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# Ernst Mach and the Origin of the Knowledge Theory in the Former Austrian Empire

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## Abstract

This paper discusses the origin of the modern social knowledge theory and Ernst Mach's role in its development and his contribution to the history of economics. We categorize economic and scientific methodologies based on the dichotomy between "describable" and "indescribable" knowledge. The arguments of both groups drew from Mach's theory and later developed along different lines. We investigate the reason for this by assessing evolutionism. It is important to assess fallibility and anti-rationalism as causes for the development of both concepts of knowledge.

We also discuss Ludwig Mises' unique standpoint. Although he criticized socialist economy planned rationally, he was also a rationalist. In other words, Mises was politically on the same side as Hayek and M. Polanyi but he was rather in a closer position about knowledge to the Vienna Circle. The aim of this paper is to consider Ernst Mach's contribution in the history of economics.

## 1 Introduction

This paper discusses the origin of the knowledge theory that dates back to the former Austrian Empire from the end of the nineteenth century and the early twentieth century. In this paper, we particularly focus on the role of Ernst Mach, a Viennese physicist and philosopher.

At present, the important role played by the knowledge theory in management science, social thought, and the economic growth theory cannot be denied. For example, management scientists discuss that the foundation of a firm's competitive superiority is accumulated and specialized knowledge in a certain organization and that it determines the development of the firm (Leonard 1998). Moreover, innovative action, which functions as the engine of development for an industry and for economic growth, is based on the tacit knowledge of routine activities in a firm and its reconfiguration (Nelson and Winters 1984).

At present, although many such knowledge theories have been proposed by American researchers, this knowledge theory originated in nineteenth-century Vienna. In this paper, we discuss a correlation chart between Mach, the Vienna Circle, the Polanyi brothers, and the Austrian School. Considering each of these relationships individually reveals that these knowledge theories were developed in the same age and place and that the modern knowledge theories discussed separately in various

fields have the same origin.

In this paper, the key concepts that will be used to discuss this are “describable” knowledge and “indescribable” knowledge. Hayek and Michael Polanyi discuss the relationship between these categories for the first time in the controversy of collectivist economic planning. The standpoint that regards the former, i.e., describable knowledge, as being important is based on constructivist rationalism and emphasizes scientifically systemized and clearly documented knowledge. The latter, i.e., indescribable knowledge, is not systemized like scientific knowledge but plays a role in scientific discoveries or entrepreneurial actions and assists us in our daily lives. It is well known that Hayek and M. Polanyi criticized the possibility of the socialist state from the latter perspective.

However, the argument of the knowledge theory was not originally proposed by Hayek and M. Polanyi. Although many researchers assert that the origin of Hayek’s argument dates back to the Scottish philosophy of the eighteenth century, there is no obvious evidence that Hayek and M. Polanyi seriously studied this philosophy before the 1940s. At that time, the primary themes of Hayek’s work were the business cycle and capital theories, while M. Polanyi was a natural scientist. Therefore, it appears more natural to assume that although these scholars were inspired by the Scottish philosophy and British empiricism, they had some idea about the concept of knowledge in society before they began to study these schools of thought seriously. In fact, although Mach was not interested in Scottish philosophy, the similarity between Mach and Hume are sometimes pointed out.

Hayek was inspired by Mach’s *Die Analyse der Empfindungen und das Verhältnis des Physischen zum Psychischen* that was published in 1900; when he was an undergraduate at Vienna University, he wrote two manuscripts, which were revised and published as *The Sensory Order* in 1952. Moreover, Karl Polanyi, the older brother of Michael, was an active supporter of Mach in his early days, and he also translated a book authored by Mach into Hungarian (K. Polanyi 1909, 1910).

In addition to Hayek, the Polanyi brothers, and the members of the Vienna Circle, other social scientists who were directly or indirectly influenced by Mach include Schumpeter—who was directly influenced by him—Peter Drucker from Vienna—who was influenced by the Polanyi brothers—and Friedman, Simon, and other American economists at Chicago University—where Carnap introduced logical positivism. Some of the streams of thought followed by these people we are linked to American pragmatism and led to the modern theory of knowledge management in management science. In this regard, one can state that a major part of the modern knowledge theory “the Mach connection.”

In the next section, we discuss the status of Mach in the history of economics. Studies in the history of economics seldom refer to Mach because he did not have a direct influential relationship with any economist other than K. Polanyi. However, if

we consider an indirect influential relationship, we can understand his importance in the history of economics.

In addition to this, we make a brief mention of Mach's views on evolutionism. Mach was an early supporter of Darwinism in Austria and established evolutionary epistemology. Moreover, it was evident that he recognized the structural commonality between physics, biology, and psychology. This viewpoint was shared by Alfred Marshall, a contemporary economist, and was developed by Alfred Rotka, a mathematical biologist and statistician, and Paul Samuelson in the twentieth century.

In the third section, we discuss the influence of Mach's empiricism on K. Polanyi and the Vienna Circle. The most obvious influence of Mach on contemporary intellectuals and students is with regard to logical positivism. Further, in section four, this problem is discussed using the argument of M. Polanyi and Hayek from the viewpoint of the dichotomy between describable and indescribable knowledge, which is the main concept in this paper.

In the fifth section, we redefine the position of Ludwig Mises from the viewpoint of the dichotomy of knowledge. Although Mises criticized collectivist economic planning along with Hayek and M. Polanyi, he supported radical rationalism and his position was fairly close to the group that regarded describable knowledge as being important. We consider Mises' philosophy in terms of knowledge.

In the sixth section, we discuss why the theories of describable and indescribable knowledge broke away from the others and adopted opposing standpoints, although both drew from Mach. We attribute this shift to the differences in their attitude toward evolutionism.

Some arguments mentioned in this paper have already been discussed in individual studies. However, no study has organized the argument of knowledge developed in the former Austrian Empire from the late nineteenth century to the early twentieth century from the viewpoint of the Mach connection. This argument will be the starting point for new studies in social science in Austria such as the Austrian School of Economics, and for the reorganization of present social science from the viewpoint of the knowledge theory.

## 2 Ernst Mach

### 2.1 The position of Mach in the history of economics

Mach was born in 1838 at Chirlitz in the Austrian Empire and lived in almost the same period as Walrus (born in 1834), Carl Menger (born in 1840), and Jevons (born in 1835). However, Mach has seldom been mentioned in the history of economics because he did not directly influence economists. In fact, he did not have an influence on three contemporary economists who played leading roles in the Marginal Revolution.

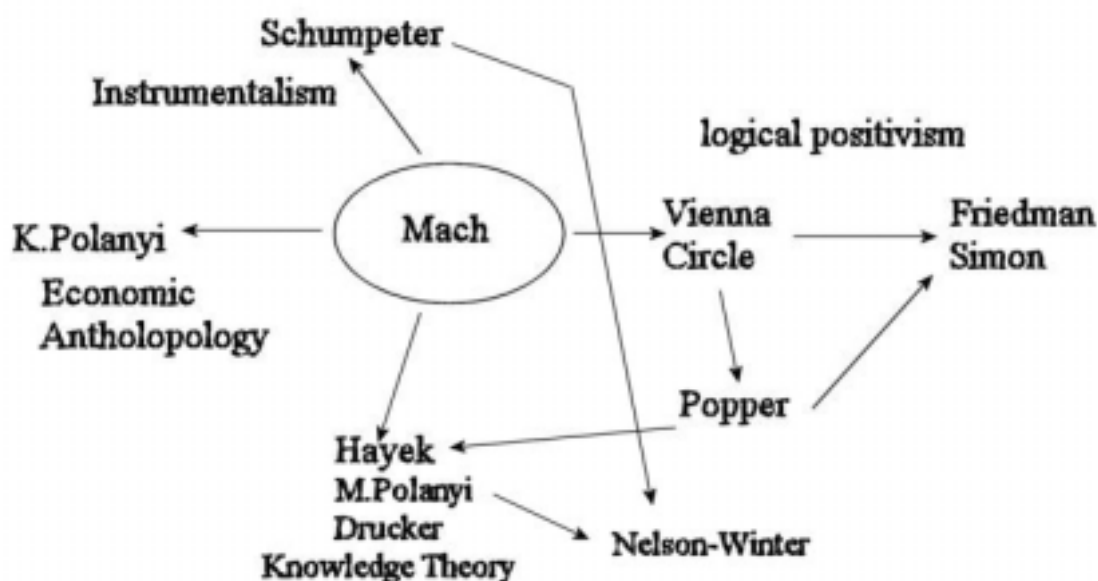


Figure 1 The Mach Connection in Modern Social Science

Although Menger, in particular, was Mach's colleague at Vienna University, there is no reference to Mach in his works because Menger was critical to psychological approach in economics<sup>3</sup>.

However, there were several ways in which Mach directly influenced social scientists who were born in the period between the late nineteenth century and the early twentieth century. Moreover, Mach's influence on economists, direct or indirect, takes several paths. Figure 1 depicts a rough representation of Mach's influence on modern economics. His influence can be categorized into (1) empiricism or positivism with regard to methodology and (2) the knowledge theory derived from his studies in cognitive psychology.

The first group has diversity and Schumpeter was inspired by Mach's instrumentalism (Shionoya 1995: 107–49). K. Polanyi also appreciated this aspect and pointed out its similarity to Pragmatism that developed in U.S.A. in the same period (Polanyi K. 1909). However, it is usually pointed out that Mach's argument influenced K. Polanyi in his early days and Marxist historical materialism later had a stronger influence on him.

Although it is one of the most important connections in the history of economics, the development of the stream of positivism from Mach through the Vienna Circle to the Chicago School is frequently overlooked. Friedman and Simon, who are supporters of logical positivism, did not refer to Mach's arguments, but it is evident that they were inspired by the logical positivism proposed by the Vienna Circle.

The most distinctive influence of this stream is the knowledge theory that originates in Mach's cognitive psychology, which is in turn based on evolutionary

epistemology. In the next section, we consider the reason why Hayek, M. Polanyi, and Drucker, who were all born in the Austrian Empire, recognized the significance of the concepts of tacit and practical knowledge in our society.

Moreover, although Mach did not have an interest in economics and has no direct connection with contemporary economists, he recognized the similarity between the equilibrium of the psychological state and dynamic equilibrium.

Through another equilibrium in mechanics—for example Stephen's and Galileo's observations of equilibrium on a slope—the index that provides equilibrium in statics can be known. Here, equilibrium is provided by the product of the measure of the hang and vertical head drop. It is clear that this rule applies to every type of mechanics. Sensory pressure is also similar to it, and we obtain the law of perpendicular displacement in every kind of power as efficiently as Johann Bernoulli.

(Mach 1910: 95)

Mach's argument suggests that in the history of modern science, physics, ecology, psychology, and economics were considered to be closely related to each other. In reality, thermodynamics that was developed by Mach, Boltzmann and Helmholtz in the twentieth century provided the foundation for ecology and economics in the process of its mathematical formulation. Mach's argument was the forerunner of this movement; moreover, in the twentieth century, it was necessary to explain modern economics through the logic of physics because economics was born in scientism in the nineteenth century.

## 2.2 Mach's evolutionism

Mach is known as an early supporter of Darwin in Austria, as can be observed from the following statement.

The impetus given by Galileo to scientific thought was marked in every direction; thus, his pupil Borelli founded the school of exact medicine, from whence proceeded even distinguished mathematicians. And now Darwinian ideas, in the same way, are animating all provinces of research. It is true, nature is not made up of two distinct parts, the inorganic and the organic; nor must these two divisions be treated perforce by totally distinct methods.

(Mach 1883: 217)

Mach asserted that Darwinian evolutionism applies not only to biology but also to other similar fields. Moreover, Mach repeatedly emphasized the following.

It will depend upon the specialists of the future to determine the relative tenability and fruitfulness of the Darwinian ideas in the different provinces. Here I wish simply to consider the growth of natural knowledge in the light of the theory of evolution. For knowledge, too, is a product of organic nature.

(Mach *ibid.*)

It is important to note that in the above statement, Mach pointed out knowledge or cognition as having an evolutionary character. He was the first to assert evolutionary epistemology from the standpoint of the physical approach, which was later pursued by Hayek and M. Polanyi.

The fact that “mental economy,” which is a key concept in Mach’s cognitive psychology, is based on Darwinian evolutionism was already pointed out. According to Mach, mental economy refers to the psychological tendency of human beings to economize the cost of thinking. For example, Mach explained mental economy in terms of mathematics as follows:

The use of the signs of algebra and analysis, which are merely symbols of operations to be performed, is due to the observation that we can materially disburden the mind in this way and spare its powers for more important and more difficult duties, by imposing all mechanical operations upon the hand. One result of this method, which attests its economical character, is the construction of calculating machines.

(Mach 1882: 196)

Mach insisted that the rationality of human thinking was the result of the evolutionary process and mental stability was the same as dynamic equilibrium. The important contribution in the field of physics by Boltzmann a critical follower of Mach in Vienna University, was to provide a dynamic and stochastic basis to the entropy maximization principle.

Further, Mach also presents the following argument:

An organism is a system that can preserve its characteristics (scientific state, body heat, and so on) while resisting external influences and can exhibit a fairly dynamic stable equilibrium. An organism consumes energy but also compensates for this energy loss by decreasing its consumption or deriving more energy from its surroundings... In physics, the phenomenon closest in analogy to an organic process is that of combustion, which spreads across its surrounding environment by itself. It is a self-sustaining process that generates an ignition temperature and raises the temperature of a nearby object to this temperature, thereby resulting in burning, assimilation, growth, expansion, and further increase. In fact, animal life involves complex burning processes.

(Mach 1903: 81–2)

From the above argument, it is clear that although the meaning of an organism is thermodynamically explained, there is no mention of evolution in the ecological system. However, considering the fact that an organism acquires this function as a result of evolution, Mach's statement appears to assume that an individual organism and the ecological system operate under the same mechanism.

Alfred Lotka and Paul Samuelson applied the second law of thermodynamics in the fields of biology and economics, respectively. The gap between thermodynamics, biology, and economics was not bridged at that time because Mach and Boltzmann did not have a direct interest in economics. However, it is not too far from the truth to state that to an extent, the development of modern economics was determined since its origin.

### 3 Genealogy of positivism

In 1895, Mach assumed the position of professor of Inductive Philosophy at Vienna University. He was first succeeded by Boltzmann and later by Schlich. As briefly mentioned earlier, although many people were directly or indirectly influenced by Mach's empiricism, in this paper, we discuss his influence from a different viewpoint, including evolutionism from ordinary interpretations. We regard the genealogy of positivism as that of expressed knowledge and compare it with tacit knowledge in the next section.

In order to clarify this comparison, we categorize Hayek, M. Polanyi, and Karl Popper in the group of the theory of describable knowledge and the Vienna Circle and K. Polanyi in the group of the theory of indescribable knowledge. The differences between these groups lie not only in their academic positions but also in their political ideas such as liberalism and socialism.

#### 3.1 K. Polanyi and Mach

K. Polanyi expressed his interest in Mach's argument at an early point in his career because his teacher in Hungary, Gyula Pikler, introduced him to Mach. K. Polanyi published the translation of Mach's *Die Analyse der Empfindungen* as a project for the Galileo Circle (Mitoma 2000: 367).

K. Polanyi appreciated Mach's anti-metaphysics and strict empiricism. In the preface of the Hungarian translation of *Die Analyse der Empfindungen*, he argued thus:

These religious, metaphysical and philosophical "solutions" are futility and confused as well as "problems" themselves. On the other hand, Mach's attitude to thinking has only naïve experience at its back and it may become only the reliable starting



point of science to discuss thinking.

(K. Polanyi 1910)

Moreover, he wrote a brief introductory paper on Mach and emphasized the significance of empiricism as well as the need to break away from metaphysics.

Ernst Mach was an eminent physicist and shaped an outstanding new age. He was born in Prague and assumed the position of the Professor of Philosophy at Vienna University. His comprehensible views and pure speculations provide a description of his thoughts. He eternally and clearly separated science from metaphysics. Mach began this work with writing a history of thermodynamics. Thereby, he confirmed that concepts in metaphysics, such as “ultimate causation,” “essence,” and “truth,” are muddled and unnecessary. Science does not look for ultimate causation, not only because an investigation of ultimate causation does not have scientific necessity but also because it is one of our bad habits that we continue to ask questions and forget the fact that we frequently pose a nonsense question.

(K. Polanyi 1909)

Although Mach’ influence on K. Polanyi can be seen only before 1910<sup>4</sup>, if we focus on empiricism or positivism, he continued to be a good student of Mach. For example, K. Polanyi (1977) pointed out the confusion with regard to the usage of the term “economic” between the formal definition—that explains this term as a scarcity that is based on a means-end relationship—and the substantial = real definition—that explains economic as something that cannot exist without a self-preserving environment. These definitions cannot be used interchangeably.

His criticism was that neoclassical economics emphasized the former but paid little attention to the latter. Although K. Polanyi concluded that Menger proposed the concept of scarcity and the assumption of a rational economic man, he also argued that Menger recognized the significance of the substantial = real definition. However, considering that Menger’s influence on neoclassical economics is not greater than that of Walrus and Jevons, K. Polanyi appears to overestimate his influence to some extent. Nevertheless, one can safely state that the reason why K. Polanyi emphasized the comprehension of an economic society from the substantial = real viewpoint was the influence of Mach.

Although K. Polanyi has some common perspectives with the historian school with regard to his criticism of Menger’s rigor theory and the insistence of the historical approach, he was critical to the mere enumeration of facts and was in favor of finding the law inductively in a particular phenomenon. He appreciated the theory of sociology represented by Weber’s typology but rarely mentioned it to the historian school.

It may also be worthwhile to make a brief mention of the relationship between

K. Polanyi and Marxism. Studies on K. Polanyi generally point out that the influence of Mach was limited to the period of his adolescence, but that of Marxism, particularly Lenin, was evident throughout his life. Lenin is well known as a critic of Mach. According to him, regarding a sense as a ground for reality is mere solipsism. From the viewpoint in which human sense, thought, culture, and so on are determined by material factors such as economy, a supposition of sense itself is metaphysics.

However, K. Polanyi's criticism of the market economy in the controversy of collectivist economic planning was more empirical and practical compared to other economists (irrespective of whether they were socialists or anti-socialists) such as Oskar Lange and Mises who discussed price determination, which is based on the theory of general equilibrium. He gathered a lot of empirical evidence to demonstrate that the market system is not the only economic system, but it is specific from the historical perspective and to insist on the possibility of the existence of the government of an economy other than the existing market system. While it was evident that his thought was under influence of historical materialism, his methodology continued to follow that of Mach to an extent.

### 3.2 Influence on the Vienna Circle

It is not necessary to emphasize the influence of Mach on the Vienna Circle<sup>5</sup>. Initially, the verifiability thesis of the Vienna Circle was based on Mach's deductivist phenomenalism. They inherited such concepts from Mach as neutral monism—that considers immediate experience as being neutral—and instrumentalism—that regards theoretical terms as tools.

The Vienna Circle was not necessarily a group that shared the same thoughts and its members gradually distanced themselves from Mach's simple empiricism. However, according to Carnap, their assertion about the relationship between a theory and experience was explained as under:

Some of these derived laws may have been known before, but the theory may also make it possible to derive new empirical laws which can be confirmed by new tests, If this is the case, it can be said that the theory made it possible to predict new empirical laws....If the theory holds, certain empirical laws will also hold. The predicted empirical law speaks about relations between observables, so it is now possible to make experiments to see if the empirical law holds.

(Carnap 1966: 231)

It may be safely assumed that these concepts influenced the positivism of economists such as Friedman.

In this paper, we consider the perspectives of the Vienna Circle on "knowledge." The background of their assertion that knowledge is solely based on

experience is arises from their belief that we can strictly distinguish knowledge from an observable term. Mach assumed that a law is induced from the accumulation of an observable term. However, we cannot directly deduce an empirical law from a theoretical law; this is because while a theoretical law involves a theoretical term, an observable law involves an observable term (Carnap *ibid.*). Carnap insisted that we can overcome this discrepancy by confirming the rule of correspondence between a theoretical term and an observable phenomenon.

It should be noted that irrespective of whether something is a theoretical or an observable term, both can be considered as clearly expressed knowledge. For example, both Maxwell's theory referred to by Carnap and the optical theory derived from it can be rationally understood. In other words, the theory of scientific discovery proposed by the Vienna Circle explains the relationship between two different types of knowledge, namely, empirical knowledge and theoretical knowledge, and epistemologically focuses on linguistically comprehensible knowledge.

Moreover, Schlich pointed out that although Mach's intuitionism does not consider the objective world or an entity that lies beyond perception, he considers that this position is not sustainable. According to his epistemological realism, we have to regard something as reality even if we cannot perceive it directly. Thus, it follows that Schlich asserted that the concept of recognition should be strictly distinguished from those of experience and intuition; however, recognition is possible only after the conceptualization of experience and judgment. For example, this is the reason why we can recognize an electron, which is not immediately observable. In other words, what we can intuitively understand is only events in the phenomenal world. Hence, although "Ding an sich" is not given to us, it does not deny the existence of the world of Ding an sich because cognition does not necessarily coincide with immediate knowledge.

While it is evident that Schlich's definition of the category of "experience" is wider than that of Mach, there is no reference to what cannot be verbalized and rationally understood, such as the theory of tacit knowledge proposed by M. Polanyi. Hence, the Vienna Circle, which neglects "the tacit dimension," is categorized as describable knowledge, even though there is a diversity of arguments between its members.

Moreover, it should also be noted that the Vienna Circle did not refer to evolutionism in any form. We have already discussed that Mach was an early supporter of Darwinism in Austria and presented arguments on evolutionary epistemology. In his age, Carl Menger considered Darwinism in economics (Menger 1871). Mendel's law was rediscovered in 1900 and genetics established its position in modern positive science. In the early twentieth century, R. Fischer and other scientists succeeded in the integration of Mendelian genetics and the Darwinian natural selection theory. Evolutionism was a symbol of scientism from the late nineteenth

century to the early twenty century.

On the other hand, even at present, it is difficult to produce accurate immediate evidence for biological evolutionism; moreover, it was more unclear a theory at the time of the Vienna Circle. The hypothesis of natural selection in particular was in dispute with Mendelian genetics in the early twentieth century because the former suffered from severe lack of direct evidence compared to the latter.

In the political aspect, social democracy, which was supported by most of the members in the Vienna Circle, always stood in opposition to social evolutionism. Although it involved a political conflict, it did not necessarily imply a conflict in scientific argument. Evolutionism was hardly discussed.

However, Popper proposed his thesis of falsifiability in order to criticize the Vienna Circle's thesis of verifiability. Considering the fact that Popper's thesis is based on the evolutionary approach, the lack of the evolutionary aspect in the argument of the Vienna Circle involves a more essential problem. Popper and Hempel's criticism and asymmetry of verifiability and falsifiability need not be discussed in detail. According to Popper, a hypothesis in science is not clearly confirmed by experience but merely demonstrates temporal and restrictive validity (fallibilism). His assertion was important because it not only criticized the thesis of verifiability but also pointed out the limitation of science. His standpoint was the same as that of Carl Menger and Kurt Gödel, who also pointed out the limitations of human reason and broke away from the Vienna Circle.

#### 4 The origin of the theory of tacit knowledge

What is a "gene" in social evolution? In biology, it was assumed to refer to something that was a medium for the transfer of genetic information. In 1902, Walter Sutton discovered that a chromosome is related to inheritance<sup>6</sup>, and the function and structure of DNA were then clarified. On the other hand, evolutionism in economics has only been considered from the viewpoint of natural selection in the long term. Modern economists who are eager to introduce the analogy of biology into economics have recently attempted to find "genes" or "DNA" in social science (for example, Nelson and Winter 1984, Shiozawa 2006). Such economists frequently consider knowledge as a candidate analogous to genes or DNA.

As we have already pointed out in the previous section, the modern knowledge theory divides knowledge into scientific knowledge or explicit knowledge and practical knowledge or tacit knowledge. However, the distinction between them is ambiguous and these concepts complement each other.

The concept of tacit knowledge was proposed by M. Polanyi and that of practical (local) knowledge, by Hayek in the controversy of collectivist economic planning. However, tracing the history of their argument leads us to Mach. For example, Mach explained practical knowledge as follows:

Pearson also practically learns many concepts. For example, he acquires ambiguous but very abstract concepts through using various instruments such as a cutlery or a spoon... Response is always released by sensory ends, led by kinesthesia and entitled by the satisfaction of sensory expectation.

(Mach 1910: 91)

The type of knowledge mentioned here appears to lie between reflection and rational knowledge. Mach pointed out that such knowledge is more complicated than reflection and that rational knowledge linked with practical knowledge. It is not difficult to consider a similarity between the argument of Mach's argument and that of Hayek in *Rules, Perception and Intelligibility* (1962).

Hayek wrote two unpublished articles in the early 1920s, which appear to be inspired by Mach. Articles entitled *Beitraege zur Theorie der Entwicklung des Bewusstseins* (September 1920) and *Das Wesen des Geistigen* (n.d.) were majorly revised and were included in *Sensory Order* (1952). Hayek did not regard Mach's influence on him as being important (Hayek 1992). As Milford correctly pointed out, it is true that the influence of Mach can be observed in the first half of *Sensory Order* and that of Popper, in the second half. However, considering that the physical understanding of psychology and evolutionary epistemology was originally Mach's idea, the fact that Hayek's knowledge theory was in the same stream as Mach's cognitive psychology cannot be denied<sup>7</sup>.

In this regard, Mach's concern was to consider a relationship between practical knowledge and observable knowledge. This is evident from the following statements:

By intense occupation with the field of experience and knowledge to which a concept belongs, we gain the facility of ensuring that whenever the word embodying and denoting a concept is used, all the experiences linked with that concept are allowed to resonate softly within us, without any precise and explicit idea about them. Concepts contain potential knowledge, as S. Stricker once aptly remarked.

(Mach 1900: 83)

and

The conceptual colligation of facts makes condensed natural science possible. Natural science will merely be an enumeration of individual facts that are endless, pointless, and useless without conceptual colligation. However, it does not mean to conclude that the conceptual system is not more than aesthetic facts with which it deals nor that it includes something different. The only function that scientific conceptual system undertakes is merely to consistently order and comprehend

aesthetic facts.

(Mach 1910: 93)

These assertions are similar to those made by M. Polanyi in his argument in *The Personal Knowledge*.

I have embarked upon an analysis of the arts of skilful doing and skilful knowing, the exercise of which guides and accredits the use of scientific formulae, and which ranges far further afield, unassisted by any formalism, in shaping our fundamental notions of most things which make our world.

(M. Polanyi 1958: 64)

The arguments of M. Polanyi and Hayek were based on evolutionary epistemology, in which a reconstruction of old knowledge yields new knowledge<sup>8</sup>. As we mentioned earlier, this concept was proposed by Mach. The first quote suggests that Mach recognized the existence of a tacit dimension that precedes explicit knowledge. Moreover, he asserted that the role of scientific activity leads “conceptual colligation” to ambiguous experimental knowledge and orders them. There is no doubt that there arose a dichotomy between explicit knowledge and tacit knowledge or practical knowledge and scientific knowledge.

On the other hand, Mach did not emphasize the significance of tacit knowledge and practical knowledge from the viewpoint of his simple empiricism because according to him, they were indescribable. M. Polanyi and Hayek did not agree with Mach’s empiricism. M. Polanyi pointed out that if Mach’s simple empiricism was strictly adhered to, then Einstein’s rejection of Newton’s definition of space would not have led him to the discovery of the theory of relativity (M. Polanyi 1958: 11). Hayek also recognized that although he partly agreed with the issue of the significance of positivism, his strict adherence to it limits our understanding. (Hayek 1952b, 1964). It can be stated that M. Polanyi and Hayek criticized along the same lines as the Vienna Circle.

However, while the criticism of the Vienna Circle is confined to the extension of the definition of experience over immediate experience, Hayek and M. Polanyi emphasized the significance of an argument over experimental verification. Although their assertions may appear like a return to metaphysics, which was rejected by Mach and the Vienna Circle, we should appreciate their argument from the viewpoint of abduction, which plays an important role in modern science.

In any case, it is entirely reasonable to state that the knowledge theory of Hayek and M. Polanyi was considered as an extension of the cognitive psychology of Mach. Hayek and M. Polanyi focused on the tacit dimension of knowledge, which was not discussed by Mach; nonetheless, it plays an important role in our society and

science. This is the starting point of the argument of indescribable knowledge.

The difference from the standpoint of the Vienna Circle, which regarded describable knowledge as being important, is attributed to the disparity in their viewpoints. On the one hand, the aim of the Vienna Circle was distinguish between scientific description and pseudoscience; on the other hand, M. Polanyi and Hayek considered that the essence of economic and scientific activities lay in the processes of discovery and emergence of knowledge. It is apparent that the difference in attitude is with regard to evolutionism. This point will be discussed later.

#### 5 Mises and desirable knowledge

Although the methodology of Mises is of little relevance to the main subject of discussion in this paper, it should be mentioned nonetheless this is because Mises' direct relationship with Mach is ambiguous. There are two reasons for this. The first is that Mises was certainly a key member of the Austrian School, but unlike Hayek, he adopted rationalism. However, his rationalism differed from that of Mach and the Vienna Circle and was based on apriorism. Mises regarded an observable event as important, supposed observable that a behavior has rationality but he did not discuss tacit knowledge. In a sense, we can categorize Mises under the group of describable knowledge, but he denied the possibility of a socialist state based on rationalism. It is interesting to note that he adopted a stance different from those of Hayek or the Vienna Circle.

The second reason is that although Mises explained all economic phenomena by radical subjectivism, he did not accept the concept of evolutionism. His rationalism does not require verification through experience, unlike the Vienna Circle, and to demonstrate falsifiability, unlike Popper. He considered empirical tests as being unnecessary by regarding an observed fact as being rational. However, this implies that the proposition put forth by Mises is not a universal but singular. This is related to his methodology of social science. Mises proposed "the science of human action" as a field independent of natural science (Mises 1949). According to him, the science of human action consists of deductive "praxeology" and a history that describes an individual event, and economics is a field of praxeology. The reason why he considered methodological duality was that a human action should be regarded as given and the starting point of praxeology, because a mechanism that causes a thought and a will to take an action cannot be determined. Mises emphasized that the proposition "a human takes an action" is self-evidential and that every human action is intentional, purposive and rational.

According to Mises, we have to regard basic categories such as causality conditions, purposiveness, regularity, value, and time as a priori because people do not have an imagination that can assume a category that is inconsistent with the fundamental logical structure of the mind. Praxeology analyzes the basic category of

human action. Mises explained that behaviors other than an intentional and purposive action are confined as reactions of cells and nerves to stimuli or involuntary reflexes. Thought, experience, and knowledge become possible only through categories of human action.

It is obvious that Mises' viewpoint is included in the category of describable knowledge; on the other hand, he criticized the Vienna Circle that adopted monism by a natural scientific method. In *The Ultimate Foundation of Economic Science*, he made the following assertion:

The argument that they do not approve of any other method for proving their proposition, except the method of natural science that makes use of an experiment and regards every rational description as being metaphysical—metaphysical implies “nonsense” in terms of positivist—is wrong. The only theme of this paper is to exposure a fallacy of the fundamental assumption of a proposition and to demonstrate how it leads to an abject result.

(Mises 1962: viii)

Mises criticism was against those people who inappropriately applied the methods and modes in natural science to the realm of social phenomena. He considered that understanding a theorem of economics, which is a field of praxeology correctly, its failure is obvious. On the other hand, his praxeology was criticized by positivists because of the arbitrariness in its supposition of action and tautology of deductive inference.

There are obvious differences between Mises and the positivists. While positivism provides regulated universality through an empirical procedure, for Mises, only the “axiom” that is a priori approved at the starting point of an argument is universal and the “explanation” of a social phenomenon does not require universality. He considered that if an axiom is accepted and there is no logical fallacy, the social theory can be established irrespective of its universality and generality. In other words, it is consistent to assert that a market economy can be rationally explained and that we cannot rationally design a society.

However, Mises' argument considerably differs from those of Hayek—who emphasized the “ignorance” of humans—and M. Polanyi—who pointed out the role of the tacit dimension. Mises' argument, which did not suppose a reason and meaning outside of individuals, required a basis for human action in rationality. In his argument, every option and relevant knowledge is known in the moment when an individual makes a decision and, in this sense, an ignorant sphere does not exist. Irrespective of whether the proposition is singular or universal, it assumes the possibility of providing a description for all knowledge. From what has been mentioned, it follows that Mises is also categorized under describable knowledge from the



viewpoint of the dichotomy of knowledge<sup>9</sup>.

6 The distinction between descriptibility and indescribability

As elucidated earlier, it is evident that Mach played an important role in the origin of several knowledge theories in the former Austrian Empire, particularly in Vienna at the same period. We have discussed the concepts of knowledge held by the Vienna Circle, Hayek, and the Polanyi brothers from the viewpoint of the dichotomy between describable and indescribable knowledge, which are two aspects of Mach's argument.

Those who drew inspiration from Mach also criticized him because he confined the ground of theoretical validity to immediate experience. However, while the Vienna Circle expanded the definition of an experience and continued to approve of positivism, Hayek and M. Polanyi suggested that science was necessary to overcome the limitation of verifiability.

However, the distinction between the categories of describable and indescribable knowledge is not clear and these concepts stimulate and complement each other. According to M. Polanyi, apprehension about an object and relevant spheres is required for an action, and "tacit knowing" plays an important role in scientific discovery. This implies that a scientific discovery is monopolized by scientists who learn the existing system of science and their tacit knowledge is based on explicit knowledge. In this manner, describable and indescribable knowledge are inherently consistent.

However, describable and indescribable knowledge are frequently regarded as being inconsistent. For example, in logical positivism, the hypotheses that are considered have to be described in the verifiable form. This implies that not only a hypothesis but also the experience used for its verification should be written in explicit form. Conversely, other experiences that cannot be confirmed or concepts that cannot be defined in a verifiable form are eventually eliminated. While modern rationalism had excluded pseudoscience and contributed to the development of science, the possibility of thought is confined because "experience" or "definition" itself has been dependent on the standard of science in each era.

On the other hand, the argument that emphasized the significance of indescribable knowledge had been overinterpreted as the theoretical ground for resistance to a movement of rational social reform in the process of secularization. For example, supporters of political conservatism frequently overlooked an actual problem without any rational explanation because they regarded it as being temporary and superficial. Needless to say, this conflict was exposed in the controversy of collectivist economic planning. However, even in the controversy, the first stage that was contended by Enrico Barone, Mises, Lange, and some others was based on rationalism. In a sense, it was based on the possibility of the general equilibrium theory in an actual society. On the other hand, in the second stage that they proposed, Hayek and M.

Polanyi criticized the negligence of the role of tacit or practical knowledge in a society without freedom (Hayek 1937, M. Polanyi 1980). Most members of the Vienna Circle were supporters of a social democratic party. Moreover, the conflict between Hayek and the Vienna Circle will be clear if we consider the views of Otto Neurath, a key member of the Vienna Circle, who violently criticized Hayek's *The Road to Serfdom* (1944) with regard to the definition of rationalism<sup>10</sup>.

At this point, we should discuss why a difference between both positions emerged. In this paper, we assumed that the difference in the attitude toward evolutionism played a critical role in this matter. As mentioned earlier, Mach was an early supporter of Darwinian evolutionism and played an important role in its introduction into cognitive psychology. We can regard Hayek and M. Polanyi as its followers<sup>11</sup>. On the contrary, although the Vienna Circle expansively adopted Mach's empiricism, they did not discuss evolutionism in a clear manner. If we consider that Popper's criticism on the Vienna Circle stemmed from the viewpoint of the evolutionary approach, the lack of argument on evolutionism not only implied that the Vienna Circle was not interested in biology but also suggested that they did not recognize the need for the introduction of evolutionism into their argument.

At the end of the nineteenth century, evolutionism was regarded as a typical positivist science in biology as well as thermodynamics. At that time, it was assumed that by the process of natural selection, biological evolution could be confirmed through the example of breed improvement by artificial selection. In the early twentieth century, Darwinian natural selection and Mendelian genetics were synthesized and a mechanism of biological evolution had just begun to be elucidated from the genetic viewpoint.

In the absence of immediate evidence, the reason why the Vienna Circle did not refer to evolutionism despite the progress of research in biology can be inferred from circumstantial evidences. We can provide two possible explanations for this. The first is that, although biological Darwinism was gradually established as science, social Darwinism became extremely distanced from research from the viewpoint of science. Second, social Darwinism frequently conflicted with social democracy on the political perspective between the late nineteenth century and the early twentieth century. Not only was the concept of the survival of the fittest politically unacceptable to the members of the Vienna Circle but the eugenic definitions, such as those of "genius" or a "superior race," were also ambiguous and arbitrary from the scientific perspective.

In addition to this, it appears that the Vienna Circle faced a greater difficulty in accepting the concept of evolutionism. As we are aware, a distinctive characteristic of evolutionism is that although it can explain the occurrences in the past, it cannot predict the future. This feature is not advantageous for constructivist thought and social reformism, such as socialism.

Moreover, as Popper correctly pointed out, the evolutionary approach is

falsifiable and, in a sense, the distinction between science and other fields is ambiguous. Therefore, it is inconvenient for the Vienna Circle, whose purpose was to distinguish science from pseudoscience, to adopt this approach. For example, Spencer's social evolutionism was based on agnosticism and acknowledged the limit of reason. It may be obvious that such "imperfectness" of evolutionism was inconsistent with logical positivism.

On the contrary, although Hayek and M. Polanyi pointed out the limit of human reason, they did not deny the role of describable knowledge in our society. The two categories of knowledge were not necessarily inconsistent with each other in their arguments. Their acceptance of evolutionism widened their perspectives and their arguments became the starting point of the knowledge theory, which is still at the developing stage in several fields.

## 7 Conclusion

In this paper, we considered the argument of human knowledge that prevailed from the former Austrian Empire from the end of nineteenth century to the early twentieth century from the viewpoint of the dichotomy of describable and indescribable knowledge and discussed the role of Mach with regard to the origin of this argument. This elucidates the connection between logical positivism, Hayek's practical knowledge, and M. Polanyi's tacit knowledge. Moreover, it can also be stated that the two different types of knowledge emerged in the former Austrian Empire, particularly Vienna, in the same period primarily due to the influence of Mach, who provided the starting point for the argument. We focused on the Polanyi brothers as representatives of these types of knowledge. Although the contentions of both groups initially drew from Mach's argument and criticized his simple empiricism, they proceeded to develop different aspects of his argument. On the one hand, K. Polanyi appreciated Mach's positivism and founded economic anthropology; on the other hand, M. Polanyi recognized the significance of evolutionary epistemology and developed the theory of tacit knowledge.

In this paper, we investigated the relationship between these concepts of knowledge and also undertook an assessment of evolutionism. Hayek and M. Polanyi further argued Mach's evolutionary epistemology and made it the foundation of their theory of knowledge and social theory. On the other hand, the Vienna Circle was neither interested in evolutionism as a social theory nor in the methodology of science because of its ambiguity. Although evolutionary epistemology is the key concept of indescribable knowledge, it is considered as being extremely ambiguous by the theorists of describable knowledge.

The two different theories of knowledge that arose from Mach's positivism and evolutionary epistemology were applied to social philosophy, psychology, and social thought; further, they were clearly contrary to each other in the controversy of collectivist economic planning that prevailed in the period between the 1920s and

1940s.

In this paper, we clarified that the theory of Mises, who initiated the controversy of collectivist economic planning, was fairly close to that of describable knowledge than that of Hayek and M. Polanyi, who were politically on the same side. It is also true that rationalism, which is based on apriorism, was in conflict with the logical positivism of the Vienna Circle. However, his argument, which explains every human behavior from the viewpoint of rationalism, demarcates Hayek and M. Polanyi. We can observe a different aspect of Mises' theory from general understanding if we consider his theory from the viewpoint of the theory of knowledge.

The role of Mach in the history of economics and social scientific philosophy has not been sufficiently understood, except in Austria. Particularly in Japan, although the influence of Mach on Schumpeter and Hayek is frequently mentioned, his position in the history of economics has not yet been studied. However, as can be observed from figure 1, logical positivism became one of the bases of the methodology of modern economics in the 1950s in America. Thus, it appears reasonable to assume the Mach connection in the history of economics.

In this paper, we realize that our argument combines many arguments made during almost seventy years. We should definitely discuss the influence of Wittgenstein and Popper on the Vienna Circle or Hayek. However, this paper focused on the influence of Mach in order to clarify his position in the history of economics. The other problems may be considered in another discussion.

#### Notes

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<sup>3</sup> The Center for Historical Social Science Literature at Hitotsubashi University has Menger's personal collection of literature, which includes Mach's *Über Umbildung und Anpassung im Naturwissenschaftlichen denken*. However, this collection does not contain any note and therefore any evidence that Menger seriously read Mach's work cannot be established. Moreover, although Keio Gijuku University has microfilms of Menger's correspondences, there is no letter from or to Mach.

<sup>4</sup> The reason why K. Polanyi broke away from Mach is the former's acceptance of the role of religion in society and his rejection of the evolutionary approach.

<sup>5</sup> For example, Stadler (2001) pointed out that in his correspondence to Mach, Neurath acknowledged that his history of science, the value theory, and that of political economy were influenced by Mach.

<sup>6</sup> Although the chromosome itself was discovered by Karl Nägeli in 1842, he did not consider it as genetic material.

<sup>7</sup> Hayek criticized Mach's concepts as follows:

I have mainly derived my knowledge from H. von Helmholtz and W. Wundt, W. James and G. E. Müller, and Ernst Mach in particular. I still vividly remember how in reading Mach—in an experience very similar to that which Mach himself describes with reference to Kant's concept of the Ding an sich—I suddenly realized how a consistent development of Mach's analysis of perceptual organization made his own concept of sensory elements superfluous and otiose, an idle construction in conflict with most of his acute psychological analysis.

(Hayek 1952: vi)

Needless to say, Mach's "element" is a key concept of his cognitive psychology. Hayek abandoned this substantial feature in Mach's argument and replaced the relationship of "thing-concepts" with "relational concepts." In *Sensory Order*, there were some critical comments on Mach's empiricism and simple realism.

<sup>8</sup> Although it is not clear, Schumpeter's theory of entrepreneurship has a similar structure. According to his theory, an entrepreneur is not an inventor who creates something out of nothing but one who carries out a "recombination" of existing business resources. According to him, the important factors in entrepreneurship are familiarity with the problem and its background, and the ability to realize the potential for profit. This is the same argument as that in M. Polanyi's theory of scientific discovery.

<sup>9</sup> Hayek recollected that when he proposed his *Economics and Knowledge* as a criticism of Mises' rationalism, Mises did not reject it (Hayek 1992). This fact suggests that in 1937, he himself identified a conflict in his argument between rationalism in social science and the role of knowledge in our society, such as a convention and practical knowledge.

<sup>10</sup> In his correspondence with Hayek, Neurath criticized Hayek's definition of rationalism in *The Road to Serfdom*.

Of course, we often differ in our judgment. But occasionally you seem to present a

situation not in harmony with documentary material. Of course, there are people – I call them pseudo-rationalists – who try to present One and ONLY ONE best solution as a scientific one and I agree with you that this pseudo-rationalism is very dangerous and may sometimes support totalitarianism. But I think you should at least mention, that there is a scientific attitude, mainly represented by Logical Empiricism, which is PLURALIST through and through. Indirectly everything may sometimes support totalitarian success (you see that I try to show that even your antitotalitarian extremism could support totalitarianism INDIRECTLY), but you are speaking of the direct support. Plato supports totalitarian practice DIRECTLY, Logical Empiricism is NOT SUPPORTING TOTALITARIANISM DIRECTLY. I should appreciate it very much, if you were kind enough to tell me, what you think about this point;

Enclosed I am sending my FOUNDATIONS OF THE SOCIAL SCIENCES, which deal with this point in detail. Even if you disagree with my arguments, you can hardly maintain, that Logical Empiricists with their scientific attitude support a totalitarian outlook.

(Neurath 11<sup>th</sup> January,45)

It appears that Neurath's counterargument was correct with regard to the points that scientism did not logically espouse totalitarianism and that socialism did not necessarily assume the form of totalitarianism. However, Hayek discussed the facts that an actual socialist state such as the USSR was a totalitarian nation and that it was a consequence of the movements of rationalism and social reform that had occurred since the nineteenth century. Hayek discovered the origin of totalitarianism in the Vienna Circle's approach of separating science from other fields and eliminating the other fields.

In this regard, Neurath's argument that we should distinguish true

rationalism from false rationalism did not appear to be valid.

<sup>11</sup> Hayek's evolutionism was influenced not only by Mach but also by Menger's theory of organic social phenomena.

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