Spring 5-1-2010

“Ambition, Distraction, Uglification, and Derision”: Carroll's Use of Mathematics and Literature to Critique Victorian Britain.

Diana Schneider

“Ambition, Distraction, Uglification, and Derision”: Carroll's Use of Mathematics and Literature to Critique Victorian Britain.

A Capstone Project Submitted in Partial Fulfillment of the Requirements of the Renée Crown University Honors Program at Syracuse University

Diana Schneider

Candidate for B.S. Degree
and Renée Crown University Honors

May 2010

Honors Capstone Project in English and Textual Studies

Capstone Project Advisor: ____________________________
(Professor Patricia Roylance)

Honors Reader: ____________________________
(Professor Claudia Klaver)

Honors Director: ____________________________
Samuel Gorovitz

Date:______________________________________

This thesis examines Lewis Carroll's writing through the lens of mathematics, arguing that Victorian mathematical theory and pedagogy are crucial contexts for understanding his literary works. Carroll is generally regarded as an author who specialized in works of literary nonsense such as *Alice's Adventures in Wonderland*. Little attention is paid to his career as a mathematician at Oxford, yet mathematics occupied a considerable amount of his time and consumed his thoughts, as evidenced by his diaries and letters. This thesis therefore addresses a gap in Carroll scholarship and bridges two academic disciplines rarely brought together.

Chapter One argues that *Alice's Adventures in Wonderland* and *Through the Looking-Glass* should be considered as products of the mathematical and literary climates in which they were written. At the time, mathematics was overstepping the bounds of reality, including nonsensical elements like imaginary and negative numbers. Similarly, literature was expanding to include non-mimetic genres, like nonsense and fantasy. Carroll was privy to both of these developments, and in the *Alice* books, he simultaneously references the new mathematical concepts and uses the new literary techniques, indicating that he saw them as analogous phenomena. Alice's negative reaction to these new elements serves as a representation of the Victorian backlash against the shifts in mathematics and literature away from the real.

Chapter Two examines a lesser-known series of mathematical riddles that Carroll published in *The Monthly Packet* magazine. In these riddles, Carroll mocks traditional power hierarchies, specifically those operating in the educational system and class structure of the Victorian period. Carroll judges each of his characters based on their mathematical ability rather than their education or social status, and thus fantasizes a meritocratic system that could replace old notions of power. This meritocracy is echoed in his treatment of readers who submitted solutions for the riddles, who were systematically sorted within Carroll's "classroom" based upon the correctness of their submissions. Carroll therefore undoes traditional hierarchies while still retaining his position at the top, the arbiter of everyone's mathematical merit.

Acknowledgments

I'd like to express sincerest gratitude to my advisor, Professor Patricia Roylance, for providing intellectual stimulation and inspiration, reading draft after draft, being unendingly flexible, and never giving up hope. Without her guidance and assistance, this thesis would never have been possible.

I'd also like to thank Professor Crystal Bartolovich for her assistance in the early stages of this work; without her honest advice and probing questions, my ideas would not have progressed past infancy.

Lastly, I am beholden to the many people who have offered support of all kinds throughout my thesis work, particularly Kalin Balcomb and Evan Lake, who patiently provided worlds of encouragement.

Table of Contents

Introduction

In January of 1868, while embroiled in work on his sequel to the immensely popular *Alice's Adventures in Wonderland*, Charles Dodgson wrote in his diary, "Left for London *en route* for Oxford. During my stay at Ripon, I have written almost all of the pamphlet on *Euclid V* by Algebra … I have also added a few pages to the second volume of Alice."[1] Simultaneously working on *Through the Looking-Glass* and a pamphlet on Euclid, Dodgson's labor as an author of children's books and his work as an author of mathematical texts was intertwined both in his daily schedule and the thoughts left in his diary. Today Dodgson, better known by his pseudonym, Lewis Carroll, is renowned as the literary mastermind famous for his Alice books and his contributions to the genre of nonsense; his twenty-five year mathematical career as a lecturer at Christ Church of Oxford is generally mentioned only tangentially.[2]

Nonetheless, Carroll's preoccupation with mathematics was

---

1 See Carroll, *The Diaries of Lewis Carroll* 265.

2 Blake states: "All this is interesting, though what Charles Dodgson did is less interesting than what Lewis Carroll wrote" (13). The remainder of the introduction is devoid of any references to Dodgson's long career at Oxford. Also see Fisher, Guilano, and Susina for similarly dismissive treatments.

undeniable. In his 1894 volume of mathematical questions and puzzles, *Pillow Problems,* Carroll's introduction reads, "Nearly all of the following seventy-two Problems are veritable 'Pillow-Problems,' having been solved, in the head, while lying awake at night."[3] Lying in his bed in the comfort of his home, Carroll's thoughts were still consumed with mathematics. Carroll was thus considering mathematical problems constantly, almost obsessively, not merely in his work at Oxford.

With extensive publishing records in both mathematics and literature, Carroll was fully embroiled in two rarely united fields. Carroll had access to two lexicons, one centered in mathematics and one centered in literature. Publishing substantially in both mathematical logic and nonsense literature, Carroll was able to draw parallels between the two fields, making larger claims than would be possible with solely mathematical or literary arguments.

Despite the constant presence of Carroll's mathematical career, his work in academia is often dismissed as a mode of economic stability, a "day job" to tide him over between successful novels. This is indicative of Carroll's lack of passion for his position; Carroll was unenthusiastic in his

---

3 Carroll, *Pillow Problems* xii.

instruction of the older, male, and typically uninterested students characteristic of Oxford.[4] However, Carroll's love of teaching mathematics is apparent in his frequent correspondence with young girls, playfully educating them through riddles, puzzles, and stories. In April of 1890, Carroll wrote to Isabella Bowen, one of his many child-friends:

> It's all very well for you and Nellie and Emsie to unite in millions of hugs and kisses, but please consider the time it would occupy your poor old very busy Uncle! Try hugging and kissing Emsie for a minute by the watch, and I don't think you'll manage it more than 20 times a minute. "Millions" must mean 2 millions at least.
>
> 20)2,000,000 hugs and kisses
>
> 60)100,000 minutes
>
> 12)1,666 hours
>
> 6)138 days (at twelve hours a day)
>
> 23 weeks [5]

Although the sexual overtones of this letter justify critical arguments regarding Carroll's preoccupation with young girls, his penchant for

4 For a lengthy description of Carroll's interaction with Oxford pupils, see Hudson 275.
5 For the full text of the letter, see Cohen 785.

mathematical education to this particular audience is also clear. However, his mediocracy as a don at Oxford causes most critics to dismiss his career as a mathematician. As a result, the impetus is almost always to attempt to identify a schism between Dodgson, the uninspiring mathematics lecturer, and Carroll, the whimsical and fantastical creator of Wonderland.[6]

But even temporally, this division is problematic. Carroll published *Alice's Adventures in Wonderland* in 1865. Only two years later he published *An Elementary Treatise on Determinants* under the name Dodgson; the pamphlet was an exploration of the use of algorithms in finding mathematical determinants. In 1887, Dodgson published *The Game of Logic,* a young person's summary of his advanced work in logic. Two years later, he published *Sylvie and Bruno* under the pseudonym Carroll; this work was a fairy-tale-testament to his achievement as a children's author. In fact, a timeline of Carroll's publications would reveal a publishing record almost alternating between mathematical and literary texts. Included in this long list of publications are also hybrid texts that combine the two genres. Most notably in this vein, Carroll published *A Tangled Tale*

6 Fisher states: " to focus upon the author who wrote insignificant, unexciting treatises on plane trigonometry and algebraic determinants ... is to do injustice to a genius of fantasy and imaginative whimsy ... he was even then spinning words magically for a short-lived publication, *The Train*, using for the first time the immortal pseudonym which set the seal on his escape into a more comforting, exciting world" (7). Similar explications of Carroll as a dual-personality can be found in Cohen and Hudson, among many others.

in 1885, a collection of mathematical nonsense riddles originally printed in *The Monthly Packet* (this text will serve as the subject of Chapter Two).

The division of Carroll as author and Dodgson as mathematician is fallacious not only chronologically. Carroll viewed his "work" as an integrated whole, laboring over mathematical, literary, and hybrid projects simultaneously. In fact, Carroll referred to his progress in each field equally, casting neither mathematical nor literary work into a lesser role. In a letter to F.H. Atkinson, an old college friend, Carroll wrote,

> But, as life shortens in, and the evening shadows loom in sight, one gets to grudge *any* time given to mere pleasure, which might entail the leaving work half-finished … There are several books I desire to get finished, for children. … Even with the mathematical book … which I am now getting through the Press, I think nothing of working 6 hours at a stretch.[7]

Carroll thus considered his "work" to be neither centrally mathematics or literature, but rather both.

This thesis serves to reunite Dodgson and Carroll in order to

---

7 Cohen 784.

identify the work that Carroll wished to accomplish in both his mathematical and literary endeavors. In each chapter I will argue that Carroll uses the lexicons of both mathematics and literature to accomplish goals broader than either of his fields of study.

Critics have historically been inclined to place Carroll in the crux of the field of literary nonsense. Carroll has been touted as the father of the genre, his work serving as a basis of comparison for many other authors. Scholars have sought to connect Carroll's nonsense to the unnerving nature of Wonderland, the political climate of his writing, societal sanity, and myriad other topics.[8] However, critics have neglected to view Carroll's nonsense as a vehicle with which to make mathematical claims.

The influence of mathematics on Carroll's work has only been explored shallowly. In an article published in *NewScientist,* Melanie Bayley provides a list of instances in which Carroll may have been referencing mathematical concepts in the *Alice* books. The argument fails to recognize the humor and playfulness with which Carroll wrote, instead attributing the oddities of Wonderland to Carroll's fear of non-referentiality[9]. Other mathematical treatments of Carroll often focus specifically on logic,

8 See Shires, Bivona, Hubbell.
9 Bayley 3.

Carroll's main area of study. However, critics fail to historicize these arguments, ignoring the mathematical changes through which Carroll was working.[10] Carroll's entanglement in both mathematical and literary fields makes the two a necessary, but as of yet under-explored pairing that I investigate in this thesis.

The first chapter, focusing on *Alice's Adventures in Wonderland* and *Through the Looking-Glass,* shows Carroll to be using the concepts and techniques of nonsense and mathematics to posit a claim about a Victorian backlash against a change then occurring in intellectual discourse. In these literary works, Carroll demonstrates a shift in mathematical theory away from the physical universe. In Carroll's time, mathematics was burgeoning with concepts lacking representation in the physical universe. Previously existing to represent the physical world in symbolic terms, mathematics was shifting toward a system valuing math for its own sake rather than as a way of explaining the physical world. Similarly, literature was extending to include non-mimetic genres, particularly nonsense, which also were not bounded by representation of the physical world.

The first chapter of this work argues that Carroll's *Alice* series

10 See, for example, Patten.

draws a parallel between the unmooring of reality in literature and in mathematics. As Alice wanders through Wonderland, she encounters unfamiliar mathematical topics encoded in nonsense literature, and her confused, hesitant, and resistant reactions to these situations demonstrate a similar Victorian resistance to both of these moves away from the physical world. Carroll thus uses the lexicons of both the mathematical and literary changes of the time period to demonstrate a wider resistance to the shifts away from direct representation of the physical world.

The second chapter also focuses on Carroll's use of mathematical vocabulary, this time in ten mathematical riddles disguised as nonsense stories that were originally published in *The Monthly Packet* and later compiled into *A Tangled Tale*. In each of these riddles, Carroll mocks common social structures and hierarchies, instead using mathematical ability as the basis for a new power structure. This power structure is echoed in his treatment of readers responding to his riddles. Sorted into categories based upon achievement, Carroll institutes a meritocratic system of which he is the master.

Mathematics and literature are often assumed to be disparate fields, and as a result, are not traditionally bridged in interdisciplinary work.

However, a new interest in this connection has arisen; for example, *The Journal of Transfigural Mathematics: Interdisciplinary Journal of Mathematics, Sciences, Literature, and Arts* was launched in 1994 to investigate this issue. According to Bharath Sriraman, author of *Interdisciplinarity, Creativity, and Learning: mathematics with literature*:

> The reasoning that one comes across in many mathematics textbooks is crisp and deductive, with one statement flowing from another until the desired outcome is reached … in a similar spirit, authors will … use … a novel in order to demonstrate how a simple story can be used to initiate the process of critical thinking … making inferences on "truths" about society and life.[11]

Sriraman rightly argues that mathematics and literature go about their work in analogous ways, using their respective forms to draw attention to truths about society and life. Carroll is the consummate author with whom to explore this connection, as his entire career was spent bridging this disciplinary gap.

---

11 Freiman 19.

"I fancied that kind of thing never happened!":
The Non-referentiality of Mathematics and Nonsense in Carroll's *Alice* Books

At the end of Alice's journey through Wonderland, she is questioned by the queens to determine her fitness to be a queen herself. As she answers the interrogations of the queens with as much sincerity as she can muster, she can't help but think, "What dreadful nonsense we are talking!"[1] Not only Alice's interview, but Alice's entire adventure is "dreadful nonsense." However, the novel references not only the genre of nonsense coming of age in Carroll's period, but also the new non-referential mathematics, considered by many to be nonsensical, that was developing concurrently. In *Alice's Adventures in Wonderland* (1865) and *Through the Looking-Glass* (1872), Carroll records a Victorian shift away from mimetic representation in both mathematics and literature and the resistance with which this shift was met. Both texts engage this historical transition, together representing the analogous shifts in Carroll's two fields of study.

[1] Hereinafter, parenthetical citations to these texts will refer to this edition. Carroll, *Alice's Adventures in Wonderland* and *Through the Looking Glass* 204.

In *Alice's Adventures in Wonderland* and *Through the Looking-Glass*, Alice is exposed to contemporary mathematical and literary changes; Carroll uses her character as a stage on which to explore the intersection of these two transformations. Carroll's Wonderland serves as a representation of a Victorian world in which the basis of mathematics and literature becomes detached from reality, and old ideas of each field must be renegotiated in order to fit into this new paradigm. In navigating this world, Alice reacts with bewilderment and even anger to drastic alterations in what she views as reality, truth, or sense. This often manifests itself in Alice's resistance and hesitance to accept the new ideas presented to her. Carroll uses *Alice's Adventures in Wonderland* and *Through the Looking-Glass* as a space in which to explore the intellectual and psychological discomfort caused by this transition in mathematics and literature.

Carroll documents this shift away from reality in literature by placing Alice, an embodiment of realism, within the emerging non-mimetic genre of nonsense; he simultaneously invokes the departure of mathematical theory from reality by including a discussion of the non-mimetic concepts that mandated a separation from the physical world.

Carroll uses Alice's exploration of this new mathematics, as well as her status as a figure of realism in a world of nonsense, to discuss the Victorian reaction to the imposition of these changes.

The mathematical and literary conversations in which Carroll's work participated provide an important context for understanding Alice's exploration of Wonderland. Embedded in both the contemporary development of mathematical theory and Victorian theories of the novel is the question of how slavishly mathematics and literature should mimic reality, an epistemological revolution not surprising at a historical moment when religion, science, philosophy, class constructs, and various other societal structures were drastically changing.

Before the departure of mathematics from reality in this period, the field was esteemed as a pristine representation of the physical universe. This notion stemmed in part from the subject's history. First, it was well-known that mathematics developed from geometric realizations. In Euclid's *Elements*, a favorite text of Carroll's and one of the most frequently printed books in the world, algebra is introduced simply as a way in which to describe geometric problems.[2] Contemporary mathematics, then, developed from ancient efforts to describe the physical world through geometry. Additionally, the entire mathematical system developed from the logical manipulation of simple and undeniable truths, called axioms. For example, x = x is a mathematical axiom that often serves as the starting place for logical manipulation. Always geometrically sound, such axioms are the origin of mathematics, and as such, the system is seen as absolute truth. From these axioms developed a complex system with particular abilities to describe the physical world.[3]

In the early nineteenth century, mathematics was not only regarded as absolute truth, but as the crown of intellectual achievement. It was thought that logical reasoning could only be taught through mathematics, and, according to Helena Pycior, "no Cambridge undergraduate could achieve honors in any subject without first demonstrating proficiency in mathematics."[4] Augustus De Morgan, famed mathematician, defended math's position in the upper echelons of the intellectual hierarchy in 1831

---

[2] For a brief discussion of Euclid's algebraic interpretations of geometry, see Ball, especially 60-61.

[3] For an extended description of the relationship of mathematics, axioms, and the physical world, see Kline 20.

[4] Pycior 150.

by championing the subject as a means of developing reasoning capabilities: “It is … necessary to learn to reason before we can expect to be able to reason … Now the mathematics are peculiarly well adapted for this purpose.”[5] Mathematics was thus considered the best and perhaps the only way to participate substantively in scholarly conversations.

Because mathematics was viewed as the absolute truth of the physical world as well as the cornerstone of academic achievement, the departure of mathematical theory from reality was particularly unnerving. If not a representational system, what was the use of mathematics? Furthermore, if the field had developed from basic axioms, how could it have possibly transcended reality?

The stakes of this particular mathematical debate undermined the entire field of study and its prestige within the academy; as a result, a flurry of discussion and confusion erupted regarding the legitimacy of various non-referential mathematical concepts. Though negative and imaginary numbers had been generally accepted as a part of the algebraic system since the Renaissance, proofs that were developed in the Victorian era demonstrated that the definition of each led to a logical contradiction.

---

[5] For his full description of the relationship between mathematical training and reasoning capabilities, see DeMorgan 7.

At that time, negative numbers were defined by textbooks as quantities less than nothing. By definition, a "quantity" was an amount more than nothing. Assuming this definition, the phrase "a quantity less than nothing" leads to a logical contradiction, and, by this reasoning, negative numbers cannot exist. Additionally, negative numbers had no physical representation in reality and therefore could not exist in the algebraic system.[6] A similar proof demonstrating the impossibility of imaginary numbers also emerged.

As this and other elements of mathematics had surpassed the level at which a direct representation in reality was possible, mathematicians struggled to renegotiate their understanding of the field. What was once regarded as a representation of the physical universe now contained elements resistant to physical representation. Thus, the choice became either to relocate the basis of mathematics from reality to a non-mimetic system, or to do away with these non-realistic elements altogether.

Mathematician George Peacock developed a new approach to algebra in the 1830s that favored creating a new, non-mimetic system. Called symbolical algebra, the system defined algebra as:

---

[6] For a full discussion of the Victorian struggle with negative numbers, see Nagel 429-474.

> a science in which their [operations and symbols] meaning and applications … can exercise no influence upon the results. … [Mathematics] regards the combinations of signs and symbols *only*, according to determinate laws, which are altogether independent of the specific values of the symbols themselves.[7]

Peacock argues that, instead of using variables and symbols to represent physical concepts, the symbols should be used only as entities on which to perform mathematics. Only after using the symbols to draw mathematical conclusions would any sort of "real world" interpretation be applied. In stripping algebraic symbols of geometric meaning, Peacock favored completely removing mathematics from the confines of any sort of physical representation. Mathematics would exist not to mimic the physical world, but as an entity of its own.

This is problematic even, and perhaps especially, in the lowest echelons of education. When first introduced to the concept of numbers, children are introduced to physical, tangible concepts of the numerical system. Consider the "counting books" that are vastly popular in

[7] For a full abstract of Peacock's thesis, see Peacock vii.

children's education. One apple, two balls, and three flowers allow a child to develop a representation of quantity based firmly in tangible concepts. Victorian nursery rhymes often used this method to concretize children’s concept of numbers:

> My father he left me, just as he was able
> One bowl, one bottle, one lable
> Two bowls, two bottles, two lables
> Three, &c.[8]

> There were two birds sat on a stone
> Fa, la, la, la, lala, de;
> One flew away, and then there was one,
> Fa, la la, la, lala, de.[9]

Peacock’s solution to negative and imaginary numbers was to remove any such representations of reality, treating a number as an entity of its own and not as a collection of objects. Undermining the pedagogical techniques of mathematics even in the earliest stages of education,

[8] Halliwell-Phillips 138.
[9] Halliwell-Phillips 25.

Peacock was calling for a dramatic overhaul of the entire mathematical system.

Peacock's suggestion of such drastic change was not easily accepted; symbolical algebra and non-referential math were met with harsh criticism, most notably from Osborne Reynolds in *Strictures on Parts of Peacock's Algebra*:

> If (as appears at first sight) it be here intended, that "at first," i.e. until something specific is introduced, the symbols are symbols only, and that the operations and their results are also purely symbolical; I answer first, a symbol, or anything merely symbolical, is nothing, until some representation is given to it, therefore if the results as well as the operations from which they are obtained be only symbolical; it is impossible to "interpret them," they must first have some meaning attached to them. In order to their being interpreted, not only must the symbols used cease to be

> symbols only, but the operations and their results must also cease to be symbolical.[10]

Though Peacock favors interpreting algebraic symbols after operations have been performed (i.e., after the symbols have been added, subtracted, multiplied, etc.), Reynolds argues that to attach meaning to something previously meaningless is only possible if it had meaning originally. He goes on to claim that interpreting symbols after they have been operated on necessarily implies assigning meaning to symbols before they are operated on, as it is impossible to have one symbol which is simultaneously meaningful and meaningless. He finally concludes that Peacock's system is impossible to carry out, making non-referential mathematics useless.

As a mathematician and professor, Charles Dodgson would have been embroiled both in the academic development and pedagogical imposition of this drastic shift in the field. Lewis Carroll's preoccupation with this is evident in *Alice's Adventures in Wonderland* and *Through the Looking-Glass*, as Alice becomes an index both of the transition to non-

---

[10] Reynolds' *Strictures on Parts of Peacock's Algebra* was originally published anonymously, but the author was later revealed by Augustus De Morgan in another publication. Reynolds 7.

referential mathematics and of the resistant reaction to this unmooring from reality.

On an entirely different plane of study, authors and literary critics were grappling with the same questions that beleaguered mathematicians. As the non-mimetic genre of nonsense was beginning to emerge where realism had previously dominated, authors and critics were also questioning the necessity of a strict adherence to the representation of reality. Just as in mathematics, authors and critics were hesitant to renegotiate a non-mimetic understanding of fiction, one that allowed content to shift from strict representation of the material world to anything that the mind could create.

One faction of authors and critics favored an entirely mimetic type of literature, condemning non-mimesis and the “illusions” of fiction. This particular viewpoint insisted that the novel’s content be firmly grounded in the physical world. George Eliot is perhaps the figurehead of this movement, preferring a blunt realism as employed in widely popular Victorian novels such as *Middlemarch*. Kenneth Graham observes that, when commenting on her art, Eliot discussed “the necessity to avoid exaggeration, conventionality, and all literary affectation; and [by the canon of simple veracity … condemns countless inferior novels.]"[11] This condemnation of any sort of "affectation" can produce a literature in which grim representation of the physical world is favored, characters adhere to a strict sense of what is believable, and the unnatural becomes fodder for criticism.

Robert Higbie notes that due to a historical milieu that urged a strict devotion to reality, escapism in the form of non-mimetic genres thrived: "the conflict between reason and the wish to believe increased. … Many writers felt compelled to choose one or the other … so that by the end of the century we find them embracing either a fairly negative and uncompromising realism or else an equally uncompromising imaginative escapism."[12] Those belonging to this latter school of thought viewed the novel as an escape from the bitter realities of everyday life. Lewis Carroll and Edward Lear, two of the best-known nonsense authors, arose in this tradition of imaginative escapism. Nonsense had certainly existed before the Victorian time period, but the age of Carroll and Lear is known in retrospect as the "golden era" of nonsense, with the work of Carroll and Lear leading the movement.

---

[11] Graham 20.
[12] Higbie 27.

Though nonsense was coming of age, it struggled for legitimacy in much the same way that non-referential mathematics did. Nonsense literature violated the devotion to reality favored by realists, overstepping similar boundaries to those violated by the literature that Eliot found so abominable. Nonsense was also dismissed via relegation to the status of children's literature.[13] Despite the popularity of both Carroll and Lear, the genre still faced the hostility of those devoted to literary veracity, as well as the dismissiveness of those unwilling to allow nonsense the status of "adult" literature.

As nonsense became a more prevalent form of literature, critics struggled to solidify a definition of the genre. What eventually came to define it was not a lack of sense, but a tension between meaning and non-meaning.[14] For example, in one of Edward Lear's limericks from *The Book of Nonsense,* "There was a Young Lady whose chin,/ Resembled the point of a pin;/ So she had it made sharp,/ And purchased a harp,/ And played several tunes with her chin."[15] The presence of meaning in this particular limerick emerges because everyone knows what it is to have a chin, and

---

[13] Tigges 5.
[14] Sewell, *The Field of Nonsense* 25.
[15] Lear 3.

what it means to be sharp. Non-meaning is created when Lear causes that woman's chin to be sharpened enough that she can use it to play a harp. The tension between meaning and non-meaning causes the effect of literary nonsense. By using non-meaning, nonsense authors transcend the boundaries of what readers understand as reality, creating fiction non-mimetic of the physical world.

In nonsense literature, this tension is created using devices that turn commonplace concepts, ideas, or objects into nonsense. These devices include the inversion of the familiar, mirroring, simultaneity, and toying with the concept of infinity.[16] In much the same way that non-referential mathematics favored a system subject to the rules of logic rather than reality, nonsense literature was subject to its own set of conventions, requiring the transfer of sense to nonsense via a specific set of techniques. Literature, like mathematics, had transcended representations of the physical world. Though subject to its own set of rules, it could now exist as a form without ties to reality.

Carroll's life saw the development of unrestricted mathematics from referential mathematics and the analogous emergence of nonsense

[16] Tigges 54.

from realism. Actively producing both mathematical and literary works, Carroll was privy to each of these conversations. In his mathematical career, he referenced Peacock's work in a satirical pamphlet regarding the salary of a professor, evidence of his familiarity with the work.[17] As a published nonsense author, he also would have been embroiled in the literary debate of the time period, which questioned the conventions of the novel in terms of its mimetic qualities.

In a relatively unusual position of participation in two seemingly but only superficially unrelated debates, Carroll has access to two lexicons, one mathematical and one literary. His use of each lexicon is seen both in his thinly veiled mentions of contemporary mathematical concepts throughout the *Alice* novels and in his deliberate toying with the conventions of nonsense.

By bringing these distinct conversations together, Carroll documents a broad contemporary shift away from reality, and in the character of Alice, demonstrates how an embodiment of the physical world reacts when thrust into the verbally and mathematically nonsensical world of Wonderland. Alice, accustomed to the familiarity of

[17] Pycior 160.

the world in which she was raised, is bothered by the mathematical and linguistic nonsense of Wonderland. In couching non-referential mathematical concepts in nonsense literature, Carroll is able to demonstrate Alice's reactions to the obviously nonsensical elements of Wonderland. As Carroll invokes non-mimetic mathematical concepts, he simultaneously employs the devices of nonsense literature, drawing the two conversations together at specific moments in the text. When reacting to the features of nonsense literature, then, Alice is also reacting to the mathematical concepts encoded in the text. Carroll thus uses his nonsense as a vehicle through which to demonstrate Alice's reaction not only to the genre itself, but also to the new non-referential mathematics. Alice's reaction to these moments is one that varies according to the amount of nonsense she encounters: as her ability to find a physical correlate with the concept decreases, her negative reaction to the situation increases.

Alice's most physically-based confrontation with the issue of negative numbers occurs during a conversation with the Mock Turtle and the Gryphon on lessons: "'And how many hours a day did you do lessons?' said Alice, in a hurry to change the subject. 'Ten hours the first day,' said the Mock Turtle: 'nine the next, and so on'" (77). After learning this formula for the number of hours of lessons per day, Alice concludes: "the eleventh day must have been a holiday?'" (78). She then encounters a logical problem: if the eleventh day yields zero hours of lessons, then how much time is spent on lessons on the twelfth day? Immediately after Alice asks the Mock Turtle this question, the Gryphon intervenes: "'That's enough about lessons,' the Gryphon interrupted in a very decided tone" (78).

In this particular scene, the non-referential concept of negative numbers is raised by Alice herself. If one hour is taken away each day, what happens at and after zero hours? Alice hypothesizes that, at day "zero," there will be holidays. She strains to find a correlate in the physical world for a quantity of zero. However, her idea of zero is contrary to a non-referential understanding of the concept. Referentially, the term zero would imply that there are no "items" to count, in this case lessons. Non-referentially, the term zero is simply an integer, and therefore would not be applied to any one activity (lessons, vacations, rest, or picnicking). In struggling to find a physical correlate for the concept of zero, Alice experiences the conflicting definitions between referential and non-referential mathematics that cause her so much confusion in Wonderland. Alice then proceeds to engage the concept of negative numbers by asking the Mock Turtle what occurs on day twelve. Though she is saved from wrestling with non-referential mathematics by the Gryphon's dismissal of her question, the idea is certainly raised.

Alice's brush with non-referential math coincides with Carroll's use of specific and deliberate nonsense techniques in his prose. Firstly, the conversation relies on a pun: the word "lesson" is allowed to take on two meanings simultaneously-- coursework and a daily "lessening" of time. The lesson/lessening pun participates in the simultaneity technique of nonsense, where two objects or ideas are thrust together and, though disparate, forced to have one unified meaning.[18] This punning occurs just as Alice is confronting negative numbers within a discussion of the educational system of Wonderland.

Secondly, Carroll employs the nonsense technique of infinity as Alice learns of the "curious plan" of the lessening lessons. Wonderland's "curious" educational plan calls for lessons that lessen every day, infinitely. According to Wim Tigges, "the required tension between meaning and non-meaning can be held unresolved by the arbitrariness of

[18] Tigges 58.

closure."[19] By failing to provide the reader with any "end" to the lessening plan, Carroll withholds the closure necessary for sense in the physical world, thus creating the tension between meaning and non-meaning that forms nonsense. Introducing an infinite "lessening" procedure, Carroll uses the concept of infinity while Alice engages the idea of zero and less-than-zero lessons.

Though the concept of "lessening lessons" is nonsense to Alice, it is not devoid of any sort of meaning. Certainly aware of what it is to "lessen" and what constitutes a "lesson," Alice is left to construct some sort of sense from the nonsense. This grappling for sense, demanded by nonsense literature, occurs alongside her attempt to develop her knowledge of non-referential mathematics. Though the ideas are foreign and bear little resemblance to her reality, her command of the words used to represent them allow her to work towards some sort of understanding of the subject.

Alice is hesitant to accept the idea of negative lessons, exclaiming, "What a curious plan!" (130). As Alice was taught to think of numbers as collections of objects (e.g. 4 apples, 3 flowers, 2 cupcakes, 1 dog), she

[19] Tigges 59.

extends this logic to assume that, if negative numbers do exist, they must have some correlation to the physical world. Upon searching for and failing to find that direct physical correlate, Alice feels compelled to ask: “And how did you manage on the twelfth?” (130). In straining to maintain a previously held understanding of the rules of mathematics, Alice demonstrates a confusion with the developing non-referentiality of the field. Unable to conceive of a mathematics in which direct physical representation is unnecessary, Alice cannot understand a world in which negative numbers are possible without the existence of “negative lessons.”

In addition to this hesitance to embrace non-referential math, Alice is reacting negatively to the nonsensical concept with which she has been confronted. The idea of lessons that lessen and an infinite diminishing of time, though possible in Wonderland, would be unheard of in Alice's world. Alice's reaction, commenting on the curiousness of the lessons plan, is her commentary on the punning and idea of infinity that create the nonsense of the situation. Alice is thus reacting with reservation not only to the non-mimetic situation into which she has been placed, but also to the non-referential mathematics to which she has been exposed.

Despite Alice's hesitance to accept a new construct of mathematics, her resistance to the idea of lessening lessons is not nearly as volatile as her reaction to other confrontations with mathematical abstraction in the two novels. Though Alice is wary of the lessening lessons presented by the Mock Turtle and the Gryphon, she is able to make some sense of the nonsense by comparing the situation to her physical world. In comparing "zero lessons" with her idea of holidays, she is able to make sense of what might happen on the eleventh day: a picnic with baskets of food, a vacation with swimming and games, or any other leisure activity. As Alice is able to find some sort of correlation between Wonderland and her world, her reaction to the educational plan of Wonderland is more timid than characteristic of her other encounters with non-referentiality and non-mimesis.

Alice engages the problem of the allowable level of abstraction of mathematics with slightly more volatility when she asks the Cheshire Cat for directions; the passage alludes to the question of whether mathematical conclusions should be decided on with regard to the physical world or worked towards by logical manipulation. "'Would you tell me, please, which way I ought to go from here?' 'That depends a good deal on where you want to get to,' said the Cat. 'I don't care much where—'said Alice. 'Then it doesn't matter which way you go,' said the Cat" (88). This passage brings to the forefront of conversation the very problem mathematicians were grappling with in the time period: how closely should mathematics mimic reality?

Archimedes wrote a book dealing with this problem called *The Method,* which details a process of finding conclusions toward which to direct the argument of a proof. By finding a physical representation of the mathematical concept under investigation, an individual could find what he or she wished to prove and then discover the steps by which to get there. For example, if a mathematician wished to find a formula for the volume of a sphere, he or she could weigh particular spheres and attempt to construct a formula that way. After finding a conclusion, the mathematician could then work to construct a rigorous and formalized proof of the conclusion.

When seen in light of contemporary mathematical debates, this passage alludes to the method of Archimedes. If Alice "does not much care" where she "gets to," she has no mathematically pre-decided conclusion to work towards. If mathematical proofs are approached without this conclusion, dictated by the physical world, the field of mathematics is allowed to progress as an entity of its own without regard for representation in reality. Carroll thus highlights the contemporary mathematical debate over referentiality in this discussion.

Carroll's work with the nonsense technique of inversion occurs simultaneously with Alice's engagement with new mathematical concepts. Inversion, also called mirroring, "on a large scale operates in the presentation of a topsyturvy world, a world beyond the looking-glass."[20] Alice's conversation with the Cheshire Cat is based on her lack of knowledge in Wonderland. Unable to find her way, she needs to ask a cat for directions, placing the cat in an authoritative position with her below. In Alice's world, the situation would certainly be reversed, that is, if cats could talk and had need for directions. Carroll thus takes a girl who is a pet-owner to a cat who is a girl-owner, creating nonsense out of sense via the technique of inversion. By creating a world in which a cat is the authority of Alice instead of the other way around, Carroll forces Alice's views, as the embodiment of the physical world, to be questioned.

[20] Tigges 56.

In addition to inversion, Alice's conversation with the Cheshire Cat is characterized by a surplus of signification, typical of nonsense literature. This technique requires that too much meaning or explication be attributed to something uncomplicated, but can also function to create nonsense when a deficiency of signification exists. Whether explication is deficient or excessive, the explanation is presented as sufficient signification in order to create a tension between meaning, encoded in the explanation, and non-meaning, created by the excess or deficiency of information.[21]

When Alice asks the Cat where to go, he explicates that her direction should be based off of her intended trajectory, and if she lacks that, any way she chooses will suffice. Even to an eight year old girl, this excess explanation is unnecessary, as Alice almost certainly understands this most basic concept. Surplus of signification takes a simple tenet of directionality from sense to nonsense. This technique, typical of the genre, necessitates that Alice, and the reader, will struggle to find meaning in the nonsense.

[21] Tigges 58.

Although Alice is certainly confused by the nonsense of the cat as well as by its position of authority, she is familiar with both the existence of cats as well as the Cheshire Cat's advice. Because Alice has some sort of understanding of the tangible elements that form the nonsense, she is able to grapple with her limited knowledge to make intellectual progress, both with regard to Wonderland situations and the references to non-referential mathematics. Thus by using nonsense techniques at the same moment as he broaches a methodological problem resulting from non-referentiality, Carroll can engage the literary and mathematical movement away from reality occurring in the period.

Born and raised in Victorian Britain, Alice is unfamiliar with the non-mimetic elements of Wonderland. Familiar with “having somewhere to go” in a referential world, she is unable to grasp the non-referential idea that direction might not matter. This strange new situation causes her to react both to the nonsense she encounters and the new mathematical concepts she experiences with bewilderment and hesitance. When the Cheshire Cat finishes giving her directions, Alice's response is: “Alice felt that could not be denied, so she tried another question” (88). Unable to either use or deny the Cheshire Cat's directions, Alice's only response is to try another question. Instead of attempting to renegotiate her knowledge of math or her knowledge of Wonderland to fit these new circumstances, Alice redirects her line of questioning; this demonstrates a slightly more aggressive reaction than in the lessons example, when the Gryphon is able to shut down her line of inquiry completely. Alice is unwilling to accept not only the cat's nonsensical excess of logic, but also the non-referential mathematical concepts discussed during this surplus of signification. Carroll, then, uses Alice's interaction with the Cheshire Cat as a way to evoke contemporary transitions away from reality, this time met with timid questioning.

Alice's conversation with the Cheshire Cat is not marked with the anger and blatant resistance characteristic of her reactions to the nonsense of Wonderland. This is due to Alice's ability to make some sense of the words of the Cheshire Cat. Many of Alice's interactions with Wonderland characters are nonsensical due to inversion, mirroring, or other nonsense techniques that remove logic from the situation. However, this particular conversation with the Cheshire Cat is made nonsensical due to an excess of logic; the Cat gives copious logical reasoning as to why going somewhere gets you somewhere. As this is an idea that makes sense in

Alice's world, but is made nonsense by excess explanation, Alice's resistance to the idea comes in the form of bewilderment and a hesitancy to accept the idea rather than an angrier or more indignant reaction.

Alice reacts with more vehemence to non-referential mathematics when she reprimands the Cheshire Cat for so quickly appearing and disappearing. She is surprised when the cat disappears slowly, leaving only a grin. "'All right,' said the Cat; and this time it vanished quite slowly, beginning with the end of the tail, and ending with the grin, which remained some time after the rest of it had gone. 'Well! I've often seen a cat without a grin,' thought Alice; 'but a grin without a cat! It's the most curious thing I ever saw in all my life!'" (91).

The image of a grin without a cat is one that has been likened to the idea of mathematics without science. According to Marvin Gardener in *The Annotated Alice*, "The phrase 'grin without a cat' is not a bad description of pure mathematics. Although mathematical theorems often can be usefully applied to the structure of the external world, the theorems themselves are abstractions that belong in another realm."[22]

Alice is thus alarmed by the non-referential separation of

---

[22] Gardner 91.

mathematics from science, as she is accustomed to math having a direct correlate in reality. Alice points to the curiosity of this separation of math and the physical world when she announces that “It’s the most curious thing I ever saw in all my life!” (91).

Alice's interaction with the Cheshire Cat, and thus her engagement with the idea of mathematical abstraction, happens just as Carroll invokes nonsense techniques once again. The discussion of a “grin without a cat” is the mirroring and inversion so characteristic of nonsense literature: in Alice's world, a cat can exist without a grin, but certainly not a grin without a cat. Carroll's use of nonsense is effective not because there is no “sense” in the conversation. Rather, Alice is familiar with both grins and cats, and cats without grins. Alice thus understands the “mirror” of the situation, and this knowledge allows her to try to make sense of the concept. When Alice is able to engage, though in limited ways, with the nonsense of the conversation, she is also engaging the foreign mathematical concepts.

In introducing such a cat, more knowledgeable than a human, Carroll puts Alice, the embodiment of the physical world, in an uncomfortable space between nonsense and reality. Like the changing field of mathematics, the contemporary changes in literature that allow for techniques like inversion are met with discomfort by Alice. In reacting negatively to the nonsense, Alice is objecting both to the changes in mathematics and in literary genres.

Alice's reaction is one of unease; she becomes unnerved with the Cheshire Cat's appearances and disappearances and is baffled by the presence of a grin without the cat's body. As an embodiment of realism, Alice is rejecting the mirroring that makes sense nonsense, converting a cat without a grin to a grin without a cat, but the “sense” present in the nonsense allows Alice enough of an intellectual footing to grapple with the idea of non-referential mathematics.

However, this idea of mathematics is as foreign to Alice as is Wonderland. Unable to reconcile referential mathematics with her previous understanding of the field, she responds with, “It's the most curious thing I ever saw in all my life!” (91). Alice is thus hesitant to accept both the nonsensical nature of Wonderland as well as the non-referential mathematics present. In Alice's interaction with the Cheshire Cat, Carroll represents the departure from physical representation then taking hold in mathematics and literature and alludes to the resistant reaction caused by that shift.

Alice's reaction to the Cheshire Cat is marked by discomfort. In her previous interactions with non-referential math, she is able to make some sense of the nonsense by relating the situation in Wonderland to her world. However, when she is confronted by a grin without a cat, she is unable to compare the situation to anything that she has confronted before. Though her previous experiences elicited irritation at most, her inability to reconcile this situation with anything familiar leads to a more intensely negative reaction of discomfort.

Alice experiences non-referential math with even more hesitance during a conversation with the Mad Hatter at a tea party: "'Take some more tea,' the March Hare said to Alice, very earnestly. 'I've had nothing yet,' Alice replied in an offended tone, 'so I can't take more.' 'You mean you ca'n't take less,' said the hatter: 'it's very easy to take more than nothing'" (57). The Mad Hatter forces Alice to question her concept of "zero tea" and whether it's possible to take less of that, or to have "negative tea," engaging both the mathematical concept of negative numbers and the idea of a quantity zero. Conflict arises, as Alice is trained to think referentially, defining zero as nothing. The Mad Hatter, however, employs a non-referential definition of zero, treating it as an integer instead of an absence of quantity. While the Mad Hatter argues that it's very easy to have more than zero tea, Alice views having zero tea as having nothing, and it's therefore impossible for her to have more.

Alice's engagement with the topic is made possible by the "slippery language" with which Carroll writes. Linda Shires states that Alice has "enormous difficulty understanding the creatures she meets in Wonderland," and that "words seem to slip and slide into each other to the point of seeming … meaningless."[23] The slipperiness that Shires points to is exactly an example of nonsensical simultaneity. In terms of non-referential math, Alice initially has the idea of "negatives" quite backward. After stating that she cannot have more than zero tea, the Mad Hatter corrects her, noting that having more than none is quite easy; it's taking some away from none that presents a problem. However, this is not simply an implication of mathematical ignorance. Alice's arguments are in one sense correct, however, she has interpreted the conversation differently than the Hatter has. When Alice states that she can't have

[23] Shires 272.

"more" tea, she isn't correct mathematically. Verbally, however, she makes a compelling case. The term "more" implies an addition to a previous quantity, and as generally understood, "zero" is not a legitimate quantity. If one starts with "zero" tea, then, one cannot have "more."

This slipperiness of language (the multiple interpretations of the word "nothing") allows Alice to struggle for meaning in the concepts of "less than zero" or "more than zero." The confusion of words and meanings is typical of the simultaneity convention of nonsense literature, which allows one word to acquire multiple meanings simultaneously. Though unfamiliar with the Mad Hatter's "nonsense" definition of zero, Alice knows what nothing is and what tea is, and she is at least able to struggle to make sense of the situation. Thus, as Alice is struggling with the nonsensical language of Wonderland, she is at the same time intellectually grappling with the non-referential math encoded in the text.

Though Alice has had little time to give her new idea of zero or negative tea any thought, her immediate reaction to this transition from referential to non-referential mathematics is irritation. This is seen in her response to the Mad Hatter's correction: "Nobody asked your opinion" (101). Alice is reacting not only negatively to the imposition of non-referential mathematics, but also to the nonsense of the situation. Discontented with the multiple interpretations of the quantity zero, Alice attempts to stifle the simultaneous meaning, provided by the Mad Hatter, that takes sense to nonsense. Carroll thus uses nonsense to make a tea-party into a struggle with non-referential mathematics.

Alice's reaction to the Mad Hatter is one of anger. As her interactions with the abstraction of mathematics become more and more nonsensical, Alice struggles harder to find meaning in the words of the Wonderland characters. Unable to do so, her reactions to the nonsense and non-referential mathematics become more intensely negative. In this situation, Alice is unable to conceive of a physical idea of negative tea. Unlike her engagement with Wonderland lessons, her idea of "zero tea" has not been discussed or affirmed, and she is unable to create a physical correlate for any of the happenings at the tea party. Without any sort of meaning in the nonsense of the Mad Hatter and the tea party, she becomes frustrated and rudely tells the Hatter that "nobody asked your opinion."

Alice calls the Mock Turtle's lesson schedule "a most curious plan," reacts with "offense" to the ideas espoused by the Mad Hatter, and is ill at ease with the Cheshire Cat. Alice’s discomfort with each situation culminates in a greater backlash in an interview with the queens. While examining Alice’s arithmetic skills to determine her fitness to be a queen of Wonderland, the Red Queen asks Alice to “take nine from eight” (205). Alice, unable to perform the subtraction, says: “’Nine from eight I can’t, you know!’” (205). The White Queen, confident in her assumption that the subtraction can be done, concludes that: “’She ca’n’t do Subtraction’” (205). Argument arises, as Alice thinks of subtraction as removing a quantity of objects from another quantity of objects. Her referential understanding of the concept of subtraction eliminates the possibility of negative numbers. The queens, with a seemingly non-referential approach to mathematics, understand subtraction as an operation on integers. The lack of agreement between Alice and the queens demonstrates the contemporary conflict between referential and non-referential mathematics.

This engagement with the non-referential idea of negative numbers occurs during an obvious use of nonsense techniques. Most notably, Alice's conversation with the queens occurs while she investigates the nonsense of the inverted power relationship between her and the monarchs. Though Alice seems to be the more logically grounded party (she even discovers that the White Queen herself cannot compute sums), they are placed in an authority position over her. This sort of inversion of character roles takes a sensical interview for a position of authority to a nonsensical situation in which two essentially insane individuals test another for a position of power. Despite the nonsense of the ruling power of the queens, Alice is familiar with the concept of monarchy and familiar with the idea of math tests. Though thrust into a nonsensical situation, Alice struggles with finding meaning in the nonsense precisely because she has a firm understanding of what the sense should be, and the lack of that sense is all the more shocking. While Alice is searching for intellectual dominion over her situation with the queens, she is engaging in a parallel act with the non-referential mathematics referred to in the passage.

Alice's resistance to non-referential mathematics and nonsense is heightened during this examination. Though she seems at least willing to engage the concept in her conversation with the Mock Turtle and the Gryphon, she is unwilling even to entertain the idea when under examination by the queens, firmly stating that she cannot perform the arithmetic. Alice thus clings to the referential mathematical system under which she was educated.

Later on in her examination with the queens, her discomfort with non-referential mathematics manifests itself in anger: "'Can you do sums?' Alice said, turning suddenly on the White Queen, for she didn't like being found fault with so much" (205). Alice thus becomes not only uncomfortable with the mathematical world in which negatives exist, but absolutely unwilling to renegotiate her knowledge to fit with a new system, as she dislikes "being found fault with so much" (205). Alice's reaction to the queens is also a hostile reaction to the inversion of Wonderland. As such inept characters as the queens would never be authority figures in Alice's world, she reacts to them with anger and disrespect. Alice thus responds negatively not only to the non-referential mathematics she encounters, but also to the nonsense conventions used in the conversation. Once again, Alice's interaction with these two characters draws to mind the shift away from reality in this period. Her reaction to the queens, this time involving blatant impudence, evokes an image of the contemporary resistance to these changes.

Carroll places Alice, a product of her environment, in a position where she is forced into a nonsensical world. Raised in Victorian Britain, Alice is unfamiliar with a world in which she might be interrogated by the queens, or in which she might become a queen herself. Her irritation with the nonsense of the situation is not only a reaction to new mathematical abstractions, but also to the changing literary constructs of the time period. Alice's resistant reaction, then, demonstrates a backlash against the changes taking shape in two fields.

When Alice is forced to consider negative numbers during her interview with the queens, she reacts with irritation, anger, and blatant resistance. Alice's other interactions with abstract math and nonsense have been marked by hesitance, confusion, and annoyance. However, this interaction with the queens prompts back-talking from Alice. This is at least in part due to Alice's inability to reconcile the situation with her previous world. Asked to compute a difference that would yield a negative number, she is unable to compare this schooling situation with a situation from her physical world. Though Alice has been in a classroom setting before, she is now being interviewed for a position with "classroom" types of questions that, in her world, have no legitimate answer. Unable to make sense of nonsense, her reaction is more intense than the annoyance or confusion typical of her previous reactions.

As Carroll invokes literary and mathematical non-mimesis simultaneously, two historical conversations are drawn together on the page. Positioning Alice between representations of reality and a world of non-reality, Carroll references a resistant reaction to the departure from reality in mathematics and literature. *Alice's Adventures in Wonderland* and *Through the Looking-Glass* thus become a place in which to explore reality, non-mimesis, and the Victorian reaction to changes in mathematical and literary theory.

"Couldn't you count better than *that?*": Mathematical Meritocracy in Carroll's *Monthly Packet* Riddles

Lewis Carroll's *Alice* books are certainly the most renowned titles in his corpus of work. However, Carroll was also an avid puzzler, compiling collections of mathematical games and riddles.[1] These volumes receive very little critical attention, perhaps because of the ambiguity of their genre or because of a hesitancy to include them in the same category as the canonical *Alice* texts.

One of these works is a collection of ten mathematical riddles written in nonsense prose and originally published in *The Monthly Packet* from 1880 to 1884. Though very little has been published on the series of puzzles, which were eventually collected into an 1885 book entitled *A Tangled Tale,* they provide insight into Carroll's perception of the social structures of Victorian Britain, specifically regarding his critique of conventional hierarchies.

In *The Monthly Packet,* Carroll creates a ranking system in which both the characters in his riddles as well as potential solvers of the puzzles

---

[1] See, for example, Dodgson's *Pillow Problems*, a book of short, intricate mathematical puzzles

are evaluated based on their mathematical capability. He thus sets up a mathematical meritocracy, a hierarchy of which he is the master. By using this power structure in his riddles and simultaneously denigrating the educational and class-related hierarchies already in place, Carroll suggests that a system of meritocracy would be preferable.

Carroll's riddles were published in *The Monthly Packet* regularly from 1880-1884. Each issue contained a new riddle, a synopsis of the last month's problem, comments on submitted solutions, and Carroll's solutions. Carroll referred to each of these riddles as knots, giving them titles such as "Knot I: Excelsior." Carroll perhaps used the word "knot" to indicate some sort of order within the chaos and nonsense of the riddles. Though knots certainly require unknotting, they are also intricately and deliberately created for some purpose.

Although Carroll's publications in *The Monthly Packet* are now commonly referred to as riddles, Carroll's use of the term "knot" suggests that the works fall into a different category. Riddles are generally classified in two groups; the first is the enigma, which is allegorically or metaphorically written, and requires careful thinking to solve.[2] For

---

developed during his bouts of insomnia and published in 1894.

[2] Cook, xvii.

example, the riddle posed in *Oedipus Rex*, "What walks on four legs in the morning, two legs at noon, and three legs in the evening?" (Answer: man), is of this type, with the "trick" of the riddle lying in a metaphorical use of the word "leg." Riddles also take the form of conundrums, which use punning within the statement of the riddle to encode both the "surface meaning" of the riddle and the "true meaning" of the riddle simultaneously.[3] For example, the common riddle, "What's black and white and red (read) all over?" (Answer: a newspaper), is of this type, clearly relying on a pun between "red" and "read" to create the puzzle.

Carroll's knots may often be described as riddles because they do bear a certain resemblance to the riddle genre, embodying aspects of both enigmas and conundrums. Enigmas and conundrums are written on two different levels, requiring the reader to draw together two linguistic concepts in order to solve them. In Carroll's riddles, the reader must also draw together two planes of meaning, one linguistic and one numerical, when translating the riddle from nonsense prose into mathematical equations. Unlike typical riddles, Carroll's require an additional step. Linguistic riddles would be solved after this act of translation, but

---

[3] Cook, xvii.

Carroll's then require the reader to decipher the mathematical problem.

Though Carroll's riddles do embody characteristics of linguistic riddles in the translation act, the “trick” of each riddle comes from a mathematical intricacy, a crucial element of establishing his mathematical meritocracy. Each riddle does require a small amount of linguistic analysis to solve, however, the majority of the solution requires a mathematical realization. Despite being disguised as riddles in their fanciful articulations, each of Carroll's ten knots was distilled down to a question statement when solutions were published in the next month's issue, and it is perhaps this distillation and implied sense of order that justifies the term “knot.” For example, the second knot involves a group of men attempting to find four apartments in a square, one to use as a day room, and the other three as bedrooms. They resolve to choose for the day room the apartment that requires the least walking for all three men to travel from their respective bedrooms to the day room. Though the riddle involves the men visiting all four apartments, asking landlords about the cats, the cabbage gardens, and the smoking of the chimneys, the question statement is quite succinct. The distillation is as follows: “A Square has 20 doors on each side, which contains 21 equal parts. They are numbered all round, beginning at one corner. From which of the four, Nos. 9, 25, 52, 73, is the sum of the distances, to the other three, least?" (86). With this question statement, Carroll removes the linguistic "slight of hand" that lies at the root of most riddles. With all necessary information wrapped into a neat paragraph at the bottom of the page, the deceit of Carroll's riddles comes instead from the trick of mathematics required to form a correct solution.

Knot I, "Excelsior," is the story of two travelers who have walked on a level road, climbed a mountain, then returned home. The reader is given the pace of the travelers on the level surface, uphill, and downhill, as well as the time of departure and time of arrival. The reader is then asked to decide how many miles were covered by the travelers and at what time of day, within half an hour, they reached the peak of the mountain. At first, the solution to the problem appears to require basic algebra: set the length of the road equal to x and the distance up the mountain equal to y. Then, the travelers have walked 2x miles along the level road at a pace of 4 miles per hour, up the mountain y miles at a pace of 3 miles per hour, and down the mountain y miles at 6 miles per hour. As they have been traveling for six hours, the equation becomes: 8x + 9y =

6. However, this equation has two variables, and no more information useful in solving for the quantity (x + y) is contained in the riddle.

The trick to solving is to notice that it would take the travelers 1/4 of an hour to walk one level mile. As their pace walking uphill is 3 miles per hour, it would take 1/6 of an hour to walk a half mile uphill, and, with a pace of 6 miles per hour downhill, 1/12 of an hour to walk that same half mile downhill. Because 1/6 + 1/12 = 1/4, it would take the travelers the same amount of time to walk one level mile as it would to walk half of a mile uphill and half of a mile downhill. The equation, therefore, becomes: (1/4)x + (1/4)y = 6. Algebraic manipulation yields: x + y = 24. The travelers have therefore walked 24 miles on their journey. This riddle, then, does require that readers have the linguistic analysis skills necessary to notice that the varying pace of the travelers must somehow be related. With this information, though, they must then make the mathematical realization that, because 1/6 + 1/12 = 1/4, a solution can be obtained despite the seeming lack of information. The riddles therefore require a bit of close reading, but essentially rely on a clever mathematical approach to the problem.

Carroll encouraged reader response to his column in *The Monthly*

Packet, replying to readers' solutions with corrections, advice, and criticism. He responded to submitted solutions as a schoolmaster, listing who was at the top of the "class" and who had fallen behind. Carroll thus became not just the author of a column, but the moderator of a lively mathematical classroom.

The Monthly Packet served as a school in which Carroll was the didactic voice; his responses to student solutions were generous and kind when solutions were sound, and rather caustic when incorrect. For example:

> Of the five who are wholly right, I think Bradshaw of the Future, Caius, Clifton C., and Martreb deserve special praise for their full analytical solutions. Matthew Matticks picks out No. 9, and proves it to be the right house in two ways, very neatly and ingeniously. (88)

However, Carroll often responded to readers not only with corrections, but also with rebukes:

> OLD HEN is nearly as bad; she 'tried various numbers till I found one that fitted *all* the conditions'; but merely scratching up the earth, and pecking about, is *not* the way to

solve a problem, oh venerable bird! (147)

This harshness was not uncommon. Carroll's taunts of failed solvers served to establish the mathematical meritocracy in his column-classroom: those with correct solutions were praised, and those with faulty methods and answers were criticized. Carroll, the master of the classroom, had the power to place people into their proper rank.`

The Monthly Packet was founded in 1851 by Charlotte Younge, who remained the magazine's editor for almost its entire forty-eight year career. Originally called *The Monthly Packet of Evening Readings for Younger Members of the English Church,* the magazine was created to target young female members of the Anglican Church. The magazine's first editorial introduction stated its desire to appeal to "young girls, or maidens, or ladies, whatever you like to be called."[4] The introduction stated the intention to include historical fiction, biographies, religious information, and other educational pieces.[5] Carroll's ten knots appeared twenty-five years after this first editorial letter, but Charlotte Younge was still the editor and the educational goals of the magazine remained much the same, only with the addition of more intellectually demanding content.

[4] Romanes 45.

Carroll's meritocracy was thus included in a magazine devoted to educational pursuits, and this juxtaposition of “classrooms” allowed Carroll to make specific claims regarding educational hierarchy and his desired ranking system.

Carroll's meritocracy was also fostered by the unintended audiences of *The Monthly Packet.* Though Younge's publication was originally tailored to young females, the magazine actually had a far wider readership. The decision to add more adult-oriented content was made when Younge realized that, based on magazine sales and prices, the publication was reaching a less specific audience than intended, one that included the lower class, men, and women of all ages. Upon this realization, the word “younger” was dropped from the magazine's name, and material appealing to a more intellectually advanced audience was included.[6]

Carroll's inclusion in a magazine read by a diverse audience also had implications for the field of mathematics. Historically a field of study reserved for upper-class men, inclusion of mathematical riddles in *The Monthly Packet* meant that Carroll was encouraging young people, old people, girls, boys, the upper class, and the lower class to pursue

[5] Sturrock 267.

mathematical education. Carroll opened the field to a broader public, making math accessible to anyone with the desire to enjoy a bit of nonsense and the capability to untangle a tangled tale. Essentially, Carroll undermines the aristocracy of mathematics, of which, as a professor at Oxford, he was certainly a part.

In fact, when the ten knots featured in *The Monthly Packet* were compiled into a book, Carroll prefaces it with this poem:

> Beloved Pupil! Tamed by thee,
> Addish-, Subtrac-, Multiplica-tion,
> Division, Fractions, Rule of Three,
> Attest thy deft manipulation
> Then onward! Let the voice of Fame
> From Age to Age repeat thy story,
> Till thou hast won thyself a name
> Exceeding even Euclid's glory.[7]

Encouraging his "pupils" to compare themselves to Euclid, Carroll invites a wider audience to identify as mathematicians. He even encourages his students to exceed Euclid, one of the most renowned mathematicians to

---

[6] Sturrock 270.

contribute to the field. Carroll thereby removes the aristocracy of mathematics and creates a meritocracy by allowing students to attempt to exceed the historical masters via accomplishment.

Though Carroll certainly opens the field of mathematics by encouraging students to participate in the legacy of Euclid, the sheer excessiveness of his introduction implies irony. Though Carroll suggests students out-math Euclid, this is a nearly impossible feat, and certainly not achievable with only addition, subtraction, division and multiplication. This creates a meritocracy in which Carroll remains at the top. As a mathematical master, he is allowed to evaluate the work of students attempting to ascend the power structure, but his position at the top is still firmly placed.

Furthermore, the solutions to the riddles themselves demanded a greater level of mathematical agility than the average student at any level might possess. Instead of using the formulaic, computational mathematical tactics that are taught at all but the highest echelons of education, each of Carroll's ten knots requires a deft manipulation of the information and a clever mathematical trick to make sense of the puzzle.

---

[7] Carroll, *A Tangled Tale* Preface.

Carroll was thus encouraging the readership of *The Monthly Packet* not only to think about mathematics, but to approach the field with a creative eye and new problem-solving tactics.

Fostering this sort of inventive thinking was unusual in the Victorian educational system. This was perhaps due to religious and societal insistence on cheerful obedience, an idea present in the educational debates of the day. *The Victorian Review* in 1882 featured this opinion: "children must, in the course even of a purely secular education, learn obedience, order, carefulness, and attention."[8] Students were trained to accept the mandates and edicts of their educators unquestioningly, without thought to any alternatives. It is not difficult to imagine that such educational attitudes might lead to intellectual stagnation, and Victorian educational institutions, even at the university level, suffered from this philosophy.

In the Victorian time period, Cambridge was experiencing an increase in enrollment, as a developing middle class desired the college educations before available only to the upper class. Despite this increase in student population and thus funding, the Cambridge curriculum

---

[8] Franklin 469.

remained stagnant, especially in their mathematics program:

> Cambridge mathematics pedagogy was shaped by pressures from outside the university, in particular how the pervasive Victorian push for efficiency in all things, including production of learned men, transformed Cambridge mathematics pedagogy into a system that … spat out graduates … Unfortunately, the trouble with such an industrialized system was that, once the conventions for successful problem-setting and solving were agreed upon, the system fell prey … to an intellectual stasis.[9]

In terms of education, the Victorian period's insistence on rules, obedience, and a strict adherence to the methods of authority figures lead to an intellectual stagnation that extended to the most prestigious institutions at the highest levels of education. Creative thinking, innovation, and new methods of problem-solving were not encouraged by academic institutions. Therefore, by encouraging readers of *The Monthly Packet* to think originally, Carroll was allowing young students to do the creative thinking that had fallen by the wayside even at institutions of

[9] Feingold 132.

higher education. Reorganizing mathematics so that university students and *Monthly Packet* readers alike were able to think about mathematics innovatively, Carroll was advocating a democratization of the field.

However, Carroll's democratization of mathematics is tempered by his interactions with potential riddle-solvers. In responding to the submitted solutions, Carroll first divides the solvers up into a "class list": those who are to receive full credit, those who are to receive partial credit, and those who have missed the solution entirely. Carroll then discusses the mistakes that each solver made, often degrading the solutions:

> In the following Class-list, I hope the solitary occupant of III. Will sheathe her claws when she hears how narrow an escape she has had of not being named at all. Her account of the process by which she got the answer is so meagre that, like the nursery tale of "Jack-a-Minory" … it is scarcely to be distinguished from "zero." (105)

Though Carroll's knots serve to open the field of mathematics to individuals who would not have previously had access, his derogatory comments on solutions indicate that not everyone is actually worthy to participate in the field. Carroll's interaction with solvers both opens the field and narrows it: he allows responses from any party, but mocks incorrect and incomplete solutions. Carroll's mathematics, then, is a field in which he is the master. Selecting the obstacles that individuals must overcome (the riddles), Carroll restricts access to the field in a new way-- by ability instead of by the possession of an Oxford diploma.

Carroll thus created his riddles in such a way that potential solvers were categorized into a new hierarchy-- one that centered around mathematical capability. However, characters within the riddles were also sorted by this new system; Carroll classifies his characters in much the same manner as his readers. Furthermore, the societal structures that could undermine this sort of meritocracy, namely the elitist Victorian educational and class systems, are mocked, overturned, and replaced by Carroll's version of hierarchy.

This is first apparent on an educational level in the relationship between Clara, a young girl from a boarding school, and her mathematically capable but socially inept aunt, Mad Mathesis, who appear in knots three, five, and seven, and ten. Though Clara is the character in this story most similar to the intended readership of *The Monthly Packet*, her educational accomplishments are satirized. Only with her crazy aunt Matty, who makes her very uncomfortable, is Clara able to learn effectively.

Carroll's third knot, “Mad Mathesis,” involves Mad Mathesis and Clara counting trains with intersecting paths that travel at different speeds. Though Clara has received the upper-middle-class boarding school education of the elite, she is not able to solve the mathematical problems of the knots and is outdone by her less conventional aunt. The power relationship between the two is characteristic of Carroll's meritocracy: Mad Mathesis does not have the societal pedigree of Clara, but she is at the top of the hierarchy in the riddles due to her mathematical prowess.

Throughout the knot, Clara valorizes her boarding school education, only to be ignored or rebuked by Mad Mathesis. Clara prattles on continuously about the moral and educational viewpoints of her “excellent preceptress.” Mad Mathesis invariably responds to Clara's principles, articulated in the words of the preceptress, with abrupt dismissiveness: “'I never make bets,' Clara said very gravely. 'Our excellent preceptress has often warned us--' 'You'd be none the worse if you did!' Mad Mathesis interrupted” (15). And again, “'I never smoke cigars,' she said in a meekly apologetic tone. 'Our excellent preceptress--' But Mad Mathesis impatiently hurried her on" (16).

In the case of the third knot, the "excellent preceptress" has not prepared Clara for the intellectual flexibility necessary to play Mad Mathesis' games. Clara follows the advice of the preceptress blindly and wholeheartedly. When asked to explain her reasoning regarding the train problem, Clara states that the excellent preceptress advises that, when in doubt, one should reference an extreme situation:

> "One day she was telling the little girls-- they make such a noise at tea, you know-- 'The more noise you make the less jam you will have and vice versa.' And I thought they wouldn't know what 'vice versa' meant: so I explained it to them. I said 'If you make an infinite noise, you'll get no jam: and if you make no noise, you'll get an infinite lot of jam.'" (28)

Clara thus uses the preceptress's advice on explaining unfamiliar concepts to little girls when betting on trains, using an "extreme case" and ending up with a wrong answer. The jam situation and the train situation are remarkably distinct, and Clara's formulaic use of the preceptress's advice results in her failure in the train situation. Though the preceptress's wisdom has ultimately failed Clara, she still avails herself to the woman's words, citing them again and again throughout the knot. Clara is uncomfortable with the educational style of Mad Mathesis. However, her desire to learn comfortably is foiled by the fact that the woman she is comfortable with is not an effective educators. Despite Clara's idolization of her preceptress, the woman is unable to assist Clara in her quest to solve mathematical problems. In fact, only when Clara is made uneasy by Mad Mathesis is she able to learn effectively.

Carroll thus adds to his critique of the social and educational structure represented in Clara. Clara is extremely naïve and misunderstands her surroundings and situations. Additionally, Clara seems to be unable to learn innovative thought from her upper-middle-class, boarding school education. Carroll is thus not only poking fun at the young, privileged female readers towards whom *The Monthly Packet* was targeted, but also mocking the educational institutions favored by this sort of people.

Clara and her Aunt Matty appear in three other knots throughout Carroll's publication in *The Monthly Packet*. In the fifth knot, Clara and

Mad Mathesis are visiting a portrait gallery, and on the way, Clara explains the reasoning that she used when determining her bets in the previous problem, which involved betting on the number of trains passed while riding another train:

> "And what made you choose the first train, Goosey?" said Mad Mathesis, as they got into the cab. "Couldn't you count better than *that*?" "I took an extreme case," was the tearful reply. "Our excellent preceptress always says, 'When in doubt, my dears, take an extreme case.' And I *was* in doubt." "Does it always succeed?" her aunt enquired. Clara sighed. "Not *always,"* she reluctantly admitted. (27)

Clara has thus begun to realize her folly, and it seems that she may attempt to correct her blind acceptance of the edicts of the "excellent preceptress." She is excited when her aunt gives her another chance to prove her mathematical ability: "Clara brightened up. 'I should like to try again, very much,' she said. 'I'll take more care this time. How are we to play?'" (29). However, as the fifth knot continues, Clara is wandering around the portrait gallery making frustrated attempts to solve the new puzzle that her aunt has posed. At this point in Clara's educational progress, she has received instruction from the preceptress and Mad Mathesis. Carroll introduces a new instructional force in the form of two women also enjoying the portrait gallery:

> "I *can't* find the one I want!" she exclaimed at last, almost crying with vexation. "What is it you want to find, my dear?" The voice was strange to Clara, but so sweet and gentle that she felt attracted to the owner of it, even before she had seen her; and when she turned, and met the smiling looks of two little old ladies, whose round dimpled faces, exactly alike, seemed never to have known a care, it was as much as she could do-- as she confessed to Aunt Mattie afterward-- to keep herself from hugging them both. (31)

Though Clara is comforted by the presence of the two old women, they are unable and perhaps unwilling to help her with her frustrating game. The women respond to Clara by exchanging "looks of alarm" and whispering to each other "of which Clara caught only the one word 'mad'" (32). Eventually, the two women leave Clara to continue her portrait game on her own, and though they clearly have a low opinion of Clara and her game, she has quite a different perspective: "'They're real darlings!' she soliloquised. 'I wonder why they pity me so!' And she wandered on, murmuring to herself" (33). Clara's floundering quest to obtain assistance from the two old women is an echo of her references to the "excellent preceptress" in the third knot. She again seeks help from someone who cannot help her.

Wandering through the portrait gallery, Clara appears "mad" to the elderly women. Interestingly, "mad" is the very word used to describe the insanity of her aunt. Though Clara is still unable to solve the riddle in this knot, her attempts to solve are much more fervent. Her attempt at the portrait gallery ends before she produces a solution, but Clara is not wrong, as she is twice at the train station. In fact, as Clara's mathematical ability improves, she is associated more strongly with her aunt. Firmly eschewing the betting and other social sins of her aunt in the third knot but then considered mad by two elderly women in the fifth knot, Clara is moving toward the societal position of her crazy (but mathematically informed) aunt.

At this point in the trajectory of the Clara and Mad Mathesis narrative, Clara has received instruction from three parties: the excellent preceptress at her boarding school, her aunt Mad Mathesis, and the two elderly women. However, Mad Mathesis' instruction seems to be the only education from which Clara learns, despite her discomfort with Mad Mathesis' blunt and forceful educational techniques. By allowing Clara to seek help from three sets of authority figures, Carroll perhaps suggests faults in the boarding school education Clara is receiving.

Though Clara may have originally thought her aunt crazy, she has at the very least an intellectual respect for Mad Mathesis, as demonstrated by a request for logical advice from her Aunt Matty at the beginning of the fifth knot. However, this respect is tempered, as Clara feels bullied by her aunt. After losing to Mad Mathesis while betting on the trains, Clara is tearful, and explains her logical reasoning “a little timidly, for she dreaded being laughed at” (28). Though Mad Mathesis clearly has the intellectually sound reasoning capabilities in the situation, Clara is ill at ease learning from her due to the woman's harsh mannerisms and teasing.

Despite Clara's timidity around her provocative aunt, the figures to whom Clara looks for guidance seem as unable to help her as she is unable to help herself. As Clara asks for help in the portrait gallery from two sweet old women, it's clear that this is a case of the blind leading the blind: Clara is unable to explain exactly what sort of portrait she is searching for, and the old women neither able to locate any sort of portrait nor draw the information necessary to finding the portrait out of Clara. Though Clara feels calm and relaxed in the presence of the women, this comfort is not conducive to the learning process nor to progress of any sort.

If Clara functions as a proxy for the intended readership of *The Monthly Packet,* then her crazy aunt Mad Mathesis functions as a stand-in for the teaching methods of Carroll. Making her student uncomfortable in order to encourage learning, Mad Mathesis educates Clara in much the same way as Carroll attempted to educate his riddle-solvers. Just as Mad Mathesis is harsh and questioning when educating Clara, Carroll admonishes his *Monthly Packet* students. While Mad Mathesis refers to Clara as "goosey," Carroll refers to a solver as a "venerable bird." Carroll thus emphasizes the value of an educational figure willing to push students to discomfort, preventing the intellectual stasis so prevalent in the time period.

Carroll's use of instructional figures argues for a meritocracy in the educational system. The excellent preceptress, put in a position of authority for her dedication to societal rules, fails to provide an effective education for Clara. Clara approaches the elderly women for assistance presumably due to their age and experience, and they are similarly unable to help her. Mad Mathesis is the only figure able to effectively educate Clara, despite being a betting woman on the fringe of society, devoid of any formal education. Carroll thus advocates for meritocracy in the educational system, using ability as a judge of instructional capability rather than other societal constructs of value, like a university education or societal finesse.

Carroll's puzzles in *The Monthly Packet* helped to broaden the field of people learning and creating mathematics. Carroll was encouraging not only the original intended upper-class readership of the magazine to solve, but also those that were not included in Charlotte Younge's initial vision of who was purchasing the publication. The socioeconomic diversification of the readership of *The Monthly Packet* makes the magazine a place in which an inter-class dialogue emerged in addition to the educational critique. Carroll's knots, particularly the fourth, “The Dead Reckoning,” depicted both the lower classes and the upper classes as silly and incompetent, mocking the entirety of the Victorian class system. Carroll uses this upturning of the class structure to institute his meritocracy. Carroll's characters are judged not for their place in society, but for their mathematical ability (and often lack thereof).

In “The Dead Reckoning,” the two travelers from the first knot are now adventuring via ship to foreign lands of the British empire. The men are presumably members of the upper class. The knot also portrays the captain of the ship and all of his sailors, two distinct classes of people. The final characters in the knot are a group of five African natives who come aboard the ship to weigh large bags of currency.

The natives are depicted, predictably, as fairly unintelligent, and much of the humor of the short story riddle stems from their situation. In the knot, the natives are fishermen who have come aboard the ship to weigh their sacks of coins, as their currency system lacks convenience: “The money of this island is heavy, gentlemen, but it costs little, as you may guess. We buy it from them by weight-- about five shillings a pound” (21). The upper-class passengers disparage the language of the natives: “It's more like sparrows in a tree than human-talk, isn't it?” (22). Though the aristocratic passengers are certainly not the voice of authority and reason in the story, the intellect of the natives is still in question. As the natives of Mhruxi attempt to measure their currency, they make so much noise that the sailors hide their weights, leaving them to use hammers, hardware, and whatever else they can find around the ship in place of counterweights. As the story moves on, the bags of coins get accidentally thrown overboard, and the captain decides to repay the fishermen for their loss. However, when he asks how much each bag was worth, he finds out the fishermen have only weighed the bags two at a time, and therein lies the root of the mathematical puzzle.

The natives portrayed in this particular tale are clearly in an inferior position, both racially and in the power structure on the ship, to the sailors and the captain. Presumably drawing in salaries much lower than the sailors or the captain, the natives are also on the lowest rung of the class-system portrayed in the knot. Their currency and language is criticized, they are unable to do their business as fishermen properly, and their behavior on the ship is scorned by the captain and the sailors alike. Carroll's illustrator for *A Tangled Tale*, Arthur B. Frost, depicted the natives this way:

The natives appear to be having childlike temper tantrums while the British sailors stand staunch and tall overlooking them in the background and the captain gesticulates sneeringly at their display. The native fishermen are clearly at the bottom of the intellectual hierarchy in this particular tangled tale, with an inferior language, monetary system, and means of calculation than that of the British. In fact, the problem encoded in this short story is caused by the fact that the natives are unable to measure their earnings effectively.

Similar class constructions exist for the sailors working on the ship. Though they fall above the native fishermen in terms of intellectual and power hierarchies, they are still inferior to their captain. They complete the work of sailing a ship, and obtain their livelihood under the watch of the captain. Intellectually, the hierarchy is quite similar. The sailors are of steadier mind than the natives, mocking their language and taking away their counterweights. However, they still lack power in the tale, as it is their forgetfulness about the placement of the coin sacks that allows the coins to fall into the sea, forcing the captain and the natives to try to recreate the weighing of the bags. Indeed, the captain of the ship must, quite literally, pay for the mistake of the sailors by compensating the natives for their loss: “'No sir!' he said, in his grandest manner. 'You will excuse Me, I am sure; but these are My passengers. The accident has happened on board My ship, and under My orders. It is for Me to make compensation'” (24). The captain's speech is capitalized each time he refers to himself, emphasizing his sense of self-importance. Though the captain rights the mistakes of the sailors, he does so in a grandiose manner that firmly establishes his authority over the crew, the native fishermen, and the entire situation.

Though the captain's knowledge and capability has earned him power on the ship, the tourists are in a high position due entirely to the class structure from which they came in England. Affluent enough to travel to exotic locations, buy new linen suits, and travel on the deck of a ship with a steward at hand, these adventurers are certainly members of the upper class, able to afford such luxuries. Despite their position of monetary power on the ship, Carroll pokes fun at these two members of the aristocracy. Firstly, the two men are extraordinarily lazy. On holiday while everyone is working, the two are lounging on a pile of cushions on the deck of the ship, under the shade of an umbrella:

> He stretched out his hand for a glass of iced water which the compassionate steward had brought him a minute ago, and had set down, unluckily, just outside the shadow of the umbrella. It was scalding hot, and he decided not to drink it. The effort of making this resolution, coming close on the fatiguing conversation he had just gone through, was too much for him: he sank back among the cushions in silence. (21)

Though Carroll certainly puts the lounging men in a position of power, they are not admirable characters, unable to even grasp a glass of water fetched by the steward. In addition to slothfulness, the two men lack the knowledge-base of the captain. While some of this can be explained because captain's life work lies in acquiring maritime knowledge, it seems as though the two travelers, with access to books and learning, would have sought information regarding the geographic locations of their adventures. The depiction of the laziness of these two characters demonstrates Carroll's preference to a meritocracy to an aristocracy. Though the two men were born into money, they are still completely useless on the ship.

Carroll continues to mock the two tourists as they try to solve the mathematical riddle of determining how much each bag weighed. The younger traveler, the son of the other, over-confidently states: "'If they didn't have five separate weighings, of course you can't value them separately,' the youth hastily decided" (25). His father is similarly unable to help the captain discern the appropriate compensation for the native fishermen: "The old man muttered under his breath 'If only my sister were here!' and looked helplessly at his son" (26). Interestingly, Carroll's scorn of the upper class tourist involves comparing his intellect to that of a woman. The depiction of aristocracy in the knot demonstrates an upper class unable to contribute productively to any sort of problem.

Though the aristocratic tourists are above the captain in societal hierarchy, the captain is the source of power on the ship and the intellectual authority for the tale. In addition to managing the sailing ship, he is also able to answer the questions of the two rich tourists, and often does so with disparaging intonation. For example:

> "Whereabouts are we now, Captain?" said he, "Have you any idea?" The Captain cast a pitying look on the ignorant landsman. "I could tell you that, sir," he said, in a tone of lofty condescension, "to an inch!" "You don't say so!" the old man remarked, in a tone of languid surprise. "And mean so," persisted the Captain. "Why, what do you suppose would become of My ship, if I were to lose My Longitude and My Latitude? Could you make anything of My Dead Reckoning?" "Nobody could, I'm sure!" the other heartily rejoined. But he had overdone it. "It's perfectly intelligible," the Captain said, in an offended tone, "to any one that understands such things." (20)

With an impeccable grasp of the geography of the region, the ability to speak in the dialect of the natives, and his savvy in managing the sailing of the ship, the certainly becomes an intellectual figure of authority, even over the lounging tourists.

However, as the story progresses into the riddle of how to calculate the amount of currency in each bag, the captain experiences a fall from his initial position of intellectual and hierarchical power. Facing difficulties similar to that of the upper-class tourist and his son, the captain is unable to solve the mathematical puzzle. Though it may seem that this lack of knowledge is necessary in order to achieve the interrogative effect of a riddle, Carroll allows characters in other knots to solve the puzzles, generally asking the reader to come to the same conclusion as the mathematically competent character in the knot. The meritocracy of mathematics is still maintained; whoever possesses the mathematical ability to solve the puzzle is the authority in the riddle, and Carroll, as the evaluator of submitted solutions, remains on top-- the king of his mathematical classroom.

Carroll thus portrays both the captain of the ship and the two tourists as losing much of their intellectual clout when they are unable to solve the mathematical puzzle, and these judgments allow a meritocracy to emerge. Interestingly, this meritocracy aligns with a subversive depiction of class structure. In constructing a meritocracy based on mathematics, Carroll is able to provide social commentary mocking individuals of any class or race for their lack of intellect, grandiose displays of power, or laziness in obtaining any sort of knowledge.

Though Carroll is suggesting a system to replace conventional notions of class, this knot can also be read in terms of the British empire that was thriving at the time of Carroll's publication in *The Monthly Packet*. This particular knot features a ship probably sailing from Africa, and the native fishermen that come on board to measure their earnings. The entire premise of the tale, then, pivots on the imperialistic presence of Britain in foreign nations. As the native fishermen come on board, they are attempting to quantify their earnings in a clumsy currency. Unable to do so due to their inability to use a scale properly, the bags of money are accidentally thrown into the sea, and it is left to the white men on board not only to decipher exactly how much money was lost, but to repay the natives for their losses.

However, the natives are uninvolved in the process of solving the riddle; the only implied solvers are the captain and the two white travelers. In essence, Carroll demonstrates a mathematical “white man's burden”: as the natives are unable to determine for themselves the amount that they are owed, it falls to the rich white men on the ship to solve the problem.

However, this idea of a positive British intervention in the life of the natives is tempered by the fact that neither the captain nor the travelers is able to solve the problem. Unlike other knots, no character has the superior math skills necessary to complete the puzzle, and it is left to the reader to “fix” the situation. The natives are only having difficulty with their currency because they are attempting to use it in a British setting. The British then perceive the need to repair the culture of the natives, and, unable to do so, the situation remains unresolved. This mathematical deficiency perhaps suggests a deficiency in effectively handling the colonial situation. Had Carroll's meritocracy been in place all along, the characters on the ship would have had the ability to solve the problem of the currency.

Carroll's social commentary is accentuated by the interaction of the reader with the tangled tale. At the end of the scenario, Carroll asks the reader to solve the puzzle, as none of the characters can themselves. By requesting that his audience solve the puzzle that encodes the social critique, Carroll in essence asks the readers to “classify” themselves-- in responding, they enter into the hierarchy of the ship. If they are able to solve the problem, they, in essence, have outdone the captain, the aristocratic men, the sailors, and the natives. If unable to solve the problem, they fall into the same helpless category as all the men on the ship. As readers place themselves into this hierarchy, they determine their class on the ship and also in Carroll's meritocracy.

In this knot, Carroll thus overturns the class structure of Victorian England by requiring intellect in order to gain real power. The power structure typical of the Victorian period applied on land; this structure is upset by the necessity for mathematical knowledge aboard the ship. By both mocking the class structure and requiring mathematical knowledge in order to solve the riddle, Carroll is subtly promoting meritocracy as an alternative to the class and race structures present in the Victorian period. Carroll thus uses his position as author in order to advocate for a new sort of power structure-- one in which, as didact and rule-maker, he was nevertheless still on top.

Bibliography

Ball, Walter William Rouse. *A Short Account of the History of Mathematics.* London: MacMillian and Co., 1901.

Bivona, Daniel. "Alice the Child-Imperialist and the Games of Wonderland." *Nineteenth Century Literature.* 41.2. (Sept. 1986): 143-171.

Blake, Kathleen. *Play, Games, and Sport: The Literary Works of Lewis Carroll*. Ithaca: Cornell University Press, 1974.

Carroll, Lewis. *A Tangled Tale.* London: MacMillan and Co., 1885.

Carroll, Lewis. *Alice's Adventures in Wonderland and Through the Looking Glass.* London, England: Heirloom Library, 1949.

Carroll, Lewis. *The Diaries of Lewis Carroll.* London: Cassell & Company Ltd., 1953.

Carroll, Lewis. *The Pamphlets of Lewis Carroll.* Charlottesville: University Press of Virginia, 1993.

Cohen, Morgan. *Lewis Carroll: A Biography.* New York: Algred A. Knopf, 1995.

Cohen, Morgan. *Lewis Carroll: Interviews and Recollections.* Iowa City: University of Iowa Press, 1989.

De Morgan, Augustus. *On the Study and Difficulty of Mathematics.* Chicago: The Open Court Publishing Company, 1898.

Dodgson, Charles. *Pillow Problems.* London: MacMillan and Co., 1894.

Feingold, Mordechai. *History of Universities: Volume XX/2.* Oxford: Oxford University Press, 2005.

Firtich, Nikolai. "Worldbackwards: Lewis Carroll, Aleksei Kruchenykh and Russian Alogism." *The Slavic and Eastern European Journal*. 48.4

(Winter 2004): 593-606.

Fisher, John. *The Magic of Lewis Carroll.* New York: Simon and Schuster, 1973.

Franklin, H. Mortimer, Editor. *The Victorian Review, Volume 6.* London: Victorian Review Publishing Co., 1882.

Freiman, Viktor; Nicole Lirette-Pitre; Bharath Sriraman, editors. *Interdisciplinarity, Creativity, and Learning: mathematics with literature, paradoxes, history, technology, and modeling.* Charlotte: Information Age Publishing, 2009.

Gardner, Martin. *The Annotated Alice*. New York: Signet, 1963.

Graham, George Kenneth. *English Criticism of the Novel, 1865-1900.* Oxford: Clarendon Press, 1965.

Green, Roger, Editor. *Diaries of Lewis Carroll.* New York: Oxford University Press, 1954.

Guiliano, Edward. *Lewis Carroll: A Celebration.* New York: Crown Publishers, 1982.

Halliwell-Phillipps, James Orchard. *Nursery Rhymes of England.* London: The British Library, 2010.

Hayles, Katherine N. *Chaos and Order: complex dynamics in literature and science*. Chicago: University of Chicago Press, 1991.

Higbie, Robert. *Dickens and imagination.* Gainesville: University Press of Florida, 1998.

Hofstadter, Douglas. *Godel, Escher, Bach: an eternal golden braid.* New York: Vintage Books, 1980.

Hubbell, George Shelton. “The Sanity of Wonderland.” *The Sewanee Review.* 35.4. (Oct. 1927): 387-398.

Hudson, Derek. *Lewis Carroll.* London: Constable, 1954.

Jackson, Rosemary. *Fantasy: The Literature of Subversion.* New York: Methuen, 1981.

Kline, Morris. *Mathematics and the Physical World.* New York: Dover Publications, 1981.

Koehler, D.O. "Mathematics and Literature." *Mathematics Magazine*. 55.2. (March 1982): 81-95.

Edward Lear, *The Book of Nonsense.* (London: Routledge, 1846) 3.

Levine, George. "Realism, or, in Praise of Lying: Some Nineteenth Century Novels." *College English*. 31.4. (January 1970): 355-365.

Lundin, Anne H. "Victorian Horizons: The Reception of Children's Books in England and America, 1800-1900." *The Library Quarterly*. 64.1. (January 1994): 30-59.

Madden, William A. "The Victorian Sensibility." *Victorian Studies.* 7.1.2. (September 1963): 67-97.

Nagel, Ernest. "Impossible Numbers: A Chapter in the History of Modern Logic." *Studies in the History of Ideas.* 3 (1935): 429-479.

Patten, Bernard. *The Logic of Alice: Clear Thinking in Wonderland.* Amherst: Prometheus Books, 2009.

Peacock, George. *A Treatise on Algebra.* Cambridge: Cambridge University Press, 1842.

Pycior, Helena. "At the Intersection of Mathematics and Humor: Lewis Carroll's "Alices" and Symbolical Algebra." *Victorian Studies*. 28.1. (Autumn 1984): 149-170.

Reynolds, Osborne. *Strictures on Parts of Peacock's Algebra.* Cambridge:

Cambridge University press, 1837.

Rackin, Donald. "Alice's Journey to the End of the Night." *PMLA*. 81.5. (October 1966): 313-326.

Romanes, Ethel Duncan. *Charlotte Mary Younge: an appreciation.* Harvard: Harvard University Press, 1908.

Richards, Joan. "Augustus De Morgan, the History of Mathematics, and the Foundations of Algebra." *Isis*. 78.1. (March 1987): 7-30.

Sacksteder, William. "Looking Glass: A Treatise on Logic." *Philosophy and Phenomenological Research*. 27.3. (March 1967): 338-355.

Sewell, Elizabeth. "'In the Midst of his Laughter and Glee': Nonsense and Nothingness in Lewis Caroll." *Soundings: An Interdisciplinary Journal.* 82.3-4. (1999): 541-571.

Elizabeth Sewell, *The Field of Nonsense*. (Charlottesville: University of Virginia Press, 1978) 25.

Shires, Linda M. "Fantasy, Nonsense, Parody, and the Status of the Real: The Example of Carroll." *Victorian Poetry.* 26.3. (Autumn 1988): 267-283.

Silver, Carole. "When Rumpelstiltskin Ruled: Victorian Fairy Tales." *Victorian Literature and Culture*. 22. (1994): 327-336.

Stevenson, Lionel. *Victorian Fiction*. Cambridge: Harvard University Press, 1966.

Sturrock, June. "Establishing Identity: Editorial Correspondence from the Early Years of *The Monthly Packet*." *Victorian Periodicals Review.* 39.3. (2006): 266-279.

Susina, Jan. *The Place of Lewis Carroll in Children's Literature.* New York: Routledge, 2010.

Terry, R.C. *Victorian Popular Fiction, 1860-1880.* Atlantic Highlands:

Humanities Press, 1983.

Tigges, Wim. *An Anatomy of Literary Nonsense.* Amsterdam: Rodopi, 1988.

Weaver, Warren. "The Mathematical Manuscripts of Lewis Carroll." *Proceedings of the American Philosophical Society*. 98.5. (October 15, 1954): 377-381.

Wilson, Robin J. *Lewis Carroll in Numberland: his fantastical mathematical logical life: an agony in eight fits.* New York: W.W. Norton, 2008.

Though Lewis Carroll's works are some of the most widely read and translated in the world, he did not actually exist. “Lewis Carroll” is in fact a pseudonym of the Oxford mathematician Charles Dodgson. He gave all of his lectures at Oxford and published all of his mathematical material under his given name. An uninspiring and stodgy don, he was regarded in the mathematical community as stiff and reserved. All of this biography seems incongruous with the persona of Lewis Carroll, the whimsical and fantastical creative genius who produced *Alice's Adventures in Wonderland*, *Through the Looking-Glass, The Hunting of the Snark,* and other well-loved nonsense works.

As a result of this seeming incongruity, critics often neglect to treat Carroll's mathematical life as an influence on his works of fiction. However, Carroll's mathematical work consumed much of his time and thought. Indeed, many of his nights of insomnia were spent working out mathematical problems. To ignore this facet of Carroll's career is to dismiss a wealth of information useful in understanding the meaning of his fiction. My thesis serves to bridge this gap in critical treatment, using the logics of mathematics and literature to explore Carroll's work in an interdisciplinary manner, therefore reuniting Charles Dodgson with Lewis

Carroll.

The first chapter of the thesis focuses on *Alice's Adventures in Wonderland* and *Through the Looking-Glass.* Carroll was working on these texts during a time of great upheaval both in mathematics and literature. In mathematics this upheaval centered around whether or not the system existed to represent the physical world symbolically. Several mathematical concepts that transcended this purpose, such as negative and imaginary numbers, had to be redefined or excised. The literary debate was quite similar, again focusing on the inclusion or exclusion of non-mimetic elements in increasingly popular genres like nonsense and fantasy. Both mathematics and literature were thus experiencing an unmooring from reality, one that was not without backlash. Notable figures in both fields were hesitant to allow these non-mimetic elements, judging them to be meaningless or useless.

Carroll examines this dual shift away from the representation of reality in *Alice's Adventures in Wonderland* and *Through the Looking-Glass.* The novels are rife with allusions to the developing non-referential mathematics; perhaps the most well-known example is that of Alice's tea party with the Mad Hatter. When the Mad Hatter asks Alice if she would like more tea, she responds that she has not yet had any tea, and thus cannot have “more” than nothing. The Mad Hatter replies that it's very easy to have more than no tea, but very difficult to have less than none. Alice is here confronted with the mathematical idea of negative numbers. At the same time that Carroll invokes this non-referential mathematical concept, he employs a literary technique characteristic of the nonsense genre: simultaneity of meaning, a technique that relies on the various coexisting interpretations of the idea of “nothing.” By employing both mathematical and literary non-mimetic elements simultaneously, Carroll points to the shifts away from reality taking place in Victorian mathematics and literature. Furthermore, in the rude response of Alice to the Mad Hatter's nonsense, Carroll demonstrates the contemporary resistance to these changes.

The second chapter examines a set of mathematical riddles that Carroll wrote and published in *The Monthly Packet,* a magazine dedicated to educating its young female readers. In these riddles, Carroll mocks of the power structures of Victorian Britain, most notably the moribund educational system and the rigid class structure. By mocking the elite of both the educational and class systems, Carroll denigrates the power hierarchies in place in his society. Instead, he judges each of his characters based on their mathematical abilities, thus instituting a meritocracy to replace conventional power structures.

For example, the fifth knot in the series takes place on a ship traveling in the British empire. Passengers are divided into a rigid class structure; two aristocratic tourists top the hierarchy, followed by the captain of the ship, the sailors, and at the very bottom, natives of the land. Throughout the knot, Carroll pokes fun at each group within the class-hierarchy. Much of this ridicule is focused on the aristocrats, who are excessively lazy, lolling about the ship whilst attended to by the sailors and crew. Additionally, the aristocrats are unable to use mathematics to solve the puzzle. Carroll thus overturns traditional ideas of power structure by deriding the aristocrats, and replaces the conventional system by one based upon mathematical ability; in this new hierarchy, the aristocrats are on the bottom.

Carroll instituted this idea of meritocracy in his treatment of readers who wrote in to the magazine with solutions to the riddles. Solvers were sorted into categories based upon the quality of their solutions. Correct solvers were put at the "head of the class," and uninformed responders were given “zero points.” Using judgment based upon mathematical ability, Carroll created a meritocratic classroom within *The Monthly Packet.* Carroll was thus suggesting a new power hierarchy, one in which, as a mathematical master, he was firmly established on top.