Theater Review

Love and the Second Law of Thermodynamics: Tom Stoppard's *Arcadia*

Like other plays by Tom Stoppard, *Arcadia* is an uproarious comedy with unsettling undercurrents. In this case, the undercurrents find their source in the second law of thermodynamics, unpredictability, and chaos, highlighting not only the limitations of scientific prediction but also the inescapable fact that we can never hope to foresee just what course our lives will take. Ruthless, irreverent humor prevents the play from straining under these weighty themes, as does a plot that shuttles between the early nineteenth century and the present.

Mathematics plays a starring role in *Arcadia*. Not only does it feature two mathematicians and a thirteen-year-old mathematical prodigy as central characters, it also uses mathematics to suffuse everyday things—a leaf, a population of birds, clouds—with grandeur and magic. The ominous implications of the second law of thermodynamics—that disorder will increase until all energy is dissipated and all light and life are extinguished—hang heavy over the play. But this bleak prognosis is in the end contravened as the lives of the characters in the past and present begin to show parallels and similarities. In the end their struggles to understand life begin to mesh, and it is the unquestioning joy of the young that points to a more hopeful path.

The text of the play is now out in paperback and appearing in bookstores. It is well worth reading, even if you plan to see it on the stage. The production at Lincoln Center offers many delights, but ultimately it does not fully capture the density and richness of the ideas in the play. Part of the problem is that, even with a three-hour running time, the cast sometimes seems to be racing against the clock. (Even the break is precisely timed: "There will be a thirteen-minute intermission," the program announced.) Lines are sometimes spit out too hurriedly, some of the cast members do not have a faultless command of the requisite British accent, and the Shakespearean sing-song pitch of one of them tends to spin out of control. All of this makes the dialogue sometimes difficult to follow. Much that is needed to understand certain complications in the plot is crammed into one overly long scene with two characters, and it can be a wearying exercise to keep track of all the details. Despite these shortcomings, the production is charming, poignant, and very, very funny.

The semicircular stage is surrounded by a scrim, onto which a pastoral scene reminiscent of a Renaissance tapestry is projected. At the center of the scene Eve holds an apple in her palm, offering it to Adam. As the lights go down in the theater, the whole scene goes dark except for a circle of light embracing Adam and Eve. That too fades as the curtain rises on the scene. It is 1809 and Thomasina Coverly and her tutor, Septimus Hodge, are studying at opposite ends of a long table. Recalling the image of Adam and Eve that has just faded, Thomasina asks, "Septimus, what is carnal embrace?" Deflecting her precocious question, he tells her that "Carnal embrace is the practice of throwing one's arms around a side of beef." Then he reminds her that she was supposed to be trying to prove Fermat's Last Theorem. (It was not long after the opening of *Arcadia* in London when Andrew Wiles made his

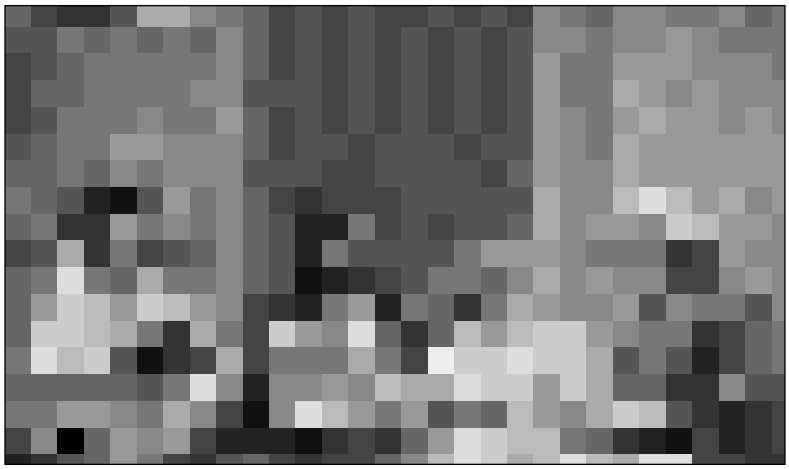
historic announcement in Cambridge that he had proven Fermat's Last Theorem. The fortuitous timing led to Stoppard being quoted in news stories about the proof.)

The "carnal embrace" Thomasina refers to is just one of many taking place at Sidley Park, the Coverly estate. Indeed, *Arcadia's* tangle of star-crossed loves becomes downright Chekhovian. Late in the play one of the characters declares that a deterministic universe isn't possible because of sex, "the attraction that Newton left out." As she puts it, "The universe is deterministic all right, just like Newton said, I mean it's trying to be, but the only thing going wrong is people fancying people who aren't supposed to be in that part of the plan." In the Arcadian universe, the common notion that love and science occupy opposite poles in human experience gets turned on its head. Rational, logical science and irrational, passionate love have something in common: both are unpredictable. The play provides ample evidence for this view.

Septimus is having a fling with the wife of Ezra Chater, a hack poet-cum-botanist who is visiting Sidley Park. Septimus's true love is Thomasina's mother, Lady Croom, a regal woman in the grandest sardonic tradition. "Do not dabble in paradox," she warns one visitor, "it puts you in danger of fortuitous wit." Quite untraditional, though, is Lady Croom's easy virtue—she frolics with a visiting Polish pianist, her neighbor Lord Byron, and, late in the play, Septimus himself. One of the weaknesses in the Lincoln Center production is that one must rely on obvious hints in the characters' lines to discover who is in love with whom; affections do not register in the actors' reactions to each other. Perhaps this was a technique to underscore the unpredictability of the attachments that arise, but it simply results in confusion for the audience.

Lady Croom understands little of her daughter's intellectual potential and even seems in the dark about her age: "How old are you this morning?" she asks Thomasina. Going on fourteen, Thomasina is mercurial, intense, brilliant, and charming. She has an uncompromising regard for fact and truth that one finds in mathematicians and children. Playing Thomasina, Jennifer Dundas is for the most part convincing, though at times she throws in a little too much eager prancing about and a few too many little-girl gurgles of delight.

At one point Thomasina goes from wittily deriding Cleopatra to sobbing over the literature lost when the ancient library of Alexandria burned down. The production shows a lack of nuance in this moment of shifting from the comic to the serious, leaving the audience uncertain at first how to react. The tone becomes clearer as Septimus tries to comfort Thomasina, telling her that eventually all great, lost discoveries will be found anew. "We shed as we pick up, like travellers who must carry everything in their arms, and what we let fall will be picked up by those behind." Trying to make sense of clues that have been left behind is a strong motif in the play. It is really the idea of modeling phenomena based on incomplete knowledge, whether one is trying to formulate a mathematical rule to represent numerical data or trying to reconstruct how people in the past lived. In this way Stoppard is able to get across an idea not well known among the general public—that mathematics, far from being just a collection of simplistic calculating rules, can provide rich descriptions of our complex world.



Scene from *Arcadia*

When the play fast-forwards to the present day, Sidley Park is the home of the latest generation of the Coverlys. The present-day action takes place on the same set, and the costuming is the only indication that the time is different. The elder Coverly son, Valentine, is a mathematician at Oxford. Using two hundred years' worth of Sidley Park game books (lists of the take when shooting parties went out), he is examining changes in the grouse population. Because of hunting, changes in the food supply, and other factors, the grouse population is not easily described by an exponential function, so Valentine is trying to formulate a more complex model.

Stoppard has understood something of the poetic heart of this area of mathematics. Describing his efforts with the "noisy" data he has on the grouse population, Valentine says it's "like a piano in the next room, it's playing your song, but unfortunately it's out of whack, some of the strings are missing, and the pianist is tone deaf and drunk…[so you] start guessing

Robert Sean Leonard and Blair Brown in *Arcadia*

what the tune might be. You try to pick it out of the noise. You try this, you try that, you start to get something—it's half-baked, but you start putting in notes which are missing or not quite the right notes. And bit by bit…" And he starts to hum "Happy Birthday".

Also at Sidley Park are best-selling author Hannah Jarvis, who is writing a history of the estate's gardens, and Bernard Nightingale, a literary scholar from Sussex University who comes to raid the libraries of Sidley Park in search of evidence that Byron had visited there. In parallel with Valentine's investigations of the grouse population, Hannah and Bernard try to "model" the Sidley Park of 1809 by piecing together clues left behind about Septimus, Thomasina and her work in mathematics, and Byron's elusive presence.

Hannah discovers some old notebooks in which it appears that Thomasina had begun experimenting with iterations of functions. Although Valentine himself is using iteration to model the grouse population, he resists the idea that what Thomasina did bears resemblance to his own work, protesting that she would have only studied classical mathematics. After her time, "maths left the real world behind, just like modern art, really," he says. "Nature was classical, maths was suddenly Picassos. But now nature is having the last laugh. The freaky stuff is turning out to be the mathematics of the natural world." The comparison between abstraction in mathematics and abstraction in art is a wonderful touch, but after that the ideas become tangled. The "Picassos of mathematics" are algebraic geometry or category theory—areas that took abstraction in mathematics to an extreme. The "freaky stuff" to which Stoppard refers is concrete, nineteenth-century mathematics taken to a new level through the use of computers.

At one point Valentine declares that something is "trivial", and when asked what he means replies, "It's a technical term." He goes on to explain: "The questions you are asking don't matter, you see. It's like arguing who got there first with the calculus. The English say Newton, the Germans say Leibniz. But it doesn't *matter*. Personalities. What matters is the calculus." As a definition of the common mathematical use of the word "trivial", Valentine's explanation misses the mark. Later in the play the word is repeated, with a character every now and again announcing that something is "trivial". In those cases too, the word is used in its normal, everyday sense. It seems that Stoppard was trying to imbue the word with new connotations, but, because Valentine's initial definition of it misfires, the word never takes on any broader meaning.

These slipups aside, Stoppard treats the mathematics lyrically and for the most part authentically. His descriptions of mathematics are necessarily rather vague, and within that vagueness he says little that is incorrect. Without relying on well-worn buzzwords like "chaos", "nonlinearity", and "entropy", he invents fresh ways of describing mathematical ideas. Here, for example, is what Valentine tells Hannah when she asks him whether one could come up with an iterated algorithm to draw a picture of a leaf:

"If you knew the algorithm and fed it back, say, ten thousand times, each time there'd be a dot somewhere on the screen. You'd never know where to expect the next dot. But gradually you'd start to see this shape, because every dot will be inside the shape of this leaf. It wouldn't *be* a leaf, it would be a mathematical object. But yes. The unpredictable and the predetermined unfold together to make everything the way it is. It's how nature creates itself, on every scale, the snowflake and the snowstorm."

Such descriptions alone are cause to cheer when the curtain comes down. Of course, chaos theory has been so hyped that one could argue that Stoppard's use of it is simply a way to burnish his play with the gloss of the scientific theory du jour. But such a view would overlook the thoroughness with which Stoppard has integrated these mathematical ideas into the action of the play. His purpose is to explore the unpredictability of passion, the clash of rationality and emotion, the way that chaos can emerge from logic; and he shows how certain mathematical ideas reflect and resonate with these themes. Even if he has understanding of other, lesser-known areas of mathematics, it is not clear that he could have chosen anything better to suit his purpose.

If the play lacks some mathematical depth, it lacks none in its characterization of the mathematician Valentine. He is convincingly bewil-

dered about how to explain mathematics but eager to do so when someone is truly curious. Far from being a cold, logical scientist, he is a man who understands something of life and love. (In one of the less believable love triangles, both Valentine and his younger brother, Gus, are in love with Hannah.) Unfortunately, Robert Sean Leonard, who plays the part, irons out Valentine's idiosyncrasies, making him clever but uninteresting. One cannot help contrasting Valentine and Bernard—two academics, two very different people. Victor Garber's portrayal of the literary scholar is not sympathetic, but it is wildly funny. He is brash, self-important, rude, capricious, and a careless scholar. But he has a perverse charm and vivacity that make Valentine look colorless by comparison.

Stoppard makes merciless fun of Bernard, who creates theories to suit his fancy, not the facts. When Hannah pokes holes in Bernard's theory that Lord Byron killed Ezra Chater in a duel, Bernard tells her that she has no "visceral belief" in herself, no "gut instinct". It is exactly his kind of "gut instinct" that leads Bernard to concoct the erroneous theory that Byron killed Chater. His theory, which he announces in a news conference, gets splashed all over the papers but is quickly undercut by Hannah's discovery that Chater died in India of a monkey bite. At the other end of the spectrum, Valentine, being a mathematician, is much more circumspect and precise in his research. But it is Hannah who turns out to have the real soul of an explorer. At one point, Valentine vows to relinquish the grouse project, but Hannah tells him not to give up. "It's wanting to know that makes us matter," she says. "Otherwise we're going out the way we came in."

In one of the most brilliant scenes in the play, Bernard delivers a passionate tirade against science. "There's no rush for Isaac Newton," he declares. "We were quite happy with Aristotle's cosmos. Personally, I preferred it. Fifty-five crystal spheres geared to God's crankshaft is my idea of a satisfying universe…I'd push the lot of you over a cliff myself. Except the one in the wheelchair, I think I'd lose the sympathy vote before people had time to think it through." And then, at the end of his mean-spirited diatribe, with laughter tumbling through the theater, the audience is suddenly rapt as he softly quotes from Byron: "She walks in beauty, like the night of cloudless climes and starry skies, and all that's best of dark and bright meet in her aspect and her eyes." This time the shift from comic to serious worked: ignorant views of science notwithstanding, Bernard illuminated a realm into which science cannot venture.

And this leads to one of the central questions of the play: How far can science and mathematics take us in explaining what life is all about? Septimus's fate was to be driven insane by what Thomasina foresaw—that the second law of thermodynamics insures the world will become more and more incoherent and disorganized. Her understanding that algebra was inadequate to describe nature tormented him to the end of his days. Hannah reads from an old letter describing Septimus's life as a hermit: "[I]t was Frenchified mathematick that brought him to the melancholy certitude of a world without light or life…as a wooden stove that must consume itself until ash and stove are as one, and heat is gone from the earth." Septimus died laboring "for the restitution of hope through good English algebra." *Arcadia* presents a spellbinding picture of what can happen when people really, *really* care about what science and mathematics have to say.

At the end of the play, the 1990s characters change into old-fashioned dress in preparation for a dance being held at Sidley Park. And then at one point, as Hannah and Valentine sit reading, Thomasina and her brother suddenly fly into the room, two kids teasing each other. Characters from both eras, who had been separate in previous scenes, suddenly appear onstage together. The effect is magical, reinforcing the sense that although the world is unpredictable, patterns emerge and reemerge as time marches on. A moment later, Valentine and Septimus are, in their separate times, examining Thomasina's crude drawing of a heat engine, solid proof that she had anticipated the second law of thermodynamics. Like a ball breaking a pane of glass, says Valentine, "You can put back the bits of glass, but you can't collect up the heat of the smash." "So the Improved Newtonian Universe must cease and grow cold," Septimus echoes.

Music floats in from off-stage, and Thomasina begs Septimus to teach her to waltz. But he is lost in thought and muses to her, "When we have found all the mysteries and lost all the meaning, we will be alone, on an empty shore." The solution she proposes peals like a bell struck in the dead of night: "Then we will dance!" Unlike Septimus, Thomasina can plumb the depths of mathematics and resurface with her exuberance for life intact. Valentine's strange brother, Gus, who has not spoken since age five and who, like Valentine, has developed a passion for Hannah, comes in to dance with her. The curtain comes down as the two couples whirl around the stage.

— Allyn Jackson

Arcadia*, directed by Trevor Nunn, played at the Vivian Beaumont Theater, Lincoln Center, New York City, until mid-August 1995. The text of the play is published by Faber and Faber, 3 Queens Square, London, WCIN 3AU, England.*