse, but his books give the impression of a man who valued friendship and was generous in sharing his insights.

Apollonius describes in detail how conics are formed by the intersection of a plane and a double cone. They include the circle, ellipse, parabola and hyperbola as well as 'degenerate' cases – the point, line and pair of intersecting lines.

circle   *ellipse*   *parabola*   *hyperbola*
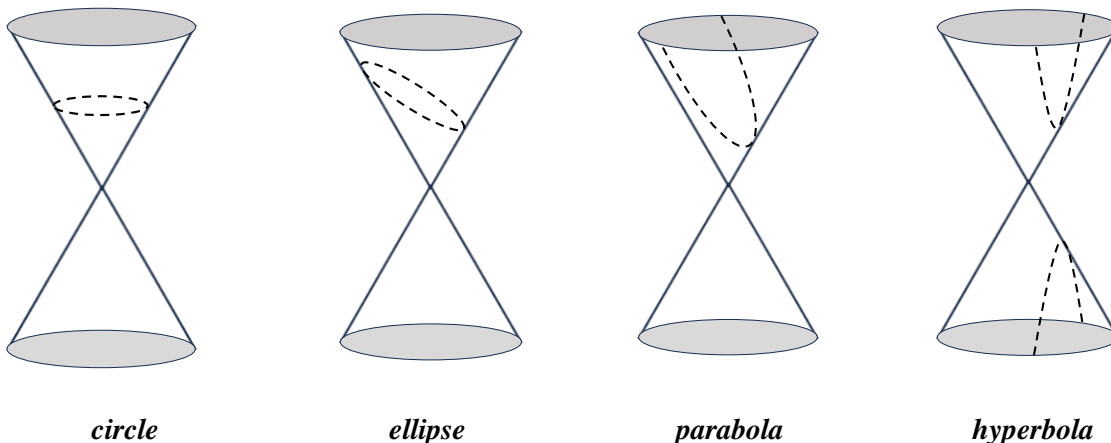
Poets past and present have been inspired by conics, whether as symbol, as metaphor or in terms of their appearance on the page. John Donne's 'A Valediction: Forbidding Mourning' draws on the image of a geometry compass set to represent the relationship between two lovers, one of whom is about to leave on a journey. Here are the last four stanzas:

Our two souls therefore, which are one,
   Though I must go, endure not yet
A breach, but an expansion,
   Like gold to airy thinness beat.

If they be two, they are two so
   As stiff twin compasses are two;
Thy soul, the fixed foot, makes no show
   To move, but doth, if the other do.

And though it in the centre sit,
   Yet when the other far doth roam,
It leans and hearkens after it,
   And grows erect, as that comes home.

Such wilt thou be to me, who must,
   Like th' other foot, obliquely run;
Thy firmness makes my circle just,
   And makes me end where I begun.

Terrance Hayes uses circle imagery in a very different way in 'How to Draw a Perfect Circle'. With its layers of meaning, finely judged juxtapositions of sensuality and violence, and Hayes' exceptional command of language, the poem is complex and powerful, compassionate and disturbing.

An elliptical shape features in one of the earliest known examples of pattern poetry. 'The Egg' was composed around 300 BC by the Hellenistic poet and grammarian Simias of Rhodes. It is one of three surviving poems by him, each of which matches its form to its subject. There is some speculation that 'The Egg' was transcribed on an actual egg. If so, it must have been a large egg! The poem has 20 lines, to be read in ascending order of length (i.e. alternately from the top and bottom of the egg, towards the middle), with an intricate metrical patterning.

Another member of the conics family, the parabola, has inspired poems by the Australian Alec Derwent Hope, Russian poet Andrei Vosnesensky, and this graceful meditation by Sarah Glaz.

Do you believe in fairy tales?

                     You can
                   spin a dragon
                  by its tail,
                 be caught
                in the whirlwind
               and propelled
              into orbit.
             After circling
            the earth for
           thirteen hundred years
          you land
         on a moon
        that was never
       inhabited, but which functions
      according to all
     the laws of mathematics.
    This is the land
     of new beginnings:
      red sky,
       pale purple sun,
        magenta clouds
         pouring heavy rains
          on dense,
           primordial vegetation.
            Blue creature — you.
             I forgot
              to mention
               that orbiting
                the earth is
                 supposed
                  to purify the
                   soul of pain.

Here the parabolic shape suggests the outline of a moon or planet, enhancing the magical description of a land 'of new beginnings', with its 'red sky/ pale purple sun, magenta clouds'.

The Voyager 1 spacecraft, which was launched by NASA in 1977, used gravity assist as it flew past Jupiter and Saturn, and is now on a hyperbolic trajectory that has taken it beyond the bounds of our Solar System. I have sought to suggest this trajectory in the shape of my Fibonacci poem 'Voyager 1'. To demonstrate this more clearly, I've superimposed a faint outline of a hyperbola.

Voyager 1

Gravity defined your journey's arc; you hitched a ride
past Jupiter, Saturn, strange moons
and shimmering rings.
Last image
looking
back
Earth.
Home.
But there's
no return.
You must fly, tiny
messenger, beyond our Sun's reach
to roam the Milky Way forever – blind, lost, alone.

All the poems considered so far are linear poems, in that they consist of lines (which may be of varying length) and are read in a given sequence. What happens if we abandon this concept of linear sequencing and instead adopt the word rather than the line as our unit of poetry? As an illustration, consider the statement:

MYSTERIES LIE HIDDEN DEEP

This starts with the word *mysteries*, but we could use another starting point, and it would still make sense:

LIE HIDDEN, DEEP MYSTERIES

HIDDEN DEEP, MYSTERIES LIE

or even

DEEP MYSTERIES LIE HIDDEN

We could write this on one side of a strip of paper, then tape the ends together so that we have a circular poem on a cylindrical shape.

Experimental poet Teo Eve has extended the concept of circularity even further in these two elegant, witty visual poems inspired by the shape of the letter O.
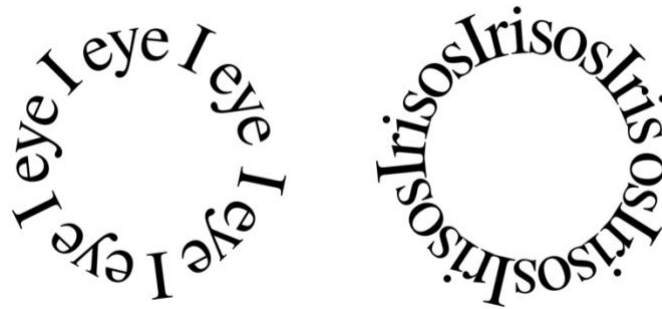
Here's another circular word-poem:

ROCKS HOLD STORIES, STILL

HOLD STORIES STILL, ROCKS

STORIES STILL ROCKS HOLD

STILL ROCKS HOLD STORIES

Suppose we take a strip of paper and write the first poem on one side and the second on the other side, upside-down.

MYSTERIES LIE HIDDEN DEEP

STILL ROCKS HOLD STORIES
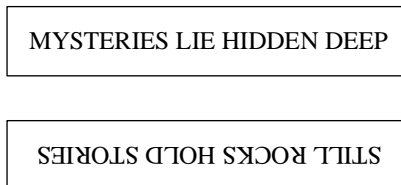
Now glue or tape the two short sides together, with a half twist in the paper strip so that the direction of the writing matches. We have created a Möbius strip poem, which can be read in a continuous loop, starting from any word.

MYSTERIES LIE HIDDEN DEEP STILL ROCKS HOLD STORIES

The charm of constructing poems in three dimensions, on cylinders or Möbius strips, is that reading becomes a tactile experience. Part of the poem will always be concealed from our view, so we must turn the object in our hands to reveal the connections between words and the shifts in meaning.

Conic sections and Möbius strips are just some of the many fascinating geometric shapes that we can explore poetically. Our final example, the Fano plane poem, is taken from the field of finite projective geometry. The Fano plane consists of seven points and seven connecting lines, with three points on each line and three lines through each point. Daniel May and Courtney Huse Wika of Black Hill State University, South Dakota, have devised an elegant poetic form using this structure, which they describe in their 2015 paper '*Galaxies Containing Infinite Worlds*: Poetry from Finite Projective Planes'. Each point in the Fano plane is represented by a word, and each of the seven stanzas includes the words connected by each line in turn.
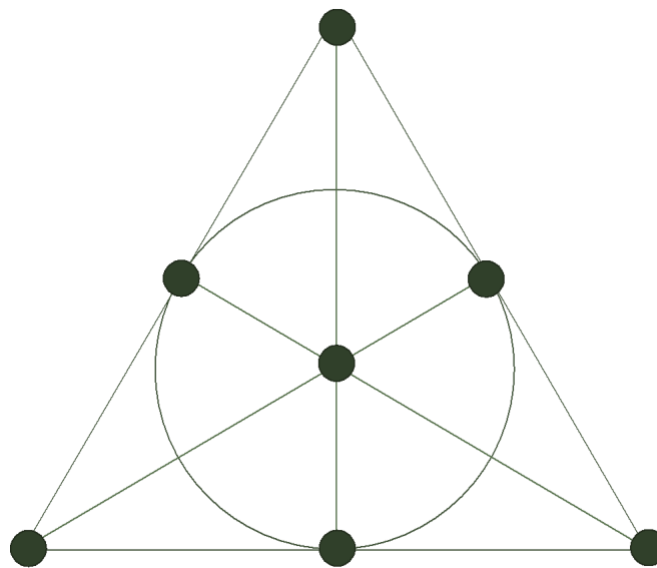
The Fano Plane

Within the constraints of this framework, the Fano plane poem offers considerable scope for flexibility. Unlike, say, the sestina, there is no restriction on the order or position of the words within each stanza. The stanzas themselves can be of variable length – Sarah Hart has written a delightfully minimalist version that consists entirely of seven three-word lines.

My Fano plane poem below is composed in tercets. The poem's structure is illustrated in the accompanying diagram and table (the numbers in the table refer to the order of the stanzas).

Timeline

Reaching back through time,
I remember light: hard lines
and strident colours,

sharp horizons separating day
from night. At times the sky
flashed electric – the dogs and I

cowered as our world crashed
around us. Childhood has close horizons.
Beyond the reach of memory

I am not separate from this earth
that birthed me: stardust
hurled through space to reach

this moment, where my separate worlds
are gathered. I watch light caress
the trees while shadows,

lengthening in silence, probe
my mind's hidden spaces. The sun
eases to a far horizon, spilling light

through space between soft clouds. I will
cherish this world as my own
in all the time that is left.
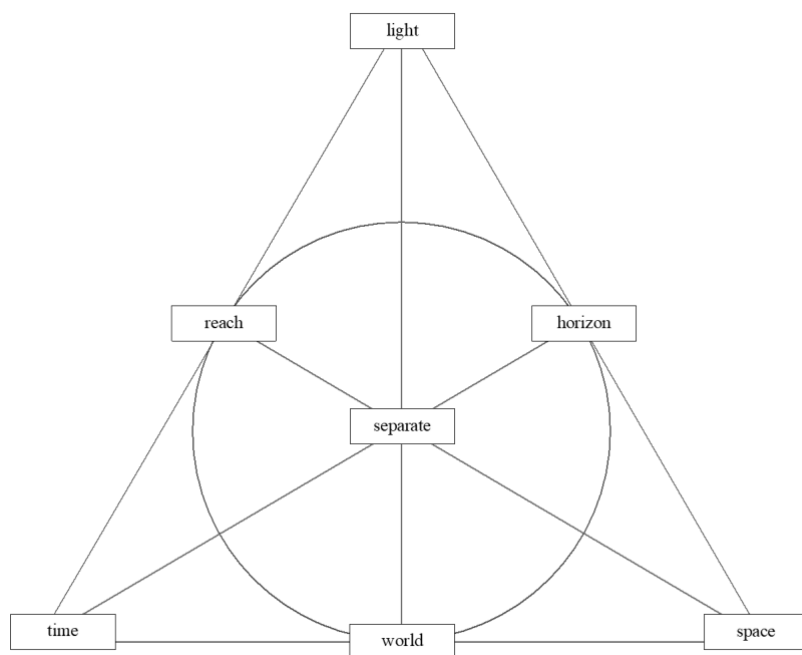
Timeline – Fano plane diagram

1	2	3	4	5	6	7
time	horizon	world	reach	light	space	time
reach	separate	horizon	separate	separate	horizon	world
light	time	reach	space	world	light	space

Would Apollonius have approved of the many poetic responses to geometry? I like to think the answer is yes.

Further Reading

Apollonius of Perga, *Conics.* An English translation by Boris Rosenfeld is available at
http://skatok.s3-website-us-east-1.amazonaws.com/Books1-7new.pdf

Marian Christie (2023) *Triangles*. Penteract Press

Ken Cockburn (2022) *Writing Circle Poems,* Scottish Poetry Library. Available
at https://www.scottishpoetrylibrary.org.uk/wp-content/uploads/2022/09/National-Poetry-Day-2022-Teachers-Resource.pdf

Teo Eve (2022) *The Ox House.* Penteract Press

Sarah Glaz (2012) 'Mathematical Pattern Poetry'. *Bridges 2012 Conference Proceedings*. Available at:
http://m.archive.bridgesmathart.org/2012/bridges2012-65.pdf

Sarah Glaz (2017) *Ode to Numbers.* Antrim House, Connecticut.

Sarah Hart (2023) *Once Upon a Prime*. Mudlark, London

Gregory Hartman et al, *Conic Sections*. Libre Texts, Mathematics. Available at
https://math.libretexts.org/Bookshelves/Calculus/Calculus_3e_(Apex)/09%3A_Curves_in_the_Plane/9.01%3A_Conic_Sections

Terrance Hayes (2014) 'How to Draw a Perfect Circle' in *Poetry*, December 2014. Available at
https://www.poetryfoundation.org/poetrymagazine/poems/57566/how-to-draw-a-perfect-circle

A. D. Hope (1972) 'Parabola' in *Poetry*, August 1972. Available at
https://www.poetryfoundation.org/poetrymagazine/browse?contentId=32339

Daniel May and Courtney Huse Wika (2015) '*Galaxies Containing Infinite Worlds*: Poetry from Finite Projective Planes'. *Bridges 2015 Conference Proceedings.* Available at:
https://archive.bridgesmathart.org/2015/bridges2015-259.pdf

Andrei Vosnesensky 'The Parabolic Ballad' (tr. Alec Vagapov). Available at
http://famouspoetsandpoems.com/poets/andrei_voznesensky/poems/22223