

Ciphers in Literature

LINCOLN SORENSEN AND NOAH WONG

Math 5347

1 Introduction

Cryptography is the science of hiding information. This can be used in many ways, the main being to keep information confidential and private. Cryptography and ciphers find most of their use in melancholy acts of espionage, warfare, through the sending and receiving of data online and at the fingers of mathematicians inventing the next code, but their uses do not end here.

In this paper we will explore an auxiliary use of cryptography, the engaging and interesting world of literary ciphers. Authors can use ciphers as unique ways to connect with their audience. Where as most applications of ciphers and cryptography are designed to keep messages confidential, ciphers as literary devices have the intention that reader's curiosity will drive them to a fulfilling moment of discovery. These codes are made to be cracked, but not too easily. The longer a reader spends solving a puzzle the more rewarding the outcome. In cases of language ciphers in high fantasy, the readers motivation may not stop until they have mastered the code the author has put forward.

We will explore two *key* (pun intended) ways that cryptography can be used in literature: First as a worldbuilding technique; ciphers can construct new fictional languages that give life and normalize the existence of fantasy worlds. Second we explore how puzzle ciphers can be used to engage readers to solve a mystery alongside the story, either with or apart from the protagonist. Both of these methods keep readers engaged during their experience, and, in many cases, long after.

2 Ciphers as Worldbuilding

Worldbuilding, the act of creating imaginary worlds, has become very common in popular literature and the entertainment industry. Worldbuilding entails constructing maps, history, culture and language of imaginary lands to make them feel realistic, we will focus on the aspect of language building, the construction of fictional languages. *Game of Thrones*, *Star Trek*, *Star Wars*, and *Avatar* all feature this kind of beautiful immersion, creating languages for alien species or humanoid races to make them seems plausible. For example, the producers of *Game of Thrones* hired David Peterson, a linguist and professional language creator to construct the fully functional and conversational language of Dothraki[6]. The language of Dothraki along with the culture, history and characters provided by author George R. R. Martin make the Dothraki people believable. These details individually may seem minute, but altogether they provide a rich background and breath life into the world of Westeros.

What must follow once your world has a fully fleshed out language of its own? *Well, written languages of course!* Our first example Dothraki is a spoken only language so it has no written text [6]. One of the first examples of text ciphers used as a worldbuilding elements in fantasy are the many works of J.R.R. Tolkien. Tolkien constructed a fantasy world known as Middle-Earth in his books, *The Hobbit*, *The Lord of The Rings* and *The Silmarillion*. Middle-Earth is filled with humans as well as humanoid races of elves, dwarfs, and orcs each with its own culture and history. Tolkien was unique in his devotion to creating fully fledged languages for Middle-Earth. To construct the written texts of his impressively developed languages, Tolkien used Anglo-Saxon runic symbols (Figure 1) to construct a written text

he calls *Cirith* or *Angerthas*. These elvish words translate literally to “runes” or “engraved letters.” For the purposes of this paper, we will refer to the *Cirith* written text as *runes* from this point on.

Anglo-Saxon Runes

ƿ F	ĥ H	ƿ E
h U/V	† N	ƿ M
þ TH	l I	l L
ƿ O	φ J	ƿ NG
ƿ R	ƿ P	ƿ D
h K	ƿ Z	ƿ D
l C	h S	ƿ A
ƿ G	† T	ƿ EE/OE
ƿ W	ƿ B	h Y

Figure 1: Anglo Runes [5]

The *Cirith* runic text is very phonetic and can be used to translate English and high-fantasy language alike. This particular cipher uses the sounds of the spoken message and encodes them as runes. Ruth S. Noel, author of *The Languages of Tolkien’s Middle-earth* and Tolkien historian, describes the runes as seperated into different sounds. From figure 2, the first 28 runic characters represent sounds that are made from the front to the back of the mouth, runes 29 through 33 are for the liquid sounds with no specific point of articulation, runes 39 through 45 are made in the top of the mouth from front to back, 46 through 52 are bottom of the mouth sounds from front to back, the rest of Cirith are miscellaneous symbols mainly for punctuation and emphasis[5]. Instead of encrypting by letters of the alphabet, Tolkien encrypts distinct sounds into this written language of runes.

44 <i>Language in Tolkien’s Middle-earth</i>		<i>Runes and Letters</i> 45	
1 ƿ p	16 ƿ zh**	31 ƿ l	46 ƿ e
2 ƿ b	17 ƿ nj - z - ks**	32 ƿ lh	47 ƿ ē
3 ƿ f	18 ƿ k	33 ƿ ng - nd	48 ƿ a
4 ƿ v	19 ƿ g	34 ƿ s - h	49 ƿ ā
5 ƿ hw	20 ƿ kh	35 ƿ s - ’	50 ƿ o
6 ƿ m	21 ƿ gh	36 ƿ z - ng	51 ƿ Mō
7 ƿ (mh) mb	22 ƿ ng - n	37 ƿ ng*	52 ƿ ō
8 ƿ t	23 ƿ kw	38 ƿ nd - nj	53 ƿ n*
9 ƿ d	24 ƿ gw	39 ƿ i (y)	54 ƿ h - s
10 ƿ th	25 ƿ khw	40 ƿ y*	55 ƿ o*
11 ƿ dh	26 ƿ ghw - w	41 ƿ by*	56 ƿ o*
12 ƿ n - r	27 ƿ ngw	42 ƿ u	57 ƿ ps**
13 ƿ ch	28 ƿ nw	43 ƿ ū - z**	58 ƿ ts**
14 ƿ j**	29 ƿ r - j - g**	44 ƿ w	ƿ l + h
15 ƿ sh	30 ƿ rh - zh - gh**	45 ƿ ü	ƿ &

Figure 2: Cirith Runes [5]

The previous image is but one of Tolkien's written language ciphers. In Middle-earth, these runes are used mainly to inscribe English and Dwarven speech. *Tengwar*, the written text pictured below (figure 3 a b), is used to inscribe the two main elf languages: "Sindarin" and "Quenya."

46 Language in Tolkien's Middle-earth	Runes and Letters		
<i>Tengwar</i>			
<p>ᚖ t <i>tinco</i> 'metal'</p> <p>ᚗ d/nd* <i>ando</i> 'gate'</p> <p>ᚘ th <i>thule, sule</i> 'spirit'</p> <p>ᚙ dh <i>anto</i> 'mouth'</p> <p>᚛ n <i>numen</i> 'west'</p> <p>᚞ r <i>ore</i> 'heart'</p> <p>᚟ r <i>romen</i> 'east'</p> <p>ᚠ s <i>silme</i> 'starlight'</p> <p>ᚡ h <i>hyarmen</i> 'south'</p>	<p>ᚖ p <i>parma</i> 'book'</p> <p>ᚗ b/mb* <i>umbar</i> 'fate'</p> <p>ᚘ f <i>formen</i> 'north'</p> <p>ᚙ v <i>ampa</i> 'hook'</p> <p>᚛ m <i>malta</i> 'gold'</p> <p>᚞ w/v* <i>vala</i> 'angelic power'</p> <p>᚟ rh <i>arda</i> 'region'</p> <p>ᚠ s <i>silme nuquerna</i> 's reversed'</p> <p>ᚡ hw <i>hwesta sindarinwa</i> 'Gray-Elven hw'</p>	<p>ᚣ c/k <i>calma</i> 'lamp'</p> <p>ᚤ i/g <i>anga</i> 'iron'</p> <p>ᚥ sh/hk <i>harma, aha</i> 'treasure, rage'</p> <p>ᚦ zh/gh <i>anca</i> 'jaws'</p> <p>ᚧ n/ng? <i>noldo, ngoldo</i> 'one of the Noldor'</p> <p>ᚨ y <i>anna</i> 'gift'</p> <p>ᚩ l <i>lambe</i> 'tongue'</p> <p>ᚪ z <i>äre, äze, esse</i> 'sunlight, name'</p> <p>ᚫ y <i>yanta</i> 'bridge'</p>	<p>ᚱ k/kw <i>quesse</i> 'feather'</p> <p>ᚲ g/gw <i>ungwe</i> 'spider's web'</p> <p>ᚳ ch/khw <i>hwesta</i> 'breeze'</p> <p>ᚴ gh/ghw <i>unquē</i> 'a hollow'</p> <p>ᚵ ngw? <i>ngwalme, ngwalme</i> 'torment'</p> <p>ᚶ w? <i>wilya, wilya</i> 'air, sky'</p> <p>ᚷ lh/lid* <i>alda</i> 'tree'</p> <p>ᚸ z <i>äre nuquerna</i> 'z reversed'</p> <p>ᚹ w <i>ure</i> 'heat'</p>
(a)		(b)	

Figure 3: Tengwar [5]

After we recognize that languages act as a cipher when they are not native to an audience: we have a language system that has been developed for the purpose of worldbuilding, and a text specific for that language. This creates interesting depth for readers and code-breakers alike. Decoding these languages is a two-step process, not only must the reader first decode the written cipher into the fantasy language, then they must decode that fantasy language into English. These devices make the world not just feel alive, but also create a unique culture that feels familiar, yet fanciful. This fantasy culture, that consists of written ciphers and made-up languages, can play a *key* role in many fans engagement with the series long after reading. A literal *secret language* that you can speak and transcribe only with fans of the series, is something that has kept fandom of this particular high-fantasy alive for nearly a century. This combined with characters and groups associated with these languages, the semblance of racial tensions between faction, and myths of ancient ruins adorned with these texts only add to the the fervor of fans involvement.

Edward James encapsulates the profound effect that Tolkien's world has had in the fantasy genre, especially in its worldbuilding efforts, "Tolkien's greatest achievement, ... was in normalizing the idea of a secondary world... Middle-earth is a separate creation, operating totally outside the world of our experience. This has become so standard in modern fantasy that it is not easy to realize how unusual it was before Tolkien." [7] Through his intense dedication to constructing Middle-Earth, Tolkien was able to create a work of literature that transcends drawing in his audience, and moves closer to belief in this world he has constructed. Without ciphers and language, our world would feel rather empty, and so would Tolkien's.

3 Ciphers as Puzzles

Books like the *DaVinci Code*, *A Series of Unfortunate Events*, and *The Gold-Bug* have all found success using ciphers as puzzles. They are often found in mystery novels, like the *DaVinci Code*, as plot devices that the protagonist must solve.

The seeds of cryptography can often be found in young adult literature. Word puzzles or relatively simple ciphers offer a novel approach to engaging young readers. These puzzles provide stories with unique experiences outside the scope of the narrative. Readers can partake in the story by trying to crack the secret message or solve the riddle, but often they are not crucial to understanding the story. These ciphers give the curious reader non-crucial information allowing them to arrive at conclusions before the protagonist. In most cases the author will provide the answer to the puzzle on a subsequent page allowing readers the choice of solving the puzzle. Not only does this allow for engagement it can force the readers to learn about ciphers. Works such as *A Series of Unfortunate Events* offer word puzzles like anagrams and acronym for young readers to mull over.

The book *Chasing Vermeer* written by Blue Balliett in 2003, is perfect example of unique approaches to reader engagement. The book tells the tale of two middle schoolers in Chicago, Calder and Petra who get wrapped up in solving the mystery of a stolen painting. The thief challenges the public with finding where he hid the painting, so the children set out to find the Johannes Vermeer work titled A Lady In Writing. Using art history, detective work and a little bit of cryptography the children are able to find the hidden painting and expose the thief.

After reading the book, it comes as no surprise that the author is a middle school teacher. She lives in Chicago and was inspired to write the book based on the scavenger hunts she made for her students[4]. The book sets out to nourish children's intelligence[3], in particular, the solving of puzzles and ciphers highlight their curiosity for finding patterns.

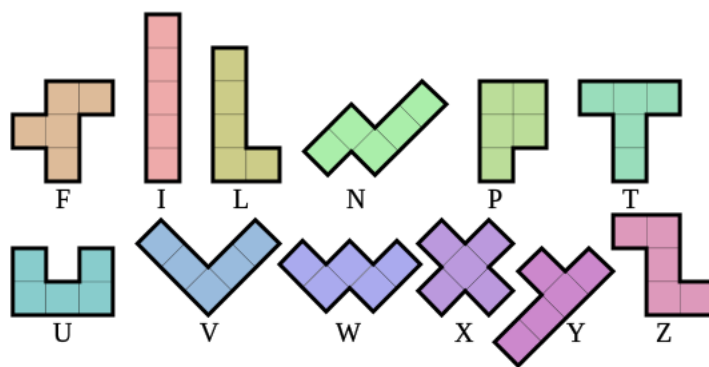


Figure 4: Pentominoes Alphabet [1]

Chasing Vermeer is full of engaging ways to get the reader thinking including a challenge to the reader to solve a hidden message in the story. To understand the code the author first introduces the idea of pentominoes. Pentominoes are geometric shapes all with five squares that share at least one edge. They are commonly found in geometric puzzles, but can be

used by mathematicians. The book opens with a short introduction on pentominoes giving each distinct shape a name based on the alphabet. These shapes play a role in the story as puzzles Calder likes to play with and as the key for decoding messages.


In the story Calder sends encrypted messages to his friend Tommy using their own secret code. Fueled by their love of pentominoes they create a table in which each letter of the alphabet corresponds with a pentomino and a number. This is a simple substitution cipher, one where each letter of the alphabet has a unique counterpart. The messages include line breaks for words and keeps the sentence's original punctuation. This provides an excellent introduction to young readers into codes and ciphers. However, this encryption technique would not hold up under the simplest code breaking techniques even without knowledge of pentominoes.

Over the course of the novel three messages are sent back and forth between the friends. Here the author leaves the decoding up to the reader and in order to keep up with the mystery at hand the reader themselves must decode the messages. The general idea presented in the messages can be gleaned from context clues, but here the author leaves the decoding entirely up to the reader. One messages reads

**L:1 F:1 Z:1 N:1 P:1 T:2,
T:1 T:2 P:q N:1 - F:2 L:2 X:2 P:1 N:1 - L:2 W:2 V:2 - Y:2 P:1 - Y:2 F:1 I:2 V:2
- V:2 L:2 L:1 L:2 F:2 P:1 - V:1 L:2 F:2 P:1. - I: W:2 V:2 - I:2 L:2 - F:2 L:2 I:2
P:1 F:3 -
V:2 L:2 F:2 F:2 F:3**

This message in plaintext reads *Calder, Fred moved out we want to come home. But no money, Tommy.* Decoding this message is crucial to the plot.

Beside the codes that act as plot device, Balliet and the illustrator Brett Helquist include another coding puzzle hidden in the illustrations. Before chapter one they include a challenge to the reader, “If you look carefully at Brett Helquist’s chapter illustrations, you will find a hidden message.” Breaking this code is more challenging and introduces an additional mystery for the reader.



	1	2	3
F	A	M	Y
I	B	N	Z
L	C	O	
N	D	P	
P	E	Q	
T	F	R	
U	G	S	
V	H	T	
W	I	U	
X	J	V	
Y	K	W	
Z	L	X	

Figure 5: Pentominoes Cipher Table [2]

These puzzles and ciphers drove the success of *Chasing Vermeer*, it made its way onto the New York Times best-seller list [3] and has since spawned two sequels. These devices have been chosen specifically for young readers comprehension, and are easily decoded by the experienced code-breaker.

In contrast, *The Gold Bug* by Edgar Allen Poe is a short story that dives into the analysis of solving ciphers. The protagonist, Legrand, describes in great detail the process of solving a substitution cipher. The ciphertext reads,

53‡‡‡305))6*;4826)4‡.)4‡);806*;48‡8 ¶(60))85;:]8*::‡*8‡83(88)5*‡;46(;88*96
 ?;8)‡(;485);5*‡2:*‡(;4956*2(5*—4)8 ¶8*;4069285);)6‡8)4‡‡;1(‡9;48081;8:8‡
 1;48‡85;4)485‡528806*81(‡9;48;(88;4 (‡?34;48)4‡;161;:188;‡?;

Legrand creates a letter frequency table to have "something more than a mere guess" [8]. Since each letter of the alphabet correspond with the same symbol in the ciphertext, the frequency of symbols will match the frequency of letters in English. This table then allows Legrand to test the most common English letters with most common symbols in the ciphertext. He discovers the most common symbol is '8' and deduces that '8' must correspond with 'e'. From here he is able to piece together words, finding ';48' decodes to 'the', until the original message appears,

A good glass in the bishop's hostel in the devil's seat
 twenty-one degrees and thirteen minutes northeast and by north
 main branch seventh limb east side
 shoot from the left eye of the death's-head
 a bee line from the tree through the shot fifty feet out.

The Gold-Bug is one of many stories that has cemented Poe as a great American writer. From *The Raven* to *Tell-tale Heart*, *The Gold-Bug* is among his most well-revered works. Poe, like Balliett, found success and acclaim in his writings. This story provided a different experience to the reader than *Chasing Vermeer*. The message is presented without a key and walks the reader step-by-step down each nitty-gritty mathematical detail of letter frequency analysis. We have seen the common use of this method in the cryptohunt and homework assignments. While *The Gold-Bug* is for an older audience it has the same motivation to entice readers, the inherent curiosity of the unknown.

4 Conclusion

Cryptography, although intended to conceal information, can be so much more. Grim circumstances: privacy, security, and warfare need code and code-breakers, but through literature we observe a silver lining. This lining is the wonder of reading a message in a code we know was intended for us, the audience. These feelings of satisfaction and independent discovery can make a message that may have been relatively simple or boring seem significant and powerful.

Whether it be for worldbuilding or puzzles to engage the audience, ciphers find their way into a variety of works of fiction in diverse ways. Their depth and difficulty can lend itself to the audience, ranging from enticing puzzles for children, mysteries that explain basis of cryptanalysis to intuitive adults, or even the inscription on an ancient(cardboard) Dwarven shield for the avid LARPer. All of these serve as extracurricular ways to engage the audience, young or old. It is also perfect for keen readers looking for a challenge. These mechanisms even may inspire some to pursue more complex ciphers and codes.

Although, these are not the only notable successes to the works we have described, it is clear few of them would have found such great success without the added depth of ciphers and puzzles for the reader. A reader that is enthralled in a mystery is one that will not soon forget the enigmas they navigated or the world they discovered.

5 Acknowledgement

We would like to thank Bethany Kubik for teaching this course and pushing us to learn about a subject outside our mathematical scope. Also, we would like to thank the giants of high fantasy, J. R. R. Tolkien and George R. R. Martin for their words, their worlds and their wacky ways. Thanks to authors like Blue Balliett and Lemony Snicket for keeping children literature interesting.

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