Strange Attractors

Poems of Love and Mathematics

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"'What, after all, is mathematics but the poetry of the mind, and what is poetry but the mathematics of the heart?' So wrote the American mathematician and educator David Eugene Smith. In a similar vein, the German mathematician Karl Weierstrass declared, 'A mathematician who is not at the same time something of a poet will never be a full mathematician.' Most mathematicians will know what they meant. But what do professional poets think of mathematics? In this delightful collection, the editors present the view of the same terrain—the connections between mathematics and poetry—from the other side of the equation: the poets. Now is your chance to see if the equation balances."

—**Keith Devlin**, mathematician, Stanford University, author of *The Math Gene, The Math Instinct*, and *The Language of Mathematics*

Strange Attractors: Poems of Love and Mathematics is a collection of about 150 poems (from various time periods) with strong links to mathematics in content, form, or imagery. The common theme is love, and the editors draw from its various manifestations—romantic love, spiritual love, humorous love, love between parents and children, mathematicians in love, love of mathematics. The poets gathered here include literary masters as well as celebrated mathematicians and scientists.

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Introduction

We, the editors who have gathered these poems, are mathematicians and poets. This collection has been an opportunity for us to merge our two interests into one project and share it with you, the reader. These pages invite you to explore the ways that mathematical ideas inhabit poetry.

The poems collected here represent the best poetry has to offer—with work by the world's finest poets—including Nobel and Pulitzer Prize winners and Poet Laureates. This collection is international, including translations of major poetic voices. The time spread for the poems is at least 3000 years—we include a fragment of *The Song of Songs* by King Solomon, circa 1000 BC, as well as contemporary American poetry. The common theme is *love*, and we interpret this theme with broad universality, from the peaks and valleys of romantic love, through the encircling love of family, nature, life and spirit, to the love that focuses on mathematics and mathematicians. Each poem has a strong link to mathematics in content, form, or imagery, and the collection engages a variety of mathematical topics—from counting to commutative rings, from the intermediate value theorem to infinity. A number of eminent mathematicians appear in the poems and highlight the human history of mathematics; a collection of biographical notes for these figures follows the poetry.

The Mathematical Poetry Resources section following this Introduction includes references for selected publications and other material connecting poetry and mathematics, as well as links to online resources for those wishing to explore various mathematical terms or topics.

Since ancient times poets have used mathematical imagery and ideas in their verses, and mathematicians versified when the spirit moved them. The earliest poet who is known by name is also the earliest mathematician who is known by name: Enheduanna, chief priestess of the moon god Nanna, in the city of Ur, daughter of the Akkadian king Sargon who captured and ruled over the region of Sumer during 2334–2279 BC. Enheduanna's duties as chief priestess required mathematics—she was involved in astronomical calendrical calculations ("measuring the skies") and also in civic mathematics related to setting boundaries of properties and engineering measurements for construc-

tion ("placing the measuring cord"). Her duties as religious leader also included the composition of temple hymns to a variety of deities. Here are lines from one of her hymns dedicated to Nisaba's temple in Ereš. Nisaba, the grain goddess, was patron of scribal arts and mathematical calculations:

> The true woman who possesses exceeding wisdom,
> She consults a tablet of lapis lazuli,
> She gives advice to all lands,
> She measures off the heavens, she places the
> measuring-cords on the earth.
> Nisaba, praise![1]

Well before the start of the twentieth century, the amount of available knowledge exceeded the learning capacity of any single individual. The result was specialization, and with it separation, sometimes perceived as rift, between mathematics and the sciences on one side and the arts and humanities on the other. In spite of this, there has been a constant stream of people on both sides of the divide working to bridge the gap.

As we look back toward and into the twentieth century, we see several forebears to our volume—people and publications that, despite the explosion of information and knowledge, have kept alive and strengthened the connection between mathematics and poetry.

Gathered by Robert E. Moritz, *Memorabilia Mathematica* (1914) is a collection of 1140 anecdotes, aphorisms, and passages by noted mathematicians, scientists, and writers on a broad variety of mathematical topics—small fragments from a selection of poetry by writers such as Dante, Goethe, and Tennyson are included, as well as poetic lines from several mathematicians. Moritz's focus, however, is on the mathematical content of verses and not on the poems.

Another landmark is Scott Buchanan's extended essay *Poetry and Mathematics*, which first appeared in print in 1929. In this philosophical treatise, the author traces with dexterity parallel patterns that he has observed in these two disciplines. *Poetry and Mathematics* is dedicated to Dante and Kepler—*to the poet who was a mathematician and to the mathematician who was a poet.*

Two fine and very different anthologies appeared in the 1950s, *Imagination's Other Place: Poems of Science and Mathematics*, edited

[1]Translated from Sumerian cuneiform sources by Åke W. Sjöberg and E. Bergmann S. J.

by Helen Plotz, and *Fantasia Mathematica*, edited by Clifton Fadiman. Plotz's anthology contains only poems and emphasizes work from well-known literary figures, whereas Fadiman's mathematical literature collection is largely prose—with its verse tending toward the light and humorous varieties. Fadiman's anthology became popular and was followed in 1962 by an equally popular sequel: *The Mathematical Magpie*, both reprinted in 1997. Following the pattern of Fadiman's anthologies, William Frucht edited *Imaginary Numbers*, published in 1999. In the vein of Plotz's anthology of science poems are the two collections *Songs from Unsung Worlds: Science in Poetry*, edited by Bonnie Bilyeu Gordon (1985), and *Verse & Universe: Poems about Science and Mathematics*, edited by Kurt Brown (1998). Our collection, consisting entirely of mathematical poems, mimics the broad variety of these volumes—with lyrics from silly to serious, from bawdy to beatific—and our emphasis has tended toward work from strong poetic voices.

Against Infinity: An Anthology of Contemporary Mathematical Poetry, edited by Ernest Robson and Jet Wimp (1979), is, to our knowledge, the earliest anthology to include only mathematical poetry. This slim volume, a treasure for mathematical poetry lovers, introduces mathematicians to concrete poetry and to poems constructed using mathematical symbols (sometimes *only* mathematical symbols). Our anthology, about thirty years later, is several times larger than *Against Infinity* and is the first-ever anthology of mathematical *love* poems.

Approaches to mathematics that reach across cultural divides to history, literature and the arts have sometimes been termed "humanistic mathematics." A mathematician who was a leader in the spread of humanistic mathematics is Alvin M. White, Professor Emeritus at Harvey Mudd College. White established and edited the *Humanistic Mathematics Network Newsletter/Journal* from 1987 to 2004. JoAnne served as poetry editor on this journal and also edited *Numbers and Faces*, a small anthology of mathematical poetry published by the HMNJ in 2001 that featured work by an international collection of poets. In 2002, Sarah's first mathematical poem, "Calculus" (included in this volume), was published in Volume 26 of HMNJ.

During the thirty-year period 1956–1986, Martin Gardner's "Mathematical Games" column for *Scientific American* frequently brought poetry to the attention of mathematicians. Gardner became well-known for his ability to make arcane topics accessible and enjoyable—and he was one of the popularizers of the *OULIPO* literary movement, formed in the 1960s in France by a group of writers

and mathematicians who developed ingenious strategies (often mathematical) for generation of new literature. The work of two Oulipians (Harry Mathews and Raymond Queneau) is included in our collection. Gardner, who occasionally versifies, has supported our anthology from the start and helped us locate the copyright-holder of one of our poems. He has offered no mathematical "love poem" of his own for us to include, but we do have from him this quatrain:

> π goes on and on,
> And e is just as cursed.
> I wonder, how does π begin
> When its digits are reversed?

Poetry journals as well as mathematical ones do, from time to time, include mathematical poems. For example, six of the poems of this anthology first appeared in the national journal *POETRY*. Additionally, a number of poets in this volume have had work presented in one of The Mathematical Association of America's journals: *The American Mathematical Monthly*, *The Mathematics Magazine*, and *The College Mathematics Journal*, as well as in *The Mathematical Intelligencer* (Springer).

There are additional new developments in humanistic mathematics: in 1998, the annual international conference of Bridges: Mathematical Connections in Art, Music, and Science was created and has met each year since inception. During the conference eclectic groups of mathematicians, scientists, artists, educators, musicians, writers, computer scientists, sculptors, dancers, weavers, and model builders come together in an atmosphere of mutual exchange and encouragement. In 2006, interested members of the Mathematical Association of America formally organized as SIGMAA–ARTS, a special interest group that fosters exchange and connections between mathematics and the arts. Established in 2007, the *Journal of Mathematics and the Arts* (Taylor & Francis) is a peer review journal that focuses on links and commonalities between mathematics and the arts.

As teachers who have used the literature of mathematics in our classrooms, we hope that this collection will be useful to other mathematicians, poets, and teachers to enliven or complement their courses. We intend this collection to be a special gift—and hope that these poems will offer unbounded opportunity for readers' pleasure.

We are indebted to all of the poets whose poems are collected here for creating fine verse. We thank both poets and publishers and other permission grantors for generosity of spirit as we negotiated for the

rights to reprint poems. We are grateful to the University of Connecticut's Office of Sponsored Programs, the College of Liberal Arts and Sciences, and the Department of Mathematics, and also to A K Peters, Ltd., for grants that enabled us to obtain rights to reprint poems in this volume. We wish to thank Klaus Peters, our publisher, and Charlotte Henderson, our editor, at A K Peters, Ltd., who believed in our project from the start, and who continually encouraged and assisted us into bringing it to completion. Most of all, we express our appreciation to each other—for kindness, forbearance, and forgiveness as we shared the burdens and the joys of putting this volume together.

In addition—

Sarah Glaz would like to thank her family, friends, and colleagues who encouraged her in this undertaking: her mother, Amalia Dauer, for reading poetry to her before she learned to count; her husband, Joe Glaz, and her writer-mathematician son, Ron Glaz, for being there and cheering her on through the ups and the downs; Marc Rubenstein, Claudine Smith, Riva and Arnold Berleant, and Vera Schwarcz, for years of friendship, conversation and poetry; her colleagues, Miki Neumann, Joan and Stu Sidney, and Mel Hochster for poems and support. She also is grateful for memories of her father, Philip Dauer, who supported her interest in mathematics.

JoAnne Growney would like to thank her family and friends for loving support throughout this project. Her warm gratitude is extended also to members of a growing network—in Germany and Portugal, in New Zealand and India and Romania, in Bloomsburg and Silver Spring—of friends who love both poetry and mathematics and who exchange mathematical poems with each other. Special thanks also to Marjorie Maddox and Jerry Wemple—experienced anthologists who offered valuable suggestions. JoAnne's portion of this anthology is dedicated to her grandchildren—Carly, Shayla, Mika, Emma, Daniel, Serena, and Ami—whose current mathematical verses are "counting rhymes," but who one day will discover the poetry of theorems and the power of poems . . . .

Sarah Glaz
Storrs, Connecticut

JoAnne Growney
Silver Spring, Maryland

February 2008

Mathematical Poetry Resources for Further Exploration

Explanations of Mathematical Concepts

Wolfram Math World, Eric Weisstein, Wolfram Research: www.mathworld.wolfram.com.

The Mathematical Atlas, Dave Rusin, Northern Illinois University: www.math-atlas.org.

Anthologies of Poetry of Mathematics and the Sciences

Against Infinity: An Anthology of Contemporary Mathematical Poetry, eds. Ernest Robson and Jet Wimp, Primary Press, Parker Ford, PA, 1979.

Imagination's Other Place: Poems of Science and Mathematics, ed. Helen Plotz, Thomas Y. Crowell Company, New York, 1955.

Numbers and Faces: A Collection of Poems with Mathematical Imagery, ed. JoAnne Growney, Humanistic Mathematics Network, Claremont, CA, 2001.

Songs from Unsung Worlds: Science in Poetry, ed. Bonnie Bilyeu Gordon, Birkhäuser, Boston, 1985.

Verse & Universe: Poems about Science and Mathematics, ed. Kurt Brown, Milkweed Editions, Minneapolis, 1998.

Anthologies of Mathematical Literature That Include Poems

Memorabilia Mathematica, ed. Robert E. Moritz, Macmillan, New York, 1914. Reprinted by The Mathematical Association of America, Washington, DC, 1993.

Fantasia Mathematica, ed. Clifton Fadiman, Simon and Schuster, New York, 1958. Reprinted by Copernicus, an imprint of Springer, New York, 1997.

The Mathematical Magpie, ed. Clifton Fadiman, Simon and Schuster, New York, 1962. Reprinted by Copernicus, an imprint of Springer, New York, 1997.

Imaginary Numbers, ed. William Frucht, John Wiley & Sons, New York, 1999.

About Mathematical Poetry: Selected Articles and Collections

Discovering Patterns in Mathematics and Poetry, Marcia Birken and Anne C. Coon, Rodopi, Amsterdam-New York, 2008.

Humanistic Mathematics Network Newsletter / Journal, 1987–2004. Established and edited by Alvin White, Harvey Mudd College; online editors Sandra and Philip Keith, St. Cloud State College (2002–2004). Selected issues archived: http://www2.hmc.edu/www_common/hmnj.

Martin Gardner's Mathematical Games: The Entire Collection of His Scientific American Column, on CD, The Mathematical Association of America, Washington, D.C., 2005.

"Mathematics in Poetry," JoAnne Growney, *Journal of Online Mathematics and its Applications*, Article ID: 1262, October 2006.

"Mathematics Influences Poetry," JoAnne Growney, *Journal of Mathematics and the Arts*, Vol. 2, No.1, pp. 1–7, 2008.

OULIPO: A Primer of Potential Literature, Translator and Editor, Warren F. Motte, Jr., Dalkey Archive Press, Urbana-Champaign, 1998.

Poetry and Mathematics, Scott M. Buchanan, The John Day Company, New York, 1929. Reprinted by The University of Chicago Press, Chicago, 1975.

"Polyaesthetics and Mathematical Poetry," Kaz Maslanka, *Journal of Mathematics and the Arts*, Vol. 1, pp. 35–40, 2007.

The World of Mathematics: A Small Library of the Literature of Mathematics from A'h-mosé the Scribe to Albert Einstein, Presented with Commentaries and Notes by James R. Newman, 4 volumes, Simon and Schuster, New York, 1956. Reprinted by Dover Publications, New York, 2003.

"Versed in Math: Modeling with Poetry in an Intermediate Algebra Course and Beyond," Sarah Glaz and Su Liang, preprint.

Organizations Supporting Mathematics in the Arts

The Bridges Organization: Mathematical Connections in Art, Music, and Science: www.bridgesmathart.org.

SIGMAA–ARTS: Special Interest Group on Mathematics and the Arts, The Mathematical Association of America, Washington, D.C.: www.maa.org/sigmaa/arts.

Poems in This Collection

The Acknowledgments section at the end of this volume contains information about mathematical poetry books published by poets featured in this volume. In addition, mathematical poetry is available on the Internet, including sites maintained by many mathematical poets and songwriters. Search engines will locate up-to-date URLs for each.

Editor–Publisher Websites

Sarah Glaz: www.math.uconn.edu/~glaz.

JoAnne Growney: http://joannegrowney.com.

A K Peters, Ltd.: www.akpeters.com.

Part 1

Romantic Love
from Heartaches to Celebrations

From *Tales from* A *Sonnetarium:* III, *Kismet*

What can't be said can't be said,
and can't be whistled either.
—Wittgenstein

Wittgenstein was wrong: when lovers kiss
they whistle into each other's mouth
a truth old and sayable as the sun,
for flesh is palace, aurora borealis,
and the world is all subtraction in the end.

The world is all subtraction in the end,
yet, in a small vaulted room at the azimuth
of desire, even our awkward numbers sum.
Love's syllogism only love can test.

But who would quarrel with its sprawling proof?
The daftest logic brings such sweet unrest.
Love speaks in tongues, its natural idiom.
Tingling, your lips drift down the xylophone
of my ribs, and I close my eyes and chime.

Manuel Alegre

From *Polar Heart*

I do not know what colour the ships are
when they shipwreck in your arms
I know that there is a body never found out there in the sea
and that living body is your immaterial body
your promise in the masts of all sailboats
the perfumed isle of your legs
your womb of conches and coral
the grotto where you await me
with your lips of foam and saltiness
your shipwrecks
and the great equation of the wind and the voyage
where chance flowers with its mirrors
its signs of rose and discovery.

I do not know the colour of that line
where the moon and masts cross
but I know that in each road there is a corner
an opening between the routine and the marvelous
there is an hour of fire for blue
the hour in which I find and do not find you
there is an opposite angle
a magical geometry where everything might be possible
there is an imaginary sea open on each page
don't you tell me that routes will
never again be born of desire
and I want the southern cross of your hands
I want your name written in the tides
in this city where in the most absurd place
at a no entry sign or traffic lights
all sunsets tell me who you are.

Translated from the Portuguese by Mick Greer and Graça Margarido

Yehuda Amichai

From *Israeli Travel: Otherness is All, Otherness is Love*

I remember a problem in a math book
about a train that leaves from place A and another train
that leaves from place B. When will they meet?
No one ever asked what happens when they meet:
Will they stop, or pass each other, or collide?
None of the problems was about a man who leaves from place A
and a woman who leaves from place B. When will they meet,
will they meet at all, and for how long?
As for that math book: Now I've reached
the final pages with the answers.
Back then it was forbidden to look.
Now it is permitted. Now I check
where I was right and where I went wrong,
and know what I did well and what I did not do. Amen.

Translated from the Hebrew by Chana Bloch and Chana Kronfeld