MECHANICAL ROOTS OF *TRACTATUS* : THE INFLUENCE OF HERMANN VON HELMHOLTZ, HEINRICH HERTZ AND LUDWIG BOLTZMANN ON EARLY WITTGENSTEIN PHILOSOPHY AND THE TRACTARIAN PICTURE THEORY

A THESIS SUBMITTED TO

THE GRADUATE SCHOOL OF SOCIAL SCIENCES

OF

MIDDLE EAST TECHNICAL UNIVERSITY

BY

OSMAN BARAN KAPLAN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR

THE DEGREE OF MASTER OF ARTS

IN

THE DEPARTMENT OF PHILOSOPHY

MAY 2022

Approval of the thesis:

MECHANICAL ROOTS OF *TRACTATUS*: THE INFLUENCE OF HERMANN VON HELMHOLTZ, HEINRICH HERTZ AND LUDWIG BOLTZMANN ON EARLY WITTGENSTEIN PHILOSOPHY AND THE TRACTARIAN PICTURE THEORY

submitted by **OSMAN BARAN KAPLAN** in partial fulfillment of the requirements for the degree of **Master of Arts in Philosophy, the Graduate School of Social Sciences of Middle East Technical University** by,

Prof. Dr. Yaşar KONDAKÇI
Dean
Graduate School of Social Sciences _____

Prof. Dr. Şeref Halil TURAN
Head of Department
Department of Philosophy _____

Assoc. Prof. Dr. Aziz F. ZAMBAK
Supervisor
Department of Philosophy _____

Examining Committee Members:

Prof. Dr. David GRÜNBERG (Head of the Examining Committee)
Middle East Technical University
Department of Philosophy _____

Assoc. Prof. Dr. Aziz F. ZAMBAK (Supervisor)
Middle East Technical University
Department of Philosophy _____

Assoc. Prof. Dr. Eren RIZVANOĞLU
Van Yüzüncü Yıl University
Department of Philosophy _____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last Name: Osman Baran KAPLAN

Signature:

ABSTRACT

MECHANICAL ROOTS OF *TRACTATUS*: THE INFLUENCE OF HERMANN VON HELMHOLTZ, HEINRICH HERTZ AND LUDWIG BOLTZMANN ON EARLY WITTGENSTEIN PHILOSOPHY AND THE TRACTARIAN PICTURE THEORY

KAPLAN, Osman Baran
M.A., The Department of Philosophy
Supervisor: Assoc. Prof. Dr. Aziz F. ZAMBAK

May 2022, 103 pages

In this thesis, the biography of Ludwig Wittgenstein, who put forward Tractarian picture theory, which is the subject of the thesis, will be told by focusing especially on his life story before he wrote the *Tractatus,* and then the general structure of the *Tractatus* will be discussed. In addition, an introduction will be made by referring to Tractarian picture theory. Then, after the "sign"-based perception theory of Hermann von Helmholtz, who was originally the grandfather of Tractarian picture theory, is explained in detail, the "mechanics" of Heinrich Hertz, a figure that Wittgenstein openly stated to be influenced, will be discussed. As it is known, Hertz was inspired by the "sign" based perception theory of his teacher Helmholtz while developing his "picture theory". Next, we will consider the similarities between Wittgenstein and Hertz and show where Wittgenstein was influenced by the Hertzian understanding of mechanics. Finally, we will talk about the famous Austrian physicist Ludwig Boltzmann's own *Bildtheorie*, which had great effects on the early Wittgenstein, and

we will clarify the relationship between it and the Tractarian picture theory. However, by arguing that the Boltzmannian picture theory is a naturalist epistemology based mostly on the Darwinian understanding of evolution, we will show that Boltzmann's main influence on Wittgenstein is related to the role he assigned to philosophy in the *Tractatus*.

Keywords: Picture Theory, Ludwig Wittgenstein, Hermann von Helmholtz, Heinrich Hertz, Ludwig Boltzmann

ÖZ

*TRACTATUS*UN MEKANİK KÖKLERİ: HERMANN VON HELMHOLTZ, HEINRICH HERTZ VE LUDWIG BOLTZMANN'IN ERKEN DÖNEM WİTTGENSTEİN FELSEFESİNE VE *TRACTATUS*'TAKİ RESİM TEORİSİ'NE ETKİLERİ

KAPLAN, Osman Baran
Yüksek Lisans, Felsefe Bölümü
Tez Yöneticisi: Doç. Dr. Aziz F. ZAMBAK

Mayıs 2022, 103 sayfa

Bu tezde, önce tezin konusu olan *Tractatus*'ta kendi resim kuramını ileri süren Ludwig Wittgenstein'ın biyografisi, bilhassa *Tractatus*'u yazmadan önceki yaşam öyküsüne odaklanmak suretiyle anlatılacak daha sonra da *Tractatus*'un genel yapısı *Tractatus*'taki resim teorisine değinilmek suretiyle ele alınacaktır. Ardından *Tractatus*'taki resim teorisinin kökensel olarak büyükbabası olan Hermann von Helmholtz'un "im" [*sign*] temelli algı kuramı detaylı olarak açıklandıktan sonra, Wittgenstein'ın etkilendiğini açıkça belirttiği bir figür olan Heinrich Hertz'in "mekanik"i ele alınacaktır. Bilindiği üzere Hertz, kendi *Bildtheorie*sini geliştirirken hocası Helmholtz'un "im" temelli algı kuramından esinlenmiştir. Daha sonra Wittgenstein ve Hertz arasındaki benzerlikler ele alınacak ve Wittgenstein'ın Hertzçi mekanik anlayışından hangi noktalarda etkilendiği gösterilecektir. Son olarak, erken dönem Wittgenstein üzerinde büyük etkileri olan Avusturyalı ünlü fizikçi Ludwig Boltzmann'ın kendi *Bildtheorie*'sinden bahsedilmek suretiyle *Tractatus*'taki resim

kuramıyla arasındaki ilişki açık hale getirilecektir. Ayrıca Boltzmanncı resim kuramının daha çok Darwinci evrim anlayışına dayanan doğalcı bir epistemoloji olduğunu savunularak, Boltzmann'ın Wittgenstein üzerindeki asli etkisinin, onun *Tractatus*'ta felsefeye biçtiği rolle ilgili olduğu gösterilecektir.

Anahtar Kelimeler: Resim Kuramı, Ludwig Wittgenstein, Hermann von Helmholtz, Heinrich Hertz, Ludwig Boltzmann

This thesis is dedicated to my parents, Selvi and Mehmet Kaplan, for their moral and financial support they have provided me until this age.

ACKNOWLEDGMENTS

First of all, though this brief acknowledgment is quite insufficient in comparison to my debt to him, I would like to express my endless thanks to my supervisor Assoc. Prof. Dr. Aziz F. Zambak, who was very generous to me in sharing his knowledge and experience with me both during my undergraduate and graduate education.

I would also like to thank the research assistants Berk Yaylım and Taylan Cüyaz and department secretary Nurgül Aygül for their assistance in technical and procedural matters.

I would like to thank my classmates Mehmet Derya Hazar, Cenk Çelik, Mert Ak and Çağrı Ertem for their loyal friendship. I would also like to express my gratitude to Ahmet Demirhan for guiding me in every matter where a brother can guide his brother, including the writing of this thesis. Undoubtedly, Mehmet Demirhan and M. Maşuk Aktaş deserve a special thanks for encouraging me in this process. I am also grateful to Mevlüt Çelik for providing me with all the sources that I could not access during the writing process of the thesis. Finally, without the endless and unconditional support of my parents, this thesis would never have been written. Last but not least, I would like to thank my dear fiancé Ferhan Başer for her patience and unconditional love.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

We expect the next big step in philosophy to be taken by your brother
(Monk, 1990, p. 55).

Ludwig Joseph Johann Wittgenstein, who was born in 1889 as the eighth and last child of Wittgensteins, one of the leading families of the Vienna bourgeoisie, pioneered a revolutionary transformation in philosophy with the effect it created in the philosophy atmosphere of the twentieth century. Wittgenstein, who is often mentioned with the logician positivists, and his book *Tractatus*, which he witnessed published throughout his life, was translated into English in 1922 and soon became popular in the philosophy circles of Great Britain. Undoubtedly, Bertrand Russell is one of the people who introduced Wittgenstein to the philosophical/intellectual world. Although the friendly relationship between Russell and Wittgenstein, which started with discussions on the foundations of mathematics and logic, was worn out by Wittgenstein's stormy life, angry character and selfish wishes, probably the main factors that shook this relationship were the changes in Wittgenstein's philosophical thoughts. Wittgenstein's life in Cambridge is often the most dedicated chapter in books dealing with both his biographies and his philosophical stance. In fact, it would not be wrong to say that the origins of Wittgenstein's entire intellectual world were treated as if it consisted of only this part of his life. However, of course, it is wrong to consider the world of the person, the culture he is influenced by, only from a certain period of his life. It would also be unfair to do this to a person like Wittgenstein who did not belong to an ordinary family and therefore did not grow up in an ordinary environment. In this thesis, we will focus on Wittgenstein's pre-*Tractatus* life, and how his engineering education, especially in Berlin and Manchester, inspired him

while writing the *Tractatus*. As it is known, Wittgenstein was an engineer before he entered the stage of philosophy as a philosopher. The idea of 'mechanics' as a dominant scientific model in the late nineteenth and early twentieth centuries was, of course, at the forefront of the scientific theories that Wittgenstein was likely to have been taught during his engineering education. At that time, one of the first books that came to mind when talking about mechanics was Heinrich Hertz's *Principles of Mechanics*. In this book, Hertz first established a mechanical world concept based on definitions, and then tried to explain the phenomena such as sound and light, which scientists were trying to explain at that time, by reducing them to mechanics. The idea, of course, did not come to Hertz out of the blue. Hertz's mechanics constituted a kind of "picture" in that it was a kind of "representation" of the world, and it is quite possible that Hertz borrowed this idea from his teacher, Hermann von Helmholtz, who developed a neurophysiologically based theory of perception. Hermann von Helmholtz is one of the rare figures that we can easily call a scientist-philosopher in our age. Helmholtz, who was introduced to the ideas of names such as Kant and Fichte at an early age, thanks to his father, began to be interested in human cognition at an early age. Although he had to study medicine due to the financial difficulties of his family, he later made important contributions to physics, such as his discovery of the "law of conservation of energy". Helmholtz's indirect contribution to the Tractarian picture theory in relation to this thesis is the development of a neurophysiology-based theory of perception. For Helmholtz, the main question was about the secret to the success of our intuition and way of thinking in representing the external world. How could objects in the external world exhibit a reciprocity with mental ideas? Although Helmholtz mentioned that our senses can sometimes mislead us, he claimed that he usually does not. He claimed the success we achieved in our actions regarding the world as the reason for this. We can walk very simply, fulfill our wishes, for example, when we are thirsty, we can go to the tap and fill a glass with water and drink it. During all these processes, if our perceptions were deceiving us, we would certainly not be able to even drink water. Helmholtz, while proposing

a theory of perception based on the senses and therefore the sense organs, compares himself with a chemist while explaining why it starts from the sense organs. Just as a chemist cannot begin his experiments without being sure of the accuracy and precision of his devices and experimental equipment, Helmholtz does not begin to explain how perception works without learning the structure and working style of the sense organs, which he sees as his own equipment (Helmholtz, 1862/1995). According to Helmholtz, we perceive the external world through our sense organs, and each of us's perception is an "impression" because it is an individual perception. Helmholtz argues that these impressions about the external world, which we obtain through our senses, function as a "sign" in the formation of the external world. The reason why Helmholtz particularly preferred the word "sign" here is that the "sign" does not bear any resemblance to the object it represents. For example, because an "image" "represents" a reality, it has a certain kind of commonality with that reality. However, the "sign" has nothing in common with the object in the external world, just as it has nothing in common between the letters in a word and the meaning of the word, that is, the object it points to. In addition, because our “impressions” are subjective, “signs” are also subjective, which means they have no objective meaning, but despite their subjective meaning, we succeed in our actions because we learn the interpretation of these "signs" through experience. What is meant by experience here is the success we have achieved in practice, so only the correct interpretation of the "signs" will make us successful in our actions. At this stage, we encounter the problem of explaining the reciprocity of “signs” with objects in the external world. Helmholtz responds briefly by arguing that every change in the physical world has a cause. According to this, behind all changes there are unchanging material substances, which reminds us of Kant's "noumena". An unchanging characteristic feature of objects in the material world is the "force" they possess. On the other hand, we can never know matter and force directly, we perceive them only through our nerve endings, which are stimulated as a result of the physical and chemical changes they cause in our sense organs. Helmholtz defines these forces of material objects as

"acting forces", which allow them to affect our sense organs. According to Helmholtz, if "movement" is the "moving force" underlying all changes, then science must refer to mechanics, that is, the science of motion, to explain the phenomena. According to Helmholtz, “the final goal of the sciences is thus to find all the movements and driving forces supplying the foundation of all other change. In other words, the final goal of the sciences is to dissolve themselves into mechanics.” (as cited in Heidelberger, 1998, p. 11). It is quite obvious that Helmholtz's idea of reducing scientific problems to mechanics influenced his student Hertz. So what is the purpose of Hertz's Mechanics? Hertz sought to offer a philosophically convincing explanation of the gap between theory and experiment. In this way, he appealed to Helmholtz's "sign" theory to clarify what exactly his teacher's representative capacity of physical theories corresponded to, but interpreted it in a very different and new way. If remembered, according to Helmholtz, sensory experiences are "signs" of "matter" and "force" that are never accessible for a person. On the other hand, according to Hertz, what theories, especially scientific theories represent, are the "signs" of the sensory experiences given to us. Accordingly, we can build the external world and make a prediction about the future experience, starting from a theory that we have before, namely representations. Hertz calls this world built through theories "*Bild*", that is, "picture". According to Hertz, we always construct a "picture" of the external world. There is a "conformity" between the relations in this "picture", that is, the relations in the mental representation and the relations in the external world. According to Hertz, it is the experience itself that provides this “conformity”. Lydia Patton explains the relationship between Hertz's *Bild* theory and reality:

> For Hertz, it is possible, then, to show why our scientific explanation of the consequences of a given mechanical experiment describes actual relations. If the system is constructed properly and the experiment is successful, we can show that the experiment, when plugged in to the possible configurations established a priori, rules out at least some of the other possible configurations of the system. This yields a way to test the *Bild* in experience: if the relations within the *Bild* contradict the observed relations, the *Bild* is ‘incorrect’.

> Further, if the *Bild* is logically inconsistent, it is not ‘permissible’ (Patton, 2009, p. 285).

Regarding the influence of Hertz's Mechanics, and therefore *Bildtheorie*'s, on Wittgenstein, James Griffin mentions that Tractarian picture theory was almost entirely borrowed from Hertz. According to Griffin, Wittgenstein applied Hertz's *Bildtheorie* to "language" as a whole (Griffin, 1964). In addition, another similarity between Hertz and the author of the *Tractatus* is their emphasis on conceptual clarity. On the other hand, Wittgenstein makes direct reference to Hertz in his views on mechanics in his *Tractatus*. According to Wittgenstein,

> “Mechanics is one attempt to construct all the propositions that we need for the description of the world according to a single plan (Hertz's invisible masses.). Hertz's invisible masses are admittedly pseudo-objects.” (Wittgenstein et al., 1984).

Another figure who greatly influenced the author of the *Tractatus*, both biographically and intellectually, is the great Austrian physicist Ludwig Boltzmann. As a figure of scientist-philosopher, he argued that some problems of science should be solved jointly with philosophy. Boltzmann influenced early Wittgenstein both through his view of the role of philosophy and his own *Bildtheorie,* because, according to Boltzmann, “each theory is only a mental picture of phenomena, related to them as sign is to designatum” (Boltzmann, 1974, p. 90–91). Although a similarity can be drawn between the theories Boltzmann regards as mental pictures and Wittgenstein's logical pictures, we must say that Boltzmann's *Bildtheorie* is a theory put forward on the basis of Darwinian evolutionary theory. Accordingly, a theory, that is, a mental representation of a phenomenon, is successful to the extent that it serves the human species at the point of survival. However, Tractarian Picture theory rather expresses a linguistic representation mechanism based on ontology and logic. Therefore, it may be misleading to say that there is a strong resemblance between Tractarian picture theory and Boltzmann, because, according to Wittgenstein, “the

relevance of the theory of evolution put forward by Darwin to philosophy is no different from the relevance of other theories in the natural sciences to philosophy" (Wittgenstein, 2001). However, it is clear that Wittgenstein was directly influenced by Boltzmann in the task he assigned to philosophy in the *Tractatus*, for there is a similar kind of anti-metaphysics in Boltzmann as later defended by the logical positivists. It could even be said that Boltzmann was the father of twentieth-century anti-metaphysics, such as philosophers like Carnap, since, according to Boltzmann, figures such as Kant, Hegel and Schopenhauer are figures representing traditional philosophy, so it is almost impossible for science and philosophy to come together to produce a solution to a problem in the philosophies of these figures. For example, Hegel's philosophical system is a moment of historical determination that encompasses all sciences, therefore, in such a system, the natural sciences constitute the kinds of knowledge that exist only as subsets and that can never contain the knowledge of the truth. However, according to Boltzmann, especially physical science should act boldly with the hypotheses and theories it put forward, and it is capable of solving even the problems that seem never to be solved by reducing them to various explanations. According to Boltzmann, there can be no laws which are called the laws of thought and which are never changed and imposed in the form of absolute truth, since, Boltzmann's epistemology is, in a sense, a naturalistic theory of knowledge based on the Darwinian theory of evolution. Accordingly, there cannot be anything that imposes itself as a universal and eternal truth as the laws of thought, because human cognition has developed a representation mechanism that will help it survive the most as a result of its interaction with nature. It is quite possible that it will develop a better mechanism over time and transfer it to the next generations by genetic means. Therefore, according to Boltzmann, even many judgments that seem a priori are actually inherited from the experiences of our ancestors, so such judgments appear to us as innate, just like the laws of thought. Therefore, according to Boltzmann, it may turn out that what seems to be a problem in terms of science or philosophy is not actually a problem. Boltzmann sees the task of science and therefore

philosophy as something close to this view. This task that Boltzmann assigns to philosophy appears in Wittgenstein's *Tractatus* as a Wittgensteinian method that shows that philosophical problems are not actually problems. According to Wittgenstein, philosophy should not solve problems, it should "dissolve" them, that is, show that they are not problems at all.

In this thesis, the biography of Ludwig Wittgenstein, who put forward Tractarian picture theory, which is the subject of the thesis, will be told by focusing especially on his life story before he wrote the *Tractatus*, and then the general structure of the *Tractatus* will be discussed. In addition, an introduction will be made by referring to Tractarian picture theory. Then, after the "sign"-based perception theory of Hermann von Helmholtz, who was originally the grandfather of Tractarian picture theory, is explained in detail, the "mechanics" of Heinrich Hertz, a figure that Wittgenstein openly stated to be influenced, will be discussed. As it is known, Hertz was inspired by the "sign" based perception theory of his teacher Helmholtz while developing his "picture theory". Next, we will consider the similarities between Wittgenstein and Hertz and show where Wittgenstein was influenced by the Hertzian understanding of mechanics. Finally, we will talk about the famous Austrian physicist Ludwig Boltzmann's own *Bildtheorie*, which had great effects on the early Wittgenstein, and we will clarify the relationship between it and the Tractarian picture theory. However, by arguing that the Boltzmannian picture theory is a naturalist epistemology based mostly on the Darwinian understanding of evolution, we will show that Boltzmann's main influence on Wittgenstein is related to the role he assigned to philosophy in the *Tractatus*.

CHAPTER 2

EARLY WITTGENSTEIN: AN ENGINEER'S PHILOSOPHICAL ADVENTURES

2.1. Ludwig Wittgenstein's Biographical Background and the Effects of His Engineering Career on the Understanding of the Universe in the Tractatus

Ludwig Joseph Johann Wittgenstein was born on April 26, 1889, the eighth and youngest child of one of the wealthiest and most prominent families in Habsburg Vienna. The residence of the Wittgenstein family was a place where important musicians of the period such as Johannes Brahms, Joseph Joachim and Gustav Mahler regularly gave concerts. Of course, this wealth was too great to be content with having a single residence. The Wittgenstein family owned many estates in and around Vienna, so it would be fair to say that little Wittgenstein grew up in an environment where mostly Viennese bourgeoisie were present. Wittgensteins' breadwinner, Karl Wittgenstein, acquired this wealth, which Wittgenstein later shared with famous artists of the period, through the Austrian iron and steel industry. Although Karl Wittgenstein was brought up as a Protestant, the Wittgenstein family was essentially Jewish. The Wittgensteins' fortunes were traced back to Karl's grandfather, Moses Maier. Maier later took "Wittgenstein", the surname of the owner of the farm where he worked. Karl Wittgenstein was also a very helpful figure to painters. In fact, the wedding portrait of Margarete Wittgenstein, Wittgenstein's sister and known as the most intellectual figure of the family, was made by the famous painter Gustav Klimt. Margarete Wittgenstein introduced her brother Ludwig to Otto Weininger and Arthur Schopenhauer, who were great personalities of the time and who would have great influences on Wittgenstein's life. Although culturally and intellectually, the Wittgensteins' home seemed like a happy and peaceful home, it was not. Ludwig's two eldest brothers, Hans and Rudi Wittgenstein, had committed

suicide at a young age. First Hans disappeared, and then Rudi, quite tragically, committed suicide. Learning from all these misfortunes, father Karl Wittgenstein began to respect the career choices of his other sons. Another of Ludwig's older brothers, Kurt, chose military service, while Paul became a musician. Her older sister Helen also chose a career in music. However, Ludwig had a different educational life from his siblings. Private tutors hired for his brothers who committed suicide were not hired for Ludwig or he was not sent to the most distinguished schools of Vienna. Even more interestingly, he was sent to a school in Linz, where a generally working-class family sent their children. In fact, this school was a school where the history teacher, who later admitted that he had learned the German populist ideas of Hitler from him, also served. Ludwig Wittgenstein attended this school for three years, but his grades were pretty bad and he didn't make much progress at this school. Alongside Schopenhauer and Weininger, Wittgenstein was also interested in a book that had a profound effect on his philosophical ideal in the *Tractatus*: *Principles of Mechanics*. Heinrich Hertz's famous *Principles of Mechanics* prompted Wittgenstein to develop a philosophical ideal based on showing that philosophical problems are not problems rather than trying to solve them. Another great scientist who caught Wittgenstein's interest was Ludwig Boltzmann, one of the physics geniuses of the time, who held a chair as a professor at the University of Vienna.

> Ludwig learnt much more from Hertz and Boltzmann: here he found the idea that science was a picture or model created by the mind, often with the utmost daring and freedom. He was to use Boltzmann's idea that different fundamental hypotheses-Ludwig called them networks might equally fit the world, and he was to use the ideas of both scientists in developing his more general account of language as well as of science (McGuinness, 2005, p. 39).

Unfortunately, while Wittgenstein was making plans to work with Boltzmann in the fall of 1906, after two years of depression, Boltzmann committed suicide on September 5, 1906. According to Wittgenstein biographer McGuinness, Hertz and Boltzmann gave Wittgenstein the idea that reality is a mental picture or correlated

with one such picture (McGuinness, 2005). Furthermore, in the "D. Company" section of Appendix A of John Blackmore's biography of Boltzmann, the following words are included regarding the relationship between Wittgenstein and Boltzmann:

> Given Wittgenstem's strong identification with the linguistic phase in Boltzmann's thought circa 1904-1905 which is only present in published form in three short pieces in Boltzmann's *Populare Schriften*, this translator has the suspicion that Wittgenstein must have had some other contact with Boltzmann's ideas, either through newspaper accounts, a friend who attended Boltzmann's lectures, or his own presence at some of them. It is also known that a fellow professor, Alois Hofler, gave lectures in Vienna on the similarities and differences between the Ideas of Mach and Boltzmann. He had difficulty obtaining official permission for the lectures, but by 1909-1910 he did give them and possibly unofficial ones earlier, hence, there were other ways in which Wittgenstein could have become attracted to a linguistic philosophy which had so many resemblances to what Boltzmann had been thinking (Blackmore, 1995, p. 220).

After Boltzmann's suicide, Wittgenstein, who gave up studying physics at the University of Vienna, decided to study mechanical engineering at the Technische Hochschule and went to Berlin. However, in the summer of 1908 he gave up on this idea and went to England with the intention of studying aviation at the University of Manchester. There he had a research project of his own that involved designing an aircraft engine. Although the design he produced here was new and original, it was not a useful design for airplanes. The period when Wittgenstein's interest in mathematics and therefore logic began, corresponds to the time when the famous English mathematician John Edensor Littlewood attended mathematics classes. At the same time, Wittgenstein began to focus on problems related to the logical foundations of mathematics during this period of various conversation groups where discussions on the philosophy of mathematics were held. This interest led Wittgenstein to two of the most revolutionary books of the time, Frege's The Foundations of Arithmetic and the Principia Mathematica, jointly written by Alfred N. Whitehead and Bertrand Russell. Wittgenstein, who later went to Cambridge to visit Russell, asked Russell for his impressions of his philosophical talent. Russell

told Wittgenstein to bring an essay after the Christmas holidays, there is no information about the content and subject of the article. Receiving the manuscript after his vacation, Russell told Wittgenstein that he was even better at philosophy than his English students and encouraged Wittgenstein to continue with philosophy. We have almost no evidence of what kind of philosophical questions Wittgenstein was preoccupied with at that time, other than what Russell mentioned in his letters to his lover Ottoline Morrell. Wittgenstein, who went on holiday to Norway with Pinsent in the summer of 1913, decided to leave Cambridge and live for a while in a house on a hillside near the shore of a remote fjord in order to implement his plan. Wittgenstein, who wrote down his thoughts on logic during his solitary life in Norway, tried to persuade his Cambridge friend, the famous morality professor G. E. Moore, to visit him. All his efforts paid off, and Moore spent two weeks in Norway with Wittgenstein. In the process, he also dictated his notes to Moore. On the other hand, he asked Moore for help in getting these grades accepted as his graduation thesis when he returned to Cambridge. Although Moore was against it, Wittgenstein, with all his childish anger, managed to persuade Russell and Moore and got what he wanted. Wittgenstein returned to Vienna in July 1914, and in 1914 World War I broke out. Wittgenstein, who made a request to be a soldier in the army in August of the same year, was assigned as an infantryman to an artillery regiment on the eastern front. In March 1916, he demanded to serve in the army not as an engineer but as a soldier, and his request was accepted. During this time, when he was at the forefront of the front, he began to write the drafts of a groundbreaking book in 20th century philosophy: *Tractatus-logico Philosophicus*. Wittgenstein was sent to be trained as a military officer at Olmütz headquarters in Moravia by September 1916, where he met Paul Engelmann, who would later become his close friend and with whom they would collaborate on the design and construction of Stonborough House. Engelmann was an architect who helped Karl Kraus in his anti-war campaign. Wittgenstein included the mystical elements in the *Tractatus*, most probably under the influence of Engelmann. Although Wittgenstein later returned to the Russian front, the end of the

war was accelerated as the October Revolution destroyed Tsarist Russia, but Wittgenstein was not sent to the Italian front until March 1917. Wittgenstein, who also showed himself with his courage and success on the Italian front, was given a time off, and Wittgenstein spent this leave at his uncle's house in Hallein. Here this groundbreaking book known as *Tractatus*-logico Philosophicus was completed in a town in Salzburg. Meanwhile, Wittgenstein would also receive the news of the death of his friend, to whom he addressed the words that would fill the dedication page of his *Tractatus*: David Pinsent died in a plane crash while doing aerodynamic research. In the preface to the *Tractatus*, Wittgenstein claimed that he had solved all the problems of philosophy to the end. The book was interestingly organized. It consisted of numbered propositions and consisted of propositions listed under seven main propositions in total. The *Tractatus* was the embodiment of a theory of meaning that Wittgenstein had pondered ever since he stepped into Cambridge, accordingly, propositions belonging to fields such as ethics and aesthetics were excluded as meaningless from this theory of meaning. On the other hand, another unusual aspect of the book is that it has a structure that seems to refute itself, because the claim of the *Tractatus* is to draw a boundary between the meaningful and the non-meaningful, but as Wittgenstein expressed, this effort to draw the boundary itself was outside the meaning as it is, therefore, it presented a paradoxical situation. Wittgenstein tried to get out of this situation with the metaphor of a "ladder". Accordingly, the person will use this book as a "ladder" to see the scene in the most realistic way, and once he sees it and understands it, he will kick the "ladder" and throw it aside. Wittgenstein sent the book to Karl Kraus' publisher, Jahoda, as soon as he finished it, but the publisher refused to print it. Wittgenstein, who did not like to be rejected, almost intimidated people with his childish anger until he found a publisher to publish the book. Finally, the famous German publisher Reclam said that he would publish the book, provided that Bertrand Russell, a famous writer of that period, wrote the foreword. However, this time, Wittgenstein did not include Russell's foreword in the book, and therefore the publisher gave up publishing it. In the autumn of 1920, when Wittgenstein took a

job as a primary school teacher in the small Austrian town of Trattenbach, the book was still unpublished. His teaching career was not very promising for Wittgenstein, because he could not contain his anger, he slapped a little girl, who had a bleeding nose and later had to leave the village. The only positive development for Wittgenstein during this time was the news that the *Tractatus* would now be published. The book was to be published with a successful English translation by Charles Kay Ogden and Frank Ramsey, with the German original to be published in the journal Annalen der Naturphilosophie. But the requirement for publication in both languages was the same: a foreword by Russell. The English edition of the *Tractatus* was published in the summer of 1922 [hence its 100th anniversary this year (2022)]. However, the book soon became very influential in England, which later led to Wittgenstein's return to Cambridge. Wittgenstein's sister, Gretl, hired him as architect when Wittgenstein returned to Vienna. Wittgenstein, together with his friend Paul Engelmann, whom he met at the front, designed this house. Wittgenstein, who was again exposed to the vibrant intellectual environment of Vienna during the construction of the house, began to meet with Viennese philosophers led by Moritz Schlick. These philosophers were members of a school of thought that would mark the twentieth century, later known as the "logical positivists" or Vienna Circle. After Cambridge's five-year scholarship to Wittgenstein ended in 1936, he returned to Norway and lived there until the end of 1937. When Adolf Hitler invaded Austria in 1938, he was in Dublin with his former student. He then sought ways to return to Vienna to save his brothers and succeeded in doing so with the British passport he received. Wittgenstein, who later returned to Cambridge, was elected to Moore's chair of moral philosophy in 1939, but declined the offer. During the Second World War, he worked various jobs in London as a patient carrier and technician. Wittgenstein remained in Cambridge for a while after the war, but resigned from his chair in 1947 and returned to Dublin. Towards the end of 1949, Wittgenstein was diagnosed with prostate cancer. Upon receiving this bad news, Wittgenstein prepared himself for death by returning to Vienna, and after staying in the family home in

Alleegasse, he returned to England, where he lived first as a guest of von Wright in Cambridge and then Anscombe in Oxford. In 1951, his condition worsened and he needed intensive care, but the thought of dying in the hospital frightened him. For this reason, he moved to the Cambridge house of his doctor, Edward Bevan, where he spent his last days and died on April 29, 1951.

2.2. The Structure of Wittgenstein's Tractatus

It is not easy to determine exactly when and how Wittgenstein's interest in philosophy began. However, in many Wittgenstein biographies it is written that before Gottlob Frege and Bertrand Russell, who had later influences on Wittgenstein such as logic and mathematics, Wittgenstein was familiar with Arthur Schopenhauer, especially because of his sister's intellectual affinity. Wittgenstein's encounters with these figures, who were the masters of logic and mathematics, while he was studying engineering, may be an indication that his philosophical world has become more and more colorless. In 1921, after a great struggle, Wittgenstein published his first book, *Tractatus* Logico-Philosophicus. In the *Tractatus*, Wittgenstein claimed—in his preface—that he had solved all the problems of philosophy until that day. However, it would not be right to say that this solution is the solution in the first sense that comes to mind. The claim of the *Tractatus* is that problems that seem to be problems are solved by eliminating them. Because, according to Wittgenstein, all philosophical problems were based on a common mistake: the misunderstanding of the logic of language. There are two basic doctrines on which the *Tractatus* is based: picture theory and logical atomism. "Picture theory", which is the subject of this thesis, is essentially the most encompassing principle of the *Tractatus*: reality can be pictured. In Wittgenstein's world in the *Tractatus*, all sentences have to be sentences about the world. Therefore, even sentences with imperative, demand and necessity moods are ultimately related to the world. So ultimately they get their meaning by being related to this world, that is, by having a factual origin. Otherwise they are completely meaningless. Inevitably, the question arises whether non-existent, imaginary things

are meaningful. According to picture theory, the condition for a sentence to be meaningful depends on whether the states of affairs that the sentence expresses are possible or not. Therefore, the sentence cannot picture a fact that is not possible in the world. Whether the sentence is correct or not depends on whether the case in question has occurred, that is, on its actuality. A sentence is made up of words, just as a substance/matter is made up of atoms. Therefore, words are the building blocks of sentences. Therefore, the way words come together is certain, they cannot come together in a way that is not possible in factual world. For example, the words "blue" and "taste", when combined in a sentence as "It has a blue taste.", this sentence will be utterly meaningless. Therefore, things that are not describable in language have no meaning, because they do not refer to a possible state of affairs in the actual world. According to Wittgenstein, the tool that provides this reciprocity between the world and language is logic. But logic functions as a mirror, showing itself only in language. Thus, language only pictures possible states of affairs. Therefore, all sentences that do not depict a possible state of affairs are meaningless. However, there are many expressions that this doctrine throws out of the world. Sentences that do not have a factual basis, that is, do not depict a possible state of affairs, are meaningless, especially the expressions of ethics and aesthetics. However, the fact that these expressions are meaningless does not mean that Wittgenstein denigrated them as useless. On the contrary, Wittgenstein argues that states of affairs in the world are governed by an accidentality, while ethics and aesthetics should stay out of the world as such non-randomness. Here's what Wittenstein says on the subject:

> The sense of the world must lie outside the world. In the world everything is as it is, and everything happens as it does happen: in it no value exists—and if it did exist, it would have no value.
>
> If there is any value that does have value, it must lie outside the whole sphere of what happens and is the case.
>
> For all that happens and is the case is accidental.
>
> What makes it non-accidental cannot lie within the world, since if it did it would itself be accidental.

It must lie outside the world (Wittgenstein et al., 2001, p. 86).

Now, let's take a closer look at the "picture theory"-based theory of meaning built by Wittgenstein in the *Tractatus*, since it constitutes the subject of our thesis.

2.3. Tractarian Picture Theory

First of all, the "picture theory" put forward in the *Tractatus* is the result of a world perception based on the idea of "representation". As it is known, "representation" is the transfer of an object or phenomenon in another representation mechanism, such as a linguistic or mental mechanism, through another means of representation, for example a picture in the case of the mind, and words in the case of language. The "representation" tool that the *Tractatus* refers to is language. So what does language mean by itself? Of course it doesn't mean anything. A language is a tool that has the potential to present a representation of the world, thanks to the words it contains and the grammatical rules it has. The language in the *Tractatus* is primarily a language of propositions. The meaning of the propositions of this language is determined by their internal structure. Wittgenstein claims that the symbols that make up the proposition come together in a certain combination style and determine the structure of its meaning.

Let's start with "objects", the most basic and simple element of *Tractatus*' ontology. According to Wittgenstein, objects must be somehow internally related to the objects with which they will come together. The most fundamental thing for an object is that it is a component of an atomic fact. Moreover, if an object is contained within an atomic fact, its existence in that atomic fact is already predetermined by the possibility of the atomic fact. Therefore, the occurrence of an object in an atomic fact is purely because the fact in question is a possible state of affairs for that object (TLP 2.011–2.0121). On the other hand, if objects were only externally related to the possible states of affairs in which they were located, there would have to be deeper

facts indicating which facts these objects can and cannot take place in. Tractarian objects are just like atoms. In short, they are simple, that is, they cannot be broken down into smaller parts. Also, the form of an object is the possible states of affairs of that object. Possible states of affairs in the world consist of a combination of these objects. Therefore, a world picture must contain these objects. In propositions 2.1 of the *Tractatus*, in order for a picture to represent -rightly or falsely- a state of affairs in the world, it must have something in common with the states of affairs in question, which can be called reality (Wittgenstein et al., 2001). According to Wittgenstein, this thing is "form of representation". The fact that the elements in the picture come together in certain ways and display a harmonious picture represents the coming together of things in the same way. According to Wittgenstein, this connection between the elements of the picture is the structure of the picture, and the possibility of the structure of the picture creates the form of representation of the picture. Here the structure and form of the picture corresponds to the structure and form of a possible state of affairs. The way objects come together in an atomic fact expresses the structure of the atomic fact. Therefore, according to Wittgenstein, form is the possibility of structure (TLP 2.033). Thus, the reality form of the proposition representing a possible state of affairs and its representation form are identical. So why is picturing an internal kind of relationship for Wittgenstein? The reason why Wittgenstein does not allow an external relationship between the form of the proposition and the possible state of affairs is related to the properties of the object, since, what makes an object itself is not some external features it has, but its internal features. Therefore, the correspondence between a name and an object is independent of how the object and the name are, it is related to what it is. In short, there is an internal relationship between object and name, otherwise there would be no way to determine which object corresponds to what in which possible state of affairs, that is, what its name is. This internal property of the object allows the names as the building blocks of propositions and therefore propositions to depict the state of affairs in question.

CHAPTER 3

HERMANN VON HELMHOLTZ: A NEUROPHYSIOLOGICAL THEORY OF PERCEPTION

3.1. Biography of Hermann von Helmholtz on the Background of His Career in Medicine and Physics

Hermann von Helmholtz, full name Hermann Ludwig Ferdinand Helmholtz, (31 August 1821, Potsdam, Prussia [Germany] - 8 September 1894, Charlottenburg, Berlin, Germany), German scientist and philosopher who made fundamental contributions to physiology and optics, electrodynamics, mathematics and meteorology. He is best known for his explanation of the law of conservation of energy. He brought into his laboratory research the practice of analyzing the philosophical assumptions on which much of 19th century science was based, and he did so with precision (Pearce, 2021, September 4). However, related to our subject, one of the most striking details in Helmholtz's biography is that his father trained him in painting and music. It was also his father who introduced him to figures such as Kant and Fichte, who also taught him classical languages. In Helmholtz's own words:

> The interest for questions of the theory of cognition, had been implanted in me in my youth, when I had often heard my father, who had retained a strong impression from Fichte's idealism, dispute with his colleagues who believed in Kant or Hegel (Helmholtz, 1862/1995, p. 390).

However, the epoch-making and revolutionary developments in physical science in that period enabled Helmholtz, as a physician and physiologist, to take a stance in favor of empiricism, a form of philosophy based on sensation and physiology, against the figures of speculative philosophy, such as Kant and Fichte, with whom he was familiar. So much so that it is possible to observe this empiricist point of view in his

masterful *Handbook of Physiological Optics* (1867), because this book, like Helmholtz's other scientific works, was written with a philosophical insight, shaped by precise physiological research and illustrated with mathematical precision and sound physical principles. Helmholtz's approach to nature, which has clearly permeated his way of doing science, showed itself in the first scientific researches he worked on in the laboratory of Johannes Müller, one of the famous biologists of the time, while he was continuing his doctorate process. Helmholtz's views on his teacher Müller are as follows:

> When I think of my own student life, and of the impression which a man like Johannes Muller, the physiologist, made upon us, I must place a very high value upon this latter point. Anyone who has once come in contact with one or more men of the first rank must have had his whole mental standard altered for the rest of his life. Such intercourse is, moreover, the most interesting that life can offer (Helmholtz, 1862/1995, p. 350).

Let's talk briefly about Müller's research that influenced Helmholtz. According to Stanley Finger and Nicholas J. Wade, in Müller's theory, the sensations we experience depend on the nerves that are stimulated, no matter how these nerves are stimulated. Similarly, whether our optic nerves are stimulated by light, electricity, or pressure, our phenomenological experience will be visual rather than auditory, olfactory, tactile, or gustatory. Backed by numerous observations on each of the sensory systems, Müller's groundbreaking idea became known as the "law of specific nerve energies" (Finger and Wade, 2002, p. 235).

One of the most important tools that Helmholtz, who invented many technical tools during his life, discovered especially in relation to our subject, is a measurement tool called ophthalmoscope, which is frequently used by ophthalmologists. During his research on the eye, Helmholtz discovered that he could focus the light reflected from the retina to obtain a sharp/clear image of the organ. This, of course, constituted supporting evidence that everything could be explained by mechanical laws, as a

thought that formed the basis of Helmholtz's philosophy and scientific worldview, against those who tried to explain the processes in the eye, which acts as an intermediary organ between the outside world and the mind, by resorting to some vitalist assumptions. Although Helmholtz's researches, which he carried out with the ideal that all sensations, especially vision and hearing, could be explained by mechanical laws during his life, it is still possible to see it as an unfinished project due to the fact that our searches for this kind have not come to an end. However today, a complete, purely sense-based explanation of consciousness and the mind, and how we "represent" the outside world, has not yet been given, especially by neuroscience and psychology. But since these are another kettle of fish, we will now examine the background of Helmholtz's view that sensing is purely mechanical processes and can be explained by natural laws. Later, we will show how the sensation-based "representation", which appears as "picture theory" in Wittgenstein, is first presented in the context of Helmholtz. Now let's look at the details of a sense-based understanding of philosophy-science in which Helmholtz places epistemology at the center of philosophy.

3.2. Hermann von Helmholtz's View of Philosophy

According to Helmholtz epistemology was the fundamental question posed regarding the beginning of all sciences at that time: "What is the truth in our intuition and thinking, and in what sense do our ideas correspond to truth?" Philosophy and the natural sciences approached this problem from two opposite directions; however, solving this problem is the joint task of both. The first, which deals with the intellectual aspect, tries to exclude from our knowledge and ideas what arises from the effects of the material world in order to express what belongs to the mind's own activity. The natural sciences, on the other hand, seek to separate things from one another by definition, naming, representation, and hypothesis, in order to preserve as pure a remnant as possible what belongs to the world of reality whose laws it seeks. Both try to achieve the same split even if they are dealing with another part of the

split. Even a naturalist cannot avoid these questions in his theory of sense perceptions or in his investigations of the fundamental principles of geometry, mechanics, and physics (Helmholtz, 1862/1995). Although Helmholtz seemed to follow a Cartesian scheme, he was of the opinion that the problem created by this division between the mind and the external world would be solved by joining hands with philosophy, which was engaged in the mind, and the natural sciences, which were concerned with the external world. On the other hand, Helmholtz is not happy with this division between the natural sciences and the intellectual sciences, and he says that this division actually started with Hegel or emerged prominently with Hegel's philosophy. Because, according to Helmholtz, such an opposition was not obvious during the reign of Kantian philosophy. Helmholtz justifies this with these words:

> Certainly, at the end of the last century, when the Kantian philosophy reigned supreme, such a schism had never been proclaimed; on the contrary, Kant's philosophy rested on exactly the same ground as the physical sciences, as is evident from his own scientific works, especially from his 'Cosmogony,' based upon Newton's Law of Gravitation, which afterwards, under the name of Laplace's Nebular Hypothesis, came to be universally recognised (Helmholtz, 1862/1995, p. 78).

According to Helmholtz, since philosophy has always been an inquiry into the sources of knowledge, which also included a Kantian critique, philosophy began to come under the reign of metaphysicians, especially with the works of Hegel and Schelling. According to Helmholtz (Helmholtz, 1862/1995), the sole purpose of Kant's "Critical Philosophy" was to test the sources and authority of our knowledge and to set a certain scope and standard for the study of philosophy in comparison with other sciences. According to his teaching, a principle discovered a priori by pure thought was a rule applicable to the method of pure thought, and never more than that. On the other hand, the 'Philosophy of Identity' attributed to Hegel spoke of frivolous things that were impossible to test. For, according to Hegel, not only psychic phenomena, but even the real world-nature, i.e. man, was the result of a creative mind, hence an act of thought similar to the human mind, called "spirit".

According to this hypothesis, the human mind seemed quite competent, so that without the guidance of external experience it was possible to know the thoughts of the Creator and rediscover them by his own inner activity. In addition, Helmholtz claimed that Hegel's belief in melding the branches of science, especially the physical sciences, within his own philosophy, thanks to the fame he achieved in his own time, triggered the avoidance of philosophy in scientists. According to Helmholtz, Hegel himself was so convinced that his philosophy was victorious that he thought it would succeed in the physical sciences as in all other fields and thus unconventionally and fiercely waged war against natural philosophers, and especially against Isaac Newton as the first and greatest exponent of physical research. While philosophers accused scientists of being narrow-minded, scientists began to look at philosophers as crazy. This led scientists to avoid philosophical influences when conducting scientific research. So much so that even those with the highest intelligence as scientists went so far as to view philosophy as not only useless but also insane ideas. Thus, the illegitimate aim of Hegelian philosophy to subordinate all other sciences to its system was not only rejected but also undermined belief in philosophy's claims to be respected, that is, the critique of the source of knowledge and the definition of the functions of the mind (Helmholtz, 1862/1995). Helmholtz mentions at the jubilee meeting in 1891 that he had little reason to be proud of his research regarding his epistemological preoccupations. Also, many metaphysicians say that it awakens even materialist metaphysicians or people with latent metaphysical tendencies from their sleep, just like Kant. But his conclusion is that the three thousand-year history of philosophy has been a battleground of disagreements, Thus, although Helmholtz may later inspire the preamble of Wittgenstein's *Tractatus* that he "puts an end to the heretofore disputes forever", he says that an average human life is not enough to solve these problems (Helmholtz, 1862/1995). Now that we have explained Helmholtz's view of philosophy in detail, we can now focus on his theory of sensation.

3.3. Hermann von Helmholtz's Theory of Sensation-Based Perception

As I mentioned in Hemlholtz's biography, his father's influence on Helmholtz's philosophical curiosity, especially with figures such as Kant, Hegel and Fichte, inevitably caused Helmholtz to be interested in epistemology. Therefore, it would not be wrong to say that Helmholtz's work on sensations was motivated by his early philosophical curiosity, which was stimulated by his father. Standing closer to an empiricist epistemology, Hemlholtz acknowledges the fact that sense perceptions can sometimes be misleading/deceptive, a fact that many empiricist philosophers admit. However, this does not make Helmholtz a skeptic [just like Descartes and many rationalist philosophers close to him] who hold that the senses can completely and always deceive us. Helmholtz argues that sense perceptions generally do not mislead us, by appealing to the success of our actions in practical/everyday life. If sense perceptions were always of a deceptive character, we would not be able to survive or perform our vital activities that require our actions. According to Helmholtz, our success in our actions often aligns with what is expected, but we cannot speak of success in what are sometimes called subjective impressions. The actions we succeed in are all objective facts, so it is possible to discover the laws that regulate these phenomena. Therefore, Helmholtz's conclusion is that the impressions of the senses are only signs for the constitution of the external world, the interpretation of which must be learned through experience (Helmholtz, 1862/1995).

Let's start by listening to Helmholtz's own words as to why he gave so much importance to sensation.

> For me, however, there is an additional special interest. Early on, my course of study had involved physiological problems: namely, the laws of nervous activity, where the question of the origin of the sense perceptions could not be avoided. Just as the chemist must investigate the correctness and trustworthiness of his scale before starting his own professional work, and the astronomer that of his telescope, so, too, the natural sciences as a whole must

> test the mode of operation of their instruments that are the source of all our knowledge: namely, the human sense organs (Helmholtz, 1862/1995, p. 394).

We perceive an object or a phenomenon in the external world through our senses, such as seeing, hearing and smelling. All these perceptions are experienced as a single experience in a single mind, so we call the experience of the external world by the mind through perceptions and sense experiences as "impression". Some empiricist philosophers have named these experiences of perceptions in the mind as "ideas". According to Helmholtz, the impressions of the senses, that is, the way they are experienced in the mind, serve as a "sign" in the formation of the external world within the mind. Just as words in a language "refer" to objects in the outside world, for example, a "table" image is formed in the mind of the person who hears the word "table" with auditory perceptions. However, Helmholtz argues that these "signs" do not have an objective meaning on their own, that they have an interpretation and that this interpretation can only be learned through experience. Although it is possible to trace the origins of mind/body dualism back to Ancient Greece, Descartes is the first person to put this problem on the agenda of modern philosophy. On the other hand, Descartes, as a rationalist, considered the senses as deceptive/misleading as well as disregarding the role played by the senses in the mental representation of the external world. However, the mental representation of an external world that is not mediated by the senses does not yet seem possible. Therefore, it is our senses that allow us to mentally obtain an approximate representation of the external world, albeit sometimes misleading. Therefore, according to Helmholtz, any attempt to explain mental representation must first begin with the senses, which are the external world's first contact points with our body.

In Helmholtz's theory of sensation, what we perceive about the outside world consists entirely of the external impressions that arise from the interaction between our sense organs and the world and that are stimulated as a result of this interaction, and transmit the relevant stimulus to the brain. Therefore, the brain, where impressions

emerge, can only have them through certain changes which of them are produced in our organs. All these stimuli are brought together in the brain to create an impression. So, for example, in the case of vision, when photons reflected from objects in the outside world are reflected on the retina, the impression of the relevant objects is formed in the brain, not the retina. Helmholtz proves this fact by eye, accordingly, the proof that visual perception is produced only in the brain, not directly on the retina, lies in the fact that the visual impression of any three-dimensional solid object is produced only by combining the impressions obtained from the two eyes (Helmholtz, 1862/1995). Furthermore, as a result of the interaction of the five sense organs with the external world, the neural mechanism common to all these senses, that is, the neural infrastructure, is the same. For this reason, the changes that occur as a result of the interaction in the nerve endings of these organs are subject to the same kind of physical and chemical laws of nature, since they are the same kind of physical and chemical changes. However, we must underline Helmholtz's emphasis on sense organs. Because, according to Helmholtz, the neural infrastructure of the sense organs is connected with the "brain" as the last stop of the appearance of the mental life we call "impression". Therefore, they have a different purpose/function from other motor nerves in the body, such as nerves associated with muscles. If we explain this by giving an example regarding vision, no part of our body except the eye has the capacity to form an "impression" in the mind by reacting to the "light" stimulus in the external world. In fact, aside from causing an impression, we do not have any organs other than the eye where "light" can cause a neural change in the organ. I don't mean a change like being able to cut through the body like laser beams, I'm talking about an external influence where neural connections can deliver a "meaningful" message without damaging the existing neural infrastructure. So we can only see through our eyes, because the neural infrastructure in our hands is conducive to the sense of “touch”, not “seeing”. Helmholtz proves this through the following example of the wound:

> After the wound had healed, they found that irritation of the upper half, which in normal conditions would have been felt as a sensation, now excited the engine branches below, and thus caused the muscles of the tongue to move. We conclude from these facts that all the difference which is seen in the excitation of different nerves depends only upon the difference of the organs to which the nerve is united, and to which it transmits the state of excitation (Helmholtz, 1862/1995, p. 150).

Furthermore, according to Helmholtz, the effect that produces the sensation of light is not necessarily the light itself, it is possible to have light-like sensations in your mind when you apply pressure on your eyelids with your hand, or when you get a solid punch. Helmholtz's conclusion is that any external factor that can stimulate our optic nerves or affect this neural structure can cause a "light" sensation in the mind (Helmholtz, 1862/1995). Therefore, although it is dependent on external effects for the emergence of a situation that seems completely subjective [totally accessible to the individual], such as the sensation of light in the mind, these external effects are not limited to "light", because what creates sensation is physical and chemical changes in the optic nerves. However, the cone and rod cells in the retina are only sensitive to the light coming from outside, so it cannot be said that the retina has much function in the sensation created by the physical changes in the optic nerves. Therefore, Helmholtz's conclusion is as follows: “Similar light produces a similar color sensation under similar conditions. Lights that activate different color sensations under similar conditions are not alike” (Helmholtz, 1862/1995, p. 166). At this point, Helmholt mentions a difference between "sign" and "image". The difference between a "sign" and an "image" is based on the difference in the type of what they represent, that is, a "sign" is something that signifies the existence of something other than itself, it has no existence independent of what it represents. On the other hand, there must be a generic partnership between what is called "image" and the object it represents, for example, a photograph of a person has a commonality with that person himself, that is, the person's body [i.e. whichever parts of the person's body are present in the photograph, e.g. face, shoulders, feet, etc.]. For Helmholtz, we explained that our senses are things that exist as a result of and in proportion to

the effects of the physical world on our sense organs. Therefore, the nature of such effects, that is, the changes that occur in our sense organs, is completely related to the reactions of our sense organ to these effects, namely with which sense organ it interacts. The quality of what we sense depends on the effect of the external world on our sense organs. Therefore, the quality of our sensation is not an "image" of the external world's influence on our sense organs, but a "sign". In other words, it does not have any partnership with the outside world, it only refers to the entity outside itself, that is, to the outside world. In short, what we call sensations are "signs" of relations in the physical world, and sensations, as "signs" of relations in reality, are as much connected with reality as the letters in a person's name are related to that person's self. Although this qualitative character of our sensations is purely a product of our physical organization, this does not mean that they are completely empty and useless. For Helmholtz:

> Hence, even though our sensations are, in their quality, only signs whose special type depends completely on our organization, they are nonetheless certainly not to be dismissed as empty appearance; rather, they are precisely signs of something, be it something enduring or occurring, and, what is most important, they can delineate for us the law of this occurring (Helmholtz, 1862/1995, p. 348).

As it is shown before, "sign" refers to a reality other than itself and takes its existence from this reality. At this point, Helmholtz goes to clarify the distinction between phenomenon and appearance. So much so that what we call "appearance" refers to the appearance of a particular object under certain conditions. For example, a garden hose can look like a snake in poor lighting conditions. However, the "phenomenon" is not like that, but it does not mean that our perception of a "phenomenon" is independent of our neural infrastructure. We know phenomena with our current physical/neural structure, but there is no question of seeing or perceiving a phenomenon in any other way. For example, we perceive the color red as red regardless of the circumstances, so there is no "deceptive" [consider the poor lighting

in the hose example] factor that would cause us to perceive the color "red" as "yellow". Helmholtz defines quality as the capacity of an object to have an effect on another object, with regard to the still unsolved problem of the qualitative character of sensation. For example, when we say "solubility" we talk about the behavior of a substance against water, when we say "weight" we are talking about the relationship of the thing in question with gravity, and for qualitative sensations such as colors, we actually mean the relationship between light and our retina (Helmholtz, 1862/1995). For this reason, it is meaningless to talk about the absolute properties of the "light" that we sense, independent of all other objects. However, it is difficult to say that Helmholtz's theory, which accepts sensations as a "sign", is a complete "sign" system. Therefore, the only thing that can be said is that under certain conditions an object will cause the same effect on the nerves of the sense organ that senses it, that is, it will cause a physical change to the same degree.

3.4. Hermann von Helmholtz's Theory of Perception

First, it can be said that Helmholtz's theory of vision was the reason why three volumes of physiological optics were written. In the "Subdivisions of the Subject" chapter of the first volume of Helmholtz's book, *Physiological Optics*, he says that "physiological optics is the science of the visual perceptions by the sense of sight." (Helmholtz, 1825/1925, Vol.1, p. 47). As I explained in detail in the Sensation section, in Helmholtz's theory of vision, the objects around us become visible to us thanks to the light reflected from the objects and falling into our eyes. This light stimulates certain sensations in the retina, which is a sensitive part of the nervous system, and these excitations are transmitted to the brain via the optic nerves, and as a result, the mind perceives certain objects in space and becomes conscious of them (Helmholtz, 1825/1925, Vol.1, p. 47). Helmholtz accordingly divides physiological optics or the theory of visual perception into three parts. The first part is primarily about the physical optics, the anatomical structure of the eye, and all non-neural functions of the eye. The second part concerns the theory of sensations of the neural

mechanism of vision, "in which sensations are evaluated on their own, without taking into account the possibility of recognizing external objects." The third part of physiological optics, or the theory of the interpretation of visual sensations, deals with the impressions that these sensations enable us to form of objects around us. The sensations that light evokes in the neural vision mechanism enable us to form concepts about the existence, shape and position of external objects. Helmholtz called these ideas as visual perceptions (Helmholtz, 1825/1925, Vol.1, p. 47). According to Helmholtz, it is impossible to ignore the mental processes that are active in sense perceptions. For we need to consider these mental processes if we want to see clearly the connection between phenomena and arrange the facts according to their proper relation to each other. Although Helmholtz believed that philosophers such as Kant had correctly analyzed these relations, the diversity in theories of human perception at that time indicated that there was no fundamental consensus (Helmholtz, 1825/1925, Vol.3, p. 2).

For Helmholtz, although the issue of "perception" is an issue that can be the object of scientific research, as we have mentioned before, since there was no general agreement among the scientists of the period about "perception", it was evaluated as a process consisting of "psychic activities". Empiricist-oriented scientists tend to derive the entire concept of space from experience, while other scientists with Kantian leanings derive more from intuition (i.e., nativistic theories of perception). Proponents of the empirical theory of perception argue that there is no need to refer to any inaccessible, unknowable force other than the faculties of the mind to explain perception (Helmholtz, 1825/1925, Vol.3, p. 2). According to Helmholtz, both approaches are successful in their own right and it is difficult to come to a clear decision between the two. But we have seen earlier that Helmholtz was sympathetic to empirical theories of perception and insisted on the enormous influence of lower mental functions and experience on perception. Helmholtz explains the relative superiority of empirical theory thus:

> No fact has yet been discovered inconsistent with the Empirical Theory: which does not assume any peculiar modes of physiological action in the nervous system, nor any hypothetical anatomical structures; which supposes nothing more than the well known association between the impressions we receive and the conclusions we draw from them, according to the fundamental laws of daily experience. It is true that we cannot at present offer any complete scientific explanation of the mental operations involved, and there is no immediate prospect of our doing so. But since these operations actually exist, and since hitherto every form of the intuitive theory has been obliged to fall back on their reality when all other failed, these mysteries of the laws of thought cannot be explained from a scientific point of view as constituting any deficiency in the empirical theory of vision (Helmholtz, 1862/1995, p. 194).

One of the reasons for this is that empirical theories have more explanatory power by using fewer hypotheses than their intuitive counterparts. According to Helmholtz, the basic thesis of empirical perception theory is that the sensations of the senses are signs for our consciousness, and how we comprehend the meanings of these signs is entirely related to our intelligence. For example, with regard to visual sensations, the signs or symbols that we obtain with our sense of sight may vary in intensity and quality, that is, in brightness and color. There may also be other differences between them, depending on where the retina is stimulated. The only way to learn the different meanings created by all these differences is experience. Therefore, the meaning of "signs", such as the regular association between two different "sign" or "ideas", the more often this association is repeated, the better we learn. Helmholtz gives an example of these repeated associations through an infant. Accordingly, babies always prefer the most primitive toy, even if they are given the most modern, sophisticated toys. After looking at such a toy every day for weeks, the baby finally learns all the perspective views it presents; then he throws it away and asks for a new toy that looks like the one he originally had. In this way, the child learns to recognize different aspects of the same object in connection with his constant movements. Grasping the shape of any object thus obtained is the result of associating all these visual images. Once we have a proper grasp of the shape of any object, we can more or less imagine

what it might look like if we looked at it from another point of view. All these different views are combined in the judgment we form about the dimensions and shape of an object. And as a result, once we encounter an object, we can deduce from it the various aspects that it will present to our view when viewed from different points of view (Helmholtz, 1862/1995). With the changes that an object in the external world brings about in the neural stimulation areas of our sense organs, we perceive this object in different aspects, for example by touching etc. All these different sensations appear unified in experience as a whole, and thus we have an idea of this object. If this idea is not accompanied by any sensation, what is in perception is a memory-image. Helmholtz gives this example from the sense of taste:

> Many articles of food produce a different impression of taste upon different parts of the tongue, and also produce sensations of odour by their volatile particles ascending into the nostrils from behind. But these different sensations, recognised by different parts of the nervous system, are usually completely and inseparably united in the compound sensation which we call taste (Helmholtz, 1862/1995, p. 191).

For Helmholtz, understanding or learning a native language is an excellent example of the workings of experience and psychic activity. This is a perfect example of how the often repeated idea of the normal meaning of perceptions can come true quickly, with unalterable certainty and without the slightest thought. Both this language learning and the interpretation of sensations in the perception of external objects are examples of unconscious inferences, which in many ways resemble regular conscious inferences made in science and ordinary life, as Helmholtz believed (Helmholtz, 1825/1925, Vol.3, p. 536). When a child is shown or given an object, the name of the object is always spoken to the child, so whenever the child sees that object or similar object, he or she hears the same sounds. In this way, the more often this situation is repeated, the more firmly the word and the image of the object are associated in the child's memory. In short, most of the mother tongue is learned unconsciously through experience in using the language (Helmholtz, 1825/1925, Vol.3, p. 536). According

to Helmholtz, this regularity between sensations does not exist in language. In language, letters come together randomly to form a word. On the other hand, we get information about the outside world thanks to the regularity between sensations. So what are these unconscious implications at work in a child's mother tongue learning process? According to Helmholtz, although it is impossible to fully define unconscious inferences, there can be no doubt about their actual existence and functioning. The presence and functioning of unconscious inferences can be determined in another way, a way more closely connected with physiological optics and perception in general (Helmholtz, 1825/1925, Vol.3, p. 1).

Let us now turn to a question left by Helmholtz's Cartesian legacy, namely the problem of correspondence between the external world and the mind. For this reason, Helmholtz believed that there could be no possible sense in speaking of any truth in our ideas other than a practical truth. Our sensations, as symbols or natural signs that signify objects, can be nothing but signs that we have learned to use to organize our actions and movements. When we learn to read or interpret these symbols, we can adjust our actions to bring about the results we desire, that is, we can act in such a way that any new anticipated sensations can arise (Helmholtz, 1825/1925, Vol.3, p. 19). For Helmholtz, the causal relationship in our knowledge of objects in the external world also applies to the properties of objects. This is how we can be successful in our actions in the outside world. Helmholtz says the following about the correspondence between the world and perception:

> The correspondence, therefore, between the external world and the Perceptions of Sight rests, either in whole or in part, upon the same foundation as all our knowledge of the actual world-on experience, and on constant verification of its accuracy by experiments which we perform with every movement of our body. It follows, of course, that we are only warranted in accepting the reality of this correspondence so far as these means of verification extend, which is really as far as for practical purposes we need (Helmholtz, 1862/1995, p. 202).

According to Helmholtz, from the very beginning of our perception of stationary objects scattered in space, this perception is the recognition of a proper connection between our movement and the sensations it causes, and this uniformity in phenomena can be seen as the basis of our rational behavior in everyday life and our knowledge of scientific laws. Consequently, we find that for Helmholtz, our sensations are merely signs of changes occurring in the outside world. Accordingly, we see that sensations can only be regarded as pictures, since they represent succession in time. For this very reason, sensations are in a position to show their direct conformity with the law regarding the succession of natural events in time. If, under the same natural conditions, the same action takes place, a person observing it under the same conditions will see the same sequences of impressions being repeated regularly. What our sense organs have accomplished is clearly sufficient to meet the demands of science as well as the practical purposes of the business man who must rely on knowledge of natural laws, and this success has been achieved partly by unwilled daily experience and partly by science (Helmholtz, 1862/1995).

According to Helmholtz and his contemporaries, Kant's claim that the observed order of nature reflects the cognitive properties of the observer rather than the nature of things in themselves, and especially the a priori "form" of intuition determines the character of perceived space and time, was the basis of intuitionistic theory of visions. On the other hand, another aspect that also shapes Helmholtz's empiricist vision theory is Müller's experimental psychology, namely that the information obtained through the senses depends on the nature of the nerves stimulated. At this point, what distinguishes nativists and Kantians is that, according to nativists, the physical mechanisms of sensory perception have a spatial character, such as the eye, retina or skin cells, which are organs of the sense of touch. Therefore, nativists explain what Kant calls the "form of intuition" by referring to human anatomy by reducing it to the spatiality of sensory mechanisms, which have a physical and spatial character. On the other hand, the order of sensation is still a priori according to nativists. According to

nativists, the mechanism by which spatial information was learned was the physiological order of vision. However, for Kant, the possibility of spatial knowledge is something that can only be obtained with the "form of intuition", therefore it has a completely a priori character. Helmholtz criticizes the application of this Kantian idea to geometry as follows:

> Nothing about the facts expressed in the axioms follows from the thought that space may be a form of intuition. If such theorems should not be theorems of experience, but rather should belong to the necessary form of intuition, then this is a further special determination of the general form of space, and therefore those reasons which permit us to conclude that the form of spatial intuition may be transcendental still do not necessarily also suffice to prove that the axioms may be of transcendental origin (Helmholtz, 1862/1995, p. 353).

So much so that in the vision theory of nativists, there is a kind of optical relationship between the outer world and the retina, and the perception of space is determined by this optical relationship. It is also possible to call this optical relationship "retinal geometry". In other words, obtaining the spatial information of objects in the external world with their projections on the retina. Here is the image Helmholtz used in his "Natural Science Related to General Science":

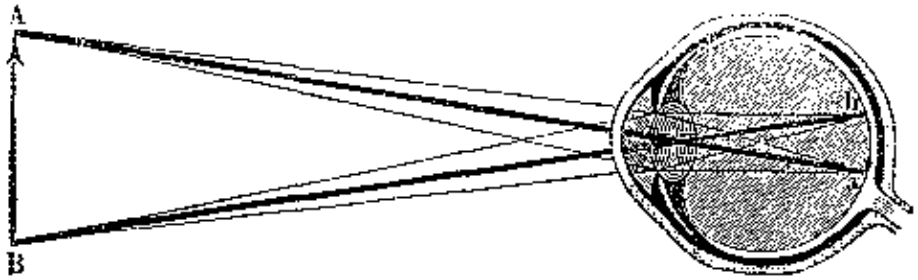

Figure 3.4.1. (Helmholtz, 1862/1995, p. 137)

In Helmholtz's "sign" theory, we have seen that "signs", which are a source of perception, are things that do not represent the external world but refer to the objects of the external world. Therefore, what we call "perception" means nothing but the

effects of objects in the external world on our nervous system. However, according to Helmholtz, in order to talk about something like "perceptual experience", we need to assume a "causality" in the structure of our thought, just like Kant's. Therefore, in Helmholtz's "sign" theory, it can be easily said that "causality" precedes perceptual experience. On the other hand, since our sensations are "signs" of what is happening in the external world, there must be a correspondence between the relations between the things happening in the external world and the relations between the sensations. So much so that this reciprocity reveals the connection between the common origins of sensations and signs. Accordingly, regular changes in the order of "signs" must also occur in a one-to-one correspondence in the order of sensations. Helmholtz refers to this regular temporal relationship between sensations and signs as one-to-one correspondence in sequences:

> Hence, in the completed representation of the experienced observer it remains, finally, a wonderful consequence that this observed spatial order of things originally derives from the sequence in which the qualities of the sensation themselves to the moved sensory organ: namely, the objects at hand in space seem to us clothed with the qualities of our sensations (Helmholtz, 1862/1995, p. 352).

Therefore, the conclusion that Helmholtz will naturally draw from here is that the causes of the changes that occur between the observable sensations are actually unobservable causes. If this inference of Helmholtz is valid, the view that Helmholtz presents appearances, that is, changes in sensations, as the effect of changes in causes constitutes a view that violates Kant's idea that causality is reduced to the world of appearances only. But Helmholtz later abandoned the idea that it required a meta-reality composed of causality, so to speak, governing the field of appearances. Helmholtz stated in his famous article "The Facts in Perception" that the positions of objects in space represent nothing but the regularity of the connections between motion and our perceptions. So it could be argued that Helmholtz is finally approaching some kind of Kantian conclusion that law-like regularities implied by

the correspondence between “sensuous-sensual” and “symbolic/sign-based” changes are the constitutive character of what is called reality. For Helmholtz, the causal law is indeed a transcendent law given a priori. It is not possible to prove this by experience because, as we have seen, without the application of inductive consequences, that is, without causal law, it is impossible even to take the first steps of experience. When completed experience shows that everything observed thus far proceeds in a law-like fashion—which we are certainly far from justifying our claim—it will always only be followed by an inductive conclusion, that is, only under the assumption of the law of causality, it is assumed that the present law of causality will hold true in the future (Helmholtz, 1862/1995).

3.5. Summary of Helmholtz's Theory of Knowledge and Its Effects on Heinrich Hertz's Picture Theory

According to Heidelberger, Helmholtz was interested in how we can know a physical reality outside ourselves, that is, in the external world. Therefore, he discussed this subject from various perspectives as a physicist, physiologist and philosopher and argued that the processes of perceiving the external world of a physicist and a normal person are not different from each other, since they both perceive the external world only through their senses and therefore there is no difference in knowing the reality of the external world. Both are dependent on their senses because they only infer the existence of the external world through their senses. On the other hand, another issue Helmholtz is interested in is the ontology of the external world, and he concluded that the ontology of the external world is a kind of "hidden causes realism", that is, a metaphysical reality (Heidelberger, 1998). A brief list of Helmholtz's metaphysical realism as follows:

1. Every change in the physical world has a cause.
2. All these changes are caused by unchanging material substances. These substances form "the hidden and immutable ground of the phenomena" that

> "lies behind the change of appearances and acts upon us" (1903a, 2:241 and 1903b, 16).
> 3. The forces with which these substances are furnished, i.e., their capacities to produce effects, are immutable. A force has to be thought of as an unchanging attribute of substance.
> 4. Matter and force are given to us only in an abstract sense but never in direct experience. "Neither matter nor forces can be the direct object of observation, but always only the inferred causes of experienced facts." (1856, 454).
> 5. If we knew the causes of the appearances, we could derive all phenomena from them in a strict and unique way. We would then be in the possession of objective truth (cf. 1882, 1: 17) (as cited in Heidelberger, 1998, p. 11).

According to Helmholtz, we cannot know the existence of something in the external world unless the thing in question causes an effect on our sense organs. Therefore, a substance needs an "acting force" in terms of its potential to act, otherwise it cannot cause a physical change in our sensory organs, that is, in our neural structure, and thus it would be unknown to us. Therefore, by continuing the ancient understanding that the idea of substance is unchanging, Helmholtz interprets changes in matter not as changes in the substance of matter, but as changes in the "acting force" in matter.

> If motion, however, is the basic change underlying all the alterations in the world, then all the elementary forces are moving forces. The final goal of the sciences is thus to find all the movements and driving forces supplying the foundation of all other change. In other words, the final goal of the sciences is to dissolve themselves into mechanics (as cited in Heidelberger, 1998, p. 11).

Although he initially tried to develop as much empiricist version of a Kantian epistemology as possible, for example, the neurophysiological mechanism, which is the basis of perception in his theory of perception, affects our knowledge of the external world, he later tried to clean up the Kantian remnants of his theory, especially under the influence of Faraday:

> was to express in his new conceptions only facts, with the least possible use of hypothetical substances and forces. This was really an advance in general scientific method, destined to purify science from the last remnants of

> metaphysics (1903a, 2:252; English version 1882, 3:53) (as cited in Heidelberger, 1998, p. 11).

This intellectual transformation of Helmholtz under the influence of Faraday led him to argue that force and matter should be viewed as the hypothetical sum of legal relations between phenomena, rather than assuming principles that can never be verified, such as substance or transcendental categories. But for all his metaphysical opposition, Helmholtz never changed the view that the true causes of phenomena are never given directly in experience, and that our experiences are merely signs from which we must make inferences to learn the true nature of the causes, since, as we have seen in detail in Helmholtz's theory of perception, our sensory impressions are represented by signs in the field of external reality in a lawful order, and the objects these signs refer to never bear any resemblance to sensory impressions. Helmholtz draws a parallel between the method of obtaining information in scientific experiments and the method of obtaining information with our sense organs. Just as the physicist observes mercury in different environments while trying to learn about mercury, what is necessary for us to learn about the human perception mechanism is to expose ourselves to such different conditions, which Helmholtz called “deliberate action”. For Helmholtz, discovering a cause in physical nature is possible only by conscious reasoning, while in the case of perception, it is the result of a completely unconscious inference. But what these two types of inference have in common is that they have an inductive structure. In order to discover the forces behind appearances, we must try to reproduce the same effect under different conditions, Helmholtz argues, in a similar way to obtaining the full and complete form of perception through seeing the object from different points of view. Before moving on to Helmholtz's effects on Hertz's electromagnetic theory, I should briefly touch on Hertz's life. Then I will talk about Hertz's work on electromagnetics.

CHAPTER 4

HEINRICH HERTZ: MECHANICAL ROOTS OF PICTURE THEORY

4.1. Biography of Heinrich Hertz with a Physics Background

Heinrich Hertz, full name Heinrich Rudolf Hertz, (22 February 1857, Hamburg [Germany] – died 1 January 1894, Bonn, Germany) was a German physicist. Hertz showed that Scottish physicist James Clerk Maxwell's theory of electromagnetism was correct and that light and heat were electromagnetic radiations. In 1880, he completed his doctorate with high honors from the University of Berlin, where he studied under Hermann von Helmholtz. In 1883 he began his work on Maxwell's electromagnetic theory. Between 1885 and 1889, while he was a professor of physics at Karlsruhe Polytechnic, he produced electromagnetic waves in the laboratory and measured the length and speed of these waves. He showed that the nature of their vibrations and their susceptibility to reflection and refraction were the same as those of light and heat waves. As a result, he determined beyond doubt that light and heat were electromagnetic radiations. Electromagnetic waves were called Hertz, but later these waves were more often called radio waves. In 1889, Hertz was appointed professor of physics at the University of Bonn, where he continued his research on the discharge of electricity in rarefied gases. His scientific papers were translated into English and published in three volumes: *Electric Waves* (1893), *Miscellaneous Papers* (1896), and *Principles of Mechanics* (1899) (The Editors of Encyclopaedia Britannica, 2022).

4.2. The Influence of Hermann von Helmholtz on Heinrich Hertz

Throughout his long career, Helmholtz became more and more interested in philosophy, gradually moving from medicine to anatomy and physiology, then

physics and finally mathematics. Continuing from 1883 until his death in 1894, Helmholtz sought to find a great unifying principle in nature. He thought this principle to be the Principle of Least Action, but attempts to derive all of physics from this principle met with similar frustration as Einstein encountered in his attempts to find a unified field theory. According to Mulligan (1987), it is indeed easy to document the relevance of Hertz's Mechanics to this work of Helmholtz. At the beginning of February 1891, Hertz was complaining about his failures in various experimental attempts, and he later returned to Hamilton's articles on mechanics, and his 1891 diary is full of references to his work on mechanical problems. For most of 1891 and 1892 this was his only preoccupation. In a letter to Helmholtz of December 15, 1892 (the same letter in which he reported on Lenard's work on cathode rays), he writes:

> Of late I have been devoting myself entirely to theoretical work to which I was incited by the study of your papers on the Law of Least Action (as cited in Mulligan, 1987, p. 717).

It is not surprising that Hertz's *Principles of Mechanics*, published posthumously in 1894, makes many references to his teacher, Helmholtz, in its preface. For Helmholtz, physical science consisted of tracing natural phenomena down to the laws of simple mechanics, and he said, for example, in his keynote speech at the Congress of German Scientists in Innsbruck, Austria, in 1869:

> ... the ultimate aim of physical science must be to find the movements which are the real causes of all other phenomena and to determine the motivation forces upon which these movements depend. In other words, its aim is to reduce all phenomena to mechanics (as cited in Mulligan, 1987, p. 717).

In the preface to *Principle of Mechanics*, Hertz refers to Helmholtz's articles on principle of least action and cyclical systems and states that Helmholtz indirectly addresses the problem investigated in Hertz's own book and offers a possible solution (Hertz et al., 1899). According to Heidelberger, in his *Principles of Mechanics*, Hertz

tried to generalize what he learned in electrodynamics through the relationship between theory and experiment. He sought to formulate it in a philosophically satisfactory way and eventually apply it in mechanics. In a sense, Hertz wanted to solve the problem he had put off when dealing with electrodynamics, namely, to clarify the representative capacity of a physical theory. To solve this problem, Hertz used Helmholtz's theory of signs, but interpreted it in a completely new way. As explained in detail earlier, for Helmholtz, sensory experiences are signs of the inaccessible external reality of matter and forces. For Hertz, rather, what theories represent are signs of the sensory impressions given to us. According to Hertz, we can predict the future from experience of the past if we only use theory to construct representations (Heidelberger, 1998). According to Patton, while writing the *Tractatus*, Wittgenstein was reading *Principles of Mechanics*, which was influenced by Hertz's Helmholtz's theory of signs but interpreted it within the framework of *Bild* or picture theory. Hertz, like his teacher Helmholtz, argued that spatial and temporal relations could only be represented in a sign system. For Hertz, however, judgments about relationships between objects are constructed within a *Bild*, which in literature is variously translated as "symbol" or "picture", although *Bild* also means "model". *Bild* for Hertz is related to Helmholtz's sign system, but one *Bild* for Hertz is constrained by basic mathematical principles that differ for another *Bild*, and by *Bild*'s basic logical concepts and conceptual primitives (Patton, 2009). Regarding "images", Hertz says in his *Principles of Mechanics*:

> The most direct, and in a sense the most important, problem which our conscious knowledge of nature should enable us to solve is the anticipation of future events, so that we may arrange our present a airs in accordance with such anticipation. As a basis for the solution of this problem we always make use of our knowledge of events which have already occurred, obtained by chance observation or by prearranged experiment. In endeavouring thus to draw inferences as to the future from the past, we always adopt the following process. We form for ourselves images [innere Scheinbilder] or symbols [Symbole] of external objects; and the form we give them is such that the necessary consequents of the images in thought are always the images of the necessary consequents in nature of the things pictured. In order that this

> requirement may be satisfied, there must be a certain conformity between nature and our thought. Experience teaches us that the requirement can be satisfied, and hence that such a conformity does in fact exist. When from our accumulated previous experience were have once succeeded in deducing images of the desired nature, we can then in a short time develop by means of them, as by means of models, the consequences which in the external world only arise in a comparatively long time, or as the result of our own interposition. We are thus enabled to be in advance of the facts, and to decide as to present affairs in accordance with the insight so obtained. The images which we here speak of are our conceptions of things. With the things themselves they are in conformity in one important respect, namely, in satisfying the above - mentioned requirement (Hertz et al., 1899, p. 1).

What guarantees the match between the necessary result in thought and the necessary effect in nature? In the first part of *Principles of Mechanics*, Hertz argues that for any given system we can give an a priori explanation of the possible geometric configurations of that system, as well as the possible transformations of the system from one state to another. This explanation is arrived at by deduction from the fundamental principle of the system, for example Helmholtz's principle of least action, as well as basic logical and mathematical axioms and basic concepts (e.g. space, time, mass). In addition, experience will answer the question of whether our a priori constraints predicting the next observed configuration capture the observed effects (Patton, 2009). Patton's views on the relationship of Hertz's *Bild* theory to reality are as follows:

> For Hertz, it is possible, then, to show why our scientific explanation of the consequences of a given mechanical experiment describes actual relations. If the system is constructed properly and the experiment is successful, we can show that the experiment, when plugged in to the possible configurations established a priori, rules out at least some of the other possible configurations of the system. This yields a way to test the *Bild* in experience: if the relations within the *Bild* contradict the observed relations, the *Bild* is ‘incorrect’. Further, if the *Bild* is logically inconsistent, it is not ‘permissible’ (Patton, 2009, p. 285).

The idea of whether a picture is "permissible" is reminiscent of logical possibility in the *Tractatus*. But we will touch on the relations between Hertz and Wittgenstein's *Tractatus* in more detail later. However, to speak very briefly about the connection here, understanding the a priori as a set of possible configurations of a system is the connection between Hertz and Wittgenstein. Let us now consider the "mechanics" of Hertz in detail.

4.3. Hertz's *Mechanics*

In his famous book, *Principles of Mechanics*, Hertz claimed that scientific theories were pictures of the outside world through symbols. It was a result of the scientific spirit of the time that Herz developed a theory of physics based on "mechanics". Because all the achievements in physics from Newton to that day were only possible with a mechanical worldview. For example, all concepts that could not be explained within a mechanical theory such as heat and light were tried to be explained mechanically by the physicists of the period. As it will be remembered, we saw that Helmholtz's studies on sensory perception were for his development of a neurophysiology-based theory of perception. Helmholtz's promising student, Hertz, sought to express his teacher's theory of perception with a mechanical theory. Hertz's writing style in Mechanics also gives an idea about his view of philosophy, since the first volume of the book is full of definitions. Conceptual clarity is thus a fundamental feature of the *Principles of Mechanics*. As it is known, the Newtonian understanding of the universe is based on four basic concepts: space, time, mass and force. Newton's concept of "force" is one that has come under heavy attack after him. Hertz, on the other hand, developed criteria on scientific theories, perhaps being the first to make philosophy of science in today's sense. Accordingly, all acceptable, i.e. plausible, theories must be conceptually consistent, meaning that there is no logical incompatibility within them. Second, a theory should not contradict experience, that is, common sense in a sense, and therefore should not contradict our empirical knowledge. Finally, if a theory provides the richest and most comprehensive

explanation by including the fewest concepts or terms, then that theory is the most appropriate, just as with the Occam's Razor principle. In short, according to Hertz, a theory should be logically sound, that is, permissible, be compatible with other empirical realities, and be able to explain the basic relationships in the world in the most comprehensive way by suggesting the least concept or term. Thus, a scientific theory is a correct theory if it best represents the relations of objects in the world as a picture of the world, and the relations in the picture do not conflict with experience. From this we deduce that Hertz is not an absolute and single theory, but a correct theory provided it meets the three criteria we mentioned above. In short, there is no single correct theory, any theory that satisfies these criteria is correct. We can now look in detail at Hertz's *Principles of Mechanics*.

Hertz's *Mechanics* is divided into two parts. The first chapter usually introduces a number of physical concepts and theorems to the reader without reference to the external world. For Hertz, all propositions express a priori judgments, just as for Kant, and are either affirmed or rejected by "laws of inner imagination" and forms of logic. On the other hand, the second part of the book contains various physical concepts defined by Hertz regarding events in the outside world. At the beginning of the first chapter, Hertz defines three fundamental concepts of physics: space, time, and mass. Hertz's first definition is that of mass-particle:

> Definition 1. A material particle is a characteristic by which we associate without ambiguity a given point in space at a given time with a given point in space at any other time.
>
> Every material particle is invariable and indestructible. The points in space which are denoted at two different times by the same mass-particle [Massenteilchen], coincide when the times coincide. Rightly understood, the definition implies this (Hertz et al., 1899, p. 45-46).

In Hertz system, material particles are space-time locations with a particular property; they are not like material objects in space and time. Material particles are attributes of space [Merkmale] and have no spatial extension. It is rather unusual to describe

the fundamental concepts of mass as properties of space and time rather than as a kind of entity in space and time. Material particles only show a unique, particular location in spacetime, so such points can be counted. This is all we need to define the concept of mass. Material particles are not like physical objects, although they are called particles. Hertz proposes them to describe the property of mass ascribed to objects, which he calls material points. Hertz's # 2 definition is directly related to mass:

> The number of material particles in any space, compared with the number of material particles in some chosen space at a fixed time, is called the mass contained in the first space.
>
> We may and shall consider the number of material particles in the space chosen for comparison to be infinitely great. The mass of the separate material particles will therefore, by the definition, be infinitely small. The mass in any given space may therefore have any rational or irrational value (Hertz et al., 1899, p. 46).

This will become clearer when we look at the 3rd definition:

A finite or infinitely small mass, conceived as being contained in an infinitely small space, is called a material point.

> A material point therefore consists of any number of material particles connected with each other. This number is always to be infinitely great: this we attain by supposing the material particles to be of a higher order of infinitesimals than those material points which are regarded as being of infinitely small mass. The masses of material points, and in especial the masses of infinitely small material points, may therefore bear to one another any rational or irrational ratio (Hertz et al., 1899, p. 46).

According to Hertz's definition #4, it is a system of material points to a set of material points considered in the same time period. The sum of the masses of the individual points represents the mass of the system. Thus, a finite system consists of a finite number of finite material points, while an infinite number of systems likewise

consists of infinitely small material points. According to Hertz, material particles are indivisible and unchanging attributes in space-time. In the second part of *Principles of Mechanics*, Hertz deals with the application of mechanical concepts to the outside world, and thus becomes clear between the external world with the definitions he made in the first chapter. Hertz mentions at the beginning of the second book that he treats space, time, and mass as symbols of objects of external experience. Therefore, the attributes of these symbols are compatible with the attributes previously assigned to these symbols or the definitions previously given to these symbols. Thus, according to Hertz, the symbols with which he describes the relationships between space, time, and mass are correct not only because we think so, but also because they are consistent with our future experience. Because the propositions expressed by Hertz about this triple relationship are compatible with the laws of thought and intuition in addition to experience. Therefore, the truth of these propositions is directly related to the general validity of a proposition. Time and space as forms in the Kantian sense are not the only subject matter for our experience, but rather things with a certain time, space and mass are the subject of our experience. Therefore, if we can talk about a certain time, space and mass, it is because they constitute the results of a certain experience. We thus obtain such a symbolic understanding by applying it to particular particles of time, space, and mass that we wish to identify with our sense perceptions. For this reason, the relationship between time, space and mass is essentially a relationship that can emerge with a certain sense perception (Hertz et al., 1899). After proposing various physical concepts and making various definitions regarding external objects and their relations, Hertz reveals his classical understanding of energy and motion. At this point, Hertz starts from a fundamental principle known as The Fundamental Law, which can be falsified empirically. Accordingly, Hertz reduces all mechanics, that is, by mechanics, what Hertz means to the world and the events that occur in it, to a principle consisting of only one sentence:

> Fundamental Law. Every free system persists in its state of rest or of uniform motion in a straightest path.
>
> Systema omne liberum perseverare in statu suo quiescendi vel movendi uniformiter in directissimam (Hertz et al., 1899, p. 144).

This law, of course, is reminiscent of Newton's first law of motion. However, as it is known, Newton's laws of motion are laws that deal with motion and force over objects, so there must be singular objects. However, Hertz's law was put forward for free systems. If remembered, Newton's first law of motion, in the absence of any force, the body continues either at rest or as a uniform linear, that is, with constant velocity. However, not including a concept such as force in the system must come at a cost. In other words, a concept is needed to replace this force. Previously, Hertz's system was free, that is, it was a system in which material points consisting of material particles took place. Therefore, when it comes to explaining motion, Newton refers to individual bodies, while Hertz refers to his holistic system of material points.

All the empirical content of classical mechanics is expressed in this claim as the greatest claim of Hertz's work, *Principles of Mechanics*, in which he reveals his own concept of mechanics:

> 309. Fundamental Law.
> Every free system persists in its state of rest or of uniform motion in a straightest path. Systema omne liberum perseverare in statu suo quiescendi vel movendi uniformiter in directissimam (Hertz et al., 1899, p. 144).

However, in *Principles of Mechanics*, Hertz seeks to liberate mechanics from these notions by clearing the notions of force and energy from the spatial and temporal relations between masses. For this, Hertz proposes the concept of hidden masses:

> If we wish to obtain an picture of the universe which shall be well-rounded, complete, and conformable to law, we have to presuppose, behind the things which we see, other, invisible things- to imagine confederates concealed

> beyond the limits of our senses... We are free to assume that this hidden something is nought else than motion and mass again, motion and mass which differ from the visible ones not in themselves but in relation to us and to our usual means of perception (Hertz et al., 1899, p. 25).

Let us now examine more closely how Wittgenstein's application of Hertz's understanding of philosophy and concept of mechanics to language led to a groundbreaking theory of meaning in the twentieth century.

4.4. Heinrich Hertz's "Mechanical" Effects on Early Wittgenstein's Philosophy

Beneath Ludwig Wittgenstein's angry character was also a sinner condemned to perpetual confession. Even in his revolutionary work, the *Tractatus*, there was a peculiar citation system of a kind that had never been seen before. While he stated that his work was connected to a line of thought and that what he said was never new, he almost admitted the people he was influenced by.

> There is truth in my idea that really in my thinking I am only reproductive. I believe that I have never invented a new line of thought: that has always been given me by someone else. I have only seized on it immediately with a passionate urge for the work of clarification. That is how Boltzmann, Hertz, Schopenhauer, Frege, Russell, Kraus, Loos, Weininger, Spengler, Sraffa influenced me (McGuinness, 2005, p. 37).

It is obvious to many biographers and Wittgenstein experts that Wittgenstein was influenced by Hertz. For example, according to James Griffin, the picture theory in Wittgenstein's *Tractatus* derives almost entirely from Hertz. In fact, it was Wittgenstein himself who was the first to apply a picture-based theory of meaning to language as a whole, not just a part (Griffin, 1964). Furthermore, it is clear that both Hertz and Wittgenstein's expectations from philosophy, that is, their philosophical ideals, are very close to each other. Because both cared about conceptual clarity. Also, both have adopted some kind of picture theory, Wittgenstein, while adopting a "picture" theory inherited from Helmholtz to Hertz through the term "sign", tried to

make a unique explanation of "reality" with his understanding of language based on logic and logical atomism from Frege and Russell. In fact, Elizabeth Anscombe, one of Wittgenstein's brightest students, claims that the *Tractatus* would not exist if Frege and Russell had not revolutionized logic (Anscombe, 1959). It is possible to say that the final components of reality put forward by Hertz in the *Principles of Mechanics* correspond to the objects in the *Tractatus*, since, in the *Tractatus*, objects are constitutive components of reality for Wittgenstein, since they are determined through their internal relations, a relation that predetermines which object will take place in which state of affairs. It is possible to see the similarity of the objects in the *Tractatus* with the objects put forward by Hertz in the *Principles of Mechanics* by the following:

> The laws of physics, with all their logical apparatus, still speak, however indirectly, about the objects of the world (TLP 6.3431).

Accordingly, Wittgenstein says that the laws of physics are related to the objects in the world, albeit indirectly. In the next proposition, by referring directly to Hertz's concept of material-point (in the translation of Pears & McGuinness, it is referred to as point-mass), he emphasizes that when Hertzian mechanics presents a picture of the world, it speaks of any material-points rather than "specific" material-points. From this, it is possible to say that Hertz's "material-point" concept corresponds to "states of affairs" in *Tractatus*. This is because, as I explained in detail earlier, Hertz defined material points to be composed of any number of interconnected material particles. In *Notebooks 1914-1916*, Wittgenstein draws an analogy regarding the way different physical theories lead to different descriptions of phenomena, through the ability to depict a surface in different ways with different geometric shapes. This gives Wittgenstein an idea of the relationship between logic and mechanics:

> Mechanics is one attempt to construct all the propositions that we need for the description of the world according to a single plan (Hertz's invisible masses.).

> Hertz's invisible masses are admittedly pseudo-objects (Wittgenstein et al., 1984).

The "pseudo-objects" that Wittgenstein refers to in the paragraph I quoted seem to be a reference to the "images" developed by Hertz in *Principles of Mechanics*.

> We form for ourselves images [innere Scheinbilder] or symbols [Symbole] of external objects; and the form we give them is such that the necessary consequents of the images in thought are always the images of the necessary consequents in nature of the things pictured (Hertz et al., 1899, p. 1).

Another similarity between Wittgenstein and Hertz is that Hertz presents the concept of "hidden mass" as a condition of the possibility of the propositions of physics, while Wittgenstein presents simple objects as a condition of the possibility of propositions. Wittgenstein says in his TLP 4.0312 "The possibility of propositions is based on the principle that objects have signs as their representatives." (Wittgenstein et al., 2001).

CHAPTER 5

LUDWIG BOLTZMANN: SCIENTIFIC REPRESENTATION AND THE DUTY OF SCIENTIST

5.1. Biography of Ludwig Boltzmann as a Physicist and Chemist

Ludwig Boltzmann, full name Ludwig Eduard Boltzmann, (20 February 1844, Vienna, Austria - 5 September 1906, Duino, Italy), one of the greatest physicists of the 19th century, whose major contribution was the development of statistical mechanics that explained and predicted how the properties of atoms (such as mass, charge, and structure) determine the apparent properties of matter (such as viscosity, thermal conductivity, and diffusion). After receiving his doctorate from the University of Vienna in 1866, Boltzmann served as professor of mathematics and physics in Vienna, Graz, Munich and Leipzig. In the 1870s, Boltzmann published a series of papers in which he showed that the second law of thermodynamics regarding the exchange of energy can be explained by applying the laws of mechanics and probability theory to the motions of atoms. In doing so, he clearly showed that the second law is essentially statistical and that a system approaches a state of thermodynamic equilibrium. During these investigations, Boltzmann tried to find a general physical law for the energy distribution among the various parts of a system at a given temperature, and he came up with the equipartition of energy theorem (Maxwell-Boltzmann distribution law). This law states that the average amount of energy in different directions of motion of an atom is the same. He found an equation related to the change of energy distribution between atoms resulting from atomic collisions and laid the foundations of statistical mechanics. Although Boltzmann's work on statistical mechanics was fiercely attacked and long misunderstood. On the other hand, the results of these studies were finally supported by discoveries in atomic physics that began shortly before 1900 and the realization that fluctuation phenomena

such as Brownian motion (the random motion of microscopic particles suspended in a liquid) could only be explained by statistical mechanics (The Editors of Encyclopaedia Britannica, 2022).

5.2. Ludwig Boltzmann's Conception of Philosophy

Boltzmann appears as a figure with the image of a hardcore scientist, as the inventor of some revolutionary theories and laws for the sciences of physics and chemistry, which were not as disconnected or disjointed as they are today. However, since the 19th century was a period when philosophy and science began to separate but did not completely separate, it would never be wrong to present Boltzmann as a philosopher, since, Boltzmann's ideas had a great impact on figures such as Karl R. Popper and Paul Feyeraband, who were the great philosophers of science of the period and later periods, especially the early Wittgenstein, which is the subject of this thesis. Popper, for example, states in his personal autobiography that he did not know much about Boltzmann's ideas, but as far as he knew it was impossible not to agree with him:

> Boltzmann is little known as a philosopher; until quite recently I too knew next to nothing about his philosophy, and I still know much less about it than I should. Yet with what I know I agree; more closely perhaps than with any other philosophy (Popper, 2002, p. 181).

According to Feyerabend, philosophy and physics are almost inextricably linked in Boltzmann's works, since, according to Feyerabend, Boltzmann is one of the rare philosophers who is not content with general ideas or simple, atomic facts, and tries to combine the general and the atomic in a single coherent point of view. Feyerabend mentions that Boltzmann hated the traditional school philosophers who had vague and absurd ideas, for example Kant, Schopenhauer and Hegel. Because Boltzmann believed that these figures spoke as if they had discovered the ultimate reality.

On the other hand, Feyerabend mentions that Boltzmann's hatred was not only limited to traditional philosophers, but also directed against other physicists of the period. These physicists are Ernst Mach and Wilhelm Ostwald. According to Boltzmann, these figures tried to protect their theories from the transcendence of physical experience by making a phenomenological physics and always pursued a physics that would be valid (Feyerabend, 2016). First of all, it would be wrong to say that Boltzmann made a philosophy of physics in today's sense or to suggest that he was engaged in philosophy of science. Because Boltzmann's aim, which we will call philosophical, was related to the foundations of science, so the nature of scientific theories was the main backbone of Boltzmann's "philosophy". Although the 19th century was presented as the era in which science made a great leap forward in many respects, many questions that scientists were interested in at that time led these scientists to pessimism due to the fact that science would not be able to solve the problems in question. However, Boltzmann, unlike these scientists, was quite hopeful about the future of science and believed that the science of the future would completely eliminate the problems that seem unsolvable today.

In short, we will consider Boltzmann's views, which can be considered as "philosophical", in the context of "picture theory" since this is the subject of this thesis, since Tractarian picture theory is often inspired by a Hertzian and Boltzmannian "picture" concept. The reason why Boltzmann is included in the discussion at this point, according to him, is that scientific theories are representations of nature. Now is the time to elaborate on the Boltzmanian concept of "representation."

According to Boltzmann, the regularities between the perception of the senses and the desires of the will are prerequisites for understanding the external world. All this can only be known by experience. The regularities between a volitional desire to drink water and a sense perception of drinking water are a good example of this. The

desire to go to the toilet, which appears after a certain period of time after drinking water, that is, after a sense perception, is an example of the continuity and regularity between volitional desires and sense perceptions. All these processes cause some memories, namely a picture of the world, to be formed in us.

All these processes cause some memories, namely a picture of the world, to be formed in us. Accordingly, certain requests of the will usually follow certain sense perceptions, just as the desire to drink water results in the sense perception of drinking water. We can call all of these processes as impressions, and they work by engaging our emotions because we act on these impressions. Also, these impressions are dependent in certain ways on our inner states. But to say that all processes are dependent on our internal states does not mean that there are no specific laws governing these processes. Thanks to the good images of memory, we can get what we desire, so these images themselves become desirable. So, through certain volitions we can refresh our memory and get better pictures, so by combining these pictures we can also have an integrated perfect picture of the world. We can consider actions that cause us to achieve what we desire and ideas that cause us to act in this way as correct ideas. We should always try to have the most correct and most economical ideas, which means that we must spend the least time and effort on the right course of action. It is precisely this kind of accuracy and economy that is expected of theories in science, for only then can they come closest to corresponding to the laws of thought. According to Boltzmann, even observations due to our childhood experiences are very effective in the formation of our correct pictures of the world. We can consider actions that cause us to achieve what we desire and ideas that cause us to act in this way as correct ideas. We should always try to have the most correct and most economical ideas, which means that we must spend the least time and effort on the right course of action. It is precisely this kind of accuracy and economy that is expected of theories in science, for only then can they come closest to corresponding to the laws of thought.

According to Boltzmann, even observations due to our childhood experiences are very effective in the formation of our correct pictures of the world. For example, a baby touching the stove is a process accompanied by certain sensory perceptions, and the formation of the baby's desire to withdraw his hand due to the pain caused by the burning of his hand shows that the chain relationship between volitions and sensory perceptions is a learning process that begins in infancy (Boltzmann & McGuinness, 1974). Boltzmann describes how the brain evolved at the point of representation of the external world:

> The brain we view as the apparatus or organ for producing word pictures, an organ which because of the pictures' great utility for the preservation of the species has, conformably with Darwin's theory, developed in man to a degree of particular perfection, just as the neck in the giraffe and the bill in the stork have developed to an unusual length. By means of the pictures by which we have represented matter (no matter whether the most suitable pictures will turn out to be those of current atomism or some others), we now try to represent material brain processes and so to obtain at the same time a better view of the mental and a representation of the mechanism that has here developed in the human head, making it possible to represent such complicated and apposite pictures (*Bilder*) (Boltzmann & McGuinness, 1974, p. 69).

Now let's take a closer look at Boltzmann's *Bildtheorie*, which he put forward in the context of scientific theories, since, before we move on to the similarities with the Tractarian picture theory, we need to illustrate his *Bildtheorie* in detail.

5.3. Boltzmann's *Bildtheorie*

In his article "On the Principle of Mechanics", Boltzmann defines the task of science as explaining more complex things with simpler ones, while the alternative is to represent complex things through clear pictures borrowed from the field of simpler/simple phenomena. According to Boltzmann, physics is an attempt to reduce phenomena such as sound, light, heat, magnetism and electricity by linking them to the motion of the smallest particles, which Boltzmann called mechanics, making

physics a well-established discipline (Boltzmann & McGuinness, 1974). The earliest form of Boltzmann's understanding of scientific theories known as *Bildtheorie* appears in his article "On the Significance of Theories" published in 1890. In this article, Boltzmann sees theories as the guiding stars in all thought and experimentation. But the version closest to *Bildtheorie* appears in the article "On the Development of the Methods of Theoretical Physics in Recent Times" published in 1899. In this article, Boltzmann refers to *Bildtheorie*'s Hertzian roots:

> Following on from there, Hertz makes physicists properly aware of something philosophers had no doubt long since stated, namely that no theory can be objective, actually coinciding with nature, but rather that each theory is only a mental picture of phenomena, related to them as sign is to designatum (Boltzmann & McGuinness, 1974, p. 90-91).

Because, according to Boltzmann, as we have stated before, the aim to be pursued is not absolute objectivity, but the theory closest to representing the external world. In spite of the fact that, we need to mention the relationship between Boltzmann's *Bildtheorie* and Hertz's picture theory, for now, we will not say anything about Boltzmann's and Hertz's discussion of which of the picture theories came first. As it will be remembered, Hertz adopted a Kantian view of the laws of thought, such that the parallelism between the laws of thought and the laws of the outer worlds mediated the emergence of knowledge. However, Boltzmann took an anti-Kantian position and argued that the laws of thought could be modified by education and experience. Let's see why Boltzmann considers the explanation he sees as the purpose of science to be "mechanical". This will also give us an idea about Boltzmann's conception of science.

First of all, let's briefly summarize why Boltzmann refers to the concept of mechanics. According to Boltzmann, all phenomena belonging to physics, such as sound, light, etc. be explained by the motion of particles. Therefore, what Boltzmann understands by "mechanics" is nothing but the representation of the motion of particles. According to Boltzmann, all metaphysical justifications are insufficient.

On the other hand, we cannot explain nature without introducing the concept of "movement" for Boltzmann. For if all qualitative changes in appearance could be represented by the picture of movements or by changes in the arrangement of the smallest parts, this would lead to a particularly simple explanation of nature. In this case, nature becomes visible to us in its most comprehensible form, on the other hand, we cannot force nature into it, for we must leave open the possibility that one picture will not suffice to represent nature, and that we also need other pictures of nature for other changes. According to Boltzmann, it is precisely the new developments in physical science that reassures us in allowing this possibility (Boltzmann & McGuinness, 1974). At this point, a debate arises as to whether our capacity to represent the external world is a priori. Although Immanuel Kant is the first name that comes to mind when it comes to the laws of thought, it would be unfair to place Boltzmann in a directly Kantian position. Because Boltzmann believed that within the framework of Darwinist evolutionary theory, man's ability to represent could change at the point of formation of new and more useful representations that would allow him to survive. However, it should be noted that Boltzmann did not radically reject the laws of a priori thought, but rather, they were passed down to us genetically from our ancestors through the evolutionary process. On the other hand, the fact that these laws were passed down to us during the evolutionary process does not show that they are absolutely correct. Therefore, time and environmental conditions may cause such laws of thought to be modified.

> Our innate laws of thought are indeed the pre-requisite for complex experience, but they were not so for the simplest living beings. There they developed slowly, but simple experiences were enough to generate them. They were then bequeathed to more highly organised beings. This explains why they contain synthetic judgments that were acquired by our ancestors but are for us innate and therefore a priori, from which it follows that these laws are powerfully compelling but not that they are infallible (Boltzmann & McGuinness, 1974, p. 167).

These views of Boltzmann, which we might call "naturalistic" today, can be understood from the difference in his use of the term "a priori". As it is known, in philosophy a priori is used for things whose truth is known without reference to experience. For example, "All bachelors are unmarried." is a proposition that we are likely to check whether its true or not without reference to experience. However, Boltzmann uses the term a priori in the sense that it is rather innately given. It also refers to ancestral experience in the evolutionary process in the sense that what is innate is also somewhat dependent on experience. The status of the laws of thought leads to chaos at the point of harmony of theories with nature. In this case, the philosopher or scientist will either have to take a stand for the laws of thought and modify his theory, or he will start to question the accuracy of the laws of thought by taking the side of the theory. Boltzmann, as a revolutionary scientist and philosopher, made his choice in favor of the second option. According to Boltzmann, the so-called incompatibility between theory and nature is not always due to a lack of theory. In the hegemony of the Kantian or Neo-Kantian understanding of science, the status of the a priori and immutable laws of thought can never be compromised. Boltzmann counters this by arguing that Euclidean geometry, on which Kantian philosophy is based, is not the absolute and sole representation of space. However, it must be said that what Boltzmann really opposes is not about the "a priori" status of the laws of thought. Boltzmann says that experience should always be referenced, thus allowing the possibility that the laws of thought that seem to be "a priori" invariable and absolute can also be modified by new experiences.

> Quite in general, Schopenhauer was not at all felicitous in what he called a priori. For example he says that it is a priori clear that space has three dimensions. Today scientists know that 'a priori' a space of more than three dimensions is conceivable and even a non-Euclidean one. Of course the question is not whether the space of experience is Euclidean or not, but what is evident a priori and what merely a matter of experience (Boltzmann & McGuinness, 1974, p. 187).

So why does Boltzmann choose "mechanics" for the explanation he presents as the task of science? According to Boltzmann, all processes, whether animate or inanimate, can be represented by mechanical pictures. Indeed, the accuracy and precision of mechanical drawings is the most intelligible compared to earlier models or forms of explanation (Boltzmann & McGuinness, 1974). Of course, according to Boltzmann, understanding nature with mechanical pictures is something that the evolutionary process has given us, and another better explanatory model can replace the "mechanical" explanatory model by undergoing various modifications in this process. Boltzmann considers our ideas and concepts as internal and mental pictures. Accordingly, the sole purpose of our thinking activity is to organize our inner pictures in such a neat and correct manner, so that we can take the most correct, that is, successful action, through these pictures (Boltzmann & McGuinness, 1974).

5.4. The Relation of Boltzmann's *Bildtheorie* to the Tractarian Picture Theory and Boltzmann's Effects on Wittgenstein's Conception of Philosophy

It is possible to see the most obvious effects of Ludwig Boltzmann on Wittgenstein through Boltzmann's "*Bildtheorie*". As I explained in detail in the previous section, Boltzmann's *Bildtheorie* is about scientific theories as a picture or model of reality. The idea that theories, one of the dominant discourses of the dominant philosophy at that time, can never be objective and therefore cannot exhibit a one-to-one correspondence with reality appears in Boltzmann. Regarding theories, Boltzmann states: “each theory is only a mental picture of phenomena, related to them as sign is to designatum” (Boltzmann, 1974, p. 90–91). However, Boltzmann's idea of being a model of reality differs from other models in that he incorporates the concept of the "atom" into the system. We have previously examined in detail Boltzmann's philosophical views. However, in order to examine its effects on Wittgenstein, we will have to mention it briefly. Boltzmann can be seen as the father of figures who marked the twentieth century in many ways and who prided themselves on being anti-metaphysical, especially Carnap, since, as I have shown with quotations before,

philosophers such as Kant, Hegel and Schopenhauer represented a traditional kind of philosophy for Boltzmann. On the other hand, it is possible to see that Boltzmann emphasized the superiority of physics, especially in his writings on statistical mechanics. For example, when it comes to the continuity of matter, Boltzmann advocates a combination of physics and philosophy, almost similar to the styles of analytical philosophers today, since, according to Boltzmann, his theory is completely different from the view that certain questions fall outside the limits of human cognition, because according to this second theory, these questions arise from the defect of human cognitive capacity, whereas Boltzmann sees the existence of these problems as an illusion. It may of course come as a surprise to Boltzmann that once this illusion is recognized, the urge to answer these questions does not disappear, however, it is very difficult for such a mental habit to lose its hold on us (Boltzmann, 1974). For Boltzmann, therefore, such questions are not questions that should be left to philosophers. In this respect, he finds Kant's philosophical style inadequate, since, according to Boltzmann, the so-called laws of thought are also a result of the evolutionary process of man. Therefore, seeing these laws as immutable and absolute laws is not an acceptable idea for Boltzmann. According to Boltzmann, the innate laws of thought are a prerequisite for us to have a complex experience. But these laws did not emerge out of nowhere, they developed gradually. Later, in the evolutionary process, they were genetically transferred to higher organized organisms. This is why such laws, acquired by our ancestors, but innate to us, however strongly they seem to be necessary, are not infallible (Boltzmann, 1974). According to Boltzmann, the laws of thought emerged as a result of people's internal connection of ideas with objects increasingly adapting to genuine connections between objects. Therefore, all rules that contradict experience were rejected and the closest to experience was retained to be considered the most correct. However, internal ideas that do not contradict experience, that is, both adapting to the connection between objects and compatible with their own object, have been transferred to the next generations through heredity in the evolutionary process. Over time, as a result of this process, what we call the

laws of thought today emerged. We think of these laws as if we were born with them. On the other hand, for Boltzmann, when it comes to an abstract field, such as logic, which is outside the field of experiment, we make a lot of mistakes in this field, since everything is very clear to us. These are the things that Kant refers to as the antinomies of reason. According to Boltzmann, we must continually decompose the concepts into their simpler elements and explain the phenomena in terms of laws we already know. Boltzmann sees this process as a very useful and necessary activity (Boltzmann, 1974). Boltzmann says the following about problems that can be seen as antinomies of the reason, such as the definition of the concept of number, the reason for the existence of the law of causality, the nature of matter, and so on:

> Questions like what is the definition of the number concept, the cause of the law of causality, the nature of matter, force, energy and so on, always irresistibly recur, even to the person who is philosophically trained. He is convinced that these concepts are taken straight from experience and not explicable further, so that here the now irresistible mental habit of asking for the cause and definition overshoots the mark, but still he cannot overcome a certain residual dissatisfaction that such important concepts as number or causality defy all attempts at definition. It is as when an optical illusion fails to vanish even after one has clarified its mechanical cause. It is a step further still if we find it inexplicable and mysterious that we or anything at all should exist and cannot quite rid ourselves of this notion even after recognizing that the concept of mystery is here as little applicable as the concept of value or otherwise in judging life as a whole (Boltzmann, 1974, p. 137).

Boltzmann's words remind us of Wittgenstein's propositions in the *Tractatus*.

> 6.371 The whole modern conception of the world is founded on the illusion that the so-called laws of nature are the explanations of natural phenomena.
>
> 6.372 Thus people today stop at the laws of nature, treating them as something inviolable, just as God and Fate were treated in past ages.
>
> And in fact both are right and both wrong: though the view of the ancients is clearer in so far as they have a clear and acknowledged terminus, while the modern system tries to make it look as if everything were explained (Wittgenstein et al., 2001).

In addition, Wittgenstein mentions an effort that Boltzmann describes as "overshooting the mark", namely that questions about life still remain unanswered even if science answers all possible questions. However, according to Wittgenstein, the solution to the problem of life is revealed only when this problem disappears (Wittgenstein et al., 2001). Now, if we recall Boltzmann's words about illusions again, according to Boltzmann, some problems are independent from exceeding the capacity of human cognition and therefore do not constitute a problem in essence. According to Boltzmann, philosophical illusions, like perceptual illusions, are difficult to get rid of. Therefore, the main task of philosophy should be to reach conceptual clarity in order not to fall into such illusions. According to Boltzmann, philosophy should only help us from the mistakes we fall into as a result of these illusions, by gradually freeing us from these confusions and contradictions. Thus, we may also need to get rid of the habits of thought that are genetically transmitted to us (Boltzmann, 1974). On the other hand, the following words of Boltzmann regarding the status of philosophical problems inherited from his age in his conception of philosophy are quite interesting:

> The question whether matter is atomistically constituted or continuous therefore reduces to the question: Which represents the observed properties of matter most accurately, the properties on the assumption of an extremely large finite number of particles, or the limit of the properties if the number grows infinitely large? Of course this does not answer the old philosophic question, but we are cured of the urge to want to decide it along a path that is devoid of sense and hope. The mental process, that we must start by examining the properties of an essentially finite aggregate and then let the number of items under it grow enormously, this process remains the same in both cases; it is merely an abbreviated expression of the same mental process expressed by algebraic signs if, as is often done, one starts from the differential equation itself in framing a theory of mathematical physics (Boltzmann, 1974, p. 169).

Here, Boltzmann's statement in the context of his influence on Wittgenstein interests us, his emphasis on our salvation from a disease, such as hoping for resolution or

understanding of such problems, because, for Wittgenstein, philosophical problems should be dissolved rather than resolved. In short, it is Wittgenstein's main aim in the *Tractatus* to show that philosophical problems do not actually constitute problems. On the other hand, it is necessary to mention the difference between Wittgenstein and Boltzmann. While Boltzmann suggested brushing aside meaningless problems, Wittgenstein was more concerned with what makes sense and what does not. We also see that Wittgenstein was not at all impressed by Boltzmann's emphasis on the evolutionary process, since, in the *Tractatus*, Wittgenstein attributed a great value to logic, which is an element of Boltzmann's structure of the abstract field, which is not based on experience and has a high probability of misleading us. In the proposition 4.1122 of the *Tractatus*, Wittgenstein stated that the relevance of the theory of evolution put forward by Darwin to philosophy is no different from the relevance of other theories in the natural sciences to philosophy (Wittgenstein, 2001). On the other hand, according to Boltzmann, the salvation of philosophy may be thanks to Darwin's theory of evolution:

> In my view all salvation for philosophy may be expected to come from Darwin's theory. As long as people believe in a special spirit that can cognize objects without mechanical means, or in a special will that likewise is apt to will that which is beneficial to us, the simplest psychological phenomena defy explanation (Boltzmann, 1974, p. 193).

In short, it is quite obvious that Hertz and his contemporary Boltzmann influenced the author of the *Tractatus* in many ways. Hertz greatly influenced the early Wittgenstein with his theory of "picture" and Boltzmann with his philosophy based on the idea of "dissolving" problems. It is even possible to argue that Wittgenstein's view of philosophy has not changed, although he later found his suggestions in the *Tractatus* insufficient. For Wittgenstein, in his later philosophy, especially on self-knowledge, in a paragraph in Philosophical Investigations, says the following about how the sentence should be constructed:

> I can know what someone else is thinking, not what I am thinking. It is correct to say "I know what you are thinking", and wrong to say "I know what I am thinking." (A whole cloud of philosophy condensed into a drop of grammar.) (Wittgenstein, 1974).

Accordingly, what is called philosophy is for Wittgenstein a clarifying activity by penetrating deep into the language, just like Boltzmann's conception of philosophy.

CHAPTER 6

CONCLUSION

As it is known, Wittgenstein was an engineer before he went down in the history of philosophy as a philosopher. It would therefore be a mistake to ignore Wittgenstein's engineering background when it comes to his early philosophy. The main reason for this is the eclectic nature of Wittgenstein's early philosophy, since the early Wittgenstein philosophy is not a purely technical like Frege, since, Wittgenstein touches on problems such as the will in the *Tractatus*, possibly due to Schopenhauer's influence. Therefore, reading the early Wittgenstein philosophy within the framework of Wittgenstein's biographical, especially his engineering career, constitutes a very accurate method for understanding the *Tractatus*. The idea of "mechanics" as the dominant scientific model in the late nineteenth and early twentieth centuries was, of course, at the forefront of the scientific theories that Wittgenstein might have been taught during his engineering education. At that time, one of the first books that came to mind when talking about mechanics was Heinrich Hertz's *Principles of Mechanics*. In this book, Hertz first established a mechanical world concept based on definitions, and then tried to explain the phenomena that scientists tried to explain at that time, such as sound and light, by reducing them to mechanics. Hertz's mechanics corresponded to a kind of "picture" in that it was a kind of "representation" of the world, and although it has not been conclusively proven that Hertz borrowed this idea from his teacher, Hermann von Helmholtz, who developed a neurophysiologically based theory of perception, it is quite clear that it had a great impact on Hertz's thinking.

Hermann von Helmholtz is one of the rare personalities that we can easily call a scientist-philosopher in our age. Helmholtz, who was introduced to the ideas of

names such as Kant and Fichte at a young age, thanks to his father, became interested in human cognition at an early age. Helmholtz's indirect contribution to Tractarian picture theory in relation to this thesis is the development of a neurophysiology-based theory of perception. For Helmholtz, the real question was the secret to the success of our intuition and way of thinking in representing the outside world. How can objects in the external world display a correspondence with mental ideas? Although Helmholtz mentioned that our senses can sometimes mislead us, he claimed that he usually does not. He claimed the success we achieved in our relationship with the world as the reason for this, since, according to Helmholtz, we usually carry out our actions without any problems, for example, we can walk, for example, when we are thirsty, we can go to the tap and fill a glass with water and drink it. In all these processes, we would certainly not be able to drink even water if our perceptions misled us. While proposing a theory of perception based on the senses and hence the sense organs, Helmholtz compares himself to a chemist in explaining why it starts from the sense organs. According to Helmholtz, just as a chemist cannot start his experiments without being sure of the accuracy and precision of his devices and experimental equipment, a scientist working in the field of cognition cannot explain how perception works without learning the structure and working style of his sense organs (Helmholtz, 1862/1995). According to Helmholtz, we perceive the outside world through our sense organs, and each of us's perception is an "impression" because it is an individual perception. Helmholtz argues that these impressions of the external world, which we obtain through our senses, serve as a "sign" in the formation of the external world. The reason why Helmholtz specifically chose the word "sign" here is that because "sign" bears no resemblance to the object it represents. For example, because an "image" "represents" a reality, it has a certain kind of commonality with that reality. However, the "sign" has nothing in common with the object in the external world, just as it has nothing in common between the letters in a word and the meaning of the word, namely the object it points to. In addition, because our “impressions” are subjective, “signs” are also subjective, that is, they have no

objective meaning, but despite their subjective meaning, we succeed in our actions because we learn the interpretation of these “signs” through experience. What is meant by experience here is the success we have achieved in practice, so only the correct interpretation of the "signs" will allow us to be successful in our actions. In Helmholtz's theory of sensation, what we perceive about the outside world is entirely due to the interaction between our sense organs and the world, and the nerves stimulated as a result of this interaction cause an impression of the outside world in the brain. Therefore, the brain, where impressions arise, can have these impressions only if the outside world causes some physical changes in the nerve endings of the sense organs. The stimuli that the external world affects on the sense organs are brought together in the brain in order to create a holistic impression. So, for example, in the case of vision, when photons reflected from objects in the outside world are reflected on the retina, the impression of the relevant objects is formed in the brain, not on the retina. Helmholtz tries to prove this fact through the example of the eye. Accordingly, the proof that visual perception is produced only in the brain and not directly in the retina lies in the fact that the visual impression of any three-dimensional solid object is produced if and only if the impressions obtained from the two eyes are combined (Helmholtz, 1862/1995). Also, regarding the interaction of the five sense organs with the outside world, Helmholtz says that the only thing common to these sense organs is the neural mechanism, that is, the neural infrastructure. Therefore, since the changes that occur as a result of the interactions in the nerve endings of these organs are the same kind of physical and chemical changes, these changes are subject to the same kind of physical and chemical laws of nature. However, at this point, it is necessary to underline Helmholtz's emphasis on the sense organs, since, according to Helmholtz, the neural infrastructure of the sense organs is connected with the "brain", which is the last stop of the mental experience we call "impression". Therefore, just like nerves associated with muscles, they have a different purpose/function from other motor nerves in the body. To explain this with an example about seeing, no part of our body, except the eye, has the capacity to

create an "impression" in the mind, namely the brain, by reacting to the "light" stimulus in the outside world. In fact, besides making an impression, we have no organ other than the eye where "light" can cause a neural change. Therefore, we can only see with our eyes, because the neural infrastructure we have is conducive to the sense of "touch" rather than "sight". Also, according to Helmholtz, the effect that creates the feeling of light is not necessarily the light itself. For example, when the person puts pressure on the eyelids with their hand or someone else punches the person hard, it is possible for the person to experience light-like experiences in his mind. Helmholtz's conclusion is that any external factor that can stimulate our optic nerves or affect this neural structure can cause a feeling of "light" in the mind (Helmholtz, 1862/1995). Thus, although the emergence of a situation that seems purely subjective depends on external influences, these external influences are not limited to "light", as the light is felt in the mind since what causes the sensation in question are physical and chemical changes in the optic nerves. However, the cone and rod cells in the retina are only sensitive to external light. For this reason, it cannot be said that the retina has much function in the sensation created by the physical changes in the optic nerves. Therefore, Helmholtz's conclusion is as follows: "Like light produces a similar color sensation under similar conditions (Helmholtz, 1862/1995, p. 166). At this point, Helmholt refers to the difference between "sign" and "image". The difference between a "sign" and an "image" is based on the difference in the type of thing they represent. Accordingly, "sign" is something that indicates the existence of something other than itself, it has no existence independent of what it represents. On the other hand, there must be a generic commonality between the so-called "image" and the object it represents. For example, a photograph of a person has a lot in common with that person, that is, with the person's body [i.e. whatever parts of the person's body are in the photo, e.g. face, shoulders, feet, etc.]. We explained for Helmholtz that what we perceive, that is, our impressions, are things that exist as a result of the effects of the physical world on our sense organs. Therefore, the nature of such effects, that is, the changes that occur in our sense

organs, are entirely related to the reactions of our sense organ to these effects, that is, with which sense organ it interacts. The quality of what we perceive depends on the influence of the outside world on our sense organs. Therefore, the quality of our sense is a "sign", not an "image" of the influence of the external world on our sense organs. In other words, it does not have any association with the outside world, it only refers to the entity outside itself, that is, to the outside world. In short, what we call sensations are "signs" of relations in the physical world, and sensations, as "signs" of relations in reality, are as much connected with reality as the letters in a person's name are about that person himself. Although this qualitative character of our sensations is purely a product of our physical organization, this does not mean that they are completely empty and useless. In Helmholtz's time, as there was no general consensus among the scientists of the time when it came to "perception", issues of perception were generally seen as processes consisting of "spiritual activities". While empirically oriented scientists tended to derive the entire concept of space from experience, other scientists with Kantian leanings were closer to theories deriving perception rather from intuition. Proponents of the empirical theory of perception argue that there is no need to resort to any unknowable and inaccessible power other than the mind's faculties when it comes to explaining perception. Helmholtz is also a proponent of this view. Thus, if these "signs" are constitutive elements of our impressions of the outside world, how can we explain the success of our actions? In short, what is the relationship between "signs" and our success in our actions? One of the reasons for this is that empirical theories have more explanatory power using fewer hypotheses than their intuitive counterparts. According to Helmholtz, the basic thesis of the empirical theory of perception is that our sensations through our sense organs constitute a "sign" for our consciousness and how we perceive the meanings of these signs is entirely related to our intelligence. For example, with regard to our sense of sight, the signs or symbols that we obtain with our sense of sight may differ in intensity and quality, that is, in brightness and colour. There may also be other differences between them, depending on where the retina is stimulated. The only way

to learn the different meanings created by all these differences is through experience. Therefore, just as in the regular relation between two different 'signs' or 'ideas', we learn the meaning of 'signs' the more often this association is repeated, the better. Helmholtz shows, through his example of infants, how repeated acts of association work in the success of 'signs'. Accordingly, even if babies are given the most modern, sophisticated toys, they always prefer the most primitive toy. After looking at such a toy every day for weeks, the baby finally learns all the perspective views it offers; then he throws it away and asks for a new toy that looks like he has at first. In this way, the child learns to recognize different aspects of the same object in connection with its constant movements, so grasping the shape of any object is the result of associating all these visual images. Once we have a proper grasp of the shape of any object, we can more or less imagine what it might look like from another point of view. All these different views are combined in the judgment we form about the dimensions and shape of an object. With the changes caused by an object in the outside world in the neural stimulation areas of our sense organs, we can perceive this object from different directions, for example, by touching or tasting. All these different sensations seem to be united in experience as a whole, and thereby we have an idea, an idea, of this object.

It can be said that the closest theory to the "picture theory" put forward by Wittgenstein in the *Tractatus* is the theory put forward by Heinrich Hertz in the *Principles of Mechanics*. Although Hertz did not deal with cognition as much as his teacher Helmholtz did with the neurophysiology-based research of perception, it can be said that the question regarding the capacity of scientific theories to represent the external world while working on electrodynamics motivated Hertz to come up with his "picture theory". To solve this problem, Hertz used Helmholtz's theory of signs, but interpreted it in a completely new way. As explained in detail earlier, for Helmholtz, sensory experiences serve as signs of the inaccessible external reality of matter and forces. According to Hertz, what the theories represent is a sign of the

sensory impressions given to us. Thus, according to Hertz, we can predict the future from experience of the past if we only use theory to construct representations. Hertz, like his teacher Helmholtz, argued that spatial and temporal relations could only be represented in a sign system. However, for Hertz, judgments about relationships between objects are constructed within a *Bild*, which also translates as "symbol" or "picture", but *Bild* also means "model". In his famous book *Principles of Mechanics*, Hertz claimed that scientific theories create a picture of the outside world through symbols. It was a result of the scientific spirit of the time that Herz developed a theory of physics based on "mechanics" since all the achievements in physics from Newton to that day were only possible with a mechanical worldview. For example, all concepts that could not be explained in a mechanical theory such as heat and light were tried to be explained mechanically by the physicists of the period. As will be remembered, we saw that Helmholtz's work on sensory perception was for the development of a neurophysiology-based theory of perception. Helmholtz's promising student, Hertz, tried to express his teacher's theory of perception through a mechanical theory. Hertz's style in Mechanics also gives us an idea about his view of philosophy, as the first volume of the book is full of definitions. It can be safely said that the issue of conceptual clarity is therefore a fundamental feature of the *Principles of Mechanics*. As it is known, the Newtonian understanding of the universe is based on four basic concepts: space, time, mass and force. Newton's concept of "force" is a concept that has been heavily attacked after him. Hertz, on the other hand, developed criteria for scientific theories and was perhaps the first person to make philosophy of science in its current sense. Accordingly, all acceptable, i.e. plausible, theories must be conceptually coherent, that is, they must not contain any logical incompatibility. Second, a theory should not contradict experience, that is, common sense in a sense, and therefore should not contradict our empirical knowledge. Finally, if a theory provides the richest and most comprehensive explanation through the fewest concepts or terms, it is the most appropriate theory for science. In short, according to Hertz, a theory should be logically sound, that is, permissible, but

compatible with other empirical realities, and should be able to explain the basic relationships in the world in the most comprehensive way by suggesting the least concepts or terms. Therefore, a scientific theory is a correct theory if it best represents the relations of objects in the world as a picture of the world, and the relations in the picture do not contradict experience. From this we deduce that there is no absolute and single theory for Hertz, but a correct theory provided it satisfies the three criteria we mentioned above. In short, according to Hertz, there is no single correct theory, each theory that satisfies the criteria is the correct theory for Hertz. It is an undeniable reality that many biographers and Wittgenstein experts influenced Wittgenstein by Hertz. For example, according to James Griffin, the picture theory in Wittgenstein's *Tractatus* derives almost entirely from Hertz. Accordingly, Wittgenstein was the first to apply a picture-based theory of meaning to language as a whole, not just a part of it (Griffin, 1964). Moreover, it is clear that both Hertz's and Wittgenstein's expectations from philosophy, that is, their philosophical ideals, are very close to each other, because they both place emphasis on conceptual clarity. Also, both have adopted some form of picture theory. While Wittgenstein adopted a theory of "picture" inherited from Helmholtz to Hertz with the term "sign", he tried to present an original explanation of "reality" with his understanding of language based on logic and logical atomism from Frege and Russell. On the other hand, Elizabeth Anscombe, one of Wittgenstein's brightest students, argues that the *Tractatus* would not have existed if Frege and Russell had not revolutionized logic (Anscombe, 1959). However, it cannot be considered as a mere coincidence that the last components of the *Bild* understanding revealed by Hertz in the *Principles of Mechanics* correspond to the objects in the *Tractatus*. Wittgenstein also claims that the laws of physics are things that speak, albeit indirectly, about objects in the world (TLP 6.3431). In the next proposition, Wittgenstein refers directly to Hertz's concept of matter-point (in Pears & McGuinness's translation, point-mass is translated). In this proposition, Wittgenstein emphasizes that Hertz's mechanics, in its claim to present a picture of the world, speaks of any material point rather than "specific" material points. From

this point of view, it is possible to say that Hertz's "material-point" concept corresponds to the "states of affairs" in the *Tractatus*. This is because, as described in detail earlier, Hertz defines material points to be composed of any number of interconnected material particles. In *Notebooks 1914-1916*, Wittgenstein draws an analogy for how different physical theories lead to different descriptions of phenomena, through the ability to depict a surface in different ways with different geometrical figures. This gives Wittgenstein an idea of the relationship between logic and mechanics. Accordingly, mechanics, according to Wittgenstein, is an attempt to construct all the propositions we need to describe the world according to a single plan. Furthermore, Wittgenstein argues that Hertz's invisible masses are pseudo-objects (Wittgenstein et al., 1984). It would not be wrong to say that the "pseudo-objects" that Wittgenstein refers to refers to "images" developed by Hertz in his *Principles of Mechanics*. Hertz claims that we create for ourselves images [*inner Scheinbilder*] or symbols [*Symbol*] of external objects (Hertz et al., 1899). Another similarity between Wittgenstein and Hertz is that Hertz presents the concept of "idden mass" as a condition of the possibility of the propositions of physics. As will be remembered, Wittgenstein also presents simple objects as a condition of the possibility of propositions. Regarding this, Wittgenstein says in TLP 4.0312: "The possibility of propositions is based on the principle that objects have signs as their representatives." (Wittgenstein et al., 2001).

Finally, it would never be an exaggeration to say that one of the most important figures that shaped Wittgenstein's view of philosophy in particular was the famous physicist Ludwig Boltzmann, since, as his biographical details show, it is quite obvious that Wittgenstein was somehow influenced by Boltzmann's thoughts. Now, let's try to briefly explain the possible effects of this great physicist on Wittgenstein through his theory of mechanics and "picture theory". First, let's briefly summarize why Boltzmann refers to the concept of mechanics. According to Boltzmann, sound, light, etc. All phenomena belonging to physics are phenomena that can be explained

by the motion of particles. Therefore, what Boltzmann understands by "mechanics" is nothing but the representation of the motion of particles. According to Boltzmann, no theory can explain nature without introducing the concept of "movement". On the other hand, if all qualitative changes in appearance could be represented by the presentation of movements in a single representation or picture, or by changes in the arrangement of the smallest parts, this would lead to a particularly simple explanation of nature. Therefore, a single picture is not enough to represent nature completely, and therefore we need different representations of nature. Boltzmann says that what gives us confidence in allowing different representations of nature is the new developments in physical science at that time (Boltzmann and McGuinness, 1974). At this point, a debate also arises as to whether our capacity to represent the outside world is a priori. In this regard, Boltzmann believed that, within the framework of the Darwinist theory of evolution, the ability to represent could change at the point that new and more useful representations were created that would ensure human survival. However, it should be noted that Boltzmann did not radically reject the laws of a priori thought, but rather, they were passed down to us genetically from our ancestors during the evolutionary process. On the other hand, the fact that these laws have been handed down to us in the course of evolution does not mean that they are universal and absolutely necessary truths. Therefore, according to Boltzmann, time and environmental conditions may cause the seemingly unchanging representations of nature to change. Finally, we need to mention Boltzmann's influence on Wittgenstein's thoughts on the role he assigned to philosophy. If we recall Boltzmann's words about illusions, some problems, according to Boltzmann, are not related to exceeding the cognitive capacity of the human being and therefore do not actually constitute a problem. Therefore, according to Boltzmann, philosophical illusions, like perceptual illusions, are difficult to get rid of. Therefore, the main task of philosophy should be to reach a kind of conceptual clarity in order not to fall into such mistakes. According to Boltzmann, the main task of philosophy is to gradually free us from these confusions and contradictions that we fall into as a result of these

illusions. As it will be remembered, according to Wittgenstein, philosophical problems should be dissolved rather than solved, that is, they should be shown that they are not actually a problem. In short, Wittgenstein's main purpose in the *Tractatus* is to show that philosophical problems are not genuine problems. On the other hand, it is necessary to mention the difference between Wittgenstein and Boltzmann. While Boltzmann suggested putting aside meaningless problems, Wittgenstein was more concerned with what make sense and what doesn't. We also see that Wittgenstein was not at all impressed by Boltzmann's emphasis on the evolutionary process. Accordingly, Wittgenstein stated in *Tractatus*' proposition 4.1122 that the relationship between Darwin's theory of evolution and philosophy is not different from the relationship of other theories in the natural sciences with philosophy (Wittgenstein, 2001). Although he later found his suggestions in the *Tractatus* insufficient, it can be said that Wittgenstein's view of philosophy did not change much, since, in the late Wittgenstein philosophy, what is called philosophy is nothing but an illuminating activity by going deep into the language, just like Boltzmann's understanding of philosophy.

This thesis, which can also be seen as an effort to extract the genealogy of the *Tractatus*, traces the "picture theory", which is the main backbone of the *Tractatus*, and which is probably inspired by a representation based on mechanics that Hertz inherited from his teacher, Helmholtz. Therefore, in the thesis, Hermann von Helmholtz's personal life story was discussed in parallel with his scientific career, and how his "sign"-based "representation" theory evolved into a "mechanical" concept of the external world with Hertz, was discussed in detail. Accordingly, Hertz, like a physicist worthy of the heir of the great importance his teacher Helmholtz attributed to mechanics, tried to explain causality in the external world by reducing the reciprocity between mental representations of objects to mechanics, that is, to the science of motion. While doing this, Hertz, especially in the first volume of the *Principles of Mechanics*, first tried to make definitions with a desire for conceptual

clarity and argued that what is expected from physics and philosophy is first of all a clear definition of concepts. For this reason, the effects of Hertz's conception of philosophy and picture theory based on mechanics on Wittgenstein cannot be denied. Wittgenstein made direct reference to Hertz in various propositions of the *Tractatus* and radically interpreted Hertz's picture theory, which he put forward on the basis of scientific theories, within the framework of a logic-based linguistic theory of meaning. On the other hand, another figure whose role can never be ignored in Wittgenstein's philosophical and intellectual biography is the famous Austrian physicist Ludwig Boltzmann. Although Boltzmann sided with a naturalist *Bildtheorie* on the basis of Darwinian evolutionary theory, Wittgenstein's words in the *Tractatus* regarding the direct relation of Darwinian theory to philosophy signal that Wittgenstein is familiar with a Boltzmannian picture theory. However, Wittgenstein seems to be trying to distinguish his picture theory from Boltzmann's by expressing that such a theory is not more related to philosophy than it is to any other branch of science. Finally, Wittgenstein's assertion that he solved the philosophical problems to the end, the assertive sentences in the preface of the *Tractatus*, is a clear indication of Boltzmann's obvious influence on Wittgenstein, since, according to Boltzmann, science, especially physics and philosophy at the same time, is obliged to eliminate these problems by showing that the problems that seem to be unsolvable do not actually constitute a problem.

In short, in this thesis, it has been tried to show that Wittgenstein's wonderful book *Tractatus*, which is generally discussed in the context of the ideas of the logician scientists Gottlob Frege and Bertrand Russell, was actually highly influenced by the philosophical and mechanistic representation models of the philosopher-scientists of his age such as Hermann von Helmholtz, Heinrich Hertz and Ludwig Boltzmann. If this work succeeds in shedding some light on the intellectual roots of the early Wittgenstein philosophy, it can be considered to have achieved its purpose.

REFERENCES

Anscombe, G. E. M. (1959). *An introduction to Wittgenstein's Tractatus*. Hutchinson Univ. Lib.

Baird, D., G., H. R. I., & Nordmann, A. (2011). *Heinrich Hertz: Classical physicist, modern philosopher*. Springer.

Blackmore, J. (Ed.). (1995). *Ludwig Boltzmann: His later life and philosophy, 1900-1906*. Kluwer Academic Publishers.

Boltzmann, L. (1974). *Theoretical physics and philosophical problems: Selected writings*. (B. McGuinness, Ed.). Reidel Pub. Co.

Britannica, T. Editors of Encyclopaedia (2021, September 1). *Ludwig Boltzmann. Encyclopedia Britannica*. https://www.britannica.com/biography/Ludwig Boltzmann

Britannica, T. Editors of Encyclopaedia (2022, January 1). *Heinrich Hertz. Encyclopedia Britannica*. https://www.britannica.com/biography/Heinrich-Hertz

Encyclopædia Britannica, inc. (n.d.). *Heinrich Hertz*. Encyclopædia Britannica. Retrieved January 15, 2022, from https://www.britannica.com/biography/Heinrich-Hertz

Feyerabend, P. (2016). *Philosophical papers*. (S. Gattei & J. Agassi, Eds.). Cambridge University Press.

Finger, S., & Wade, N. J. (2002). The Neuroscience of Helmholtz and the theories of Johannes Müller. *Journal of the History of the Neurosciences*, *11*(3), 234–254. https://doi.org/10.1076/jhin.11.3.234.10392

Griffin, J. (1964). *Wittgenstein's logical atomism*. Oxford University Press.

Heidelberger, M. (1998). From Helmholtz's Philosophy of Science to Hertz's Picture Theory. In Robert S. Cohen & Marx W. Wartofsky (Eds.), *Heinrich Hertz: Classical Physicist, Modern Philosopher* (pp. 9-24). Springer-Science+Business Media, B.V.

Helmholtz, H. von, & Cahan, D. (1995). *Science and culture: Popular and philosophical essays*. University of Chicago Press.

Hertz, H. R. (1899). *The principles of mechanics presented in a new form*. (D. E. Jones & J. T. Wallley, Trans.). Macmillan.

Mulligan, J. F. (1987). The influence of Hermann von Helmholtz on Heinrich Hertz's contributions to physics. *American Journal of Physics*, *55*(8), 711–719. https://doi.org/10.1119/1.15062

McGuinness, B. (2005). *Young Ludwig: Wittgenstein's life, 1889-1921*. Oxford University Press.

Mulligan, J. F. (1987). The influence of Hermann von Helmholtz on Heinrich Hertz's contributions to physics. *American Journal of Physics*, *55*(8), 711–719. https://doi.org/10.1119/1.15062

Monk, R. (1991). *Ludwig Wittgenstein the duty of genius*. Vintage.

Patton, L. (2009). Signs, toy models, and the a priori: From Helmholtz to Wittgenstein. *Studies in History and Philosophy of Science Part A*, *40*(3), 281–289. https://doi.org/10.1016/j.shpsa.2009.07.004

Popper, K. R. (2002). *Unended quest: An intellectual autobiography*. Routledge.

von, H. H. L. F., & C., S. J. P. (1925). *Helmholtz's treatise on physiological optics (Vol.1,2,3)*. The Optical Society of America.

Williams, L. Pearce (2021, September 4). *Hermann von Helmholtz*. *Encyclopedia Britannica*. https://www.britannica.com/biography/Hermann-von-Helmholtz

Wittgenstein, L. (1974). *Philosophical investigations translated by G.E.M. Anscombe*. (G. E. M. Anscombe, Trans.). Blackwell.

Wittgenstein, L. (1984). *Notebooks 1914-1916*. (G. H. von Wright & G. E. M. Anscombe, Trans.). University of Chicago Press.

Wittgenstein, L. (2001). *Tractatus logico-philosophicus*. (D. F. Pears & B. F. McGuinness, Trans.). Routledge.

APPENDICES

A. TURKISH SUMMARY / TÜRKÇE ÖZET

20. yüzyılda geleneksel felsefeden kopuşu temsil eden kitapların başında gelen *Tractatus Logico-Philosophicus*'un yazarı Ludwig Wittgenstein, felsefe sahnesine bir filozof olarak girmeden evvel bir mühendisti. Bu nedenle, Wittgenstein'ın erken dönem felsefesi olarak adlandırılan *Tractatus Logico-Philosophicus*'u kaleme aldığı dönemdeki düşüncelerinin köken aldığı figürleri incelemek, bu dönemindeki fikirlerinin daha net şekilde önemli bir rol oynayacaktır. Wittgenstein'ın erken dönem felsefesinin doğasının eklektik olduğunu söylemek yanlış olmaz, çünkü erken dönem Wittgenstein felsefesi Frege gibi salt teknik, mantık ve matematiksel gayelere dayanmaz, çünkü Wittgenstein, muhtemelen Arthur Schopenhauer'ın etkisiyle *Tractatus*'ta irade gibi meselelere de yer verir. Bu nedenle erken dönem Wittgenstein felsefesini Wittgenstein'ın biyografisi, özellikle de mühendislik kariyeri çerçevesinde okumak, *Tractatus*'u anlamak için oldukça mühim bir yöntem teşkil eder.

On dokuzuncu yüzyılın sonlarında ve yirminci yüzyılın başlarında baskın bilimsel model olarak “mekanik” fikri, elbette, Wittgenstein'ın mühendislik eğitimi sırasında karşılaşacağı bilimsel teorilerin başında geliyordu. O zamanlar mekanik denilince akla gelen ilk kitaplardan biri Heinrich Hertz'in *Mekaniğin İlkeleri* idi. Hertz bu kitabında önce tanımlara dayalı bir mekanik dünya kavramı kurmuş, ardından bilim adamlarının o dönemde açıklamaya çalıştığı ses ve ışık gibi olguları mekaniğe indirgeyerek açıklamaya çalışmıştı. Hertz'in mekaniği, bilhassa "temsil"e dayalı bilimsel model fikri, nörofizyolojik temelli bir sistem geliştiren hocası Hermann von Helmholtz'dan ödünç aldığı kesin olarak kanıtlanamasa da, Helmholtz'un algı teorisinin Hertz'in düşüncesi üzerinde büyük bir etkisi olduğu oldukça açıktır.

Hermann von Helmholtz çağımızda rahatlıkla bilim insanı-filozof olarak adlandırabileceğimiz ender kişiliklerden biridir. Küçük yaşta Kant ve Fichte gibi filozofların fikirleriyle babası sayesinde tanışan Helmholtz, küçük yaşta insan bilişine ilgi duymaya başlamıştır. Helmholtz'un bu tezin ilk bölümü olarak önemi de Tractarian resim teorisine dolaylı katkısından kaynaklanır; çünkü Helmholtz nörofizyoloji temelli bir algı teorisi geliştirmiştir. Buna göre, Helmholtz'un algı kuramının temelinde yatan soru, sezgimizin ve dış dünyayı temsil etmedeki düşünce tarzımızın başarısının ardındaki sırdı. Örneğin, dış dünyadaki nesneler zihinsel fikirlerle nasıl oluyor da denk düşebiliyordu? Helmholtz bu soruyu, duyularımızın bazen bizi yanıltabilme ihtimalinden söz ederek yanıtlasa da, aslında duyularımızın o kadar da güvenilmez olmadığını iddia ederek yanıtlamıştır. Bunun nedeni olarak ise dünya ile ilişkimizde elde ettiğimiz başarıyı öne sürmüştür, çünkü Helmholtz'a göre genellikle eylemlerimizi sorunsuz bir şekilde gerçekleştiriyoruz, örneğin yürüyebiliyoruz yahut susadığımızda, musluğun yanına giderek bir bardağa su doldurup içebiliyoruz. Eğer duyularımız asla güvenilemeyecek nispette bizi aldatan şeyler olsalardı, su içmek gibi oldukça basit bir eylemi gerçekleştirmekten dahi aciz olurduk. Helmholtz, duyulara ve dolayısıyla duyu organlarına dayalı algı teorisini geliştirdiği esnada, işe neden duyu organlarıyla başladığını açıklarken kendisini bir kimyagerle karşılaştırır. Helmholtz'a göre nasıl ki bir kimyager, cihazlarının ve deney ekipmanlarının doğruluğundan ve kesinliğinden emin olmaksızın deneylerine başlayamazsa, biliş alanında çalışan bir bilim adamı da duyusunun yapısını ve çalışma tarzını öğrenmeden algının nasıl çalıştığını açıklayamaz. Helmholtz'a göre dış dünyayı duyu organlarımız aracılığıyla algılarız ve her birimizin algısı bireysel/tekil/münferit bir algı olduğu için birer "izlenim"dir. Helmholtz, duyularımız aracılığıyla edindiğimiz dış dünyaya ilişkin bu izlenimlerin, dış dünyanın oluşumunda bir "im" işlevi gördüğünü ileri sürer. Helmholtz'un burada özellikle "im" kelimesini tercih etmesinin nedeni, "im"in temsil ettiği nesneyle arasında hiçbir benzerlik taşımıyor oluşudur. Örneğin, bir "imge/imaj" belirli türden bir gerçekliği "temsil ettiği" için, söz konusu gerçeklikle belirli bir tür ortaklığa/benzerliğe sahiptir.

Ancak, "im"in dış dünyadaki nesneyle hiçbir ortak yanı yahut benzerliği yoktur, tıpkı bir sözcükteki harflerle sözcüğün anlamı, yani işaret ettiği nesne arasında hiçbir ortak yanı olmaması gibi. Ayrıca “izlenimlerimiz” öznel olduğu için “im”ler de özneldir, yani nesnel bir anlamdan yoksundurlar, ancak bizler, imlerin bu öznel anlamlarına rağmen eylemlerimizde başarılı oluruz çünkü bu “im”lerin yorumunu deneyimler aracılığıyla öğreniriz. Burada deneyimle kastedilen, pratikte elde ettiğimiz başarıdır, bu nedenle "im"lerin doğru yorumu, eylemlerimizde başarılı olmamızı sağlayan yegâne unsurdur. Helmholtz'un duyumsama kuramında, dış dünyayla ilgili olarak algıladıklarımız her şey tamamen duyu organlarımız ile dünya arasındaki etkileşimden türer ve bu etkileşim sonucunda uyarılan sinirler beyinde dış dünyanın bir izlenimini oluşturur. Dolayısıyla izlenimlerin zuhur ettiği yer olarak beyin, bu izlenimlere ancak dış dünyanın duyu organlarının sinir uçlarında bazı fiziksel değişikliklere neden olması sayesinde sahip olabilir. Dış dünyanın duyu organlarında neden oldukları değişimler neticesinde meydana gelen uyarılar beyinde bir araya getirilerek bütünsel bir izlenimin oluşmasına yardımcı olur. Yani örneğin görme durumunda, dış dünyadaki nesnelerden yansıyan fotonlar retinaya yansıdığında, ilgili nesnelerin izlenimi retinada yahut organ olarak gözde değil beyinde oluşur. Helmholtz bu olguyu göz örneği üzerinden örnekler. Buna göre, görsel algının doğrudan retinada değil, yalnızca beyinde üretildiğinin kanıtı, herhangi bir üç boyutlu katı nesnenin görsel izleniminin, ancak ve ancak iki gözün birden işin içine dahil olmasıyla elde edilen izlenimlerin birleştirilmesiyle üretilmesidir. Ayrıca Helmholtz, beş duyu organının dış dünya ile etkileşimine ilişkin olarak, bu duyu organlarının tamamında ortak olan tek şeyin nöral mekanizma, yani nöral altyapı olduğunu söyler. Dolayısıyla bu organların sinir uçlarında meydana gelen etkileşimler sonucu meydana gelen değişiklikler aynı tür fiziksel ve kimyasal değişiklikler olduğundan, bu değişiklikler aynı tür fiziksel ve kimyasal doğa yasalarına tabidirler. Ancak bu noktada Helmholtz'un duyu organlarına yaptığı vurgunun altını çizmek gerekir, çünkü Helmholtz'a göre duyu organlarının sinirsel altyapısı, zihinsel deneyim dediğimiz son durak olan "beyin" ile doğrudan bağlantılıdır. Bu nedenle tıpkı kaslarla

bağlantılı olan sinirler gibi vücuttaki diğer motor sinirlerden farklı bir amaca/işlevlere sahiptirler. Bunu görmeyle ilgili bir örnek üzerinden açıklamak gerekirse, göz dışında hiçbir organımız dış dünyadaki "ışık" uyarısına tepki vererek zihinde yani beyinde bir "izlenim" yaratma kapasitesine sahip değildir. Kısacası, "ışık"ın sinirsel değişikliğe neden olabileceği göz dışında bir organımız yoktur. Bu nedenle sadece gözlerimizle görebiliriz, çünkü sahip olduğumuz sinirsel altyapı "görme" duyusuna elverişlidir. Ayrıca Helmholtz'a göre ışık hissini yaratan etki mutlaka ışığın kendisi değildir. Örneğin, kişi eliyle göz kapaklarına baskı yaptığında veya bir başkası kişiye sert bir yumruk attığında, kişinin zihninde ışık benzeri deneyimler yaşaması mümkündür. Helmholtz'un vardığı sonuç, optik sinirlerimizi uyarabilen veya bu nöral yapıyı etkileyebilecek herhangi bir dış faktörün zihinde bir "ışık" hissine neden olabileceğidir. Dolayısıyla tamamen öznel görünen bir durumun ortaya çıkması dış etkenlere bağlı olsa da, en nihayetinde ışık izlenimi zihinde zuhur ettiği için bu dış etkiler "ışık" ile sınırlandırılamaz. Dolayısıyla bu tür etkilerin doğası yani duyu organlarımızda meydana gelen değişimler tamamen duyu organımızın bu etkilere verdiği tepkilerle yani hangi duyu organıyla arasındaki etkileşimle ilgilidir. Algıladığımız şeyin niteliği, dış dünyanın duyu organlarımız üzerindeki etkisine bağlıdır. Dolayısıyla duyumuzun niteliği, dış dünyanın duyu organlarımız üzerindeki etkisinin bir "imgesi" değil, bir "im"idir. Yani dış dünya ile hiçbir ilişkisi yoktur, sadece kendi dışındaki bir varlığa yani dış dünyaya atıfta bulunur. Kısacası, duyum dediğimiz şeyler, fiziksel dünyadaki ilişkilerin "im"leridir ve gerçeklikteki ilişkilerin "im"leri olarak duyumlar, bir kişinin adındaki harflerin o kişinin kendisiyle ilgili olduğu kadar gerçeklikle bağlantılıdır. Duyumlarımızın bu niteliksel karakteri tamamen fiziksel organizasyonumuzun bir ürünü olsa da, bu onların tamamen boş ve yararsız oldukları anlamına gelmez. Helmholtz'un döneminde, konu "algı" olduğunda bilim adamları arasında genel bir fikir birliği olmadığı için, algı sorunları genellikle "ruhsal/tinsel faaliyetlerden" müteşekkil süreçler olarak görülüyordu. Emprisist yönelime sahip bilim adamları, tüm uzay kavramını deneyimden türetme eğilimindeyken, Kantçı eğilimlere sahip diğer bilim adamları, algıyı sezgiden türeten

teorilere daha yakındı. Emprisist algı teorisinin savunucuları, algıyı açıklamak söz konusu olduğunda, zihnin yetileri dışında bilinmeyen ve erişilemeyen herhangi bir güce başvurmaya gerek olmadığını savunuyorlardı. Helmholtz da bu görüşün bir savunucusuydu. Bu nedenle, eğer bu "im" denilen şeyler, dış dünyaya ilişkin izlenimlerimizin kurucu unsurlarıysa, eylemlerimizin başarısını nasıl açıklayabiliriz? Kısacası, "im"ler ile eylemlerimizde başarılı olmamız arasındaki ilişki nedir? Emprisist yönelimli teoriler sezgisel muadillerine göre daha az hipotez kullanarak daha fazla açıklayıcı güce sahip oldukları için o dönemin bilim adamları arasında daha çok tercih edilen teorilerdi. Helmholtz için ise, emprisist algı teorisinin temel tezi, duyu organlarımız aracılığıyla sahip olduğumuz duyumlarımızın bilincimiz için bir "im" teşkil ettiği ve bu imlerin anlamlarını nasıl algıladığımızın tamamen anlağımızla ilgili olduğuydu. Örneğin görme duyumuzla elde ettiğimiz im veya simgeler, yoğunluk ve nitelik, yani parlaklık ve renk bakımından farklılık gösterebilir. Retinanın uyarıldığı yere bağlı olarak aralarında başka farklılıklar da olabilir. Tüm bu farklılıkların yarattığı farklı anlamları öğrenmenin tek yolu deneyimdir. Bu nedenle, tıpkı iki farklı "im" veya "ide/fikir" arasındaki düzenli ilişkide olduğu gibi, "im"lerin' anlamını bu ilişkilendirme ne kadar sık tekrarlanırsa o kadar iyi öğreniriz. Helmholtz, bebeklerle ilgili örneği aracılığıyla, bağlantılandırmaya ilişkin mükerrer eylemlerin "im"lerin başarısında ne tür bir rol oynadığını ortaya koyar. Buna göre bebeklere en modern, sofistike oyuncaklar verilse bile her zaman en ilkel oyuncağı tercih ederler. Haftalarca her gün bu türden bir oyuncağa baktıktan sonra, bebek nihayet oyuncağı tüm açılardan görmek suretiyle öğrenir; sonra onu fırlatır ve yeni bir oyuncak ister. Bu şekilde, çocuk aynı nesnenin farklı yönlerini onu tekrar tekrar görmek suretiyle öğrenir, dolayısıyla herhangi bir nesnenin şeklini kavramak, tüm bu görsel görüntüleri ilişkilendirmenin sonucudur. Herhangi bir nesnenin şeklini doğru bir şekilde kavradığımızda, başka bir bakış açısından nasıl görünebileceğini az çok tasavvur edebiliriz. Tüm bu farklı görüşler, bir nesnenin boyutları ve şekli hakkında oluşturduğumuz yargıda birleştirilir. Dış dünyadaki bir cismin duyu organlarımızın sinirsel uyarı alanlarında neden olduğu

değişiklikler ile bu cismi farklı yönlerden örneğin dokunarak veya tadarak da algılayabiliriz. Tüm bu farklı duyumlar bir bütün olarak deneyimde birleştirilmiş görünüyor ve Helmholtz'a göre bu yolla söz konusu nesnenin bir fikrine, bir ideasına sahip olabiliyoruz.

Wittgenstein'ın *Tractatus*'ta ortaya koyduğu "resim kuramı"na en yakın kuramın Heinrich Hertz'in *Mekaniğin İlkeleri*'nde ortaya koyduğu kuram olduğu söylenebilir. Hertz bilişle, hocası Helmholtz'un nörofizyoloji temelli algı araştırmasıyla uğraştığı kadar ilgilenmese de, elektrodinamik üzerinde çalışırken bilimsel teorilerin dış dünyayı temsil etme kapasitesiyle ilgili meselenin Hertz'e ilham verdiği söylenebilir. Bu meseleyi çözmek için Hertz, Helmholtz'un "im"ler kuramına başvursa da onu tamamen yeni bir şekilde yorumlamıştır. Daha önce ayrıntılı olarak açıklandığı gibi, Helmholtz için duyusal deneyimler, madde ve kuvvetlerin erişilemez dış gerçekliğinin imleri olarak hizmet ederler. Hertz'e göre teorilerin temsil ettiği şey, bize verilen duyusal izlenimlerin bir imidir. Böylece, Hertz'e göre, temsilleri inşa etmek için yalnızca teoriyi kullanırsak, geçmişteki deneyimlerden yola çıkarak geleceği tahmin edebiliriz. Hertz, hocası Helmholtz gibi, mekansal ve zamansal ilişkilerin ancak bir im sisteminde temsil edilebileceğini savundu. Bununla birlikte, Hertz için, nesneler arasındaki ilişkiler hakkındaki yargılar, "sembol" veya "resim" olarak da tercüme edilen bir *Bild* içinde oluşturulur, ancak *Bild* aynı zamanda "model" anlamına gelmektedir. Hertz, *Mekaniğin İlkeleri* adlı ünlü kitabında, bilimsel teorilerin semboller aracılığıyla dış dünyanın bir resmini oluşturduğunu iddia etti. Newton'dan o döneme dek fizikte elde edilen tüm başarılar ancak mekanik bir dünya görüşü ile mümkün olduğundan, Herz'in "mekaniğe" dayalı bir fizik teorisi geliştirmesini zamanın bilimsel ruhunun bir sonucu olarak görmek mümkündür. Örneğin ısı ve ışık gibi mekanik bir teoride açıklanamayan tüm kavramlar dönemin fizikçileri tarafından mekanik olarak açıklanmaya çalışılmıştır. Hatırlanacağı gibi, Helmholtz'un duyusal algı üzerine yaptığı çalışmanın, nörofizyoloji temelli bir algı teorisi geliştirmeye yönelik olduğunu görmüştük. Helmholtz'un öğrencisi Hertz,

hocasının algı teorisini mekanik bir teori ile yeniden yorumlamak suretiyle ifade etmeye çalıştı. Öte yandan Hertz'in *Mekanik*'teki üslubu, kitabın ilk cildi tanımlarla dolu olduğundan, onun felsefeye bakışı hakkında da bize bir fikir verir. Kavramsal netlik konusunun bu nedenle *Mekaniğin Prensipleri*'nin temel bir özelliği olduğu rahatlıkla söylenebilir. Bilindiği gibi Newtoncu evren anlayışı dört temel kavram üzerine kuruludur: uzay, zaman, kütle ve kuvvet. Newton'un "kuvvet" kavramı kendisinden sonra ağır saldırıya uğrayan bir kavramdır. Hertz ise bilimsel teoriler için kriterler geliştirmiştir. Buna göre, tüm kabul edilebilir, yani makul teoriler kavramsal olarak tutarlı olmalıdır, yani herhangi bir mantıksal uyumsuzluk/çelişki/tutarsızlık içermemelidir. İkincisi, bir teori deneyimle, yani bir anlamda sağduyuyla çelişmemeli ve bu nedenle empirik bilgimizle çelişmemelidir. Son olarak, bir teori en az kavram veya terime başvurarak en zengin ve en kapsamlı açıklamayı sunuyorsa, bilim için en uygun teoridir. Kısacası Hertz'e göre bir teori mantıksal olarak sağlam, yani izin verilebilir ancak diğer ampirik gerçekliklerle uyumlu olmalıdır ve dünyadaki temel ilişkileri en az kavram veya terim öne sürmek suretiyle en kapsamlı şekilde açıklayabilmelidir. Bu nedenle, Hertz'e göre bilimsel bir teori, dünyadaki nesnelerin ilişkilerini dünyanın bir resmi olarak en iyi şekilde temsil ediyorsa ve resimdeki ilişkiler deneyimle çelişmiyorsa, doğru bir teoridir. Bundan, Hertz için mutlak ve tek bir teori olmadığı, ancak yukarıda bahsettiğimiz üç kriteri karşılaması koşuluyla doğru teorilerin var olduğu sonucuna varıyoruz. Kısacası Hertz'e göre tek bir doğru teori yoktur, kriterleri karşılayan her teori Hertz için doğru teoridir. Birçok biyografi yazarının ve Wittgenstein uzmanının Wittgenstein'ı Hertz ile etkilediği yadsınamaz bir gerçektir. Örneğin, James Griffin'e göre, Wittgenstein *Tractatus*'undaki resim kuramını ileri sürerken Hertz'den ilham almıştır. Buna göre Wittgenstein, resme dayalı bir anlam teorisini dilin bir parçası olarak değil, bir bütün olarak dile uygulayan ilk kişidir (Griffin, 1964). Ayrıca, hem Hertz'in hem de Wittgenstein'ın felsefeden beklentilerinin, yani felsefi ideallerinin birbirine çok yakın olduğu açıktır, çünkü her ikisi de kavramsal açıklığa vurgu yapmaktadır. Ayrıca, her ikisi de bir tür resim teorisi benimsemiştir. Wittgenstein,

"im" terimiyle Helmholtz'dan Hertz'e miras kalan bir "resim" teorisini benimserken, Frege ve Russell'dan gelen mantık ve mantıksal atomizme dayalı dil anlayışıyla "gerçekliğin" özgün bir açıklamasını sunmaya çalışmıştır. Öte yandan, Wittgenstein'ın en parlak öğrencilerinden Elizabeth Anscombe, Frege ve Russell mantıkta devrim yapmamış olsalardı *Tractatus*'un asla yazılamayacağından bahseder (Anscombe, 1959). Ancak Hertz'in *Mekaniğin Prensipleri*'nde ortaya koyduğu *Bild* anlayışının son bileşenlerinin *Tractatus*'taki cisimlere karşılık gelmesi salt bir tesadüf olarak değerlendirilemez. Wittgenstein ayrıca dolaylı da olsa fizik yasalarının dünyadaki nesneler hakkında konuşan şeyler olduğunu iddia eder (TLP 6.3431). Öyle ki bir sonraki önermede Wittgenstein, Hertz'in madde-nokta kavramına doğrudan atıfta bulunur. Bu önermede Wittgenstein, Hertz'in mekaniğinin, dünyanın bir resmini sunma iddiasında, "belirli" maddi noktalardan ziyade herhangi bir maddi noktadan bahsettiğini vurgular. Bu açıdan bakıldığında Hertz'in "maddi-nokta" kavramının *Tractatus*'taki "olaylar"a tekabül ettiğini söylemek mümkündür. Bunun nedeni, daha önce ayrıntılı olarak açıklandığı gibi, Hertz'in herhangi bir sayıda birbirine bağlı maddesel parçacıktan oluşan muhtelif maddi noktalarını tanımlamasıdır. *Defterler 1914-1916* eserinde Wittgenstein, bir yüzeyi farklı geometrik şekillerle farklı şekillerde tasvir etme yeteneği aracılığıyla farklı fiziksel teorilerin fenomenlerin farklı tanımlarına nasıl yol açtığına dair bir analoji kurar. Bu, Wittgenstein'a mantık ve mekanik arasındaki ilişki hakkında bir fikir verir. Buna göre, Wittgenstein'a göre mekanik, dünyayı tek bir plana göre tanımlamak için ihtiyaç duyduğumuz tüm önermeleri inşa etme girişimidir. Ayrıca Wittgenstein, Hertz'in görünmez kütlelerinin sahte nesneler olduğunu iddia eder (Wittgenstein ve diğerleri, 1984). Wittgenstein'ın atıfta bulunduğu "sözde nesneler", esasında Hertz'in *Mekaniğin İlkeleri* eserinde kendimiz için dış nesnelerin imgelerini/görüntülerini [*inner Scheinbilder*] veya sembollerini yarattığımızı iddia ettiği şeylerdir (Hertz ve diğerleri, 1899). Wittgenstein ile Hertz arasındaki bir diğer benzerlik, Hertz'in "gizli kütle" kavramını fiziğin önermelerinin olasılığının bir koşulu olarak sunmasıdır. Hatırlanacağı gibi, Wittgenstein basit nesneleri de önermelerin olanağının bir koşulu

olarak sunar. Bununla ilgili olarak, Wittgenstein *TLP* 4.0312'de şöyle der: "Önermelerin olasılığı, nesneleri temsil eden imlerin var olduğu ilkesine dayanır" (Wittgenstein ve diğerleri, 2001).

Son olarak, Wittgenstein'ın özellikle felsefeye bakışını şekillendiren en önemli şahsiyetlerden birinin ünlü fizikçi Ludwig Boltzmann olduğunu söylemek asla abartı olmaz, çünkü biyografik detaylarının gösterdiği gibi, Wittgenstein'ın Boltzmann'dan etkilendiği oldukça açıktır. Şimdi bu büyük fizikçinin Wittgenstein üzerindeki olası etkilerini mekanik teorisi ve "resim teorisi" üzerinden kısaca açıklamaya çalışalım. Öncelikle Boltzmann'ın mekanik kavramına neden atıfta bulunduğunu kısaca özetleyelim. Boltzmann'a göre ses, ışık vb. fiziğe ait tüm olgular, parçacıkların hareketi ile açıklanabilir olan olgulardır. Dolayısıyla Boltzmann'ın "mekanik"ten anladığı, parçacıkların hareketinin temsilinden başka bir şey değildir. Boltzmann'a göre, hiçbir teori "hareket" kavramına başvurmaksızın doğayı açıklayamaz. Öte yandan, görünümdeki tüm niteliksel değişiklikler, hareketlerin tek bir temsil veya resimde sunulması veya en küçük parçaların düzenlenmesindeki değişikliklerle temsil edilebilseydi, bu, doğanın özellikle basit bir açıklamasına yol açardı. Bu nedenle, doğayı kusursuz ve tam olarak temsil etmek için tek bir resim yeterli değildir ve bu nedenle farklı doğa temsillerine ihtiyacımız vardır. Boltzmann, doğanın farklı temsillerine imkân tanıma konusunda bizi teşvik eden şeyin, o dönemde fizik bilimindeki yeni gelişmeler olduğunu söylüyor (Boltzmann ve McGuinness, 1974). Bu bağlamda Boltzmann, Darwinist evrim teorisi çerçevesinde, insanın hayatta kalmasını sağlayacak yeni ve daha kullanışlı temsillerin oluşturulduğu noktada temsil yeteneğinin değişebileceğine inanır. Bununla birlikte, Boltzmann'ın *a priori* düşünce yasalarını kökten reddetmediğini, bunların evrim sürecinde atalarımızdan genetik olarak bize aktarıldığı fikrinde olduğunu belirtmek gerekir. Öte yandan, bu yasaların bize evrim sürecinde intikal etmiş olmaları, onların evrensel ve mutlak zorunlu yani asla değişmez şeyler oldukları anlamına gelmez. Dolayısıyla Boltzmann'a göre zaman ve çevre koşulları, doğanın değişmez gibi görünen temsillerinin değişmesine

neden olabilir. Boltzmann'ın Wittgenstein'ın felsefeye biçtiği role ilişkin düşünceleri üzerindeki etkisine değinmemiz gerekirse, Boltzmann'ın yanılsamalarla ilgili sözlerini hatırladığımız takdirde, Boltzmann'a göre bazı problemler insanın bilişsel kapasitesini aşmakla ilgili değildir ve dolayısıyla esasında bir problem teşkil etmezler. Bu nedenle Boltzmann'a göre felsefi yanılsamalardan kurtulmak, en az algısal yanılsamalardan kurtulmak kadar zordur. Dolayısıyla bu tür hatalara düşmemek için felsefenin temel görevi bir tür kavramsal netliğe ulaşmak olmalıdır. Boltzmann'a göre felsefenin temel görevi, bizi bu yanılsamalar sonucunda içine düştüğümüz bu karışıklık ve çelişkilerden yavaş yavaş kurtarmaktır. Hatırlanacağı gibi Wittgenstein'a göre felsefi problemlere çözüm bulmak yerine çözündürülmeli, yani aslında birer problem teşkil etmedikleri gösterilmelidir. Kısacası, Wittgenstein'ın *Tractatus*'taki temel amacı, felsefi problemlerin hakiki birer problem olmadığını göstermektir. Öte yandan, bu noktada Wittgenstein ile Boltzmann düşüncesi arasındaki bir farka da değinmek önemlidir. Boltzmann anlamsız sorunları bir kenara bırakmayı önerirken, Wittgenstein daha çok neyin anlamlı olup neyin olmadığıyla ilgilenmektedir. Ayrıca Wittgenstein'ın Boltzmann'ın evrim sürecine yaptığı vurgudan hiç etkilenmediğini görüyoruz. Buna göre Wittgenstein, *Tractatus*'un 4.1122 numaralı önermesinde Darwin'in evrim teorisi ile felsefe arasındaki ilişkinin, doğa bilimlerindeki diğer teorilerin felsefe ile olan ilişkisinden farklı olmadığını belirtmiştir (Wittgenstein, 2001). Daha sonra *Tractatus*'taki önerilerini yetersiz bulsa da, Wittgenstein'ın felsefeye bakışının pek değişmediği söylenebilir, çünkü geç Wittgenstein felsefesinde felsefe denilen şey, tıpkı Boltzmann'ın felsefe anlayışı gibi, dilin derinliklerine inmek suretiyle yüzeyde karmaşık gibi görünen meseleleri açıklığa kavuşturma faaliyetinden başka bir şey değildir.

Tractatus'un soykütüğünü çıkarma çabası olarak da görülebilecek bu tez, *Tractatus*'un ana omurgasını oluşturan ve Hertz'in büyük ihtimalle hocası Helmholtz'tan miras aldığı mekaniğe dayalı bir temsilden esinlenen "resim teorisi"nin

izini sürer. Bu nedenle tezde, Hermann von Helmholtz'un bilimsel kariyeri paralelinde kişisel yaşam öyküsü tartışılmış ve onun "im" temelli "temsil" teorisinin, Hertz ile birlikte dış dünyanın "mekanik" bir kavramına nasıl evrildiği tartışılmıştır. Buna göre Hertz, hocası Helmholtz'un mekaniğe verdiği büyük önemin mirasçısı bir fizikçi olarak, nesnelerin zihinsel temsillerle arasındaki tekabüliyeti mekaniğe, yani hareket bilimine indirgemek suretiyle açıklamaya çalışmıştır. Bunu yaparken Hertz, özellikle *Mekaniğin İlkeleri*'nin ilk cildinde, öncelikle kavramsal netlik arzusuyla tanımlamalar yapmaya çalışmış ve fizikten ve felsefeden beklenenin her şeyden önce kavramların net bir tanımı olduğunu savunmuştur. Bu nedenle Hertz'in mekaniğe dayalı felsefe anlayışı ve resim kuramının Wittgenstein üzerindeki etkileri yadsınamaz. Wittgenstein, *Tractatus*'un çeşitli önermelerinde doğrudan Hertz'e atıfta bulunmuş ve Hertz'in bilimsel kuramlar temelinde ortaya koyduğu resim kuramını mantık temelli dilbilimsel bir anlam kuramı çerçevesinde yeniden yorumlamıştır. Öte yandan Wittgenstein'ın felsefi ve entelektüel özyaşamöyküsünde, rolü asla göz ardı edilemeyecek bir başka isim de Avusturyalı ünlü fizikçi Ludwig Boltzmann'dır. Boltzmann, Darwinci evrim teorisi temelinde natüralist/doğalcı bir *Bildtheorie*'yi (resim kuramı) savunsa da Wittgenstein'ın *Tractatus*'ta Darwinci teorinin felsefeyle doğrudan ilişkisine ilişkin sözleri, Wittgenstein'ın Boltzmann'ın resim teorisine ilişkin düşüncelerine aşina olduğuna işaret eder. Ancak daha önce de değindiğimiz üzere Wittgenstein, böyle bir teorinin felsefeyle diğer bilim dallarından daha fazla ilişkili olmadığını ifade ederek kendi resim teorisini Boltzmann'ınkinden ayırmaya çalışıyor gibi görünüyor. Son olarak, Wittgenstein'ın felsefi sorunları sonuna kadar çözdüğünü iddia ettiği, *Tractatus*'un önsözündeki iddialı cümleleri, Boltzmann'ın Wittgenstein üzerindeki bariz etkisinin açık bir göstergesidir, çünkü Boltzmann'a göre bilim, özellikle fizik ve felsefe aynı anda zaman, çözümsüz gibi görünen sorunların esasında birer sorun teşkil etmediğini göstermek suretiyle bu sorunları ortadan kaldırmakla yükümlüdür.

Kısaca bu tezde, genel olarak mantıkçı bilim adamları Gottlob Frege ve Bertrand Russell'ın fikirleri bağlamında tartışılan Wittgenstein'ın 20. yüzyıl felsefesine damga vuran eseri *Tractatus Logico-Philosophicus*'un aslında Hermann von Helmholtz, Heinrich Hertz ve Ludwig Boltzmann gibi çağının filozof-bilim adamlarının ileri sürdükleri felsefi ve mekanik temsil modellerinden oldukça etkilendiği gösterilmeye çalışılmıştır. Dolayısıyla bu çalışma, erken dönem Wittgenstein felsefesinin entelektüel köklerine ışık tutmayı başardığı nispette, amacına ulaşmış addedilebilir.

B. THESIS PERMISSION FORM / TEZ İZİN FORMU

ENSTİTÜ / INSTITUTE

Fen Bilimleri Enstitüsü / Graduate School of Natural and Applied Sciences ☐

Sosyal Bilimler Enstitüsü / Graduate School of Social Sciences ☒

Uygulamalı Matematik Enstitüsü / Graduate School of Applied Mathematics ☐

Enformatik Enstitüsü / Graduate School of Informatics ☐

Deniz Bilimleri Enstitüsü / Graduate School of Marine Sciences ☐

YAZARIN / AUTHOR

Soyadı / Surname : Kaplan
Adı / Name : Osman Baran
Bölümü / Department : Felsefe / Philosophy

TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English): MECHANICAL ROOTS OF *TRACTATUS*: THE INFLUENCE OF HERMANN VON HELMHOLTZ, HEINRICH HERTZ AND LUDWIG BOLTZMANN ON EARLY WITTGENSTEIN PHILOSOPHY AND THE TRACTARIAN PICTURE THEORY

TEZİN TÜRÜ / DEGREE: **Yüksek Lisans** / Master ☒ **Doktora** / PhD ☐

1. **Tezin tamamı dünya çapında erişime açılacaktır. /** Release the entire work immediately for access worldwide. ☒
2. **Tez iki yıl süreyle erişime kapalı olacaktır.** / Secure the entire work for patent and/or proprietary purposes for a period of **two years. *** ☐
3. **Tez altı ay süreyle erişime kapalı olacaktır.** / Secure the entire work for period of **six months**. ***** ☐

***** *Enstitü Yönetim Kurulu kararının basılı kopyası tezle birlikte kütüphaneye teslim edilecektir. / A copy of the decision of the Institute Administrative Committee will be delivered to the library together with the printed thesis.*

Yazarın imzası / Signature **Tarih** / Date .....
(Kütüphaneye teslim ettiğiniz tarih. Elle doldurulacaktır.)
(Library submission date. Please fill out by hand.)

Tezin son sayfasıdır. / This is the last page of the thesis/dissertation.