

# Arcadia: A Drama of Chaos

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## ABSTRACT

As a paradigm shift away from Newtonian determinism and a solution to thermodynamics pessimism, chaos theory presents a new perspective of a world that is both ordered and disordered, in which Man is neither totally free nor entirely bound. Chaos theory transcends disciplinary boundaries and offers a fresh approach that has resonated through various genres, particularly drama and novel. In *Arcadia*, Stoppard interweaves chaos theory into the play's content and structure. The paper aims to reveal how Stoppard utilized the two branches of chaos theory: order hidden in chaos and order arising from chaos to present a universal image. By integrating universal humanism with modern science, Stoppard proposes that we are not only influenced by chaos, but we are also an integral part of it. Man can create as much disorder as order and can influence change within a system through his own choice.

**Keywords:** Stoppard; *Arcadia*; chaos theory; Newton; thermodynamics

## INTRODUCTION

### The Evolution of Chaos

*Arcadia* (1993) utilized the emerging field of chaos thematically and structurally to mimic how order bifurcates into chaos and how, out of chaos, order can beget. Since the paper's primary goal is to establish *Arcadia* as a drama of chaos, it is pertinent first to recount the story of chaos, its two main branches, and its core principles before delving into the analysis.

### The Legacy of the Past

Throughout history, chaos has been viewed as a source of ambiguity, evil, and formlessness. Humans have relied on linearity, centrality, hierarchy, reductionism, and dualism to impose order and discern things in simple dichotomies. Anything that falls outside of this logical framework is often labeled as irregular, statistical dirt, or simply chaos. Newton's discoveries in motion, gravity, and math enhanced this view. They presented a mechanistic and deterministic worldview. Predictability, time-reversibility, and control are possible in this machine-like universe governed by causal determinism. This view infiltrated all avenues of inquiry, and Newton was depicted as the "new Moses," who brought the "tables of the law" (Prigogine and Stengers 1984, 27). Although it robbed Man of free will, it provided him comfort, security, and power over nature. Once he managed to break the code, the future would be at hand. Simon Laplace's fantasy soared him high; if he were next to God at the moment of creation, he could predict the entire future using nothing but Newton's laws. To Orthofer (2002), Laplace was not the first. He was preceded by Archimedes, whose eureka moment pushed him to boast that, given the right lever, he could move the earth. Accordingly, such a mentality has set a limit between man and nature. Man is no longer a part but a participant, and the universe is no longer a home but an object to be examined and controlled (173).

Chaos was resurrected with the advent of thermodynamics around the 1850s. Pioneered by Joseph Fourier, Sadi Carnot, and Emile Clapeyron and recognized as a science at the hands of William Thomson and Rudolf Clausius, thermodynamics, born out of the need to improve the efficiency of steam engines, describes the relation between heat and other forms of energy. According to Barri J. Gold (2010), while the first Law of Conservation asserts that the quantity of energy remains as it is, the second Law of Dissipation declares that the quality of this energy is not; something will be lost. The energy is still there in the universe but is no longer applicable. The second law reveals further that the universe moves in one direction: from order to disorder. This process, which is inevitable and

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irretrievable, pushes Gleick (1987) to portray the second law as "a one-way street" (308). Such a tendency, called entropy, promises nothing but dissipation and death. It undermines Newton's model and declares that a perpetual machine is a fantasy and the universe's fate is the heat death or the Big Crunch.

Moreover, a countermovement against the Newtonian model was growing among nineteenth-century scientists. While Henry Poincaré's three-body problem led him to believe that precise predictability is a far-reaching dream and paved the way to a phenomenon that will be referred to later as the butterfly effect, Lyapunov and Birkhoff's findings softened the earth to two more concepts of chaos, i.e., the tipping points and the strange attractor (Kellert, 1994). On the other hand, Niels Bohr and Werner Heisenberg concluded that matter could not exist simultaneously in opposite states. The observer plays a crucial role in defining the state of the observed object, which shattered the idea of passive observation and objective reality and opened the door for quantum physics. Briefly, quantum physics and thermodynamics bring to light that indeterminacy is inherent in the universe and ripped to pieces the concepts of the clockwork model and passive observer: how we wish the world to be and how it is are not the same. The world is less controllable and predictable than we would like. While chaos theory is still almost a century ahead, these discoveries made chance, disorder, and uncertainty functioning words in describing the universe. They presented disorder as the law of nature and offered nothing but pessimism and purposeless life.

### Chaos Theory: A Paradigm Shift

Chaos is a science of process, not of state, of becoming, not of being (Gleick 1987, 5). It describes the behavior of a nonlinear dynamic system that is highly sensitive in its initial conditions and works on the threshold of chaos. In other words, it describes the sudden transition from order to chaos where the consequences are hard to predict. Chaos challenges the traditional Newtonian linearity, predictability, and reductionism paradigms and promotes nonlinearity, unpredictability, and holism. With its holistic view, it has spread rapidly across different fields of knowledge, including cultural and literary domains, where its mechanism and terminology have resonated through various genres, particularly drama and novel. Its implications have impacted the scientific world, the philosophy of knowledge, and the concept of free will.

### The Two Branches of Chaos

An interdisciplinary theorist, N. Katherine Hayles (1991), identified two Branches of Chaos: one with an underlying structure of order and the other that leads to order (1-3). Gleick's *Chaos: Making of a New Science* (1987) exemplifies the former, while Prigogine and Stengers' *Order out of Chaos: Man's New Dialogue with Nature* (1984) delves into the latter. Gleick's work focuses on practical applications of chaotic systems, exploring concepts like the butterfly effect, strange attractors, and fractal geometry. On the other hand, Prigogine and Stengers' book takes a philosophical approach, investigating the relationship between thermodynamics and chaotic systems. It examines the innovative power of dissipation in chaotic systems and the idea of self-organization, where order emerges from chaos without external intervention.

### Order in Chaos

Chaos theory preaches that, like order, the disorder has a profound patterned structure. Only the erratic behavior makes it look random to the casual observer. It maintains that chaotic systems are replete with order rather than mere noise or statistical dirt, as traditionally thought. Chaotic systems are created by an underlying deterministic, non-probabilistic process, meaning they are governed by precise rules rather than chance. The core principles of this type of chaos are the butterfly effect, strange attractors, and fractal geometry.

As a fundamental cause of chaos, the butterfly effect is both a playful and compelling image. Even the tiniest disturbance in the input of a system may lead to catastrophic results in the output. No matter how precise the initial conditions are, there will be a limit beyond which the speculation about the future or even the past of a system becomes impossible. Hence, irreversibility and predictability are far-reaching dreams. Before the advent of chaos theory, the butterfly effect was associated with kismet, messy human affairs, or coincidence. Now, it is a part of reality. It provokes a tantalizing philosophical question regarding the free will-determinism debate. While Newtonianism clears man from responsibility and leads to apathy and passivity, chaos provides a mechanism that allows free will to work from within. The responsibility, if not totally, is partially ours.

Nonetheless, some long-term predictions are possible because of the strange attractor. So, what is it? It is any point within a system that attracts the system to it in a phase space. It acts like a magnet. It attracts, restricts, and guides a system through endless, non-repeating paths within set boundaries called the basin of attraction. Hence, to figure out

the behavior of a chaotic system, one must first identify its attractor. While the butterfly effect is linked to the unpredictable part of the chaos, the strange attractor is associated with the stable one (Stewart 2002, 130). In the physical world, attractors take on the forms of physical properties. In contrast, in the human realm, they take on the shape of human desires and emotions, where their meanings can strongly determine human behavior, which is not random but intricately ordered. It is shaped by various factors within an individual's psyche and indefinite environmental conditions.

The linear Euclidean geometry proved to be inadequate to describe chaotic natural phenomena. Whenever a nonlinear equation appeared, scientists pragmatically replaced it with linear approximations or avoided it. Gaston Julia (1893-1978), a French mathematician, attempted to solve nonlinear equations using nothing but pencil and paper. Although the number of iterations of an equation was small, he managed to produce remarkable forms of nature. However, his efforts went unnoticed till the 1970s when his findings were rediscovered by Benoit Mandelbrot of IBM (1924–2010), a maverick scientist who used to think visually. Instead of solving problems analytically, he instinctually looks at them in terms of the shapes they produce. He invented a sort of math that relies on visual shapes, not formulae, and gave it the name fractal geometry.

As order in a chaotic system is invisible to the naked eye, fractal geometry can reveal these pockets of order when simulated on a computer screen by repeatedly feeding back the results of an equation. One of its essential features is self-similarity at different scales. It implies recursion, a pattern inside a pattern, and the rate at which these recursions occur approaches a limit that proved to be a universal constant (Hayles 1991, 10). Interestingly, recursion also shows that chaotic systems have continuity in that the original order is carried throughout all levels. Thus, any change will quickly be disseminated throughout the entire system. Hence, to examine order amid chaos, one has to focus on symmetries among various scales, not individual units. Briefly, one has to look for these repetitive dominant patterns.

### Order out of Chaos

Utilizing the new mathematics of chaos, Ilya Prigogine (1984) was able to demonstrate that open systems have the ability to create order from disorder. This process, known as self-organization, creates dissipative structures that expel or disperse entropy into the environment while importing negentropy, or negative entropy. It is entirely an internal process without any influence from the outside. Prigogine's theory relies on a new interpretation of the second law of thermodynamics, viewing entropy as a constructive force that produces life and drives the world toward greater complexity rather than toward death. According to Prigogine, the universe was preceded by a quantum vacuum, and fluctuations within it brought the original matter into being.

While the scenario of a Big Crunch or heat death is the inescapable end of the universe as dictated by the second law, chaos theory promotes that a Big Bounce could also be another possible scenario. Our universe is able to be reborn. Briefly, like the first branch, the second has a vision of a world that can renew itself rather than a universe that is constantly running down, as 19<sup>th</sup>-century thermodynamicists believed. According to this view, the disorder does not impede the process of self-organization. Instead, it stimulates and enables it to function. Overall, Man's struggle to impose order on an irregular world is over, and the paradox of order versus disorder is settled with chaos theory. With Prigogine, chaos is transformed into the universe's progenitor, the order's precursor and partner, rather than its antagonist.

### Why Chaos Theory?

In an interview with M. Gussow in 1995, Stoppard mentioned that what attracted him to chaos theory was not only its capacity to provide compelling metaphors for human behavior but also how determinism and random events shape our lives. Interestingly, Stoppard found that these two concepts were not incompatible. He viewed chaos mathematics as a means of exploring the unpredictability inherent in determinism. Chaos theory, here, presents a world that combines order and disorder in which Man is neither totally shackled, as Newtonianism suggests, nor entirely free.

In scene iv, Valentine shows his discontent. Scientists were busy with "the very big and the very small" and forgot the "ordinary-sized stuff which is our lives." They are pretty good at predicting things at the frontier "of the galaxy or inside the nucleus of an atom," but they are unsure if it will rain tomorrow (*Arcadia* 1993, 48). According to Valentine, Chaos theory managed to secure a middle ground between relativity and quantum physics. It is neither preoccupied with massive objects nor engaged with small ones, i.e., the atoms. It simply works in between, i.e., our world.

Conversely, unlike traditional methods of analysis affected by Newtonianism and rely primarily on the style of examining the evidence, balancing opposing perspectives to reach a conclusion, chaos theory presents a dynamic,

holistic model that looks for overriding patterns to probe productions that fall outside the territory of traditional criticism (Gillespie 2008, 3-5). Thus, in *Arcadia*, Stoppard deliberately departed from the traditional Newtonian approach of well-made plays, which follows a linear and chronological sequence of events. Instead, he embraced the theatre of chaos that allows the dynamic interaction of all elements and is governed by an internal logic that mimics the behavior and structure of a chaotic system.

## METHOD

*Arcadia* integrates the two branches of chaos and their core principles into structure and content. As a representative of the unpredictable aspect of chaos, the butterfly effect will work on the inciting events that trigger the conflict and on these tiny, unnoticeable incidents that result in false predictability and cause misinterpretations of past events. These minor incidents can no longer be attributed to chance or messy human affairs as they used to be. Every single element that exists at the moment of creation of a system contributes to its evolution. With its ability to attract, confine, and lead a chaotic system within set boundaries in phase space, the strange attractor, the predictable part of the chaos, will focus on thematic concepts that bind drama's other elements to follow a particular direction. It can perform a triple function: a guide for interpretation, a magnet that pulls plot threads together, and a driving force that compels events toward a particular direction.

Nevertheless, attractors cannot provide a complete understanding of how order emerges from chaos as they only focus on specific points, and it is quite likely for chaotic systems to switch attractors during the process. Hence, the role of fractal geometry is highly decisive in providing us with the overall picture. It can identify the pockets of order in a chaotic system by tracing self-similarities. Self-similarity implies repetition, a pattern inside a pattern, a typical trait of Tom Stoppard's dramatic art. *Arcadia* is full of self-similarities and the act of doubling, i.e., self-similarity of situations, characters, dialogue, costumes, and musical accompaniments. Lastly, self-organization, an entirely spontaneous and internal process, will be utilized to explain how order can emerge from chaos. It suits perfectly the discussion held in scene vii, the final and climax scene, between the main characters of both periods who question whether the world can be reborn and whether long-lost treasures of the past can be restored despite the inescapable grim face of thermodynamics.

## ARCADIA: A DRAMA OF CHAOS

“Chaos was the law of nature; order was the dream of man.” H. B. Adams

Premiered at the Royal National Theatre in 1993 and on Broadway two years later, Tom Stoppard's *Arcadia* is a stunning critical success locally and globally. Both productions garnered considerable attention from critics and the public alike. The play was garlanded with many awards, including the prestigious British Olivier Award in 1993 and the distinguished New York Critics' Circle Award in 1995. Inspired by James Gleick's bestselling book *Chaos: Making New Science* (1987), Stoppard's masterpiece is a play of and about ideas. The Czech-born British playwright reached the pinnacle of his career with a drama that evokes emotion and intellect.

As described by Gleick, chaos is a science of becoming, not of being. Hence, Stoppard sets the play in two different timelines, 1809–1812 and the present, but within a single theatrical space: a schoolroom of Sidley Park, a grand country estate of an aristocratic family in Derbyshire. To secure a backdrop of becoming, Sidley Park is constantly in the process of change. Stoppard breaks his drama into two acts to mimic how order bifurcates into chaos. Each comprises three scenes shuttling back and forth between two alternating plots. While scenes i, iii, and vi are set in the past, scenes ii, iv, and v are set in the present until both timelines converge in the final scene. Nonetheless, the final scene itself incorporates small bits of both timelines, continuously switching until things merge completely where characters of both periods share the stage. Science is used as a vehicle to discuss a world ruled first by Newtonianism, then revised by thermodynamics, and then by the unpredictable determinism of chaos theory. By incorporating science with human nature, Stoppard casts light on the role of human choice and action to expound that we are not only affected by chaos, but we are also a fundamental part of it. Chaos ensues when human actions roused by human passions and desires, such as love, hate, or sex, disrupt the natural order. These passions and desires become an external input for a complex system where no one can predict with certainty the outcomes. Here comes the role of human will as an essential part of the chaotic universe, not merely subject to its whim.

*Arcadia* revolves around themes of science, sex, history, literature, and gardening, which in turn soften the earth to argue a set of dichotomies, including but not limited to Newtonianism vs. chaos, classicism vs. romanticism, determinism vs. free will, predictability vs. unpredictability, reversibility vs. irreversibility, science vs. humanities, thinking vs. intuitiveness, and last but not least life vs. death. Hence, before hoisting a sail or delving into analysis, it

is imperative to cast some light on past and present storylines.

The past story is prompted by a string of arguments and clashes over carnal embraces vs. cuckoldry, dueling challenges, Newtonianism vs. entropy/thermodynamics, and Euclidian geometry vs. fractal geometry to be concluded with the classicism vs. romanticism argument over the garden renovation. Minor issues, like Fermat's last theorem, threat and love letters, a book dedication, the sounds of hunting gunfire, a game book containing all birds being hunted, and a hermit drawn on the garden's sketchbook, are all inserted within to foreshadow future events.

The present story is propelled by the efforts of three scholars, Hannah Jarvis, Bernard Nightingale, and Valentine Coverly, to reconstruct the past utilizing the miscellany of books, letters, and piles of palimpsests. While Hanna works on a new book about the Sidley Hermit, whose death she attributes to "the decline from thinking to feeling" (*Arcadia*, 27), Bernard tries to prove his theory regarding Byron's sudden departure from England in 1809. On the other hand, Valentine is examining the rise and fall of the grouse population in relation to factors like food, predation, hunting, and mating success.

### The Garden: Classicism vs. Romanticism

As emphasized earlier, chaos is a science of becoming, not being. Hence, Stoppard sets the events in two different timelines, 1809–1812 and the present, but within a single theatrical space: the stately mansion of Sidley Park. To secure a background of becoming, people and events are taking place with respect to the ecological environment of Sidley Park, which is constantly evolving.

The playwright utilizes the garden to illustrate the transition from classicism to romanticism. It is a drastic change from the human-imposed order of Enlightenment to embracing disorder through romanticism. It is first revealed by Lady Croom, who believes that Mr. Noakes causes havoc on her flawlessly ordered garden, and secondly by Hannah Jarvis, who investigates the Park hermit—her connection to “the nervous breakdown of the Romantic Imagination” (*Arcadia*, 25). Whereas the classic style corresponds to Newton and Euclidean geometry, the Gothic-romantic chimes with chaos and fractal geometry.

This change went through three phases: from the formal Italian style of sublime geometry, "Paradise in the age of reason" until 1740 to the French formal design of Capability Brown that shows man's ability to subdue nature into forms of centrality and symmetry to be ended with Mr. Noakes' Gothic mystery of the Romantic. The French design, which made the mansion at the center of a radial road system, implies man's domination over nature. Nevertheless, over time, there was a shift towards concealing human intervention to align with the taste of the new era (*Arcadia*, 27).

To Hanna, the entire English landscape was designed by gardeners who imitated foreign painters, who in turn evoked classical authors. It is like a journey from Virgil to Claude into Salvator Rosa and Noakes. Lady Croom identifies another source: *The Castle of Otranto* (1764) by Horace Walpole, the first Gothic novel, and *The Mysteries of Udolpho* (1794) by Ann Radcliffe, a typical Gothic romance. The spirit of this genre permeates Noakes' design and brings Lady Croom's disapproval. She cannot grasp why a rustic-like hovel hermitage replaces her gazebo, goblins dwell in her beloved hyacinth alley, and her Chinese bridge is usurped by "a fallen obelisk overgrown with briars." She cannot understand what the "eruption of gloomy forest" means. She believes that "nature as God intended" should be tightly ordered, tightly symmetrical, and provided carefully with the correct number of sheep that are "tastefully arranged" (*Arcadia*, 12).

While to Septimus, this transformation into a picturesque style is quite “monstrous,” to Captain Brice, it is a sort of rape when the fine English garden is haunted by “Corsican brigands.” Nevertheless, to Hanna, who prefers rationality over sentimentality, it is a “Gothic novel expressed in landscape” (*Arcadia*, 25). It symbolizes “the decline from thinking to feeling” (*Arcadia*, 27). Booby Kennedy (2016) states that such a shift in English garden architecture during the 18th century indicates the growth in nationalistic pride since the dominant symmetrical style was too French.

In conclusion, self-similarity means recursion, a pattern within a pattern—a typical trait of Stoppard's dramaturgy. The three styles of the Crooms' garden illustrate the three modes of interpreting the relation between order and disorder. The Italian style affected by classicism is refashioned by Capability Brown, affected by Neo-classicism of the age of reason, which absorbed Newton's clockwork model and Euclidian geometry. Hence, in myth and biblical paradise, gardens usually appear as places of perfection. The force of chaotic nature has been tamed and ordered, a version of nature as people prefer it to be. Conversely, Noakes' style superimposes untamed nature in the style of Salvator Rosa. It is not chaotic but relatively well-planned. It stresses nonlinearity and discontinuities instead of



cohesion and symmetry. Briefly, it stresses orderly disorder. When accused of stressing irregularity by Captain Brice, Noakes replies that "Irregularity is one of the chiefest principles of the picturesque style" (*Arcadia*, 12). Thomasina favors this transformation, describing Noakes' scheme as "perfect" (*Arcadia*, 10). For this reason, she declares him at the end of the play as the "Emperor of Irregularity," in contrast to Capability Brown, the master of forms (*Arcadia*, 85). Noakes masterfully reflects nature as it is, not what we wish it to be.

### Carnal Sex: The Attractor 'Newton left out'

As referred to in the method section, to discern the behavior of a chaotic system, it is quite crucial to identify its attractor first. Stoppard uses this concept as a sort of sexual gravity. Thomasina's question, "What is carnal embrace?" establishes sex as the driving force around which the plot evolves, the action revolves, and meaning unfolds (*Arcadia*, 1). It presents the audience with a series of sexual misadventures occupying Sidley Park in which Septimus himself and his offstage friend Byron are involved.

Septimus is baffled when he finds that his tryst with Mrs. Chater in the gazebo is revealed. Unconvinced with her tutor's biological and then clinical definitions of sex, Thomasina told him that while she was eating her pudding the day before, she heard the butler, Jellaby, telling the cook that the groom overheard Mr. Richard Noakes, a landscape architect, telling Mr. Ezra Chater, a second-rate poet, that he saw his wife in a carnal embrace with somebody in the gazebo. Mr. Noakes might be a voyeur, but his spy-glass was not directed accidentally. Meanwhile, Mr. Chater breaks into the study room, challenging Septimus to a duel. With a mixture of bravado and flattery, Septimus declines the request and promises to write a good review of Chater's last poem, *The Couch of Eros*. The latter forgives Septimus' frivolous behavior and offers to inscribe Septimus' copy of the book.

Thomasina's role as an observant allows her to see what others choose not to see. She teases her tutor by saying, "Mama is in love with Lord Byron," which clearly affects him. She adds that in his endeavor to impress Lady Croom, Byron slips that Septimus is the writer of a searing review of Mr. Chater's first poem, *The Maid of Turkey*, in front of Chater himself (*Arcadia*, 36). This remark, along with Captain Brice's encouragement, Chater challenges Septimus to a duel. The suspense rises when we discover that Brice brings the Chaters to Sidley Park. He is driven by jealousy at discovering his mistress taken away from him by a fresh Cambridge graduate. Chater, the cuckold, is the only one who does not realize what is happening. Brice is deeply attached to Mrs. Chater and eventually marries her when Chater passes away. He pays a lot for her husband's publication and more to take them on his expedition, although he knows that Mr. Chater is neither a good poet nor a qualified botanist. It is all done for his obsession, Mrs. Chater (*Arcadia*, 71).

As a plot twist, Mrs. Chater is noticed by Lady Croom leaving Byron's room in the middle of the night. Immediately, Lady Croom dismissed everybody: Byron, the Chaters, and her brother, Captain Brice. She even blamed Septimus for inviting Byron. In an attempt to mollify the Landlady, Septimus burnt Byron's letter. Assuming his love can never be requited, Septimus confides her to a letter to be read after his death. Lady Croom does not follow his instructions and reads the letter. Scene vi ends with a late-night rendezvous between the two, possibly serving as a source of comfort for her after losing Byron.

In scene vii, three years later, Lady Croom indulges in a new relationship with Count Zelinsky, which makes Septimus feel sulk. In *Arcadia*, relationships are empowered by sexual desire, which is erratic and unpredictable. To Thomasina, the whole responsibility is ours. She attacks Cleopatra's choices severely as they affect her, her country, and the whole course of history. She brings shame to the sex of women. She only needs a Roman general dropping his ship's anchor outside her window, and, to hell, the empire. What hurts Thomasina is not only the loss of an empire but the loss of the great treasures of the Alexandria library. It is an irrecoverable loss. She believes that history would have been more fruitful if the virgin Queen Elizabeth had superseded the lusty, nymphomaniac Cleopatra. She heralds Queen Elizabeth, who resists temptation and never sacrifices power or knowledge for the sake of carnality. Sex, here, is identified as an uncontrollable agent that can wreak havoc and hinder progress.

Modern period relations are a reflection of that of the past. Almost every character has his/her twentieth-century counterpart. Like Lady Croom and Byron, the current Lady and Bernard are engaged in an intimate relationship. Like Thomasina, Valentine tells Hannah that his mother lends Bernard her bike, a kind of "safe sex, possibly the safest." As Byron did, Bernard gave the lady a copy of Horace Walpole's book (*Arcadia*, 51). However, his potential affair with Chloe put things at stake. Unlike Septimus, who is cautious of Thomasina's feelings, Bernard, who is twice Chloe's age, is not. He refuses to take responsibility, accusing Chloe of pulling his leg: "Every time I turned round she was up a library ladder. In the end I gave in" (*Arcadia*, 64). Being caught by Chloe's mother, like Byron, he was forced to flee.

Bernard's relationship with Chloe is quite similar to that between Septimus and Mrs. Charter, a casual one. Both quickly drop such relations. The woman he invites for sex in London is Hanna. However, he is not the only admirer. Valentine is desperately in love with her as well as Gus, the 15-year-old boy. Gus is like his ancestor, Thomasina, who asked her young tutor about carnal love at the age of thirteen. Both might be motivated by innocence rather than experience. On the other hand, Hanna puts love in its proper place; "nothing against it," but it is not the priority (*Arcadia*, 63). Intellectually, her isolation has flickers of a feminist dimension. Her best-selling book about Caroline Lamb, Byron's deranged lover, is dismissed by male scholars, the Byron gang, who; "unzipped their flies and patronized all over it" (*Arcadia*, 22). While, to Valentine, Hanna's reserve is a sort of mannerism rather than neurotic, to Chloe, it is because she has been "deeply wounded in the past" (*Arcadia*, 57). Although she has received many marriage offers, weighing between available sex and "not being allowed to fart in bed," the latter wins. This deliberate crudity might be to show how open she is to the whole thing, contrary to what others think of her. Interestingly enough, Gus manages at the end to change her mind regarding feeling issues.

Briefly, this amalgam of relations of both periods overthrows the Newtonian deterministic world and enhances the role of sex in bringing both order and chaos to the world. In a discussion with Valentine, Chloe says she does not support Newton's view of a deterministic world because it overlooks the role of human sexual desire. Valentine summarizes her view as the "attraction that Newton left out" (*Arcadia*, 74). Chloe, here, presents an alternative worldview built around sex as a decisive factor not linked to Newtonian determinism. She establishes human sexual desire as an agent of chaos capable of toppling Newton's determined world. The significance of her argument lies in the autonomy and power Chloe imparts to human action. Man is not helplessly bound but rather a free agent able to create order and chaos. Lady Croom makes a similar suggestion but attributes the defect to God's humor, which "directs our hearts everywhere but to those who have a right to them" (*Arcadia*, 71). In doing so, she relieves us from the burden and supports determinism but from a religious point of view. Chloe's viewpoint is enhanced by Thomasina, who suggests that Newton's deterministic world is incomplete because it overlooks the "action of bodies in heat," or simply thermodynamics, which causes chaos by increasing entropy. To Lady Croom, if so, the Nymphomaniac, Mrs. Charter, "would overthrow the Newtonian system in a weekend" (*Arcadia*, 84).

Overall, it is clear that human relationships do not adhere to the predictable Newtonian two-body model but instead favor the chaotic and unpredictable three-body model. The complexity of these entanglements makes it astonishingly challenging to anticipate outcomes. Septimus is in love with Lady Croom, but she is infatuated with Byron and later shows interest in Count Zelinsky. Captain Brice loves Mrs. Charter, who feels for Septimus and flirts with Byron. Thomasina becomes infatuated with Septimus at seventeen after feeling dazzled by Byron at sixteen. Lady Croom is interested in Bernard, who has slept with her daughter Chloe, but Bernard is more attracted to the reserved Hanna, who rejects both him and Valentine and chooses to dance with Gus instead. At the end of the play, Mr. Charter, who made a dueling challenge to defend his wife's reputation, dies from a monkey bite. Septimus went crazy, and both Byron and Bernard, who slept with anything that moved, fled Sidley Park. Thomasina and Hanna, who prefer the Queen Elizabeth model, work first, romance later or not, end differently. Hannah cannot say no to cute and bashful Gus and is drawn into an uncomfortable dance. Thomasina, who still engaged scientifically, indulges herself in Cleopatra's model and her tragic version. Both ladies grasp it at the end that emotion and intellect are inseparable.

### **The Butterfly Effect & the Reconstruction of History**

History is a dominant theme in *Arcadia*. The play delves into the nature of truth and evidence through the lens of chaos theory, precisely the butterfly effect. It explores how the misinterpretation of inklings left by the past can twist the course of history. To Kellert (1994), history is replete with "examples of small events that led to...long-lasting changes in the course of human affairs" (p.5). Like any dynamic system, history is subject to sudden twists, random decisions, and unexpected minor events that defy logical deduction. These minuscule details work like tiny changes in the initial condition of a system. They should not be overlooked, no matter how insignificant they may appear.

Determinism and predictability are put to the test by Hannah Jarvis, a late thirties author, Bernard Nightingale, a late thirties university don and literary historian, and Valentine Coverly, a late twenties chaotician specializing in biology, in an attempt to reconstruct the history of Sidley Park; to detect what exactly happened in Derbyshire two centuries ago. While Hanna is tracing the manor's history for a new book about the Sidley Hermit, whose death she assigns to 'the decline from thinking to feeling,' Bernard seeks to prove his theory regarding Byron's sudden leave of England in 1809. Whereas the former employs the garden sketchbook and piles of papers with mysterious and perplexing proofs about the end of the world, the latter utilizes the so-called Byron's copy of Charter's book, *The Couch of Eros*, which contains three letters; two are accusatory letters from Mr. Charter and one cautionary letter from Mrs. Charter. Meanwhile, Valentine, the chaotician, is examining the rise and fall of the grouse population in relation to predation,

hunting, mating success, and food by using his inheritance of a complete set of game books, which detail the precise number of grouse shot at the estate each year.

Valentine's position as a science representative is contrasted with that of Bernard and Hanna, who stand for literary study. Juxtaposing these opposing backgrounds, Stoppard tries to present the dichotomy of thinking, Hanna, versus intuitiveness, Bernard, on the one hand, and the dichotomy of science, Valentine, versus humanities, Bernard, on the other—to pose a question, which is more important the idea or the person who creates it? Stoppard also poses another question regarding the best method—to adopt a scientific approach as Hanna and Valentine believe or to follow human guts as Bernard thinks, as history repeats itself in a general view, but does it follow the same paths? All this is set in a fractal-like structure, i.e., past and present, to help the audience see how minute changes in initial conditions result in vastly false interpretations of historical events.

The difference between a thinker and a feeler is revealed through character descriptions and their contrasting classical and romantic mindsets. Hanna, who dresses casually, tries to expose the decline from thinking to feeling. Bernard, who wears flamboyantly, seeks to uncover the dark motive behind Byron's sudden leave; a lacuna in Byron's biography must be covered. While Hanna prioritizes thought over emotion, Bernard values style over substance.

Bernard's certainty regarding his so-called groundbreaking theory relies on a book, *The Couch of Eros*, found in Byron's library, which contains three letters penned by Mr. Chater without the name of the addressee, scathing anonymous reviews, and a warm inscription dedicated to Septimus Hodge. Moreover, his theory is supported by several other findings: Mrs. Chater's remarriage took place around the exact date of Chater's alleged duel (*Arcadia*, 9, 89), Byron and Septimus were contemporaries at Cambridge (*Arcadia*, 32), and an entry from the game book shows that Byron spent some time at Sidley Park (*Arcadia*, 54).

Hanna does not support his theory, which is more inventive than deductive. It is not conceivable that Byron borrows the book, reviews it, posts the review, seduces Mrs. Chater, kills her husband in a duel, and then flees within two or three days. Who can do that? Bernard replies arrogantly, "Byron" (*Arcadia*, 59). Bernard ignores any element that does not support his theory: "You've left out everything which doesn't fit" (*Arcadia*, 59). He also lacks intellectual honesty. He re-writes the letter burnt by Septimus, which reveals how personal interest can affect history (*Arcadia*, 57). Bernard's Newtonian narrative is a good example of weighing evidence, excluding what does not fit to reach the causally-structured desired conclusion. When Hanna asks for proof, Bernard replies: "You'd have to be there, you silly bitch" (*Arcadia*, 49)!

Much of Bernard's confusion stems from overlooking tiny details, e.g., he needs to notice that the three letters are without the addressee's name because Septimus throws the covers (*Arcadia*, 55). He ought to find out who is being challenged to a duel. Further, Bernard disregards the sycophant inscription as an indication that the book does not belong to Byron. He also presumes that the penciled superscription on Charter's first poem, *The Maid of Turkey*, must be Byron's handwriting, while it is Septimus' (*Arcadia*, 49). Besides, the character of Mr. Chater is quite misleading. He is a would-be poet, a would-be botanist, a would-be duelist, and a confirmed cuckold. He has been manipulated by Captain Brice, who is obsessed with his wife. Lady Croom stated that her brother paid fifty pounds for Chater's publication, and he intended to pay another 150 pounds to take the Chaters to the West Indies. Captain Brice even managed to deceive the admiralty, the Linnean Society, and His Majesty the Botanist, Sir Joseph Banks, to guarantee that the Chaters would be on Board (*Arcadia*, 71).

Actually, Mrs. Chater-Septimus' casual affair in the gazebo and Lady Croom's impulsive offering of Septimus' copy of *The Couch of Eros* to Byron because of her attraction to him as well as the latter's reading of Septimus' scathing review of Chater's first poem are the butterfly effects that led to duels and the subsequent misinterpretations.

Upon returning from his seminar in London, Bernard is faced with Hanna's discovery of a letter revealing that Mr. Chater died out of a monkey bite in Martinique in 1810, and Captain Brice married his wife. Mr. Charter, the botanist who discovered the dahlia flower, and Mr. Charter, the poet, are the same person. Bernard's first reaction was being "fucked by a dahlia" (*Arcadia*, 88-89). Succinctly, Bernard's theory of the century is not hit by a butterfly but instead being swept by something tenderer, the dahlia flower. Bernard is taught that causal presumptions do not work in a nonlinear environment, and any minute detail should be noticed. This behavior makes him seem like a history stooge than a thoughtful researcher. All he can do in the end is to apologize to everybody (*Arcadia*, 95).

Conversely, the science vs. humanities debate erupted between Valentine and Hanna on the one hand and Bernard on the other when the latter is told that his theory is incomplete and his approach is not scientific. To Hanna, Bernard has gone "from a glint in [his] eye to a sure thing in a hop, skip and a jump." Bernard retorts, "I'm not a scientist," and



ridicules Hanna for misunderstanding Byron and even putting the wrong picture on the book's cover (*Arcadia*, 59-60). He also attacks Valentine, saying that art is a mysterious realm of life. It cannot be quantified in scientific terms. Valentine cannot "stick Byron's head in [his] laptop" (*Arcadia*, 60). During this rhetorical argument, Valentine stresses that personalities hold no significance compared to scientific advancement. It is insignificant who comes up with calculus first, the English or the German, rather than the knowledge itself. Bernard is exasperated and reacts acutely, accusing Valentine of mixing progress and perfectibility. The world can wait for Newton, but "a great philosopher is an urgent need," and "a great poet is always timely." He can't imagine "anything more trivial than the speed of light...big bangs [or] black holes" or even Valentine's stupid grouse. Bernard values great art as something timeless. He favors Aristotle's cosmos and the Newtonian mechanistic universe as the latter is insensitive to time. He follows his diatribe by reciting Byron's poem "She Walks in Beauty." He believes expanding the personal universe is more important than the physical universe (*Arcadia*, 61).

Hanna, the epitome of facts, is drawn in many ways, from her casual clothes (*Arcadia*, 15) to her rebuff to dance (*Arcadia*, 33), to her repulsion of being kissed (*Arcadia*, 49), or taking part in celebrating (*Arcadia*, 90), reveals her anti-romantic temperament. She deliberately classifies herself as an outsider. Her pursuit is the hermit of Sidley Park. She picks him as the ideal symbol for her upcoming book on landscape and literature, "*The Genius of the Place*" (*Arcadia*, 28). She sees him as a mathematician shrouded by the aura of a genius and thus a symbolic figure for the decline from the age of Enlightenment, reason, and order into "the whole Romantic sham," reflecting truthfully the history of the Sidley Park Garden (*Arcadia*, 27). Out of fun, Thomasina draws a hermit into Mr. Noakes' hermitage, which has yet to be built. The fact that Septimus later becomes the hermit guides Hannah to deduce, falsely, that the hermit might have been drawn by a "later hand" (*Arcadia*, 25).

Bernard gave Hanna a book about the hermitage, mentioning that the hermit had a tortoise called Plautus. Meanwhile, Valentine entered with the letter, asking Hannah to read it aloud. Valentine explains that it discusses entropy, thermodynamics, and the world's end. This discovery is highly connected to Thomasina's. Hanna tells Valentine that Septimus and the hermit were born in the same year. Given the drawing of Septimus and Plautus by Gus, Hanna then begins to realize that the hermit is nothing but the grief-stricken Septimus, who spent the rest of his life trying to find an equation to reverse the entropic end of the universe (*Arcadia*, 65-66). Relying only on facts can be unreliable. Hence, Hannah, who tries to support everything by proof, still needs her intuition.

In the end, both cold rationality and intuition are failed. Bernard's theory is undermined by the fact that the only letter, if not burnt, can cast some light on the truth. Hanna's theory is blown up by a French magazine article. The piles of papers she found in the hermitage are not a work of madness but rather a continuation of Thomasina's intuitive algorithms. The hermit is not as mad as everybody thinks, including Hanna, but a heartbroken man. Despite Hannah and Bernard's faith in logic and intuition, they could not accurately reconstruct the past. Neither intuition nor logic can withstand human beings' fickle and chaotic nature, particularly when sex or love is added to the equation.

### Final Scene: Bifurcating into Chaos & Self-Organization

"Every act of creation is first an act of destruction." Pablo Picasso

The last scene, which occupies a quarter of the play, reviews the order versus chaos journey. The two periods that run in parallel come to merge at the end of the play. The scene opens with Chloe telling Valentine that what causes the Newtonian deterministic world not to work properly is; "all because of sex" (*Arcadia*, 73). Valentine concedes: "Ah. The attraction that Newton left out" (*Arcadia*, 74). The sister-brother chat is mulled over scientifically through Thomasina recounting her tutor that the Newtonian worldview is incomplete due to the "action of bodies in heat" (*Arcadia*, 84). Accordingly, Newton's laws can operate properly in a vacuum. It is the friction that lowers predictability. This pun is intended to refer implicitly to the unidirectional second law of thermodynamics, which undermines Newtonian determinism.

Later, audiences are shifted to another more profound argument between Valentine and Hanna over the purpose of human endeavor and existence in the face of an entropic world. To Hanna, what makes life worth living is not the arrival but the journey: "It's wanting to know that makes us matter" (*Arcadia*, 75). It is better "to struggle on knowing that failure is final" (*Arcadia*, 76). This argument brings us back to a similar one between Valentine and Bernard over personalities versus knowledge. To Valentine, what matters is not the person but the knowledge itself (*Arcadia*, 61). According to Stoppard, epistemology should define human worth rather than eschatology or trivial, mundane results.

As she finishes her speech, Hanna looks over Valentine's shoulder. She is enchanted by the beauty of "the Coverly set"—an equation Thomasina wrote and pushed "a few million times" through Valentine's computer. Valentine shows

her how the order is encoded within chaos. In the "ocean of ashes, islands of order. Patterns making themselves out of nothing.... Each picture is a detail of the previous one," endlessly repeating (*Arcadia*, 76). Hanna wonders if the world is saved after all. Valentine affirms that we are still doomed, but "if this is how it started, perhaps it's how the next one will come (*Arcadia*, 78). Valentine gives us hope that a new Big Bang could follow the upcoming Big Crunch due to the thermal death.

As the scene develops, the plot bifurcates into a chaotic region. Characters from both timelines are sharing the stage. Septimus gives Thomasina a prize-winning essay from France about heat propagation, which contradicts Newton's determinism. Whereas Thomasina indulges in reading the essay, the flirtatious piano doubles its notes, and the droning beat of Noakes' steam engine can be heard in the background. The playwright slyly asserts the relation between bodies in the heat, whether in the physical world or the throes of human erotic passion. Lady Croom enjoys playing the piano duet with Zelinsky, her latest lover; Mr. Noakes proudly uses his Improved Newcomen steam pump—the only one in England.

Suddenly, Thomasina thumps the essay on the table as she immediately grasps its implications. Unable to describe the entropic diagram mathematically, she draws it. She starts lamenting how the Newtonian worldview is insufficient. She realizes that the reason is "hidden in this gentleman's observation,"—referring to Joseph Fourier's work on heat transfer and propagation in solid bodies (*Arcadia*, 84). In the preliminary discourse of his book *The Analytical Theory of Heat* (1822), Fourier admits that, like gravity, heat "penetrates every substance of the universe." However, they do not follow the same rules. The huge mistake made by Newton's successors was to generalize his principles to all aspects of nature. Fourier concludes that no matter how wide "the range of mechanical theories" is, it cannot cover "the effects of heat" because they "make up a special order of phenomena, which the principles of motion and equilibrium cannot explain" (Pp.1-2).

Thomasina resumes that the problem lies not only in Newton but also in Euclidian geometry. If God bestows it, then God "could make only a cabinet," and He "must love gunnery and architecture" (*Arcadia*, 37, 84). She believes there is another geometry because "Mountains are not pyramids and trees are not cones" (*Arcadia*, 84). Meanwhile, Lady Croom enters, complaining about the sound of Noakes' engine used to drain her beloved lake (*Arcadia*, 85). The piano's music, a symbol of harmony, order, and conservative classicism, is interrupted by the noise of Noakes' steam engine, a symbol of disharmony, disorder, and liberal romanticism.

Later, Thomasina baffles Noakes—who thinks it is news related to Napoleon, by saying that his engine is inadequate since he gets less than what he puts in it (*Arcadia*, 86). She herein references Sadi Carnot's booklet *Reflections on the Motive Power of Fire* (1824) on heat dissipation, which must be eliminated to get maximum efficiency. As a son of Napoleon's minister of war, Lazare Carnot, who was exiled to Germany after Napoleon's ignominious defeat, Carnot worked hard to develop a robust theory for steam engines. He was convinced that England's superior technology in this area had contributed to Napoleon's downfall and the loss of his family's prestige and fortune. However, Carnot died at 36 due to a Cholera breakout. His belongings and books were buried with him as Cholera was regarded as contagious. Fortunately, Émile Clapeyron, a French mining engineer, rediscovered his work and inserted it as a graphical footing in his book *Memoir on the Motive Power of Heat* (1834). Through Clapeyron's article, Rudolf Clausius, a German physicist, learned about Carnot's theory of heat. He modified Carnot's suppositions, which helped him to put the second law of thermodynamics and the concept of entropy.

Septimus picks up Thomasina's diagram about the steam engine and starts studying it. Thomasina explains that contrary to Newton's equations, which can go backward and forward, the heat equation goes only forward. This is why "Noakes's engine cannot give the power to drive Mr. Noakes's engine" (*Arcadia*, 87). Septimus' faith in "nothing can be lost" is tested (*Arcadia*, 38). Things, now, are thoroughly mixed as the three scholars, Septimus, Valentine, and Hanna, doubled by time, are pondering over Thomasina's diagram. To Valentine, it is the "diagram of heat exchange." It is an irreversible process. Thomasina predicts the end of the universe, which baffles Septimus; "The Improved Newtonian Universe must cease and grow cold." The only possible solution, as Thomasina thinks, is to seize time and start dancing (*Arcadia*, 93).

The play ends with a couple from each period dancing together. While the characters of the past period have a formal ball, the modern couple is having a costume ball, dressing up like the people of the earlier period. They are supposedly unaware of each other. Gus and Hanna dance awkwardly; Septimus and Thomasina dance fluently, symbolizing chaos and order. It is a highly moving finale, tugging the body and heart beautifully. All dichotomies set throughout the play, i.e., order vs. chaos, classicism vs. romanticism, thinking vs. intuitiveness, and life vs. death, have disappeared. Although Thomasina will surely die once the dance ends, her work and love will not be lost. Driven by affection, Septimus dedicates himself to furthering her algorithm. His work led Hannah to Sidley Park, where she encountered

Gus, who innocently fell in love. Hannah cannot say no to cute and bashful Gus, especially after he brings her the proof of the hermit's real identity. Love that was lost in 1812 has been restored in 1993.

The idea of loss and restoration through knowledge runs throughout the drama. Loss comes in the form of untimely death and the destruction of unfinished works, usually by fire. The works of a budding genius, Thomasina, are preserved through a devoted lover, Septimus, and restored through the efforts of a distant descendant, Valentine. Valentine rediscovers her geometry of nature. The retrieval of the Coverly set is a simulation of Julia's set, which is done only by pencils and papers, to be fed into Mandelbrot's computer at IBM labs during the 1970s after decades of negligence. Fermat's elusive theorem, thought to be a hoax, was approved to be true two months after *Arcadia's* debut in 1993 at the hands of Andrew Wiles—a brilliant mathematician from Princeton University. Thomasina's fictional story of the untimely death of a genius is well repeated in reality. Sadi Carnot's tragic loss of life and books is outlived by a fellow citizen, Clapeyron, and culminated by the efforts of Rudolf Clausius, the founder of thermodynamics. The burning of Alexandria library is redeemed through thousands of libraries worldwide, and the plays of Sophocles and Euripides are revived through hundreds of science dramas; one of the best is *Arcadia*.

All the above examples from fiction and reality assert that nothing is truly lost. Even though death of self or universe is inescapable, so is regeneration. Life is an endless self-organized algorithm that repeats itself in different shapes, places, and times. What matters, as Valentine said, is knowledge (*Arcadia*, 61). It makes us who we are. Professor William W. Demastes once wrote in the introduction to his book *Theatre of Chaos* (2005): “after centuries of seeing chaos as the exact opposite of order, contemporary Western civilization is once again beginning to adjust its vision to see chaos as a place of opportunity, a site of interactive disorder generating new orders and of order transforming to regenerative disorder” (p. xii).

## CONCLUSION

Stoppard subtly incorporated the two branches of chaos thematically and structurally. As there is order in chaos, it is possible for chaos to produce order through the process of self-organization. While the garden metaphor demonstrates the transition from Newtonianism to chaos and history clarifies predictability challenges in highly sensitive systems, sex is utilized to reveal how chaos occurs.

Chaos occurs when people driven by sex or other emotions disturb the natural order. Such desires become an exterior input into a complex system where no one can predict the results or reverse the process, and here comes the role of man's choice. It is quite pivotal in this process. People become agents in a world that mixes order and disorder in which we are neither totally free nor entirely bound. Characters, switching between past and present, not only reveal the connection between the chaotic inclination of the world and human action but also exhibit room for action in a universe inclining towards chaos. By combining universal humanism and modern science, *Arcadia* suggests that we are not only affected by chaos, but we are also a part of it.

To mimic how order bifurcates into chaos, the drama is structured in a fractal-like shape where two stories from past and present move nonlinearly until things mix up in the final scene. To reveal the level of determinism, the two stories are set within a single theatrical space, Sidley Park. The deliberate double frame allows each period to comment on the other. Nevertheless, in the end, time and place dissolve, individual experiences become collective, and the corresponding stories merge to present a universal message that chaos is not the end but a catalyst for a new beginning. It is well-expressed through the idea of loss and continuity through knowledge. Like any chaotic system, Man can thrive on the disorder, renew from within, and set new attractors.

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