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BAKALÁŘSKÁ PRÁCE

Time travel and its reflection in American literature of the 1940s through 1950s

Literární reflexe cestování časem v americké literatuře 40. a 50. let

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Odevzdáním této bakalářské práce na téma Time travel and its reflection in American literature of the 1940s through 1950s potvrzuji, že jsem ji vypracovala pod vedením vedoucího práce samostatně za použití v práci uvedených pramenů a literatury. Dále potvrzuji, že tato práce nebyla využita k získání jiného nebo stejného titulu.

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ABSTRAKT

Tato bakalářská práce se zabývá pojetím cestování časem v americké literatuře během období 40. a 50. let 20. století, které je považováno za Zlatý věk science fiction. Teoretická část práce seznamuje s vědeckými teoriemi té doby a podává ucelený přehled nejběžnějších jevů, které se objevují v souvislosti s cestováním do minulosti i budoucnosti ve vědě i literatuře. Zde jsou vysvětleny časové paradoxy a vědecké hypotézy, které tyto paradoxy řeší. Praktická část se poté zaměřuje na způsoby a důsledky cestování časem v pěti vybraných dílech od různých autorů. Cílem práce je analyzovat a porovnat různé přístupy k této problematice jak mezi sebou, tak s vědeckými poznatky.

KLÍČOVÁ SLOVA

cestování časem, stroj času, časoprostor, science fiction, americká literatura

ABSTRACT

This bachelor's thesis deals with the concept of time travel in American literature during the period of the 1940s and 1950s, which is considered the Golden Age of science fiction. The theoretical part of the thesis introduces the scientific theories of that time and provides a comprehensive overview of the most common phenomena which appear in connection with traveling to the past and future in science as well as literature, including the explanation of time paradoxes and scientific hypotheses which resolve them. The practical part then focuses on the means and consequences of time travel in five selected works by different authors. The aim of the work is to analyze and compare different approaches to this topic, both with one another and with scientific knowledge.

KEYWORDS

time travel, time machine, space-time, science fiction, American literature

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1 Introduction

Time travel was no novelty in the literature of the 20th century. There were stories of people who find themselves in a different time written already in the preceding centuries. However, these do not use time travel in the true sense of the word because the protagonists of these stories are moved to the past or future by means of magic, dreaming, hibernation, or hypnosis. Nevertheless, they are still considered as works of time travel fiction since they use time travel as a plot device. The writers offer no logical explanation, or scientific clarification of the process. This lack of any elucidation is typical of a time slip, a literary technique in which a character is moved to a different time by unknown means.

Influenced by industrialization, writers were becoming more interested in exploring the possibilities offered by scientific progress. This gave rise to a different method which employs a mechanical device as a means of travelling through time. In science as well as in fiction, this device is called a time machine. (Bolonkin 32) Although a time machine has not yet been invented, it has appeared in literature since the late 19th century. The English writer Herbert George Wells was the first to introduce the object to the wide public with his 1895 novel *The Time Machine*, which was written at a time when time travel was considered impossible by scientists. (Wittenberg 86) That changed in 1905 when Albert Einstein published his special theory of relativity, according to which it is theoretically possible to travel into the future. (Hunter)

According to Wells' Time Traveller, there is a four-dimensional space, and not a three-dimensional space, which is used in Euclidean geometry and was widely accepted at that time by most mathematicians as true. To the three spatial dimensions, time was added as the fourth dimension. Only a couple of hard scientists suggested that there is a fourth dimension before. However, this idea was on the margins of science as it was in breach of the contemporary doctrine of the three-dimensional universe. Interestingly, the notion of four dimensions was later embraced by Einstein in the general theory of relativity in 1915. (Gleick 7-10)

The Time Machine has had a major influence on the vast majority of time travel works since its publication. Since then, the invention has been explored by writers as well as film makers from around the world. Each work presents a different form with varied possibilities. For instance, some fictive time machines are used for travelling to the past but not into the future, or vice versa. Moreover, while Wells' time machine did not move in space, his successors often combine time travel with travelling to a different location to make the storyline more intriguing.

Whether or not time travel is truly feasible stays a matter of debate among scientists until this day. Some physicists postulate that travelling through time is practicable. On the other hand, some of them are rejecting the idea altogether. There are also some who acknowledge travelling to the future, but find it impossible to move to the past because it would disrupt the time continuum and create a temporal paradox. This disparity of opinions is adopted by science fiction writers as well. The authors are dealing with the same questions as scientists do, sometimes even predating its scientific denomination.

As far as the literary context is concerned, Roberts regards the 1940s and 1950s as the 'Golden Age of Science Fiction'. (195) The works which were written during this era typically followed a linear narrative and contained predictions of future progress in technology and science. In most cases, they were published, sometimes serialized, in magazines. During this period, writers aimed to be as scientifically accurate as possible and wrote fiction which was plausible and logical and, moreover, was in agreement with the contemporary knowledge of physics, astronomy, biology and other hard sciences. This approach gave rise to a new sub-genre of science fiction known as 'Hard Science Fiction'. (Roberts 195)

The Golden Age was predominated by North American authors. (203) The most influential figure of the period was John W. Campbell, the editor of the science fiction magazine *Astounding* since 1938. He personally controlled the content of the magazine and thus shaped the science fiction genre and its course. (195) In *Astounding* the most recognized writers published their first works.

Similarly, the science fiction genre was becoming more and more popular among the public. It was at this time that the first fan conventions were taking place. The first World Science Fiction Convention was in 1939 in New York City and since then it has been held annually. Although the first 'Worldcons' did not reach such dimensions as those of today, they were attended by science fiction writers such as Ray Bradbury and John W. Campbell. (203)

For my analysis I have chosen five works, each of which is based on a different proposition: *By His Bootstraps* by Robert A. Heinlein, *Flight to Forever* by Poul Anderson, *A Sound of Thunder* by Ray Bradbury, *Experiment* by Fredric Brown and *The Men Who Murdered Mohammed* by Alfred Bester. Widely recognized as one of the classics, *By His Bootstraps* is a representative of the works published in *Astounding*. Moreover, one type of the causal loop was named after it, namely, the Bootstrap Paradox. (Janicker 210) Similarly, *Flight to Forever* is clear evidence of Wells' lasting influence on the genre. Another classic, *A Sound of Thunder* is probably the most famous literary example of the Butterfly Effect to the extent that it is sometimes referred to as the origin of the name. (Nahin 369) On the other hand, *Experiment* is a prototype of the 'short-short' form, or the flash fiction, and unusually uses a time travelling object instead of a person. Lastly, *The Men Who Murdered Mohammed* is a humorous story with an original plot line, which reacts to other time travel stories and their predictable denouements and recurring themes. (D'Ammassa 2025)

2 Theoretical Part

2.1 Definition of time travel

To put it simply, time travel means that a person or an object travels through time either into the past or future. Unfortunately, such a definition is rather vague and therefore the American philosopher David Lewis proposed a more precise definition in 1976. According to Lewis, in order to define time travel, we need to distinguish between two kinds of time: external time and personal time. (145) External time is a linear ordering of events as it would be witnessed by someone who has never travelled through time. The length of this time is objective and fully independent of anyone's subjective perception of time. On the other hand, personal time refers to the duration and ordering of events from the point of view of a particular person. Hypothetically, it can be measured by a wristwatch of the said person. Only if there is a discrepancy between these two times, time travel occurs. (Wasserman 3-7)

2.2 Physics in the 1950s

Time travel is a topic explored by physicists, philosophers as well as science fiction writers. In the field of physics, it has become a matter of interest since Albert Einstein posted his theories of relativity.

In 1905 he published the special theory of relativity, which introduced the phenomenon of time dilation. It stated that "the faster you move through space, the slower you move through time" (May). Later on, it was illustrated by a phenomenon called the Twin Paradox, which was discussed by a number of physicists in the following years. The Twin Paradox is a thought experiment which deals with two identical twins, one of whom travels to space at near-light speed whilst the other twin stays on the Earth. When the space traveller reaches the Earth again after a longer period of time, he is greeted by his twin brother, who looks significantly older than him, i.e. his twin, as well as the whole planet, has aged more quickly than the traveller. By returning home, he moves forward in time into his own future, faster than his twin brother does. Thereby the theory allows time

travel to the future. (Rastogi) Theoretically, time travel to the past could be realised by moving faster than light. However, the equation of special relativity says that no material object can ever reach such speed. (Hunter)

In 1908 Einstein's teacher Hermann Minkowski developed Einstein's proposition of special relativity and presented the concept of space-time. Space-time is a four-dimensional universe, where the three dimensions of space (length, width and height) and one dimension of time are combined. (Siegel) This model suggests that the movement in the temporal dimension should be possible in the same way as it is in the spatial ones.

In 1915 Einstein published the general theory of relativity, which dealt with gravitating objects such as black holes and their influence on space-time. It proposed that time passes at a different speed depending on the location in the gravitational field. The closer someone is to an object with strong gravity, the more slowly the time passes compared to the time speed outside of the gravitational field. That is how one can travel to the future. In addition, gravity was incorporated in space-time. According to general relativity, space-time is not flat as Minkowski believed. On the contrary, thanks to the gravitational force of objects, it can be distorted into any shape, including loops. On this basis, mathematicians Willem Jacob van Stockum and Kurt Gödel proposed the existence of 'closed time-like curves' in 1937 and 1945 respectively. (Hunter) A closed time-like curve refers to "a curious path where [an object] eventually returns to the exact same coordinates in space and time that it was at previously" (Jones). Therefore, travelling to the past and visiting one's own younger self may happen.

In 1935 another concept, which aligns with general relativity, was developed. Einstein and physicist Nathan Rosen suggested the existence of wormholes. A wormhole is a bridge which connects divergent points in space-time while shortening the distance between them. (Harvey and Tillman) It may occur between different spatial locations, times, but also universes. (Hunter) It provides the faster-than-light movement; thus it enables travelling through time into the past as well as to the future. However, the 'Einstein-Rosen bridges' are highly unstable, so

whenever something enters them, there is an almost zero chance that it would reach the other end of the bridge. To make a wormhole traversable, ‘exotic matter’ needs to be added. (Harvey and Tillman) Nevertheless, such matter was not found to this day and it is believed that only some far more advanced technology could possibly stabilise a wormhole.

The truth is that none of the aforementioned means could be realized by the contemporary technological resources. Therefore, time travel remains in the realm of theoretical physics. Nevertheless, Einstein’s theories, which are still a fundamental part of physics, do not in any way preclude the existence of time travel, wormholes, or closed time-like curves.

2.3 Literary techniques

Time travel in fiction occurs mainly in two manners: a time slip and a time machine. Other means of time travel are suspended animation, time dilation and time loop.

2.3.1 Time slip

A time slip is a plot mechanism which allows the authors to make their characters travel in time without the necessity to give a satisfactory explanation of how it happened. Typically, the characters are not in control of the process as it often happens by accident and, consequently, they struggle to find a way back, which often happens in the same unexpected fashion as the first journey. These stories contain no scientific descriptions of time travel. Instead, they include incidents such as a slumber which lasts for multiple years, an injury which causes unconsciousness, or an encounter with supernatural powers. Usually, the writers are not interested in the cause of time travel, and neither are they dealing with temporal paradoxes, or other potential consequences. The central theme lies in juxtaposition of two or more different eras and how the protagonist tackles the relocation to the past or future. It is not uncommon to use this technique in order to comment on social issues and present a utopian society, especially when he or she travels to the future.

The most notable example of a time slip is Mark Twain's 1889 novel *A Connecticut Yankee in King Arthur's Court* (Janicker 208), which tells a story of an engineer from Connecticut who wakes up in Arthurian England after being hit on the head in a fight and then travels back to his time with the help of Merlin, who puts him to a magical sleep. (Howell)

2.3.2 Time machine

A time machine represents a different, more scientific approach to time travel. The authors attempt to demonstrate the possibilities of scientific progress by the invention of a time machine. The creation of a time machine plays a pivotal role in the story and special emphasis is placed upon it.

The story which popularized a time machine and influenced the majority of subsequent writers is *The Time Machine* by H. G. Wells. (Janicker 208)

2.3.3 Suspended animation

Suspended animation is a temporary state during which biological processes in a human body are slowed down while life functions are still maintained, resulting in the ageing process either stopping or becoming much slower than it normally would. The idea is based on hibernation of animals during winter. The person can then wake up from suspended animation after hundreds of years while all his contemporaries are long deceased.

The first stories which featured this experience used supernatural or magical powers to induce an extremely long sleep upon their characters. Later on, the authors started to employ a more scientific method in the form of a suspended animation chamber, also known as a stasis or cryogenic chamber, that is to say a machine which halts the vital functions.

Nevertheless, it is debatable whether it can be considered as a real example of time travel because although the character is not conscious during the passed years, his body is still present at all times. (Wasserman 12)

2.3.4 Time dilation

Time dilation is a paradoxical phenomenon implied by Einstein's theory of relativity. It proposes that time passes at different speeds for different observers depending on their reference frames. (May) In fiction, it is usually accomplished by travelling at the speed of light, or near an object with a strong gravitational field. (Nahin 542)

2.3.5 Time loop

Time loop, or temporal loop, is another plot device used in fantasy and science fiction. Not to be confounded with a causal loop, a time loop is a seemingly endless repetition of a span of time, which always begins in the same moment (typically, the moment of waking up) and ends either at a specific time, or after some incident such as the death of the trapped person. The temporal loop then resets itself and the character is returned to the beginning of the time loop sequence, but usually with the memories of the preceding loop retained. However, other characters do not remember anything and they experience the day in the same way as before. The objective of the character is to break the cycle and continue in a linear timeline. (Nahin 309)

2.4 Time travel paradox

Paradoxes are a set of circumstances which seem to be true, but at the same time come across as being incomprehensible considering that the circumstances are composed of two or more contradictory realities. They appear to be mutually exclusive in most cases, which means that if one reality exists, it is impossible for the other reality to exist as well. In effect, time paradoxes, or temporal paradoxes, logically contradict time travel.

In physics, there are two major categories of temporal paradoxes: causal loops and consistency paradoxes. (Grondin 414)

2.4.1 Causal loops

Causal loops contain a closed loop in time "in which cause and effect run in a repeating circle" (Miller). The causality loops do not alter the timeline's history thus they do not suggest any inconsistency in time. Nonetheless, they trigger a self-created entity without the apparent point of origin. Even though it goes against the usual order of causality, there is no reason to consider this event impossible at all. Causal loops are 'self-consistent', i.e. there is no change with each pass through the loop. The events of the causal loop are firmly established in time and they cannot be altered in any way. They occur on a single invariable timeline where time travelling to the past secures that the cause is fulfilled.

This category includes Bootstrap Paradox and Predestination Paradox.

Bootstrap Paradox

The Bootstrap Paradox, or the Ontological Paradox, takes place when something or someone travels to the past and, as a consequence, triggers an unending cause-effect loop where the origin of the item or the person is beyond the bounds of possibility to determine. Such an object is described as 'self-created' or 'uncaused' and exists even though it has never been created. (Wasserman 21) In other words, a future event causes a past event, which, consequently, causes the future event and so on. The events in the loop remain unchanged every time the person enters the timeline.

The Bootstrap Paradox can be exemplified by a story of an avid reader of Shakespeare. After she invents a time machine, she travels back in time to meet her great hero. When they meet, Shakespeare is about to start writing her favourite play, *Hamlet*. However, Shakespeare is struggling to start, and so, in order to help him, she gives him her copy of *Hamlet*, which she has taken with her. Shakespeare then copies the whole script and begins to rehearse the play. In this case, it is unclear who wrote the play script and where the words came from.

A different example involves a person as the 'self-created object'. A man travels to the past, one year before he was born, and meets a woman. They are dating for several months and she becomes pregnant. Unaware of the situation, they break up

and the time traveller comes back to his proper time. A baby boy is born, who grows up to be the time traveller. In this example, the origin of the man cannot be fully determined because his father line consists only of him. That is to say the time traveller is his own father, paternal grandfather, etc.

The Bootstrap Paradox is in breach of some of the laws of physics, namely the law of causality and the law of entropy. The violation of causality lies in the change of the usual order of preceding cause and succeeding event. As far as the law of entropy is concerned, the second law of thermodynamics says that the entropy of a system must increase in time, i.e. a system goes from a state of order to a state of disorder under any circumstances. Therefore, a thing which is constantly circling in a loop should decline as the item gets older. However, this would cause a disruption in the timeline if the item one day ceased to exist.

Predestination Paradox

The Predestination Paradox involves a person who is travelling to a specific point in the past in order to prevent some incident to happen. However, while trying to avoid it, this person eventually becomes an active participant of the unfortunate event and it is his or her actions that become its cause. The past remains unchanged and it cannot be altered in any way because such attempts then result in causing the incident itself. Past events are thus destined to happen in the exact same way irrespective of the time traveller's intention. According to this paradox, what is done is done and not even a time machine can change it. (Miller)

To give a hypothetical example, an art collector has lost his whole collection after his house was set on fire, so he builds a time machine and travels back in time to catch the arsonist and save his collection. While he is anxiously waiting for him, he lights a cigarette but accidentally drops the lighter, which then sets the house on fire and inevitably destroys the art collection. Subsequently, the time traveller returns to his proper time and continues to live his life in a linear way knowing that it was him who was responsible for the fire. In this case, the inventing of the time machine

caused the destruction of the paintings as well as the destroyed paintings caused the construction of the time machine.

2.4.2 Consistency paradoxes

Consistency paradoxes arise provided that a journey into the past may alter the course of past events. If a man travels back in time and there he intentionally does something to change his own timeline, it will create a new reality where the deed prevents the cause of the time travel from taking place. These paradoxes are 'self-inconsistent', i.e. the outcome of the changes are inconsistencies which contradict history and logic.

Recurrent examples of consistency paradoxes are the Grandfather Paradox, the 'Killing Hitler' Paradox, and Polchinski's Paradox.

Grandfather Paradox

The Grandfather Paradox is the best-known representative of the consistency paradox. A time traveller detests his grandfather, and so he decides to travel to the past and kill his grandfather before his grandparents met, thus precluding him from becoming his grandfather. However, the death of his grandfather would make the birth of one of his parents, and consequently his own birth, impossible. Thus, if a time traveller had not been born, he could have never travelled to the past to kill his grandfather. But if his grandfather had not been killed, he would have had a child and a grandchild, who would eventually become a time traveller and so on. (Nahin 48)

In general, this paradox can concern all ancestors because a premature death of any of them would ultimately disrupt the subsequent family line. (Wasserman 71) A notable variant is the Retro-Suicide Paradox, or the Auto-Infanticide Paradox, that is to say a time traveller murders his younger self before he can travel to the past. (72)

Killing Hitler Paradox

The 'Killing Hitler' Paradox, or simply the Hitler Paradox, deals with a fundamental change of a major historical event and the hypothetical problem of trying to rewrite history. The story goes as follows: a man who is in possession of a time machine decides to prevent the Second World War by killing Hitler before his rising to power. He travels to Hitler's childhood and kills him. Then, ideally, the Second World War would not break out and the time traveller would achieve his goal. However, there arises a paradoxical situation — if someone travelled to the past and killed Hitler as a child, it would remove any mention of Hitler from all historical records, hence the time traveller would no longer have any reason to wish for Hitler's earlier death and to use the time machine. (Bodin 255)

In contrast to the Grandfather Paradox, the Hitler Paradox would make a more significant impact on the world as it would affect, more or less, the life of practically every human being since the beginning of the Second World War.

Polchinski's Paradox

The Polchinski's Paradox is a specific case of the consistency paradoxes which was proposed by American theoretical physicist Joseph Polchinski. (Rastogi) The paradox presents a situation wherein a billiard ball falls into a wormhole and appears nearby few moments earlier. The ball then continues in the movement until it collides with its younger self, changing its trajectory, so that the newer version of the ball precludes the older version of the ball from entering the wormhole in the first place. (Miller)

2.5 Solutions

Scientists have been aware of the possible paradoxes of time travel since the model of space-time was introduced. The temporal paradoxes disrupt the standard notion of causality, in which the cause precedes the effect. Because of this, a great number of philosophers and theoretical physicists have proposed varied theories to resolve the inconsistencies of time travel.

The most common solutions are:

2.5.1 Multiverse Hypothesis

The Multiverse consists of an infinite number of parallel universes, which are coexisting next to each other. This hypothesis states that a change of the past gives rise to the creation of an alternate timeline, in which the present and future are altered by the change. In this way, the original timeline is protected from any paradoxical situation because whenever the time traveller alters some past event, he enters an alternate timeline. (Bodin 256)

The 'many-worlds' hypothesis solves the consistency paradoxes, such as the Grandfather Paradox, or Hitler Paradox. In this case, when the grandson arrives back to his proper time, he appears in an alternate reality, where he has never existed and where all traces of his existence have been removed, including his belongings as well as all records and memories of him. Similarly, there would be one reality with the World War II as we know it and another one without it.

2.5.2 Timeline-Protection Hypothesis

The Timeline-Protection Hypothesis is based on the premise that a paradox can never occur. Because of the logical contradiction to the timeline's history, philosophers argue that one can only act in such a way which is in accordance with what has happened before. All attempts to modify the past ends unsuccessfully because something always stops the time traveller to complete the act. (Del Monte)

For example, if the time traveller shoots at his ancestor, he misses the target, or the gun fails to fire etc. Similarly, Polchinski's billiard ball may change its course, but still enter the wormhole. Such an act is always prevented, no matter how unlikely it might seem. The timeline remains unchanged come what may.

2.5.3 Self-Healing Hypothesis

The Self-Healing Hypothesis permits the time travellers to modify past events in any way they wish. Afterwards, a different set of events is triggered so that the present would stay the same. In this way, the timeline protects itself. (Bodin 257)

By way of illustration, if the time travellers try to save John F. Kennedy from being assassinated, they may achieve it on the 22nd of November 1963. However, after returning to their proper time, they will eventually find that it happened a few days later.

2.5.4 Timeline-Corruption Hypothesis

The Timeline-Corruption Hypothesis proposes that temporal paradoxes are bound to happen and they cannot be avoided under any circumstances. Any change in the past, however negligible it may be, may initiate a dramatic shift in the future. (Del Monte) This is called the Butterfly Effect, a base of the Chaos Theory, which is presented by the question, if "the flap of a butterfly's wings in Brazil [can] set off a tornado in Texas" (Lorenz). It is widely accepted that it is possible and that originally minor actions may cause enormous cascade reactions in the future. Furthermore, it is impossible to predict the full extent of the outcome.

2.5.5 Destruction-Resolution Hypothesis

The Destruction-Resolution Hypothesis is an extreme variation of the Timeline-Corruption Hypothesis. It postulates that any paradox would destroy the whole universe, which would make any time travel hazardous. (Del Monte)

2.5.6 Chronology Protection Conjecture

Nevertheless, there are also physicists who believe that the paradoxes have no solution and that the possibility of a paradox forbids time travel to the past. The Chronology Protection Conjecture suggests that the laws of physics would prevent closed time-like curves from appearing if necessary. A prove for this assumption is supposed to be the Fermi Paradox. Originally, the Fermi Paradox involves extra-terrestrial life and the contradiction between high estimates of its existence and the absence of clear evidence asking: "If they are there, where are they?" (Forgan 121). In a similar way, it can be applied to the existence of time travel and rephrased to: 'If time travel is possible, where are the time travellers from the future?' Nonetheless, there are various solutions to this question: Firstly, time travel to the

past is impossible. Secondly, the final destination cannot be chosen arbitrarily, so that not every time period is visited by time travellers. Thirdly, time travellers are keeping their identity secret.

2.6 Anachronism

Another phenomenon which often stems from time travel is called anachronism. The Oxford Learner's Dictionary defines anachronism as "something that is placed, for example in a book or play, in the wrong period of history". Conventionally, anachronisms are errors, which are made either unintentionally because of the author's lack of research or deliberately for dramatic purposes. The chronologically misplaced item can be an invention, discovery, knowledge, idea or even a word. For example, in William Shakespeare's play *Julius Caesar*, a mechanical clock is mentioned, although it was not yet invented at the time when the play takes place.

In time travel fiction, anachronisms are clearly intentional. They are more common in journeys to the past, when time travellers introduce some invention or discovery which is common in their proper time but a major breakthrough in the past time. For instance, in Mark Twain's *A Connecticut Yankee in King Arthur's Court*, the protagonist introduces inventions such as gunpowder and bicycle in the Arthurian era. (Howell)

3 Practical Part

3.1 Plot of the selected works

3.1.1 *By His Bootstraps*

By His Bootstraps is a short story written by Robert Anson Heinlein, which was published in the October 1941 issue of the *Astounding Science Fiction* magazine. (Broderick 63) It is one of the first works in which a time traveller interacts with his past self. (Janicker 210)

The story is set in 1952, when Bob Wilson writes his graduate thesis regarding metaphysics while being locked in his room. All of a sudden, a mysterious circle starts to grow behind him and someone goes out of it. The stranger, who introduces himself as Joe, has a black eye and a swollen upper lip. Bob does not recognize Joe, although he has a feeling that he has already seen him. Joe tells him that the circle is actually a portal to the future called the 'Time Gate'. He offers Bob to follow him through it. However, Bob is incredulous at the feasibility of time travel. In order to prove his point, Joe takes Bob's only hat and tosses it in the Time Gate. To Bob's surprise, it disappears from sight. Nevertheless, Bob does not want to leave and has a drink instead. When Joe loses patience and wants to push Joe towards the circle, another stranger, who looks similar to Joe, walks out of it. Suddenly, a telephone starts to ring and Bob receives two phone calls. The first call is from an unknown man and the second one is from his girlfriend Genevieve. She tells him that he has forgotten his hat by her that afternoon, which Bob dismisses because he was the whole day in his room. After he hangs up the phone, he is annoyed by her and decides to go to the future. However, the stranger tries to prevent Bob from entering the Time Gate, starts to fight with Joe and accidentally hits Bob in the face, which sends him through the portal.

When he wakes up, he finds himself in the Hall of the Gate in the High Palace of Norkaal over thirty thousand years in the future. There he meets Diktor, a middle-aged man, who tells him about the place. It was built by an extra-terrestrial creatures

called the ‘High Ones’, who enslaved people but left the Earth a long time ago. Diktor then sends Bob back through the Gate to fetch another man. There he notices a man who is writing a thesis. To his shock, he realizes that he has entered the same room a few moments before leaving and he has now become Joe. Although he does not remember what he said, he acts in exactly the same way as before. When the stranger appears from the Gate, he recognizes himself in him. After Bob leaves, he is warned that Diktor has deceived him.

Nonetheless, he goes back to the Hall, where he meets Diktor, who gives him a list of items which he needs from the twentieth century. Bob becomes frustrated and instead goes back to his room to break the cycle and prevent himself from entering the Gate in the first place. However, the scene plays out in the same way again. When Bob is alone, he contemplates what he is going to do. As he is not content with his life, he decides to return to the future, where he finds his hat and a vocabulary of the contemporary language. Then he adjusts the time machine and goes to gather all the items from Diktor’s list. However, when he wants to go back, he finds that the Time Gate has vanished. Therefore, he wants to use the one in his room after the departure of his earlier selves. To pass the time, he visits Genevieve and forgets his hat by her. Afterwards, he calls himself to check that Bob ‘Number One’ is still in his room.

When he arrives to the Hall, he resolves to replace Diktor as the local ruler. Therefore, he moves ten years back so that he could establish himself. With the help of the items which Diktor asked from him, he becomes the chief of the local people, who call him ‘Diktor’, which means ‘chief’ in the local language. After ten years, he sets up the Time Gate to see his former room and a hat as well as an unconscious man appear. At this point, Bob realizes that he is the Diktor whom he met ten years ago. Therefore, he starts to arrange the events to play out in the same way as before, only this time Bob is in the role of the Diktor.

3.1.2 *Flight to Forever*

Flight to Forever is a novella by Poul Anderson, which was published in 1950. (Broderick 76) The story is reminiscent of Wells' *Time Machine*, where the protagonist travels to the distant future but remains in the same place. (Howell)

Set in 1973, it tells a story of physicist Martin Saunders, who with the help of his colleague MacPherson invented a time machine. He and mechanic Sam Hull test the machine and move a hundred years into the future. When they want to come back, they find themselves unable to reach their original time. The time machine is not capable to bring them further than to the year 2008. Because of that, they decide to travel forwards in time to find technology which would allow them to return to their proper time. In 2500 Sam is murdered and Martin runs away far in the future. In 3000 he encounters Belgotai, who wants to travel with Martin. They set off and continue searching for the negative time machine.

In 50,000 he loses all hope that there will ever exist technology which would enable him to travel back home and decides to stay there. After a year, he is sent into the future against his will by Vargor Alfri, who is jealous of Martin. He then travels millions of years into the future, where his time machine is upgraded and where he is told to travel to the end of the universe. After seeing the end of the universe, Martin witnesses the Big Bang and realizes that he could reach his proper time. Consequently, he travels to 1973 and meets his girlfriend Eve and MacPherson. The upgraded time machine then dissolves.

3.1.3 *A Sound of Thunder*

The short story *A Sound of Thunder* was written by Ray Bradbury in 1952 and is considered as one of the classics of science fiction. (Nahin 50)

The story takes place in 2055, where the time machine is already used in business. It tells a story of Eckels who goes on a hunting trip to the Mesozoic Era. The trip is organized by the company Time Safari Inc. and costs ten thousand dollars. The goal of the expedition is to shoot a Tyrannosaurus Rex. Before entering the time

machine, he has a conversation with one of the employees about the results of the presidential election, which according to them turned out well.

After reaching their destination, the hunters are instructed by their guides, Travis and Lesperance, to walk only on the floating Path laid by the guides. As Eckels sees the dinosaur in front of him, he begins to panic. Therefore, he is told to return to the time machine and stay there until the Tyrannosaurus Rex is killed. On his way, Eckels falls off the Path and steps on the grass. Because of that, Travis initially wants to leave Eckels in the past as he is scared of the consequences this action might cause. When they all come back to 2055, Eckels perceives that the world has slightly changed. Suddenly, Eckels notices a dead butterfly on his shoe. After he finds out that the presidential elections have been won by the other candidate, he desperately begs Travis to return it into the past, but Travis raises his gun instead.

3.1.4 *Experiment*

Experiment is a short-short story, which was written by Fredric Brown and published in 1954. It is an example of flash fiction, i.e. a very short story of up to two thousand words with a plot twist at the end. (Hill 7)

In the story, Professor Johnson has constructed the first time machine and is about to test it in front of his colleagues. The time machine is only an experimental model for small objects. First, he sends his experimental object, a brass cube, five minutes into the future. The cube disappears and reappear five minutes later. Then he activates the machine to send the cube five minutes into the past. The cube emerges on the platform of the time machine five minutes before three o'clock. Before Johnson sends it back in accordance with the past events, one of his colleagues suggests that he should not place it on the platform and observe the consequences. Johnson agrees. At three o'clock, everything except the cube ceases to exist.

3.1.5 *The Men Who Murdered Mohammed*

The Men Who Murdered Mohammed is a short story written by Alfred Bester in 1958. (Gleick 206)

The story is about professor Henry Hassel, who one day in 1980 finds his wife cheating on him with another man. To take revenge, he quickly assembles a time machine and travels to the past to kill her grandfather, thus prevent her from being born. However, his wife does not disappear and so he travels back to kill her grandmother, which does not work either. He is then told by his computer that the present could only be changed by a significant act. Therefore, he starts travelling to the past and shooting celebrities such as George Washington, Napoleon and Mohammed, but the present still remains the same. When he wants to talk with Wiley Murphy, an expert on time and also his wife's lover, he is unable to touch him and even talk to him. Suddenly, a man shouts at him from the outside. It is professor Israel Lennox, who explains that because he was trying to alter the present, he has erased his past and has become a ghost. He can now move freely through time, walk through the walls, but may not speak with anyone except Israel, a fellow time traveller, who also killed famous people in the past, including Mohammed. The story ends with Henry and Israel departing to listen to a lecture of the French physicist André Marie Ampère, who died in 1836.

3.2 Hard science

The authors of science fiction employ scientific knowledge as the major theme in their works, and time travel stories are no exception. Some of them are particularly precise as far as scientific references are concerned. In the Golden Age, Einstein's breakthrough postulations influenced the majority of science fiction writers to the extent that they often referred to the results in their works. The special theory of relativity is mentioned by Anderson when his time travellers experience the limitations of physics. One of Einstein's assumptions is confirmed by them, namely, that one would "need infinite energy to get beyond the speed of light" (Anderson 7).

Likewise, Heinlein refers to the general theory of relativity. In the beginning, Bob dismisses time travel in general as he writes in his thesis that although "its necessities may be formulated under any and all theories of time", there are "certain things about the empirical nature of time which preclude the possibility of the

conceivable proposition" (Heinlein 50). In other words, even though something can be mathematically formulated, does not necessarily mean it is practicable. Moreover, his time machine is based on the model of four-dimensional space-time as presented in Einstein's general relativity.

A recurring phenomenon in science fiction is the possibility of self-visitation, i.e. interacting with one's older or younger own self, which corresponds to the closed time-like curves in physics. It is central to Heinlein's story, who even allowed his protagonist to talk with three versions of himself at the same time (two in person and one on the phone). Heinlein does not set any limitations in his story in this respect. Bob is able to argue, fight with himself and even give himself a black eye. On the other hand, Bradbury blankly forbids it. He explains that "when such occasions threaten, Time steps aside. Like an airplane hitting an air pocket" (Bradbury 5). His time machine simply skips the time where self-visitation may occur. Similarly, Bester does not give his characters the chance to talk with themselves. However, it is important to acknowledge that Henry tries to visit his earlier self only after he erases his past. At that time, he is incapable of touching or speaking to anyone and can only observe them. Unconventional reasoning was used in the case of Brown's cube. There are never two cubes present at the same time thus self-visitation is out of the question. The cube disappears from Johnson's hand and reappears on the platform of the time machine.

Self-visitation may cause the time traveller to learn of the results of his actions before he takes them. The Safari guides are incapable of learning about the outcome of the expedition in advance as the time machine jumps in time to prevent the paradox. However, Heinlein does not consider such event paradoxical although he takes into account the problem of free will. Bob participates in the same scene three times, which means that he knows what will happen. Nonetheless, he believes that "his own free will had worked to create the same scene over and over again" (Heinlein 30).

3.3 Time machine

A time machine is usually a human invention. Out of the five chosen works, only Heinlein opted for an unknown extra-terrestrial race from the distant future, the 'High Ones', to be the creators of the Time Gate. However, the story does not give any explanation how and why they constructed it. By the time Bob arrives in the Hall of the Gate, they have already left the Earth. Similarly, Bradbury's time machine is already in operation in the beginning of the story. It is used as a means of transportation for hunting tourism. On the other hand, both Anderson's and Brown's time machines are still in development. They are a result of scientific research and are currently used for experiments. For example, Anderson's time projector went on two test drives "twenty years ahead and twenty back" (3). By contrast, Bester's time machine is invented and built by a raging ingenuous professor "in exactly seven and one-half minutes" (121) and used immediately afterwards.

Each story presents a different concept of a time machine. Heinlein calls his machine the 'Time Gate' and it consists of a circular portal and a control panel, which is situated on a raised floor above the portal. The controls are "four colored spheres the size of marbles hung on crystal rods arranged with respect to each other as the four major axes of a tetrahedron" (Heinlein 77). The four controls correspond to the four-dimensional space-time as presented by Einstein's theory of general relativity. The final destination can be thus anywhere in time and space and is "controlled by moving the proper sphere in or out on its rod." (77) Interestingly, the panel does not have any digital display with spatial and temporal coordinates. To distinguish the set position is possible only visually, by looking at a small image of the other end of the Gate on the panel. However, the control panel with the other end of the Time Gate cannot be moved anywhere. The portal is described as "a great disk of nothing, of the color one sees when the eyes are shut tight" (50), "a simple locus hanging in the air, its flat depth filled with the amorphous colors and shapes of no-vision" (57). Such description resembles the theoretical appearance of a wormhole. Furthermore, the time travel itself occurs by simply "stepping through

that circle" (52), though one must be careful about not hitting the edge of it. The sensation of the travel is nothing extraordinary, but is "like stepping through a curtained doorway into a darker room" (62).

A far less detailed description of the time machine is given by Bester. Similarly, to Heinlein, Bester opted for an immobile time machine, which is able to send the traveller to any point in history. The destination is set by a dial in advance and confirmed by a press of a button. "The machine [makes] a noise like defective plumbing" (Bester 121) and the traveller disappears and reappears somewhere else in the past. Only the passenger is moved to the past and later comes back by "the automatic recall of the time machine" (121).

Likewise, Bradbury describes his time machine only briefly as "a mass and tangle, a snaking and humming of wires and steel boxes", which lights up in different colours and makes "a sound like a gigantic bonfire" (1). The time machine moves in time together with the travellers. During their journey to the past, they witness how "Suns fled and ten million moons fled after them" (3). "Time was a film run backward" (3) for them. Although not clearly stated, there is, in all probability, no movement in space, but only in time. Their way back to the present happens in the same way just in the opposite direction. This could imply that the time machine can achieve the speed of light and even surpass it, however, Bradbury does not address the technology behind his invention.

Anderson's time machine works on a similar principle as Bradbury's but with different results. The time machine is depicted as "a metal cylinder some ten feet high and thirty feet long" with "battery banks and the massive dimensional projector" (Anderson 3) along with a compartment for two passengers. In the compartment, there is a "switch which [controls] their rate of time advancement" (4) and a dial, which shows in which year they are. The projector accelerates to such speed that it can travel through time. However, "the farther back [they] go, the more [energy they] use per year" (6), so "beyond a period of about seventy years, infinite energy is required" (13). On the other hand, travelling to the future consumes only a small amount of power, so that "they [have] energy enough to travel to the end of

the world" (7). The time machine cannot move in space arbitrarily, but "the ground-level machine in the projector automatically materialised it on the exact surface whenever it emerged" (5). This means that the machine would never appear in the air, or underground. Furthermore, "mass-sensitive circuits [prevent] the machine from halting whenever solid matter occupied its own space" (5). While it moves through time, there is just greyness outside and the projector is noisy.

A completely different time machine in almost every respect is used by Brown. His time machine "is a small-scale experimental model", which looks like "a postage scale" and "[operates] only on objects weighing less than three pounds, five ounces and for distances into the past and future of twelve minutes or less". There are "two dials in the part under the platform" (Brown), one for travelling to the past and the other to the future. Before sending an item to the past, one has to set and activate the machine.

3.4 Time traveller

All stories except *Experiment* are explicitly said to be set in the future, which is not uncommon for science fiction. While Anderson, Bester and Heinlein opted for a protagonist from the twentieth century, Bradbury chose a man from the twenty-first century.

Time travellers can be classified in two categories. The first type is portrayed by a scientist, who is also the inventor of the time machine and whose journey is part of the research. In this category, we may include Anderson's Martin Saunders and Sam Hull as well as Bester's Henry Hassel and Israel Lennox. While Anderson's researchers study the possibility of travelling to the past as well as future, Bester's scientists examine the consequences and paradoxes of travelling into the past.

The second type is represented by a common person, who is in search of adventure but has no knowledge of how the time machine works. This category contains Heinlein's Bob Wilson, Anderson's Belgotai, Bradbury's Eckels and other hunters. Both Bob and Belgotai are using the time machine to escape their former lives and

plan to settle at some point in the distant future. On the other hand, Bradbury's time travellers are away on a jaunt and then they come back home.

In Bester and Bradbury, the time travellers only visit some point in the past and then they return to their original time. While Bradbury describes only one journey, Bester depicts countless trips to historical periods. In stark contrast stands Anderson, whose protagonist makes numerous stops on a round trip around all of time but eventually comes back to his proper time. On the other hand, in Heinlein, Bob is wandering between two epochs thirty thousand years away from each other and finally settles in the future.

Heinlein allows his character to interact with his younger and older selves. On the first occasion, Bob does not recognize himself. Heinlein argues "that a person does not look at his own face, even in mirrors, in the same frame of mind with which he regards another's face" (66). On the second occasion, it takes him some time to realize that he is at the exactly same scene only in a different role. Interestingly, he is irritated by his other versions most of the time. For instance, Bob 'Number Two' "resented this interloping duplicate of himself anyhow; to be asked to follow his lead blindly irked him" (73).

Unusually, Brown does not introduce any living time traveller. Instead, there is only one object, a brass cube, which travels through time.

3.5 Paradoxes and their solutions

Although the time machine is a vital part of the story, the main focus lies in the philosophical and logical dimensions of time travel. Sometimes their usage in literature predates the scientific formulation of paradoxes and their solutions. Bester, Bradbury, Brown and Heinlein explored the temporal paradoxes connected with travelling to the past in their works.

Causal loops are in a great detail examined by Heinlein. His protagonist experiences one scene from three different perspectives and, moreover, meets his ten-year-older self. The second time Bob enters his room through the Gate is an example of the Predestination Paradox. Bob 'Number Three' tries to break the cycle by

preventing Bob 'Number One' from entering the Time Gate on the first occasion. However, in the end it is him who, though accidentally, sends him through the Gate when they are fighting. Thus he becomes the cause of the event he wanted to prevent.

Furthermore, the Bootstrap Paradox is discussed as well. The origin of some of the items and knowledge cannot be traced. By way of illustration, the content of the notebook is in such a loop. After finding the vocabulary in the control booth, he travels with it ten years into the past. "When the notebook he had stolen had become dog-eared and tattered almost to illegibility some four years back, he had carefully recopied its contents in a new notebook. […] The worn-out notebook he had destroyed; it was the new one he intended to obtain, and leave to be found" (Heinlein 112) in the control booth. This means that the two notebooks were the same notebook only in a "different segments of the same physical process, manipulated by means of the Gate to run concurrently, side by side, for a certain length of time" (113). Heinlein put only the content and the knowledge gained by reading the notebook in the causal loop, rather than the notebook itself. In this way, the loop does not breach the law of entropy and the notebook can disintegrate in time. The mystery is how Bob has learned the language. "His older self had taught his younger self a language which the older self knew because the younger self, after being taught, grew up to be the older self and was, therefore, capable of teaching" (113). In this case, the origin cannot be identified. A similar path undergoes the list of items and books, which help Bob to become the chief, and the information of how to control the Time Gate. But the most striking example is Bob's arrival in the future. "[He] went through because [he] came back from going through to persuade [him]self to go through" (75). That is to say, the causation of it is fully circular.

After Bob understands that he is caught in a loop, his first reaction is an attempt to break the cycle. He tries to recite a nursery rhyme, which is something he did not do before. However, he finds himself unable to recall any, feeling uneasy because of the look of his earlier self. Heinlein's solution thus correlates with the Timeline-

Protection Hypothesis. Although "he could not recall, word for word, what the conversation had been" (67), all scenes happen in exactly the same way each time. In the end, he wilfully behaves in the same way as before, putting the hat and notebook in the control booth.

In comparison with the other authors, Heinlein created an extraordinarily complicated chronology of events. In the year 1952, there are four Bobs present at the same time. Supposing that he becomes another version of himself every time he leaves the Hall of the Gate through the Time Gate, the chronological order of events is as follows:

While Bob 'Number One' is writing in his room, Bob 'Number Four' arrives on campus. A few moments later, Bob 'Number Two' comes in the room followed by Bob 'Number Three'. Meanwhile, Bob 'Number Four' visits Genevieve and then calls Bob 'Number One'. The first one to leave is Bob 'Number One', followed by Bob 'Number Two' and Bob 'Number Three'. Lastly, Bob 'Number Four' enters his room and goes through the Time Gate as well.

Thirty thousand years in the future, Bob 'Number Five' has just travelled ten years to the past. After ten years have passed, Bob 'Number One' appears from the Time Gate, followed by Bob 'Number Two'. Later on, Bob 'Number Three' arrives but promptly leaves again. Shortly thereafter, Bob 'Number Four' enters the Hall and departs ten years into the past. Then Bob 'Number Two' leaves, later followed by Bob 'Number One'. After his departure, Bob 'Number Five' is finally freed from the loops and can continue in a linear timeline.

On the other hand, Bester rejects the use of loops in his story and writes that "Hassel does not make a circle in time, ending where the story begins—to the satisfaction of nobody and the fury of everybody—for the simple reason that time isn't circular, or linear, or tandem, discoid, syzygous, longinquitous, or pandiculated" (123). However, he is interested in the consistency paradoxes. In an attempt to prevent his wife to be born, Henry kills her grandfather and then her grandmother before she was born. He does not concede that erasing the reason for his travel could potentially create a paradox and thinks that he will "be a bachelor" or "married to

somebody else" (121) instead. Later, he tries to change the future by performing a significant act. At first, he kills many well-known personalities before they became famous, e.g. George Washington, Christopher Columbus, and Mohammed. Because all of his actions are unsuccessful in changing the past, he then explains Marie Curie nuclear fission, which then destroys Paris. Similarly, Israel slaughtered animals and people alike to research how time travel works. Nevertheless, the present and all records of the persons concerned remain the same. In the end, he is unable to touch anything and nobody can hear and see him, except "the Simplex-and-Multiplex Computer", which is sensitive enough "to hear him through a sort of wave-interference phenomenon" (126). Bester presents an unusual denouement. He calls it "chronicide", i.e. "with each act of destruction [the time travellers] dissolved a little" (129) until they were gone completely. His understanding of time is that "there is no universal continuum", but "only billions of individuals, each with his own continuum; and one continuum cannot affect the other" (128). To illustrate it, he likens the continuums to "millions of strands of spaghetti in the same pot" and everybody who tries to change the past will consequently "become the spaghetti sauce" (128). Henry and Israel may move freely in time, but cannot interact with any living person anymore.

Israel's first destination was the Pleistocene, where he wanted to take photographs of some already extinct animals. Unfortunately, he stepped on an insect and killed it. Israel feared that after "returning to [his] world" he would "find it completely changed as a result of this single death" (128). This is an obvious reference to Bradbury's *story A Sound of a Thunder*.

In contrast, Bradbury's time travellers go to great lengths to preserve the past. Although their theory has not yet been proven, the Safari Guides believe that killing one mouse could "destroy […] an entire history of life" (Bradbury 4). Therefore, all passengers are sterilized beforehand and wear oxygen masks, so they "can't introduce [their] bacteria into an ancient atmosphere" (4). Furthermore, they are allowed to walk only on the Path from anti-gravity metal "to keep [them] from touching this world of the past in any way" (3) and to shoot only animals which are

going to die very soon. After shooting the dinosaur, they “can't take a trophy back to the Future” (9) and must take out all the bullets from him to prevent anachronisms. The hunters are warned that a fine must be paid for any disobedience. Despite all the precautions, Eckels alters the present by killing a butterfly and bringing it on his shoe back to his proper time. However, the change is subtler than they originally thought. At first, Bradbury describes it in this way: “The room was there as they had left it. But not the same as they had left it. The same man sat behind the same desk. But the same man did not quite sit behind the same desk.” (10) It has changed the spelling, which is illustrated by the modification of the sign from “TIME SAFARI, INC. SAFARIS TO ANY YEAR IN THE PAST. YOU NAME THE ANIMAL. WE TAKE YOU THERE. YOU SHOOT IT” (1) to “TYME SEFARI INC. SEFARIS TU ANY YEER EN THE PAST. YU NAIM THE ANIMALL. WEE TAEK YU THAIR. YU SHOOT ITT” (11), as well as the results of the presidential election. Bradbury’s conclusion corresponds to the Timeline-Corruption Hypothesis and is the first example of the Butterfly Effect. (Howell) Nonetheless, it should be noted that the time travellers, unlike the others, remember what the world originally looked like and do not know the full extent of the alteration yet.

In a similar way as Bester, Brown also hypothesizes about the outcome caused by a consistency paradox. His experiment with the cube is logically similar to Polchinski’s Paradox. Instead of a billiard ball, a brass cube is not send to the past where it already appeared. The effect of this deed is that “the cube remained. But the entire rest of the universe, professors and all, vanished” (Brown). Such an ending tallies with the Destruction-Resolution Hypothesis.

A different notion of time continuum is introduced by Anderson. When travelling backwards in time, one can only move over a span of just seventy years because then it becomes too energetically demanding. This does not change at any point in the future, which suggests that it is the laws of physics that do not permit anyone to travel any further rather than lack of technology. On the other hand, travelling forwards in time is unlimited and consumes noticeably less energy. It would seem that Anderson does not want his time traveller to visit the past. Nonetheless, his time

continuum is “spherical in all four dimensions” (Anderson 34), which means “that every particle newly formed in the Beginning had exactly the same position and velocity as every corresponding particle formed in the previous cycle” (33-34). In other words, after the universe ends and everything collapses, it begins again with the same Big Bang, which created the collapsed universe. “The universe was mortal, but it was a phoenix which would never really die” (33). By way of illustration, “if you travelled long enough, through space or time, you got back to your starting point” (34). In this way, one could visit any historical period. However, Anderson does not create any paradoxical situation and only allows Martin to return to his proper time.

Furthermore, one of the aliens, whom Martin encounters in the future, believes that the negative time machine will never be invented because otherwise there would be travellers from the future, which is the reasoning of the Fermi Paradox. Martin offers a solution that they might not be interested in their age, for they “have complete records of it” and would rather “go back to investigate more primitive ages, where their appearance might easily pass unnoticed” (17).

4 Conclusion

The main aim of this thesis was to analyze the different approaches to the problematics of time travel in the literary works of the Golden Age of science fiction. The Golden Age lasted in the United States approximately from 1940 to 1960 and many of the classics were published during this period. Time travel fiction was influenced to a great extent by H. G. Wells' novel *The Time Machine*, which popularized the idea of using a mechanical device to travel in time.

The theoretical part focused on the phenomena related to travelling in time. As science fiction is closely related to sciences such as physics and mathematics, this part provides the scientific context of the 1950s. In physics, the possibility of travelling through time has become a matter of interest since Albert Einstein published the theories of special and general relativity. The subsequent hypotheses of closed time-like curves and wormholes are based on Einstein's propositions. In literature, there are two main methods of how to relocate a character to a different era. While a time slip usually utilizes an accident, a time machine uses a scientific invention to travel through time. The theoretical part exemplified the various paradoxical situations, which are caused by travelling to the past. The paradoxes can be divided in two categories: causal loops and consistency paradoxes. The possible alteration of the past events is then resolved by a wide variety of hypotheses such as the Multiverse and the Timeline-Protection Hypothesis, which are explained in the thesis as well.

The practical part explored travelling through time in the five selected works from some of the most respected science fiction writers. All of them employ a time machine, however, the amount of scientific explanation differs considerably. While Anderson and Heinlein attempt to describe the circumstances and consequences in great detail, Bradbury, Brown and Bester are not as exact. Nevertheless, each of the story examines some part of the subject matter. *Flight to Forever* focuses on the feasibility of time travel and the limitations of laws of physics, whereas *By His Bootstraps* is more interested in the causal loops. On the other hand, the focus of *A Sound of Thunder*, *Experiment* and *The Men Who Murdered Mohammed*

lies in the consequences of travelling to the past. All in all, although science fiction is substantially influenced by hard sciences, it is not fully consistent with it. The authors go further in their treatment of time travel than the scientists as they have unlimited freedom to write about any reality they can think of.

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