Great Books, Poetry and Mathematics

Emily Grosholz
Department of Philosophy
Sparks Building
The Pennsylvania State University
University Park PA 16801
erg2@psu.edu

Abstract

I have just finished writing a book on poetry and mathematics, entitled *Great Circles: The Transits of Mathematics and Poetry*. When it is published in early 2018, it will help launch a new series of books published by Springer, "Mathematics, Culture and the Arts," edited by Marjorie Senechal (Editor of the *Mathematical Intelligencer*), Jed Buchwald at the California Institute of Technology, and Jeremy Gray at the Open University. The first part of the book is autobiographical, and this excerpt explains how the Great Books Program at the University of Chicago encouraged me to think and write about poetry and mathematics in tandem, over half a century.

Although I am a philosopher, and teach in the Philosophy Department at the Pennsylvania State University, when I applied to university fifty years ago, I didn't say I wanted to study philosophy, but rather that I wanted to study poetry and mathematics. This odd conjunction made sense at the University of Chicago because undergraduate education there was still steered by the star of Robert Maynard Hutchins' College, a pedagogical structure built on the Great Books program. Because of a scholarship, during my freshman year I was enrolled in 'Liberal Arts I,' a special series of lectures organized by the classicist James Redfield. These lectures were also a conduit to my undergraduate major, 'Ideas and Methods,' created by Richard McKeon. (He was terrifying, by the way; to see why, re-read Robert Pirsig's *Zen and the Art of Motorcycle Maintenance*, where he is depicted as The Chairman [10].) There I first discovered Scott Buchanan's *Poetry and Mathematics* [3]. My well-worn edition from 1962 adds a new Introduction written in 1961 to the text, which was first published in 1929. Here are the lines that most inspired me: "It was only when I actually gave the lectures [on poetry and mathematics] to a small and sympathetic audience that I found stable patterns, although not the elements that I sought. Much to my surprise, I found that mathematics and poetry run parallel patterns, such that one illuminates the other. A puzzle in one has a corresponding puzzle in the other, and sometimes, though not always, they can be understood together when they are unintelligible apart. Ordinary language attests to the connection, as when one counts numbers and recounts a story, or when geometrical figures are compared with figures of speech, or when in Greek the word for ratio is *analogon*, or when physiological functions can be expressed in mathematical functions. There are dangers in this etymological game, as I learned when a word led me astray, but there is also confirmation of many guesses if the faith in words is boldly followed" ([3], pp. 17-18).

The Introduction also gives an account of the genealogy of the Great Books program, though it doesn't go back far enough. I thus catapult us back across two thousand years, to the origins of the Trivium and the Quadrivium, the *fons et origo* of the Great Books program. Perhaps you have guessed that we are returning to ancient Rome. The Roman philologist Varro (Marcus Terentius Varro, 116 – 27 BCE) studied for a while in Athens with an Academic philosopher, which links him to the tradition of Plato's Academy. His work *Disciplinae* consists of nine books, whose titles suggest a classification of knowledge: Grammar, Logic and Rhetoric; Geometry, Arithmetic, Music, Astronomy; and Architecture and Medicine. This classification was taken up by Martianus Capella, a Neoplatonist who lived around 400 CE; he transmitted the classical Roman curriculum to the early Middle Ages (especially the Carolingian Renaissance that grew from the court of Charlemagne around 800 CE) through his influential book *De septem disciplinis*, an allegory where Philologia is married to Mercury and so receives seven handmaidens: Grammar, Logic and Rhetoric compose the Trivium, and Geometry, Arithmetic, Music and Astronomy compose the Quadrivium. Architecture and Medicine are demoted because apparently they are too material and mechanical. These seven *Artes Liberales* encompassed what a free person needed to know in order to take part in civic life.

Now we catapult back up to the recent past. Throughout the European Middle Ages, the Trivium and Quadrivium (the literary arts and the mathematical arts) presided over the birth of the modern university, in Bologna, Paris, Oxford and Cambridge, Padua, Salamanca, Coimbra and elsewhere. Between 1600 and 1700, philosophers helped to invent modern science, the first stirrings of democracy, and the rise of Protestantism, which together drove the Enlightenment between 1700 and 1800. Around 1800, in consequence, it finally occurred to a few people that a university education might be made available to everyone.

Birkbeck College, part of the University of London, is named after George Birkbeck, a Quaker, physician and pioneer in adult education, who gave free lectures on the ‘mechanical arts’ to workmen in Glasgow around 1800, an initiative that led to the creation of the Mechanics’ Institute there in 1821. When he later moved to London, he worked with the philosopher Jeremy Bentham and two MPs to create the London Mechanics Institute in 1823: it became the Birkbeck Literary and Scientific Institution in 1866, and then Birkbeck College. By the mid-19th century, there were over 700 such institutes in Britain and its colonies. John Lubbock, 1st Baron Avebury, was Principal of the Working Men’s College in London from 1883 to 1896 (he was also a banker and a scientist); in that capacity, he offered a list of 100 Great Books, all in English translation, for workers without Greek or Latin, in 1886. The list was widely published and discussed.

From 1925 to 1929, Scott Buchanan was Assistant Director of the People’s Institute in New York City, which had been established thirty years earlier to supplement training in the mechanical arts at Cooper Union. This is where he presented the lectures that became *Poetry and Mathematics*. The People’s Institute had become a place where immigrants from the lower East Side of Manhattan met with the intellectuals at Columbia on the upper West Side, as well as “internal migrants,... who spent their summers in harvesting on the Great Plains or in lumber camps, and who rode the rods back to New York for the winter... continuing the reading and discussion which had started when they knew Jack London. One could always find them during the day conversing and smoking in the lobby of the reading room of the New York Public Library, at Fifth Avenue and Forty-second Street. These two groups, the East Siders and the Wobblies, as we used to call them, were with the graduate students from the local universities at that time probably the best read audience in America” ([3], p. 14).

Then there was Will Durant himself at the Labor Temple, Mortimer Adler running the Columbia Honors Course in Great Books, and Richard McKeon who had just returned from working on medieval philosophy with the great French philosopher Étienne Gilson at the Sorbonne. “He [McKeon] insisted that I had stumbled into a rediscovery of the seven liberal arts, the trivium—grammar, rhetoric, and logic—and the quadrivium—arithmetic, geometry, music and astronomy” ([3], p. 19). Together, Buchanan, Adler and McKeon talked about what a modern version of the seven liberal arts might look like. From 1930 to 1952, Adler developed the Great Books program with Robert Maynard Hutchins at the University of Chicago, and in 1946 arranged with the Encyclopedia Britannica to re-print 443 great books in a 54-volume set. McKeon followed them there in 1934, and stayed for forty years. With his friend Stringfellow Barr, Buchanan set up the Great Books program at St. John’s College in Annapolis, Maryland, in 1937.

My experience in the Mathematics Department was mixed: none of my professors could see me as a potential research mathematician. I wanted to create mathematics, not just study it; but I didn't know how to formulate the wish and no one around me did either. However, I came away from my undergraduate courses in mathematics with a set of good textbooks and a number of useful insights, which have helped me to prolong my informal study over the decades. My two favorites were Springer and Thorpe's *Lecture Notes on Elementary Topology and Geometry* [11] and Garrett Birkhoff and Saunders Mac Lane's *A Survey of Modern Algebra* [1], which arose from their classroom experience at Harvard in the last 1930s. I am not alone in my enthusiasm for this book: upon its fiftieth anniversary, the *Mathematical Intelligencer* published a five page account of it [2]! Here is how the authors characterized it in that issue: "The 'Modem Algebra' of our title refers to the conceptual and axiomatic approach to this subject initiated by David Hilbert a century ago. This approach, which crystallized earlier insights of Cayley, Frobenius, Kronecker, and Dedekind, blossomed in Germany in the 1920s. By 1930, relatively new concepts inspired by it had begun to influence homology theory, operator theory, the theory of topological groups, and many other domains of mathematics.' (Hitler effectively exploded Hilbert's circle, destroying the brilliant mathematical culture in Göttingen that had flourished since the early 19th century, beginning with Gauss, and continuing through Riemann, Klein, Hilbert and Emmy Noether.) This textbook introduced me to groups, rings and fields!

Meanwhile, as a major in "Ideas and Methods" with a minor in mathematics, I went on to write a senior thesis about poetry and mathematics. Inspired by Kenneth Burke's identification of "four master tropes" in his *A Grammar of Motives* [4], I argued that figures of speech, which we associate with works of literature and poetry in particular, also constitute figures of thought. Metaphor sets up a discourse by means of a correlation or a perspective; metonymy chastens the discourse by means of well-defined reductions; synecdoche develops it by various inventive representations; and irony exhibits its limits, setting it into the context of a larger dialectic. These habits of thought are salient in mathematical traditions as well as poetic traditions; thus I used these literary terms to explain the progression of thought about algebraic topology in Singer & Thorpe, as I used them, in parallel, to illuminate the unfolding of a various Elizabethan sonnets that I was studying at the time.

Now some of these arguments show up in later chapters of my new book, *Great Circles: The Transits of Mathematics and Poetry* [9], soon to be published by Springer. For example, in an earlier book I trace how Descartes launches analytic geometry in his *Geometry*, where he establishes a precise correlation (call it a metaphor) between algebraic curves and polynomials with a finite number of terms and exponents that are natural numbers (usually very small natural numbers: he doesn't get much beyond the cubic curves). He also introduces curves as tracings by means of hinged rulers, a kind of synecdoche, though ironically he doesn't allow the mechanical drawing of transcendental curves into his geometry, due to his highly reductionist conception of method, based on the metonymy of the curve as constructed in a certain sense from finite line segments. (See Chapters 1 and 2 in [5] for details.) The organized investigation of transcendental curves must wait for the infinitesimal calculus and Leibniz's development of the theory of differential equations. A similar story could be told about the constitutive metaphor established between the complex numbers and the geometric plane in the work of Gauss and Riemann, as well as that established between topological spaces and groups (homotopy on the one hand and homology on the other) in the late 19th and early 20th centuries. The algebraic topologists I listened to at the Blue Parrot in Cambridge in 1969 were worried, ironically, about the limits of the latter metaphor. In my new book, I trace those developments, as well as analogous developments in mathematics. For example, I follow constitutive metaphors (for example, that of erotic love and the hunt) through the sonnet sequences of Surrey, Sidney, Spenser and Shakespeare, examine how the metaphors are reductively and ampliatively elaborated, and then explain how Shakespeare in particular leads his poems ironically to confess their own limitations and point beyond themselves. Figurative habits of thought organize and develop poetic discourse as well as mathematical discourse.

The past years 2016 and 2017 saw the publication of my work on the history and philosophy of mathematics, *Starry Reckoning: Reference and Analysis in Mathematics and Cosmology* [7] and my compendium of poems *The Stars of Earth: New and Selected Poems* [8]. Somehow the heavens appear in all my recent titles, perhaps inspired by recent forays into ancient, early modern and modern cosmology, and a trip to the Gunnison Valley Observatory in Colorado. Here is a poem recently published in *PN Review* which recounts that adventure [6]:

Astronomy (Gunnison Valley Observatory, Colorado)

The empty page reproaches me
Like the blue sky devoid of clouds,
The sun's diffuse, refracted light
Hiding ten thousand visible stars
And, further off, a hundred billion
Galaxies our eyes will never see,
Red-shifting as they leave us, waving goodbye.

Goodbye, goodbye. I can't recall
Their names sometimes; sometimes their names
Come back to me: Vega, Aldebaran.
Sometimes a lucky telescope extends
Up from a cleft observatory dome
Perched on the high plains, ringed about
By berms and mountains: then the stars appear.

Look! There are the rings of Saturn,
Horns, and there are craters on the moon,
And seas that are not seas, and there,
O look! a double star that peers
Like fox eyes from the den of space.
And there's a spiral galaxy, all arms.
And here's the poem, burning on the page.

But what better evocation of the marriage of poetry and mathematics than the ecliptic with its constellations, or (seen through a glass darkly) a spiral galaxy?

References

[1] Birkhoff, G. and Mac Lane, S. *A Survey of Modern Algebra*. MacMillan (1953).
[2] Birkhoff, G. and Mac Lane, S. "*A Survey of Modern Algebra*: The fiftieth anniversary of its publication," *Mathematical Intelligencer* 14:1 (1992), pp. 26-31.
[3] Buchanan, Scott. *Poetry and Mathematics*. J. B. Lippincott Co. (1962).
[4] Burke, Kenneth. *A Grammar of Motives*. (1945).
[5] Grosholz, Emily. *Cartesian Method and the Problem of Reduction*. Oxford University Press (1991).
[6] Grosholz, Emily. "Astronomy," *PN Review* Vol. 42, No. 2 (2015).
[7] Grosholz, Emily. *Starry Reckoning: Reference and Analysis in Mathematics and Cosmology*. Springer (2016).
[8] Grosholz, Emily. *The Stars of Earth: New and Selected Poems*. Word Galaxy / Able Muse Press (2017).
[9] Grosholz, Emily. *Great Circles: The Transits of Mathematics and Poetry*. Springer (forthcoming in 2018).
[10] Pirsig, Robert. *Zen and the Art of Motorcycle Maintenance*. William Morrow & Co. (1974).
[11] Singer, I. M. and Thorpe, J. A. *Lecture Notes on Elementary Topology and Geometry*. Scott, Foresman & Co. (1967).