Journal of Humanistic Mathematics

Volume 4 | Issue 2 July 2014

Joining ``the mathematician's delirium to the poet's logic'': Mathematical Literature and Literary Mathematics

Rita Capezzi
Canisius College

Christine Kinsey
Canisius College

Recommended Citation

Capezzi, R. and Kinsey, C. "Joining ``the mathematician's delirium to the poet's logic'': Mathematical Literature and Literary Mathematics," *Journal of Humanistic Mathematics*, Volume 4 Issue 2 (July 2014), pages 67-82. DOI: 10.5642/jhummath.201402.07 . Available at: https://scholarship.claremont.edu/jhm/vol4/iss2/7

Joining "*the mathematician's delirium to the poet's logic*": Mathematical Literature and Literary Mathematics

Rita Capezzi

Department of English, Canisius College, Buffalo NY 14208, USA
capezzir@canisius.edu

Christine Kinsey

Department of Mathematics and Statistics, Canisius College, Buffalo NY 14208, USA
kinsey@canisius.edu

Synopsis

This paper describes our team-taught interdisciplinary mathematics and literature course, *Mathematical Literature and Literary Mathematics*, which invites students to consider Raymond Queneau's challenge: "Why shouldn't one demand a certain effort on the reader's part? Everything is always explained to him. He must eventually tire of being treated with such contempt." We study works by Berge, Borges, Calvino, Perec, Queneau, Robbe-Grillet and Stoppard, among others. From a literary critical perspective, the course highlights the play of language rather than the primacy of meaning. We choose texts where mathematical concepts are subjects or structuring elements of the literature, and ideally both. Overall, the course has been enjoyable and productive for both students and its professors so far: the students learn; we learn, both from each other and from the students; and a good time is had by all.

When interdisciplinary course proposals were solicited by the All-College Honors Program[1] at our college, we imagined it would be both enjoyable and productive to introduce students to a wide range of mathematical con-

[1] http://www.canisius.edu/honors-program/, accessed on July 11, 2014.

cepts which could naturally apply to or overlap with literary constructs. We expected from the students[2] an active engagement with the challenges of unfamiliar textual structure, encouraging them to take seriously (but not too seriously) Raymond Queneau's challenge: "Why shouldn't one demand a certain effort on the reader's part? Everything is always explained to him. He must eventually tire of being treated with such contempt." Primarily juniors and seniors from a wide range of majors, our students were stunned and amazed by these possibilities; the course has become popular and well-regarded for the unexpected insights and convergences we highlight. For this paper, we draw upon our experiences teaching this course in Fall 2012 and Spring 2014.

At *ResearchGate*, a social networking site founded by Bill Gates and open to scientists and researchers to share their work, Frederic Briand of the Mediterranean Science Commission posed the following question [5]: "Mathematics and literature—do you know examples of mathematical structure or concepts leading to great, enduring literary works?" Many professors and scientists from around the world contributed answers, citing many of the writers that we teach in our course. From Edwin A. Abbott's *Flatland* to Tom Stoppard's *Arcadia*—and ranging through poetry, fiction, and drama—there is much to read where the mathematical and the literary converge.

Several recent books, either emerging from teaching or suitable for it, describe the multiple and productive ways specific literary works and the arts in general converge with mathematics, including William Goldbloom Bloch's *The Unimaginable Mathematics of Borges' Library of Babel* [3] and Felipe Cucker's *Manifold Mirrors: The Crossing Paths of the Arts and Mathematics* [9]. A literature search of articles published since 2000 reveals numerous discussions of teaching math through literature at the primary and secondary level; see for instance Bharath Sriraman's "Mathematics and Literature" describing a middle school algebra class where the instructor taught critical thinking using Abbott's *Flatland* [27]. At various universities, courses in-

[2]The work of our students demonstrates best the nature of the course as well as the understanding and joy the students got from it, and thus we quote extensively from their writing. We would like to thank the following students who gave us permission to use their work in this essay: Christopher Eppolito (math and philosophy major), Taylor Klun (biology pre-med major), Sarah Urban (statistics major), all of whom took the class in 2012, as well as Colin Shanahan (philosophy major), who took the class in 2014.

tended for pre-service and in-service teachers highlight children's books appropriate to the task. Fresno Pacific University's *Using Literature to Teach Mathematics* is one such example [23].

There are also a range of college level mathematics courses, taught by mathematics professors, that use literature to highlight mathematical principles and their significance to the human condition. These courses often can fulfill a part of a university's general education requirements as well. For example, interested readers can find information on courses ranging from *Truth and Beauty: Mathematics in Literature* at Arcadia University [8]; to *Studies in the Literature of Mathematics* at Westfield State University [11]; from *Fractals: The Geometry of Nature* at Western Carolina University [1]; to *Can Zombies Do Math?* at Pomona College [13]. A course more similar to the one we teach is a sophisticated freshman seminar, *Mathematics and What It Means to Be Human*, created by an English professor together with a mathematics professor and offered at the University of Maryland Baltimore County; interested readers can find a detailed account at [17].

When we teach our course, *Mathematical Literature and Literary Mathematics*, the first thing we want to communicate to our students is that mathematics and literature interact in wonderfully weird and humorous ways. As co-instructors, we find the texts we use exciting, and we are delighted and intrigued by the play of language we each discover through our different disciplinary lenses. Our own personal enjoyment is key for our teaching in the context of the All-College Honors Program. Generally, the Honors Program course offerings are heavy on humanities and short on mathematics. Our course can count as, and fulfills the requirements of, both a literature seminar and a mathematics seminar. Students who do not feel particularly math-inclined imagine the course as a way to take their medicine with a dose of literary sugar. This, of course, works in reverse for the math-inclined students for whom another literature class is a necessary evil. Either way, they imagine killing two birds with one stone. Rather, we encourage them to laugh at the same jokes in two ways.

In selecting materials, we choose texts where mathematical concepts are subjects or structuring elements of the literature, and ideally both. From a literary critical perspective, the course highlights the play of language rather than the primacy of meaning. We introduce the literary theory suited to the structures and themes of the course texts if and only when needed. We offer students the basics of these concepts as tools for closely reading the

patterns of each text, rather than focusing on literary history or linguistic and social critique. Thus, we emphasize concepts from both structuralism and post-structuralism. When appropriate, we assist students in recognizing and understanding the various grammars underlying the form and meaning of the texts. Also when appropriate, we help them to see when such grammars are being purposely manipulated and called into question through techniques such as *diffèrance*, self-referentiality, and iteration.

The mathematical structuring enables us to look at both sign systems and signifiers. All of the texts we use demand "the informed reader", one who comprehends a standard structure and can see the play of grammar and meaning within and against the structure. With the focus on mathematics as both metaphor in and construct of the literary object, analysis is simultaneously highly productive and rich with detail. Our work is particularly gratifying when convergence between the disciplines occurs, for example, when iterative algorithms encounter iteration with a difference, as in Tom Stoppard's *Arcadia* [28]. Iteration, in fact, is a major theme in the course.

While we could not expect all students to understand either advanced critical theory or advanced mathematics, we can anticipate a range of perspectives and knowledges enabling students differently but thoughtfully to access the various constructs we bring to the course texts. To demonstrate their understanding, students write standard analyses and short research papers. Importantly, on several occasions they also write texts using constraints (poems organized by π, flowcharts, and so on), learning firsthand the joys of creating original versions of different forms of constrained writing. Below we include two samples of the creative and two samples of the expository writing of our students. The creative examples demonstrate that the students understood and could enact the constrained writing models at the intersection of mathematics and literary production. The expository samples show that the students could explain how mathematics both structured a literary text as well as created interesting thematic and philosophical considerations for readers to ponder.

Some of the mathematical material is presented in workshop format, though we also use lectures, mainly for the more complex and unfamiliar concepts [15]. The workshops consist of carefully sequenced activities in which students explore the topic of the day. Both the lectures and workshops are followed by discussions of the mathematical topic and how it is integrated into the literary texts. At the end of the term, students are required to write

a research paper on a mathematical topic of their choosing that relates to the course. Our topic suggestions include flowcharts and structured programming, number systems, iteration, chaos theory, fractals, the heat equation, infinity, maze solution algorithms, graph theory, probability, and symmetry.

We begin and end the seminar with the OULIPO literary movement, allowing us to introduce the axiomatic approach and its applications to writing. While drawing on a range of texts from *The OULIPO Laboratory* [22] and related documents available on the internet, we have students read and intensively analyze works by Georges Perec and Claude Berge, as well as the results of several poem generators based on mathematical principles. Perec's *The Art and Craft of Approaching the Head of your Department to Submit a Request for a Raise* [19] enables a discussion of flow charts, computers, and Turing's proof of the unsolvability of the Halting Problem, while Berge's short story "Who Killed the Duke of Densmore" [2] leads to an investigation of graph theory, interval graphs, and Hajos' theorem. Poems, of course, are always constrained by meter and rhyme, including those where the writer consciously rejects those constraints. However, poems structured by eye-rhymes or by the digits of π serve both to remind students what they already understand and to offer surprisingly fruitful variations. In a gesture of circling back, we conclude the course by dallying with excerpts from Perec's *Life: A User's Manual* [18], highlighting digressions on knight's tours and Graeco-Latin squares.

When we introduce his *The Art and Craft of Approaching Your Head of Department to Submit a Request for a Raise* (conveniently abbreviated for the American audience as *The Art of Asking your Boss for a Raise*), we explain that Perec, besides being a member of the OULIPO group and so devoted to exploring the nexus of mathematics and experimental literature, was working as an archivist for a medical research library. When Jacques Perriaud of the Computing Service of the Humanities Research Center in Paris challenged "a writer to use a computer's basic mode of operation as a writing device," Perec did, employing Perriaud's own example of the procedure used in a large corporation to ask for a raise. We explain that in the distant past of the mid-1960s, most programs were designed using flowcharts; since computers were the size of a room, programming was taught only in technical and engineering colleges and universities, and time on a computer was very expensive. To highlight the important textual structures mimicking computer programming, we draw students' attention to how his biographer

David Bellos describes Perec's scheme (on page *xiii*, Introduction to [19]):

> He chose to write *in extenso* the progress of an imaginary computer-mind as it iterates a set of choices in pseudo-real time. He also chose to simulate the speed and tireless repetitiveness of a computer program by abandoning all forms of punctuation as well as the distinction between upper- and lower-case letters. The result is an almost unreadable fifty-page text that looks like (but actually is not) a single, breathless sentence.

In class, following from the conditions under which Perec constructed his text, we discuss the constraints of flowcharts, especially the ultimate sin for a computer programmer, the endless loop. It would clearly be extremely useful to have a program that would check a piece of code for any such loops. This brings us to the Halting Problem. Russell's paradox and Alan Turing's 1936 proof of the impossibility of a general solution to the Halting Problem are then presented in class along with examples of flowcharts with finite loops and infinite loops. Students are then responsible for avoiding endless loops in writing their own flowcharts and accompanying text.

One student in particular, a philosophy major, did an excellent job mimicking Perec's style and avoiding the endless loop. Below is an excerpt:

> *Today is the day you really absolutely must go to the store you've been putting it off for far too long and really if you delay any longer you just know it will never get done so you put on your walking shoes and walk outside and see that the weather is rather bad and it's really hot and muggy you know those days where it feels like you're just swimming through the air as if the air is water like it is raining but it's not raining because it's actually just really hot sunshine so you realize you need some sunglasses and a fan to help with all this heat so you are walking to the store but you decide you cannot walk to the store it is just so hot and it's a rather long walk, and so you will take the subway because the subway is cool these times of the years just like it is warm during the winter kinda funny how that works but that's how it works it's like a thermos keeping hot things hot and cold things cold but the other way around so you go to the not warm but cool subway and wait for it to arrive and wonder whether it will be*

late or not but of course it's just your luck that the subway is late as it always is and in fact it is cancelled because someone killed someone by stabbing them a lot in a different station down the line and oh my god that's so horrifying why would someone do that you say loudly and the police come to question you and they take you away and you have to answer questions and you ask them why you have been taken away and asked questions and they say it's standard procedure and to just answer the asked questions which they are asking and you ask them an asked question regarding a lawyer and they don't like that so they take you and put you into a cell and you talk to your lawyer and he says it doesn't look good and they have lots of evidence and you are confused because it seems like there shouldn't be any evidence but you shrug and tell your lawyer that you will just do what he says but your lawyer isn't a very good lawyer and the evidence is overwhelming even though there shouldn't be any evidence and you are locked in jail for 15 years for a crime of passion with an opportunity for parole and you get out on good behavior after five years and get back to your home and everything is as you left it and you wait for a little while and realize that today is the day you really absolutely must go to the store you've been putting it off for far too long and really if you delay any longer you just know it will never get done so you put on your walking shoes and walk outside and see that the weather is rather bad and it's really coming down outside and we're talking the buckets just buckets of pouring drenching rain and thunder and lightning flashing and rumbling not in that order but the other way around and you know what would make this a lot better would be an umbrella to keep the buckets just buckets of pouring drenching rain off of your head and shoulders not to mention your back and arms and all the other parts of your body which are all as if you have just taken a shower which you did before you left but probably could have avoided with all this rain so you decide you cannot walk to the store because there are buckets just buckets of pouring drenching rain and it's a rather long walk, and so you will take the subway because the subway is dry when it is raining out because of some sort of funny business where things underground stay dry . . .

This goes on for ten hilarious pages, including various weathers and shopping objectives and a surprising amount of bloodshed. He also created a marvelously detailed three-page flowchart, sadly too long to include, aptly illustrating his story.

Our introduction to online poem generators gives students access to Queneau's *Cent Mille Milliards de Poèmes* [21, 26], the $N + 7$ Machine [7], as well as Pilish [14]. These structures fascinate many students.

For another assignment, one student, a philosophy and mathematics dual major, chose to write a poem using the digits of π as a structuring device. The introduction of π allowed us to go into a digression on the differences among rational, algebraic, and transcendental numbers and their representations. As he explains:

> *Standard pilish is a very specific constraint; the nth word of the work must contain exactly the number of letters that the nth digit of that irrational, transcendental number π dictates. However, this may be difficult to fulfill when a number of digits in a row are small, and impossible when the nth digit is a 0; standard pilish has the built-in provision that a ten letter word is used for each occurrence of 0, and words having more than ten letters take the place of two digits in the expansion of π. However, thirty-three words into the poem, one [meaning this student writer] discovered that one has little knowledge of ten letter words. Undeterred by these happenings, one determined a new regulation for pilish; henceforth, what had originally been intended as a bombarding of fictitious constructs concerning a catechumen and exorcists intumesced into a lament. The new version of pilish differs from standard pilish in a single way: ten letter words are not allowed, and each '0' in the decimal expansion of π corresponds to an 'O' in the poem. It was from this new constraint that one came up with the idea of a lament.*

Despite his disclaimer, note the student's clever use of numerous 10-letter words in his explanation. We include on the following page his Pilish poem in its entirety, which contains no 10-digit words but many 8-digit, 9-digit, and even 11-digit ones. We think it is clear that our student not only understood the Pilish constraint but that he may have exceeded the desired level of hilarity in his production.

Pi: a Lament

Why? I mean, a savvy commoner's pi induced angry men (mathy monsters, miniscule mortals) discharge, "the 'pi' you demonize from abject pi hating into the one dementia aid of Senator Santorum's 'three!'[3] *O to woefully wondrous aids (a rapturous bishop's a groovy spelunker, yes?) testament unfolding yon blabber-mafia! I!!!"*

O angry extortee, me!

O undiluted fashion! When tradeoffs make this wrath impending on you!

O garnish everyone a better life!

O ending un-examined living! Ay!

O veracity: unadorned, unremitting, truthful! Goatee of exegesis!

O thy duty circling! To lords one logo bespangling! (giggles?)

O undone futures, travelers, fractals! In a word: mourning.

O forecast dreary truth, I: one, to fraction, to sum?

O denial: 'three's good.' RADICAL!

O judiciary! the senator's math lost! Hooray!

O luminance, truth usurp!

O tumor forsooth; do-in the '3' Alabama is freed! Our math's overruled gits!

O founders, a pi restored! More hotheads? Loopinesses! I deleted that wrong!

O on homework, earn A!

O on, onwards!

O a loyalist's day, holiness, truth. To mathematics!

[3]Referring to an infamous double entendre headline during the 2012 Republican Primary: "Santorum comes from behind in Alabama three-way."

In the middle of the course, we read *Arcadia* [28], a play productive both mathematically and in terms of literary analysis. Stoppard is the patron saint of the OUTRAPO, the theater version of the OULIPO, and the literary structure of *Arcadia* is organized by and dependent upon iteration, chaos theory, and fractals. It provides many rich opportunities to discuss mathematics. We derive the algorithm for finding Pythagorean triples and present Fermat's Last Theorem as the claim that no solutions to the analogous problem exist for higher powers, mention Andrew Wiles' proof (published in the same year when *Arcadia* was first staged), and discuss the theorem's role in the play. Another lecture involves Newtonian determinism, Laplace's demon, the heat equation, and entropy. We spend one day on a workshop on iteration, in which students, with the aid of calculators, play with the limits of recursively defined sequences of varying types: convergent, divergent, oscillating, and chaotic. Another day we study fractals. Students derive formulae for the perimeter and area of the Koch snowflake and the area of the Sierpinski gasket. The Chaos Game is described and used to further explore the Sierpinski gasket. We define and compute the fractal (Hausdorff-Besicovitch) dimension for these examples, and exhibit several more complex fractals.

Arcadia has received significant critical discussion (see, for instance, [12, 16, 25, 29]), and, though our students wrote some fascinating analyses of the play, we will not dwell upon it overlong here. Below we provide only a brief excerpt from an analytical essay by a statistics major:

> *Stoppard uses Thomasina's pursuit to discover the meanings behind the iterated algorithm and the second law of thermodynamics as a parallel to her character. Similar to Valentine, Thomasina finds order in knowledge and education. She thrives on learning new things and discovering them on her own. However, during this time period, society has a different view on how young women should behave. For young women such as Thomasina, society finds order in marriage and properness, and disorder in knowing 'too much.' Society would find Thomasina's attitude and brilliance as chaotic and improper. In scene three while professing her hatred for Cleopatra, Thomasina says 'I never knew a heroine that makes such noodles of our sex' (Stoppard, 42). However, as the play progresses and Thomasina ages, she too becomes infatuated with love, for Lord Byron and then for Septimus, just as a young girl 'should.'*

> *This shift from being outspoken and critical to submissive to the desires of society comes from Thomasina's knowledge. She understands that throughout history society has bred young women to fall in love and be married off without much education or knowledge, and there is nothing that can be done to undo this. Just as heat goes to cold but cold cannot go to heat, Thomasina realizes that no matter how much she fights society, she will end up being married off despite her wishes.*

Our student has a refined understanding of how Stoppard has made mathematical and scientific principles both a subject as well as a structuring element of his text and thus produced an overlapping relationship between humor and pathos.

If the OULIPO and Stoppard are overtly and self-consciously structuring their texts according to mathematical principles, several experimental fiction writers of the 20$^{\text{th}}$ Century take a different turn. These marshal a critique of rationality by organizing their texts to emphasize the limits of certain mathematical concepts for defining reality. Circle-packing problems and the fourth dimension come up in discussions of Robbe-Grillet's *Jealousy* [24]. Stories by Borges [4] also are fertile ground for exchanges about computation, infinity, and the Infinite Monkey Theorem ("The Library of Babel"); probability ("The Lottery of Babylon"); and maze solution algorithms ("The Garden of the Forking Paths"). And finally, Italo Calvino's *If on a winter's night a traveler* [6] brings us to paper folding, book imposition, and kaleidoscopes. While providing accuracy of description, these writers employ mathematical strategies as a way to undercut any full account of the inter- and intra-personal tensions circulating through each text.

As an example of mathematics taken to the edge of reason, Jorge Luis Borges produces an intriguing interplay of mathematics and story in "The Lottery of Babylon." During our exploration of this story, we have another workshop day to play with basic rules of probability, expected value, and humble games of chance, such as lotteries and card games. When Borges' lottery evolved, "[s]omeone tried something new: including among the list of lucky numbers a few unlucky draws" [4, page 102]; in class we thus explore the changes in the outcome of a lottery when the parameters vary. Further, textual references to Zeno's Fallacy and Pascal's Wager lead to a discussion of the theory and meaning of probabilities. The entire text is written in the passive voice with conflicting reported understandings of the source of the

game, though the stakes and the relevance are always clearly available to characters and to readers. The story reinforces, however, the notion of life as a game of chance, with the final arbiter shrouded in mystery despite a clear sense of the logic of the game.

One student, a pre-med biology major, after explaining very well the workings of probability, defines the central conundrum of this text:

> *[T]he poor still felt excluded because they could not afford to participate in the Babylon lottery. In response, the lottery became free and mandatory for all Babylonians. The lottery became the Babylonian's reality, in which their lives were governed by the random outcome of the drawing. A simple drawing could elevate an individual to the council of wizards, or subject an individual to mutilation or death. Their lives were in the hands of the Company, and all they could do was hope that, by chance, they would have a winning ticket that led them down a favorable path. As a result, 'it made the Company accept complete public power,' and the Babylonians had no say in how their lives would unfold (68). [Yet the] story also suggests that there was always a sense of higher authority among the Babylonians, even when it was known to not exist.*

Both random chance and ultimate control collide in Borges's story, and students generally understand that formation well, though they are as puzzled by its source and significance as any of the Babylonians (and us).

We find that the team-teaching element of our course creates both an enjoyable and educational atmosphere for students and professors. It is crucial that the professors bring their distinct disciplinary vocabularies and viewpoints to each discussion, even when the focus of the day is on one aspect or another of the course. We feel that this approach really surprises students and encourages their creativity and willingness to experiment. In part, this is because we allow them to see that we are "life-long learners," not claiming expertise in the other's discipline but fascinated by the insights we can each gain from the other. Further, because they can see meaning being generated through the methods of two disciplines, students are encouraged to bring their own special disciplinary knowledge to the materials at hand. We also think that attention to the concepts of iteration and infinity lead students to contemplate the large questions about human existence and the meaning

of life. Especially last semester, students were fascinated by the notion of multiple timelines or bifurcating paths leading to multiple universes and the concept of quantum suicide, a subject for which we had not planned. In fact, we learned about it from the students.

It was interesting to discover how a mathematician and a literary scholar, both fascinated by the same text, can bring such different attention to the acts of reading and interpretation. When discussing the opening scenes of Robbe-Grillet's *Jealousy*, for example, reckoning the space in which banana trees are planted seems like a mere counting exercise to the mathematician. But when the literary critic sees the precision of the patterns, it is clear that the section serves to foreground an emphasis on precise observation of detail, a fundamental characteristic structuring the entire novel.

We learned from each as well the relevance within both our disciplines of "iteration" for reading constrained writing. For example, Perec's story is characterized, as necessitated in programming, by repetitions, importantly repetitions with a difference. Considered in the light of the concept "differance" or "repetition with a difference," developed by language philosopher Jacques Derrida [10], any repetition is necessarily "different," never self-same. A "self-same" repetition, of course, would invalidate a program, where a repetition of the same would lead to a loop which might stagnate the program. Rather, each repetition with a difference in Perec's story fulfills the promise of a functional program through slight yet significantly meaningful shifts in language which serve to convey a surprising array of emotions.

We bring these different and yet convergent understandings to each other, enriching our own sense of the text and the pleasure of reading it. We are convinced that such an interplay in the classroom enriches the student experience as well. In many ways, this course has become the perfect educational experience: the students learn; we learn, both from each other and from the students; and a good time is had by all.

References

[1] Julie Barnes, *Fractals: The Geometry of Nature*, course syllabus, November 2006. Available at http://www.wcu.edu/academics/departments-schools-colleges/cas/casdepts/mathcsdept/mathcsacadprogs/mathematics/bs-in-mathematics/syllabi-for-undergraduate-mathematics-courses/math-192-syllabus.asp, accessed on July 7, 2014.

[2] Claude Berge, "Who Killed the Duke of Densmore?" in *The Oulipo Laboratory*, translated by Iain White, Atlas Press, London, 1995.

[3] William Goldbloom Bloch, *The Unimaginable Mathematics of Borges's Library of Babel*, Oxford University Press, Oxford, 2008.

[4] Jorge Luis Borges, *Collected Fictions*, translated by Andrew Hurley, Penguin Books, New York, 1998.

[5] Frederic Briand, "Mathematics and literature—do you know examples of mathematical concepts or structures leading to great, enduring literary works?" Question posted at *Researchgate.net*, February 3, 2013. Available at: https://www.researchgate.net/post/Mathematics_and_literature_do_you_know_examples_of_mathematical_structure_or_concepts_leading_to_great_enduring_literary_works, accessed on July 2, 2014.

[6] Italo Calvino, *If on a winter's night a traveler*, translated by William Weaver, Harcourt, San Diego, 1979.

[7] Peter Christian, *The N+7 Machine*. Available at http://www.spoonbill.org/n+7/, accessed on July 9, 2014.

[8] Marion Cohen, "Truth and Beauty: A Course in Math and Literature," *FOCUS, The Newsletter of the MAA*, Volume **30** Issue 6 (December 2010-January 2011), pages 17-18.

[9] Felipe Cucker, *Manifold Mirrors: The Crossing Paths of the Arts and Mathematics*, Cambridge University Press, Cambridge, 2013.

[10] Jacques Derrida, *"Speech and Phenomena" and other essays on Husserl's Theory of Signs*, translated by David B. Allison, Northwestern University Press, Evanston, 1973.

[11] Philip Hotchkiss, *Studies in the Literature of Mathematics*, course syllabus, Spring 2009. Available at http://www.westfield.ma.edu/math/faculty/hotchkiss/MA216/216syl.pdf, accessed on July 5, 2014.

[12] Daniel Jernigan, "Tom Stoppard and 'Postmodern Science': Normalizing Epistemologies in 'Hapgood' and 'Arcadia'," *Comparative Drama*, Volume 37 Issue 1 (Spring 2003), pages 3–25.

[13] Gizem Karaali, "Humanistic Mathematics: An Oxymoron?" *Diversity & Democracy*, Volume **15** Issue 2 (2012), page 21.

[14] Michael Keith, *Writing in Pilish*. Available at http://www.cadaeic.net/pilish.htm, accessed on July 9, 2014.

[15] Christine Kinsey, *The Mathy Bits*, unpublished manuscript, Canisius College, Buffalo, NY, 2014.

[16] Lucy Melbourne, "'Plotting the apple of knowledge': Tom Stoppard's Arcadia as Iterated Algorithm," *Modern Drama*, Volume 41 Issue 4 (Winter 1998), pages 557-572.

[17] Michele Osherow and Manil Suri, "Mathematics and What It Means to Be Human, Part I," *The Chronicle of Higher Education*, October 7, 2012. Available online at http://chronicle.com/article/MathematicsWhat-It-Means/134850/, accessed on July 5, 2014.

[18] Georges Perec, *Life: a User's Manual*, translated by David Bellos, David Godine, Boston, 2009.

[19] Georges Perec, *The art and craft of approaching your head of department to submit a request for a raise*, translated by David Bellos, Verso, London, 2011.

[20] Raymond Queneau, *Exercises in Style*, translated by Barbara Wright, New Directions, New York, 1981.

[21] Raymond Queneau, "A Hundred Thousand Billion Poems" in *Oulipo Compendium*, Harry Mathews and Alastair Brotchie, eds., translated by Stanley Chapman, Atlas Press, London, 2005.

[22] Raymond Queneau, Italo Calvino, Paul Fournel, Jacques Jouet, Claude Berge, and Harry Mathews, *Oulipo Laboratory*, Atlas Press, London, 1995.

[23] Wilbert Reimer, *Using Literature to Teach Math*, Course description, November 2011. Available at http://ce.fresno.edu/cpd/courses/coursedetails.aspx?courseCode=EDU-920, accessed on July 4, 2014.

[24] Alain Robbe-Grillet, *Two Novels: Jealousy and In the Labyrinth*, translated by Richard Howard, Grove Press, New York, 1965.

[25] Michael Roeschlein, "Theatrical Iteration in Stoppards Arcadia: Fractal Mapping, Eternal Recurrence, Perichoresis," *Religion and Literature*, Volume 44 Issue 3 (Autumn 2012), pages 57-85.

[26] Beverly Charles Rowe, *Queneau's Sonnets*. Available at http://www.bevrowe.info/Queneau/QueneauRandom_v5.html, accessed on July 9, 2014.

[27] Bharath Sriraman, "Mathematics and literature," *Australian Mathematics Teacher*, Volume **59** Issue 4 (2003) pages 26-31.

[28] Tom Stoppard, *Arcadia*, Faber and Faber, New York, 1993.

[29] Susanne Vees-Gilani, "Hidden Order in the 'Stoppard Set': Chaos Theory in the Content and Structure of Tom Stoppard's Arcadia," *Modern Drama*, Volume 42 Issue 3 (Fall 1999), pages 411-426.