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History of Western Philosophy and Quantum Language (Including Quantum Mechanics, Statistics, Fuzzy Logic, etc.)

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Abstract

Although there are many different types of philosophy, many philosophers agree that the mainstream of Western philosophy (Socrates, Plato, Aristotle, Descartes, Kant, Wittgenstein) developed toward the perfection of Socrates' absolutism. But can the absolutism maintain its central position after analytic philosophy? There are pessimistic views on this problem, such as that of R. Rorty, the standard-bearer of neo-pragmatism. Recently, I proposed quantum language (which is including quantum mechanics, statistics, fuzzy sets, etc.). I think that that this theory is not only one of the most fundamental scientific theories, but also the scientific final destination of Western philosophy. If so, Socrates' dream has come true. The purpose of this paper is to discuss the above and to inform readers that quantum language has the power to create a paradigm shift from the classical mechanical world view to the quantum mechanical worldview.

Keywords

Quantum Language, Linguistic Copenhagen Interpretation, Fuzzy Logic

1. Introduction

I have recently introduced "quantum language (=QL)" and given a new view of the scientific part of Western philosophy in my two books [1] [2]. That is, I asserted that the location of QL in the history of western philosophy is shown in the following **Figure 1** below.

Here, [Ⓔ, ⑥, Ⓖ, ⑦, Ⓛ] is discussed in ref. [2], and [Ⓐ, ①, Ⓑ, ②, Ⓗ, ⑧, …, ⑫, Ⓛ] is discussed in ref. [1].

(It may be curious that [E: QM] belongs to realistic dualism, but this is an unsolved problem and its solution must be left to future geniuses.)

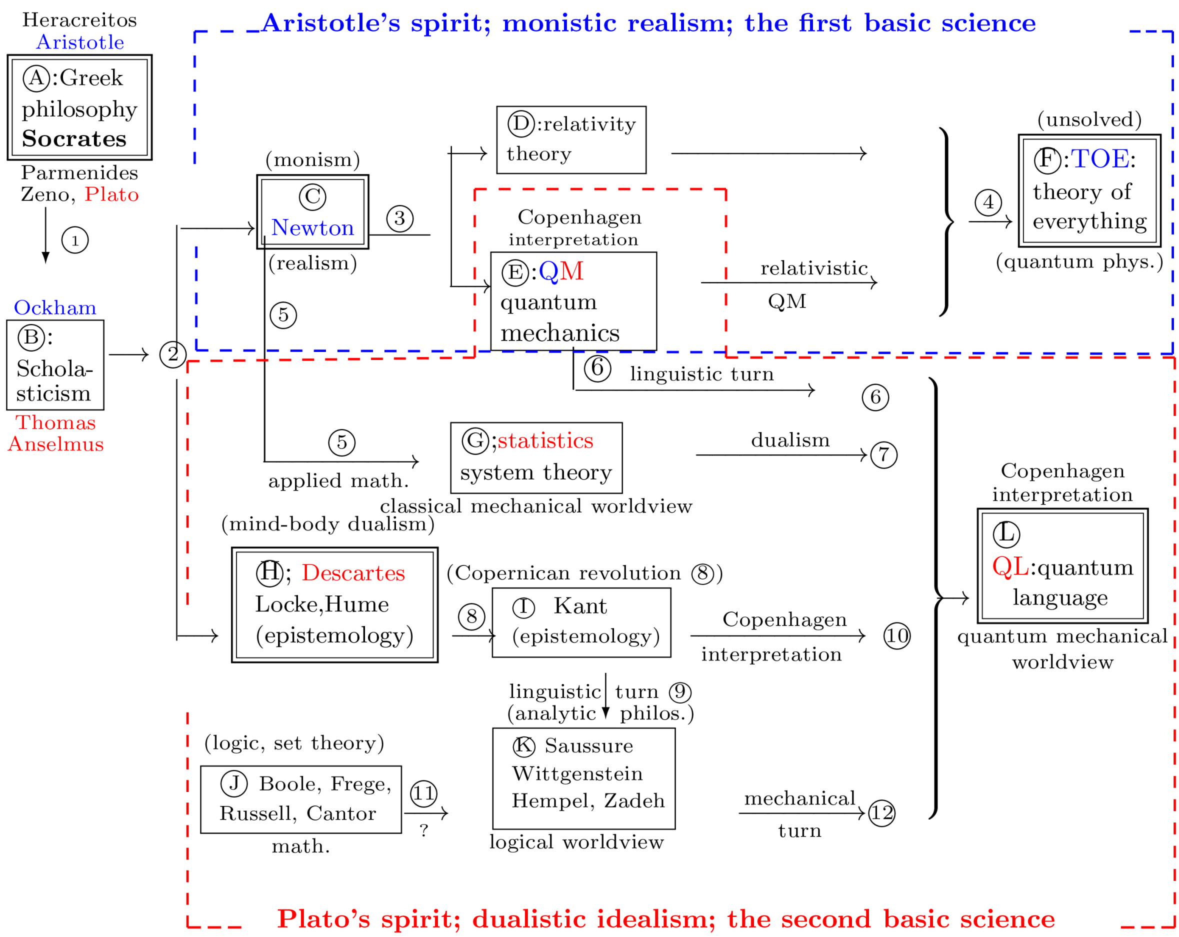


Figure 1. The Location of QL in the history of scientific worldview (*cf.* refs. [1] [3]).

The first thing to note in the figure above is Ⓔ $\xrightarrow{⑥}$ Ⓛ, Ⓖ $\xrightarrow{⑦}$ Ⓛ, and Ⓚ $\xrightarrow{⑫}$ Ⓛ, that is,

(A) QL is a development of quantum mechanics, statistics, and fuzzy logic (*i.e.*, roughly speaking, quantum mechanics, statistics and fuzzy logic are included in QL), thus QL can be expected to be one of the most useful scientific theories. And thus, I think that QL is a language that describes science (or precisely, the second basic science). Also, Ⓘ $\xrightarrow{⑩}$ Ⓛ means the development of the Copenhagen interpretation (*cf.* (J_5) in Section 3).

In this paper, I would call the science related to TOE (*i.e.*, physics) the first basic science, and the science related to QL the second basic science. Here, our interest concentrates mainly on the second basic science.

Although everyone knows what "progress" means in the first basic science, it is usual to consider that the concept of "progress" is non-sense in philosophy. However, in this paper I focus only on the scientific part of philosophy. Then it is natural to think of "progress" such as

(B) If "Ⓨ is closer to QL than Ⓧ" in the second basic science, then we call Ⓧ progresses to Ⓨ, and denote Ⓧ $\rightarrow$ Ⓨ.

(This is because I believe that QL is the scientific final destination of Western philosophy.)

Then, we have three "progresses" in **Figure 1** as above.

(C1) [Ⓐ $\xrightarrow{①}$ Ⓑ $\xrightarrow{②}$ Ⓗ $\xrightarrow{⑧}$ Ⓘ $\xrightarrow{⑨}$ Ⓚ $\xrightarrow{⑫}$ Ⓛ]

(where we ignore Ⓘ $\xrightarrow[?]{⑪}$ Ⓚ (*cf.* Remark 9)).

(C2) [Ⓒ $\xrightarrow{⑤}$ Ⓖ $\xrightarrow{⑦}$ Ⓛ]

(C3) [Ⓒ $\xrightarrow{③}$ Ⓔ $\xrightarrow{⑥}$ Ⓛ]

Therefore, I would like to conclude that

(D) Socrates' absolutism (*i.e.*, to "make a language of science") is realized by QL.

The purpose of this paper is to reexamine (C_1) - (C_3) and strengthen the idea of (D) (and (A)).

Remark 1. Many philosophy enthusiasts may consider that the next two are "progress".

1) Descartes → Locke → Hume → Kant

2) Kant → Husserl

I agree with (1), but not (2) is. This is because I think Husserl said too much about "more than science". However, this is not a negative factor of Husserl's phenomenology as philosophy, since philosophy is not only science.

2. The Mathematical Foundations of Quantum Language

QL has the following structure:

$$\boxed{\boxed{\text{QL}}} = \underset{\text{(Sec.2.2.1)}}{\overset{\text{(measurement)}}{\boxed{\text{Axiom1}}}} + \underset{\text{(Sec.2.2.2)}}{\overset{\text{(casality)}}{\boxed{\text{Axiom2}}}} + \underset{\text{(Sec.3)}}{\overset{\text{(how to use Axiomes 1 and 2)}}{\boxed{\text{Copenhagen interpretation}}}}$$

Readers wishing to read this paper in a literary context are advised to skip this section (*i.e.*, Section 2) except Example 2.1 and Remark 2.

2.1. Mathematical Preparations (the C^*-Algebraic Formulation of QL)

QL was initiated in refs. [4]-[10] ([10] is easy to read). Consider an operator algebra $B(H)$ (*i.e.*, an operator algebra composed of all bounded linear operators on a Hilbert space H with the norm $\|G\|_{B(H)} = \sup_{\|u\|_H=1} \|Gu\|_H$). Let $\mathcal{A}(\subseteq B(H))$ is a C^*-algebra, (*i.e.*, norm-closed subalgebra of $B(H)$) (*cf.* refs. [11] [12]).

Our purpose of this section is not to explain QL in general situation but to explain QL in an understandable setting. Thus, from here, I devote ourselves to the following simple cases:

$$(\text{E}) \quad \text{QL} = \begin{cases} (\text{E}_1): \text{quantum QL} \quad (\text{when } \mathcal{A} = B(\mathbb{C}^n), \text{ where } H = \mathbb{C}^n) \\ \qquad \text{i.e. the } C^*\text{-algebra composed of all } (n \times n) \\ \qquad \text{complex matrixes} \\ (\text{E}_2): \text{classical QL} \quad (\text{when } A = C(\Omega)), \\ \qquad \text{i.e. the space of all complex-valued} \\ \qquad \text{continuous functions on a compact space } \Omega. \end{cases}$$

The pair $[\mathcal{A}, B(H)]$ (or in short $\mathcal{A}$), is called a C^*-algebraic basic structure. Let $\mathcal{A}^*$ be the dual Banach space of $\mathcal{A}$. That is, $\mathcal{A}^* = \{\rho \mid \rho$ is a continuous linear functional on $\mathcal{A}\}$, and the norm $\|\rho\|_{\mathcal{A}^*}$ is defined by
$\sup\left\{\left|\rho(G)\left(= {}_{\mathcal{A}^*}\langle \rho, G\rangle_{\mathcal{A}}\right)\right| \mid G \in \mathcal{A} \text{ such that } \|G\|_{\mathcal{A}}\left(=\|G\|_{B(H)}\right) \le 1\right\}$.
Define the **mixed state** $\rho(\in \mathcal{A}^*)$ such that $\|\rho\|_{\mathcal{A}^*} = 1$ and $\rho(L) \ge 0$ for all $L \in \mathcal{A}$ such that $L \ge 0$. And define the mixed state space $\mathfrak{S}^m(\mathcal{A}^*)$ such that

$$\mathfrak{S}^m(\mathcal{A}^*) = \{\rho \in \mathcal{A}^* \mid \rho \text{ is a mixed state}\}.$$

A mixed state $\rho\left(\in \mathfrak{S}^m(\mathcal{A}^*)\right)$ is called a **pure state** (or simply, **state**) if it satisfies that $\rho = \theta\rho_1 + (1-\theta)\rho_2$ for some $\rho_1, \rho_2 \in \mathfrak{S}^m(\mathcal{A}^*)$ and $0 < \theta < 1$ implies $\rho = \rho_1 = \rho_2$. Put

$$\mathfrak{S}^p(\mathcal{A}^*) = \{\rho \in \mathfrak{S}^m(\mathcal{A}^*) \mid \rho \text{ is a pure state}\},$$

which is called a *state space*. It is well known that

$$\text{(F)} \begin{cases} [\text{Case}(\mathrm{F}_1)]; & \mathfrak{S}^p\left(B_c(H)^*\right) = \{\rho = |u\rangle\langle u| \mid \|u\|_H = 1\} \\ & \quad \text{where } |u\rangle\langle u| \text{ is the Dirac notation} \\ [\text{Case}(\mathrm{F}_2)]; & \mathfrak{S}^p\left(C(\Omega)^*\right) = \{\rho = \delta_{\omega_0} \mid \delta_{\omega_0} \text{ is a point measure at} \\ & \quad \omega_0 \in \Omega\} \approx \Omega. \end{cases}$$

In [Case (F_2)], under the following identification:

$$\mathfrak{S}^p\left(C(\Omega)^*\right) \ni \delta_\omega \leftrightarrow \omega \in \Omega,$$

ω and Ω is respectively called a state and a state space.

2.2. Axiom 1 (Measurement) and Axiom 2 (Causality) in Classical Systems

In this section, for simplicity, we consider only the case $\mathcal{A} = C(\Omega)$ (*i.e.*, the classical system).

2.2.1. Axiom 1 (Measurement)

Consider a basic structure $C(\Omega)$, which is the algebra composed by all complex continuous functions on a compact space Ω.

The triplet $\mathrm{O} = (X, 2^X, F)$ is called an observable in $C(\Omega)$ (*cf.* ref. [13]), if it satisfies the followings.

1) X is a finite set, $\mathcal{P}(X)$ is the power set of X, *i.e.*, $\left(\mathcal{P}(X) = 2^X = \{S : S \subseteq X\}\right)$.

2) $F : 2^X \to C(\Omega)$ is a map such that $0 \le [F(\Xi)](\omega) \le 1 (\forall \omega \in \Omega)$, and
$F(\Xi_1 \cup \Xi_2) = F(\Xi_1) + F(\Xi_2) \left(\forall \Xi_1, \forall \Xi_2 (\subseteq X) \text{ such that } \Xi_1 \cap \Xi_2 = \emptyset\right)$

3) $[F(X)](\omega) = 1 (\forall \omega \in \Omega)$, $[F(\emptyset)](\omega) = 0 (\forall \omega \in \Omega)$,

Further, $\mathrm{M}_{C(\Omega)}\left(\mathrm{O} = (X, 2^X, F), S_{[\omega_0]}\right)$ is called the measurement of the observable $\mathrm{O} = (X, 2^X, F)$ for a system S with the state ω_0.

Then, I have the following Axiom, which is the mathematical generalization of [14].

Axiom 1 (measurement);
With any classical system S, a $C(\Omega)$ can be associated in which measurement theory of that system can be formulated. When the observer takes a measurement $\mathsf{M}_{C(\Omega)}(\mathsf{O}=(X,2^X,F),S_{[\omega_0]})$ the probability that a measured value x $(\in X)$ is obtained by the measurement is given by $[F(\{x\})](\omega_0)$.

Example 2.1 [Bald man paradox]

For simplicity, consider the basic structure $C(\Omega)$, where the state space Ω = the closed interval [0, 1] ($\subset \mathbb{R}$: real lie).

Let's assume that the maximum number of hairs on the head of adult men is 150,000 (=1.5 × 10^5). Let M be a set of all adult men. For any $m_i\,(\in M)$, define his "bald rate $\omega(m_i)$" by

$$\omega(m_i)=1-\frac{\text{Number of hairs on Mr } m_i\text{'s head}}{1.5\times 10^5}$$

Put $\Omega=[0,1]$. Define the "bald observable" $\mathrm{O}_B=\left(\{Y,N\},2^{\{Y,N\}},F_B\right)$ in $C(\Omega)$ such that (**Figure 2**)

$$[F_B(\{Y\})](\omega)=\begin{cases}0 & (0\le\omega\le 0.3)\\ \frac{5}{2}\omega-\frac{3}{4} & (0.3\le\omega\le 0.7)\\ 1 & (0.7\le\omega\le 1.0)\end{cases}$$

$$[F_B(\{N\})](\omega)=1-[F_B(\{Y\})](\omega)\quad(0\le\omega\le 1)$$

Further, suppose that there are 100 respondents, and furthermore, the following question is asked to them

(G1) Is Mr m_i (with the bald rate $\omega(m_i)$) bald or not?

Assume that the results of the responses are as follows.

$$\text{(G2)}\quad\begin{cases}100[F_B(\{Y\})](\omega(m_i)) \text{ respondents say "Yes, Mr. } m_i \text{ is bald"}\\ 100[1-F_B(\{Y\})](\omega(m_i)) \text{ respondents say "No, Mr. } m_i \text{ is not bald"}\end{cases}$$

This can be probabilistically interpreted as follows.

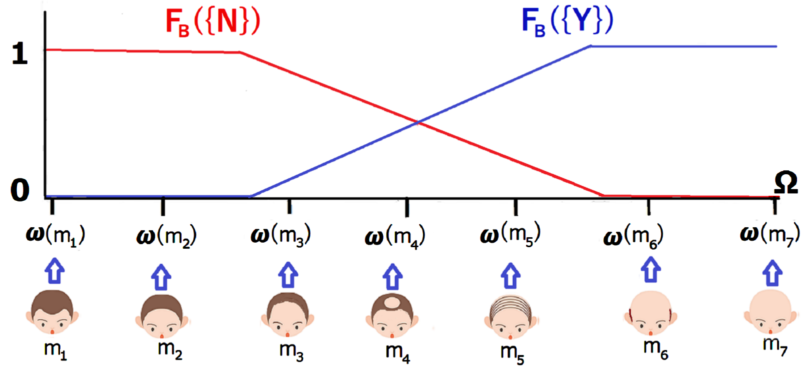


Figure 2. Bald observable $\mathrm{O}_B=\left(\{Y,N\},2^{\{Y,N\}},F_B\right)$ in $C([0,1])$.

(G3) When a respondent is *randomly* selected out of 100, the probability that this respondent answer "yes" to question (D_1) is $p_1 = [F_B(\{Y\})](\omega(m_i))$.

(Here, note that "probability" can be created by "ratio" + "at random")

Which is equivalent to

(G4) Consider the measurement $M_{C(\Omega)}\left(O = \left(\{Y,N\}, 2^{\{Y,N\}}, F_B\right), S_{[\omega(m_i)]}\right)$. Then, the probability that a measured value Y is obtained is given by $[F_B(\{Y\})](\omega(m_i))$.

Remark 2. 1): I believe that fuzzy theory (by Zadeh (*cf.* ref. [15]; (1965)) is not yet generally recognized as a scientific theory. If Zadeh's fuzzy theory is approved by the general scientific community, then the "bald man paradox" has been solved by Zadeh, but few people think so. In the history of dualism (≈Western philosophy), there not a few theories that have gained excessive support from the general public without any solid reasons. Zadeh's [15] is one of the most cited papers of the 20th century, and while fuzzy theory has gained general public support, it has yet to gain firm ground. Zadeh's late paper [16] (2008) is written some criticisms of fuzzy theory by Kalman and others fairly. Reading this, I think that their critics are still more convincing. Obviously, his fuzzy theory can never beat statistics. For fuzzy theory to be generally accepted, it must be formulated within QL (a theory more powerful and beautiful than statistics). This has been my policy since the beginning when I proposed QL (*cf.* [4] [5] [6] [7]).

2): However, it does not yet mean that clarifying the bald man paradox in the framework of QL will lead to general acceptance. In the end, it comes down to a question of a classical mechanistic worldview (statistics) vs. a quantum mechanical worldview (QL). To settle the problem of worldviews, it is not enough to be "useful" or to have "solved famous puzzles"; a major problem has to be solved. For this reason, in Section 4 later in this paper, we will tackle the biggest problem in the history of Western philosophy, Socrates' dream.

2.2.2. Axiom 2 (Causality)

Consider two basic structures $C(\Omega_1)$ and $C(\Omega_2)$. A linear operator $\Phi_{21} : C(\Omega_2) \to C(\Omega_1)$ is called a homomorphism if there exists a continuous map $\phi_{12} : \Omega_1 \to \Omega_2$ such that

$$[\Phi_{21}(f_2)](\omega_1) = f_2(\phi_{12}(\omega_1)) \quad (\forall \omega_1 \in \Omega_1, \forall f_2 \in C(\Omega_2))$$

Then we have the following axiom, whose origin is Heisenberg's kinetic equation (equivalently, Schrödinger equation) in quantum mechanics.

Axiom 2 (causality);
Consider the ordered set $\{t_1, t_2\}$, where $t_1 < t_2$, and two basic structures $C(\Omega_{t_1})$ and $C(\Omega_{t_2})$. The causality is represented by a homomorphism: $\Phi_{t_2 t_1} : C(\Omega_{t_2}) \to C(\Omega_{t_1})$.

For a detailed discussion, see. refs. [1] [2].

3. The Linguistic Copenhagen Interpretation

I think that the problem "What is the Copenhagen interpretation of quantum mechanics?" is unsolved (*cf.* ref. [17]). However, I think that the problem "What is the linguistic Copenhagen interpretation of quantum language?" is answered below. I have an opinion that the linguistic Copenhagen interpretation is the true Copenhagen interpretation. That is, the linguistic Copenhagen interpretation is common to QL (=QM + classical QL) and QM. (*cf.* ref. [10]). Thus in this paper I consider the linguistic Copenhagen interpretation and the Copenhagen interpretation as the same thing.

Here, note that

(H_1) **Axiom 1 and Axiom 2 are a kind of incantation (spell, magic word, metaphysical statement), and so they cannot be tested experimentally.**

And thus, I say:

(H_2) After we learn the spell (=Axiom 1 and Axiom 2) by rote, we have to exercise and lesson the spell (=Axiom 1 and Axiom 2). Since quantum language is a language, it may be unable to use well at first. It will make progress gradually, while applying a trial-and-error method.

In fact, even without knowing the linguistic Copenhagen interpretation, we could largely understand Example 2.1 [The bald man's paradox].

However, I think:

(I_1) if we would like to make speed of acquisition of quantum language as quick as possible, we may want the good manual how to use the axioms.

Hence, I think that

(I_2) the linguistic Copenhagen interpretation

=the manual to use the spells (Axiom 1 and Axiom 2)

Using Wittgenstein's saying: *What I cannot speak about I must pass over in silence* (ref. [18]), I say that

(I_3) the linguistic Copenhagen interpretation

=Rules for distinguishing between "what I can speak about"

And "what I cannot speak about".

He wanted to do this but couldn't, so his book became literary. As the linguistic Copenhagen interpretation is a manual, there is no end to the details. (I think that there is no complete linguistic Copenhagen interpretation). The following is a list of particularly important points.

…

Now let me explain the linguistic Copenhagen interpretation below ((J_1) - (J_5)).

(J_1) **Dualism**: Use the axioms (=Axiom 1 and Axiom 2), always keeping the following diagram in mind! (due to Descartes).

Here, dualism is a way of understanding the world with the Descartes Figure in mind. The image of the measurement is [ⓐ + ⓑ], which should not be regarded as an interaction. That is, the relationship between ⓐ and ⓑ above cannot be represented by any dynamical equation. This is because if the dynamical equations existed, dualism would not hold and monism would become a monism. Thus, it is better not to say [ⓐ + ⓑ] explicitly in **Figure 3**. If we consider this as a physics issue, I believe that the majority of researchers support "monism", but I am not concerned with physics here. Also, the measurer cannot measure himself. (See **Table 1** and **Figure 3**)

Thus, the most important word in dualism is "observable". That is,

- An observer prepares the measuring instrument (≈observable), measures the subject (≈state), and obtains the measured value. Thus, the order is "observable" → "state" → "measured value".

Hence, I think that Descartes is the greatest contributor to the Copenhagen Interpretation.

…

(J_2) **Existence**: I argue that there are no words (*i.e.*, concepts) other than those enumerated in Axiom 1 and Axiom 2.

Thus, I agree with Parmenides (*cf.* Remark 5 later), who said that everything does not change; there is no motion and no change; time does not exists; there exists only one and not many. If one wants to use the term "space-time", it must be defined in terms of Axiom 1 and Axiom 2. There are various ways of doing this, but the method devised by Leibniz (space-time relations theory) is the basic one (see Leibniz-Clarke correspondence in [1] [19] [20]). I used to think that space-time theory in philosophy was the ravings of philosophers who could not understand Einstein's theory of relativity, but this is not the case. I cannot understand the ontology of philosophy, but I can understand if "existence = key words (=words in Axiom 1 and Axiom 2)".

…

(J_3) **Only one measurement is possible**: There is no "many" but "only one" (due to Parmenides and Kolmogorov).

Parmenides' and Kolmogorov's arguments are quite similar.

Kolmogorov's extension theorem (*cf.* ref. [21]) that implies that there is only one probability space'. If there is one probability space (=sample space), then "there is only one measurement". Then there is also one state. Therefore, the state does not move (adopting the Heisenberg picture, rejecting the Schrödinger picture). In the same sense, Heisenberg's equations of motion are more principled than Schrödinger equation though these are equivalent in the simple cases. In other words, there is no concept of "after measurement". This (J_3) may appear to be a very strong constraint, but it can be circumvented by using tensor space. Under this constraint (J_3), I proved Heisenberg's uncertainty principle and the wavefunction collapse (see [22] [23]).

Table 1. Dualism [Descartes and QL].

Descartes	[A] (=mind)	[B] (=body (≈sensory organ)) (Mediating of A and C)	[C] (=matter)
Quantum language	**Measurer** [measured value]	**measuring instrument** [observable]	**System** [state]

…

(J_4) **Instrumentalism (utility rather than truth)**

QL is instrumentalist. In QL, all results are approximate. Also, Popper's falsifiability (*cf.* [24]) is basic, but all-around.

…

(J_5) **Western philosophy**

I do not mean to make a joke, but I think that

- The history of Western philosophy (*i.e.*, [Ⓐ $\xrightarrow{①}$ Ⓑ $\xrightarrow{②}$ Ⓗ $\xrightarrow{⑧}$ Ⓘ $\xrightarrow{⑨}$ Ⓚ] in (B_1)) is the history of the pursuit of the linguistic Copenhagen interpretation without knowing Axiom 1 and Axiom 2.

Particularly, mathematics is not used in the Copenhagen interpretation's part of QL. Note that both epistemology and the Copenhagen interpretation start with the Descartes **Figure 3**. Therefore, it is natural that the similarity between philosophy (dualistic idealism) and the Copenhagen interpretation is to be expected. I can assert that

- Many of maxims of the philosophers can be regarded as a part of the linguistic Copenhagen interpretation.

For example, Wittgenstein's quote "The limits of my language mean the limits of my world" (*cf.* [18]) is the essence of QL.

It should be noted that both mainstream Western philosophy and QL are dualistic. Thus, I believe that the linguistic Copenhagen interpretation can be characterized as a manual on how to use dualism.

Remark 3. As mentioned above, I believe that "the true Copenhagen interpretation = the linguistic Copenhagen interpretation". A hundred years on, we still haven't got a definitive answer to the question "What is the Copenhagen interpretation?" (*cf.* ref. [17]). I think this is because we assume that this question is a matter of physics. However, I believe that it is a matter of philosophy (or more precisely, the second basic science). Thus I consider the linguistic Copenhagen interpretation and the Copenhagen interpretation as the same thing (*cf.* [10]). That is, the Copenhagen interpretation of quantum mechanics is defined by the linguistic Copenhagen interpretation of quantum mechanics. Also, though every interpretation of quantum mechanics has its advantages and disadvantages, I think the linguistic Copenhagen interpretation of quantum mechanics

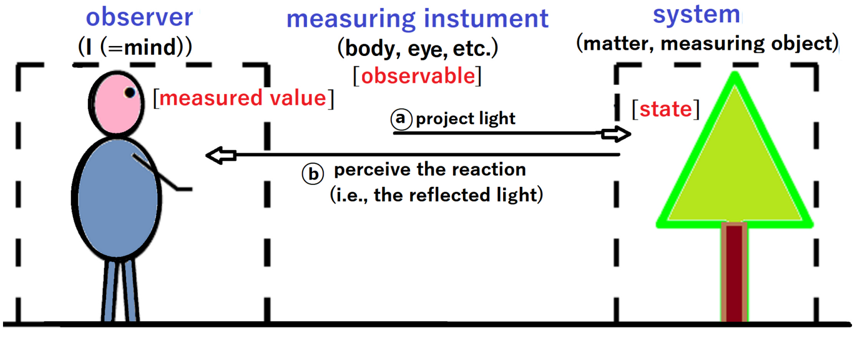


Figure 3. [Descartes Figure]: "measurement (= ⓐ + ⓑ)".

is standard. (The advantage of QL is that it is 'simple and easy', so the Heisenberg cut is not assumed in this paper to be one of the linguistic Copenhagen interpretation.)

Remark 4. QL can solve various paradoxes (e.g., Schrödinger cat (Section 10.5 in [2]), two envelope problem (Section 5.6 in [2], or [25]), Monty Hall problem (Section 5.5 in [2], or [26]), Zeno's paradoxes (**Figure 4**, Section 2.4 in [1]), brain in a vat (Section 9.3 in [1], or [19]), Ergodic problem (Chapter 14 in [2], or [27]), Hume's problem (Section 9.5 in [1], or [28]), Grue paradox (Section 9.6 in [1]) posed in quantum mechanics, statistics and philosophy (especially, philosophy of mind) within QL (*cf.* [1] [2]). Readers are encouraged to challenge the various paradoxes in the philosophy of mind. (I think that this is the reason for the existence of the philosophy of mind.) At that time, the current linguistic Copenhagen interpretation may not be sufficient, and it may be necessary to add new conditions. Alternatively, (J_1) - (J_4) may need to be rewritten somewhat. Therefore, I consider it impossible to fully describe the linguistic Copenhagen interpretation. That is because I believe that all scientific theories (at least, QL) are approximate theories.

4. History of Western Philosophy from a Scientific Perspective of QL

4.1. Fundamental Concepts in Science

For philosophy, beginning with Socrates, to grow healthily and acquire a scientific worldview, the following key concepts had to be introduced.

(K_1) dualism: by Plato, Descartes

(K_2) parameterization: by Aristotle, Newton

(K_3) causality (=Axiom 2): by Newton, Heisenberg, Schrödinger

(K_4) measurement (=Axiom 1): by Born

(K_5) idealization (=the Copernican revolution, linguistic turn), by Kant, Wittgenstein

(K_6) fuzzy logic: Zadeh, (TF)-measurement (Definition 4.1)

In this section, I will illustrate these in the history of Western philosophy.

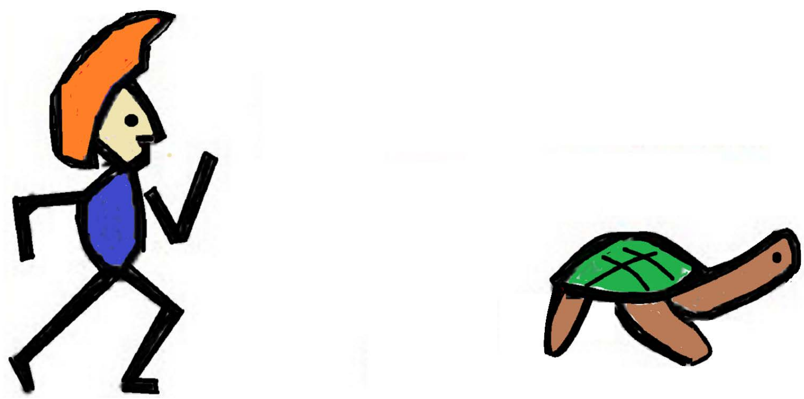


Figure 4. Zono's paradox (Achilles and the tortoise).

4.2. The Beginning of Sciences

Although some may argue that philosophy exists in all regions of the world and in all periods, and that Western philosophy originating in ancient Greece is not the only special one, this paper is concerned with Western philosophy originating in ancient Greece. This is because I believe that Western philosophy stands out from the rest in terms of being "scientific".

The pyramid complex at Giza in Egypt was built around 2500 BC, so the level of science and technology at that time must have been considerable. However, I consider the ancient Greek philosopher Socrates (469-399 BC) to be the founder of philosophy (or more precisely the founder of the scientific worldview, Socrates' absolutism). That is, as seen in **Figure 1**, I believe that the scientific worldview has formed the mainstream of Western philosophical history (which somehow assumes "progress").

4.3. Protagoras (Relativism) vs. Socrates (Absolutism)

In ancient Greece, where democracy worked to some extent (despite slavery), it was important to "defeat your opponent through argument and debate". There were roughly two ways of doing this. One was the Protagoras' (490-420 BC) method of "the art of oratory." He said "Man is the measure of all things." There are different interpretations of this, but let us assume that he thought "there is no objective truth." That is, if the book sells, it is the truth.

The other was the method of Socrates (469-399 BC), "asserting what is right (*i.e.* the truth)." Of course, Protagoras (relativism) vs. Socrates (absolutism) is not a matter of saying which is right.

It is not simple, because there are problems with correct answers and problems without correct answers. Rather, there are many questions in life for which there are no right answers, and it is more common to consider Socrates' side to be at a disadvantage. But if I think this way, philosophy cannot begin. If we adhere to the position that Socrates is the founder of philosophy, we have to admit that:

(L) Socrates envisaged "problems with correct answers". In other words, he envisaged a "scientific problem". And Socrates' dream is "the discovery of scientific thinking (≈the language of science)".

This is a problem that has puzzled many philosophical geniuses for nearly 2500 years, and to reward their efforts, humans must not lag behind generative AI in solving this problem.

If it had been only a dream, Socrates' name would not have survived to the present day. This is where Plato (427-347 BC) and Aristotle (384-322 BC) come in. (Socrates' disciple is Plato and Plato's disciple is Aristotle). These two men followed Socrates' legacy and challenged problem (L).

Remark 5. It may be disrespectful to Parmenides (about 520-450 BC, about 50 years older than Socrates) to write as above. As seen in (J_2) and (J_3), his achievements in dualism (*i.e.*, the Copenhagen interpretation) are staggering. Zeno

(490-430 BC) was also his disciple. Parmenides was too much of a genius for his philosophy to become mainstream Western philosophy.

4.4. Plato: The Discovery of Dualism

In order to realize Socrates' dream, Plato formulated his theory of Ideas.

Theory 4.1 [Theory of Ideas]:
Plato's theory of ideas, for example, is as follows.

(M) In the real world, it cannot be said that "love always wins over money". But in the heavenly world (the world of Ideas), "love always wins over money" is an objective truth. And we can realize the existence of the world of Ideas through Ideas.

This is Plato's theory of ideas.

Plato's Idea Theory may be a fairy tale. I think that the history of mainstream Western philosophy is the story of the gradual scientific arming of this fairy tale. Plato used various metaphors to explain his Idea Theory. The Plato's theory above referred to "The Allegory of the Sun" in Section 3.3.3 in [1].

Remark 6. (*cf.* Chapter 3 in [1]). Recall (J_1) Dualism in Section 3. Descartes' dualism has the following form:

$$[\mathrm{A}:\mathrm{mind}] \quad \leftarrow \underset{\text{(medium)}}{[\mathrm{B}:\mathrm{body}\,(\approx \mathrm{sensory\ organ})]} \rightarrow \quad [\mathrm{C}:\mathrm{matter}]$$

This suggests a correspondence between Theory of Ideas and QL (*i.e.*, measurement theory (*cf.* ref. [9])) as Table 2.

4.5. Aristotle: The Discovery of Quantitative Representation, Newton: The Discovery of Causality

Aristotle proposed the concepts such as "eidos" and "hyle" as follows.

Theory 4.2 [Edios(=Aristotle's Idea) and hyle]: Aristotle said that

(N) **Edios** (= Aristotle's Idea = true form) is not in the heaven, but in **hyle** (= matter = particle= thing).

In short, Aristotle simply stated that

"the nature of a thing is in the thing (not in the heavens).

It is difficult to understand the meaning of hyle" and edios" above. However, if I remember that

$$\text{(O)}\quad \underset{\text{final cause}}{\overset{\text{hyle; [eidos]}}{\boxed{\text{Aristotle}}}} \xrightarrow[\text{progress}]{} \underset{\text{causality (=Newton's kinetic equation)}}{\overset{\text{particle; [state](=(position, momentum))}}{\boxed{\text{Newton}}}}$$

I can say

Table 2. Dualism [Plato, Descartes and QL].

Plato (Allegory of the Sun)	actual world	Idea (=sunlight)	Idea world
Descartes	[A] (=mind)	[B] (=body (≈sensory organ)) (Mediating of A and C)	[C] (=matter)
quantum language	**Measurer** [measured value]	**measuring instrument** [observable]	**System** [state]

(P) Aristotle found "eidos (=state)" (*i.e.*, quantitative representation, or parameterisation)

Thus, we obtain Table 3:

Quantitative representation and causality are very important in science. In fact, philosophies without those concepts, (e.g., Descartes, Kant, Wittgenstein, etc.) are scientifically useless. Newtonian mechanics, statistics and quantum mechanics, on the other hand, are most useful. However, note that, in the quantum language (=Axiom 1 and Axiom 2 + Copenhagen interpretation), the Copenhagen interpretation's part does not use mathematics. This means that the similarity between philosophy (dualistic idealism) and the Copenhagen interpretation is to be expected (see (J_5) in Section 3, and $\xrightarrow[\text{interpretation}]{\text{Copenhagen}}$ ⑩ in Figure 1).

Remark 7. 1): There are many things in the history of Western philosophy that only became clear later. For example, I believe that a tentative theory of the understanding (interpretation) of the relationship between Plato and Aristotle emerged around the time of Descartes and Newton, via Scholastic philosophy (Anselmus, Thomas Aquinas, Occam, etc.). Since Aristotle built his theory with biology in mind, some may not agree with "(P): eidos = state". However, my policy is that if "Aristotelian philosophy $\xrightarrow{\text{progress}}$ Newtonian mechanics" is accepted, then the old argument about eidos is unnecessary and we should proceed as [(P): eidos = state]. This is true throughout the history of Western philosophy. For example, the relationship between epistemology (Descartes, Kant) and analytic philosophy can only be understood from a QL perspective (see Section 4.12 later). Also, note that the "progress" in Figure 1 (or in (B)) cannot be understood without the present theory QL. Recall "history is an unending dialogue between the past and the present" by Carr (*cf.* [29]).

2): Aristotle also has an aspect of being the father of realistic science (=the first basic science = physics) (*i.e.*, [Aristotle → Newton → Einstein → TOE) in Figure 1). This was not emphasized in this paper. Thus, the representation such as "Aristotle's Idea" was not so wrong. In fact,

- The most essential thing (Aristotle's Idea) is "eidos (=state)," and Newton's equation of motion is the equations of state.

On the other hand, in quantum mechanics, the most essential thing is "Plato's Idea (=observable)," in fact, Heisenberg's equation of quantum motion is the equation concerning observables (Axiom 2 in Section 2.2.2).

Table 3. Monism [Aristotle, Newton], dualism [Descartes, Plato and QL].

Aristotle (monism)	/	/	Hule [eidos]
Newton (monism)	/	/	Particle [(position, momentum)]
Plato (Allegory of the Sun)	actual world	Idea (=sunlight)	Idea world
Descartes	[A] (=mind)	[B] (=body (≈sensory organ)) (Mediating of A and C)	[C] (=matter)
quantum language	**Measurer** [measured value]	**Measuring instrument** [observable]	**System** [state]

4.6. Scholasticism Ⓑ in Figure 1; Anselmus, Thomas Aquinas

This section owes mainly to Chapter 6 in [1], or [30]. In AD.380, Christianity became the state religion of the Roman Empire. Augustine (354-430), the greatest Catholic priest, adopted Plato's theory of Ideas to strengthen Christianity. On the other hand, the philosophy of Aristotle spread to Islam. In the era of crusade expedition (1096 1270), cultural exchanges emerged and the Plato vs. Aristotle debate (called the problem of universal such that "Is Plato Idea Necessary?") flourished within the Scholastic school. Anselmus (1033-1109) and Thomas Aquinas (1225-1274) appeared and deepened Plato's ideas.

[Anselmus]: Consider the following statement:

- $\underset{\text{(indivisual)}}{\text{Socrates}}$ is a $\underset{\text{(universal)}}{\text{human being}}$ (≈ $\underset{\text{(matter)}}{\text{Mr.}\, m_5}$ is $\underset{\text{(observable)}}{\text{bald}}$).
- (*cf.* Example 2.1))

Then. I see that "Socrates" ⟷ indivisual and "human being" ⟷ universal since "m_6" (⟷ system with a state $\omega(m_6)$) and "bald" (⟷ observable). Recall the Copenhagen interpretation (D_2) in Section 3, which says that

- An observer prepares the measuring instrument (≈observable), measures the subject (≈state), and obtains the measured value, that is, the order is "observable" → "state" → "measured value".

Thus, Anselmus said "The universal precedes the individual".

[Thomas Aquinas]: He considered three universals as follows:

1) Observable ≈ Universals, which are formed in divine reason and exist before the individual things (universalia ante rem),

2) State ≈ Universals that exist as generalities in the individual things themselves (universalia in re),

3) Measured value ≈ Universals that exist as concepts in the mind of man, that is, after things (universalia post rem).

Thomas understood the order: "observable" → "state" → "measured value". Thus, I think that Thomas' theory + quantity representation ≈ QL (in Table 4).

Remark 8. The problem of universals (*i.e.*, What is Plato's Idea?) is not an old problem, but a contemporary one. It is almost identical to the following contemporary problems:

Table 4. Monism [Aristotle, newton], dualism [Plato, scholasticism, Descartes, QL].

Aristotle (monism)	/	/	Hule [eidos]
Newton (monism)	/	/	Particle [(position, momentum)]
Plato (Allegory of the Sun)	actual world	Idea (=sunlight)	Idea world
Scholasticism (Anselmus)		universal	individual
Scholasticism (Thomas Aquinas)	human intellect (universale post rem)	divine intellect (universale ante rem)	Individual (universal in re)
Descartes	[A] (=mind)	[B] (=body (≈sensory organ)) (Mediating of A and C)	[C] (=matter)
quantum language	**Measurer** [measured value]	**measuring instrument** [observable]	**System** [state]

1) Does science need measurement? (Note that Newtonian mechanics has not the concept "measurement".)

2) As analytic philosophy Ⓚ in **Figure 1** has erased dualism (=Plato Idea), but is this correct?

3) Is dualism necessary for science?

4) Does science need the concept of "fuzziness"? (*i.e.*, statistics versus QL (*cf.* [16]))

I think that the above (*i.e.*, (a) - (d)) should be said to be the problem of universals today (*cf.* [1] [2]). Thus I think that the problem of universals is not yet unsolved, and thus, this is the most important problem in philosophy. As I will write in the "Conclusions" of the last section, my real purpose is to lead QL to victory in the "Statistics vs. QL".

4.7. Descartes (1596-1650) Ⓗ and Newton (1642-1727) Ⓒ

Let us now summarize Descartes' position and Newton's position. I think Newton's position is simple. Newton is said to have read Galileo (1564-1642) and Kepler (1571-1630) while at Cambridge University, and to have seen the 'apple fall from the tree' when he returned his hometown in 1665-67 due to a plague epidemic, which inspired the idea of universal gravitation. In other words, Newton discovered Newtonian mechanics by compiling the observational data collected by Galileo, Kepler and Tycho Brahe (1546-1601). Newtonian mechanics was accepted unconditionally by all because it could deductively calculate Kepler's laws of planetary motion and predictions of the return of Halley's comet.

Descartes' position, on the other hand, is subtle. Descartes, in the tradition of Plato and Scholastic philosophy, summarized dualism in terms that anyone could understand as follows.

(Q) $[A:\text{mind}] \quad \underset{(\text{medium})}{\leftarrow [B:\text{body}] \rightarrow} \quad [C:\text{matter}]$

Which can be seen as a popularization of the theories of Thomas Aquinas in Scholastic philosophy (*cf.* [30]). This, of course, was Descartes' feat, but nobody knew how to develop it into a science. In hindsight, only the genius Leibniz (1646-1716) had the potential to do so, but unfortunately Leibniz failed to discover Axiom 1 and Axiom 2 of QL.

Nevertheless, I marvel at the sensitivity of the general public who continued to support (Q), which no one truly understood.

4.8. Locke, Hume, Leibniz, Kant; Popularization and the Copernican Revolution

In the post-Descartes era, a much larger readership emerged than in previous eras due to the widespread use of printed materials. This brought about the popularization (or, Aliteratisation) of philosophy (dualism). And "popularization" naturally meant "avoidance of quantitative arguments". Popularization and non-quantitative argumentation have determined the shape of philosophy to this day. Also, sophistry, such as the cogito proposition, "I think, therefore I am," was accepted as truth as long as the masses found it interesting. That is, if the book sells, it is the truth. In addition, it was natural to target subjects outside the scope of Newtonian mechanics, and "cognition" became the main theme of philosophy.

Although Locke's ideas (the primary quantity, and the secondary quantity) were excellent, the unintelligible oppositional structure of "British empiricism (Locke, Hume) versus continental rationalism" became popular (*cf.* [31]).

Kant's bizarre claim to have laid the philosophical foundations of Newtonian mechanics was also favorably received by the masses. Or perhaps Kant just wrote about the aspirations of the masses.

However, it is worth noting that Leibniz's relationalism of space-time was written against Newton and is almost identical to the space-time of the quantum language (*cf.* [1] [19] [20]).

I also think that Kant's Copernican revolution (*cf.* [32]) is the gold standard of modern philosophy. Kant prevented epistemology from becoming a brain science and put forward Kantian philosophy as a (non-physical) idealism. I think Kant was well aware that Socrates' dream was an exploration of scientific thought and not a brain-scientific fiction.

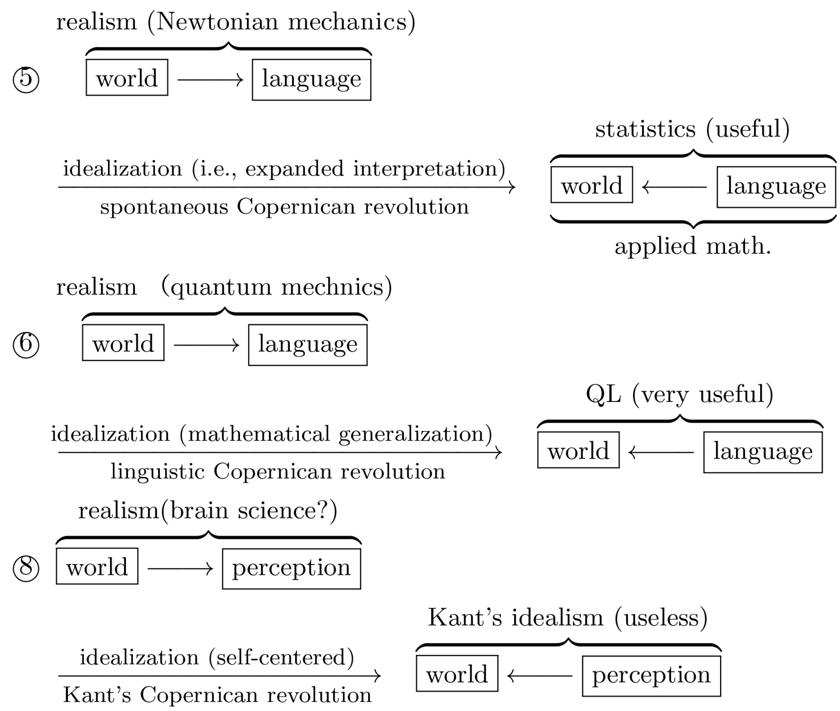
4.9. Idealism; Three Copernican Revolutions ⑤, ⑥ and ⑧ in Figure 1

In this paper, I use the term of the Copernican revolution in broad terms as the convenient way of transforming realism into idealism. In **Figure 1**, I can find three Copernican revolutions, *i.e.*, ⑤, ⑥, ⑧.

In particular, ⑤ is a spontaneous Copernican revolution, and thus it is non-theoretical, and thus, the most difficult Copernican revolution to understand. For example, the question remains, "How did probability enter in statistics?" However, this question was naturally resolved by deriving statistics from QL (refs. [1] [2]).

The ⑥ in **Figure 1** is the most important Copernican revolution for us, where I get QL (=language of science) by mathematical generalization of quantum mechanics (physics).

Kant's Copernican revolution ⑧ is a simple philosophical method of creating "idealism" (perception first, world second, *i.e.*, [perception] → [world]) from "realism" (world first, perception second, *i.e.*, [world] ← [perception]). But it is also non-theoretical and literary.



Here, I think that the true Copernican revolution is ⑥. If so, I can understand Wittgenstein's famous following (*cf.* [18]).

(R) The limits of my language mean the limits of my world

Which expresses the essence of scientific idealism. However, Wittgenstein did not indicate "my language", so his argument became literature.

Above, the only true idealism (*i.e.*, scientific idealism) is QL in ⑥. However, I would like to think that the discoverer of idealism is Kant. Because without Kant's Copernican revolution, I think Socrates' dream would have been crushed at that point.

4.10. Statistics (≈Dynamical System Theory, *i.e.*, Classical Mechanical Worldview) vs. QL (*i.e.*, Quantum Mechanical Worldview)

In order to claim that QL is the realization of Socrates' dream, classical QL must absorb statistics (≈ dynamical system theory, *i.e.* the most useful basic theory of science) and logic (see Remark 9 in Section 4.12 later).

Let us illustrate this. Consider a measurement $\mathsf{M}_{C(\Omega)}\left(\mathsf{O}=\left(X,2^X,F\right),S_{[\omega]}\right)$. Let $\left[F\left(\{x\}\right)\right](\omega)$ be denoted by $P_\omega\left(\{x\}\right)$. Thus, $\left(X,2^X,P_\omega(\cdot)\right)$ can be regarded as a sample space with parameter $\omega(\in\Omega)$. If I start from this point (*i.e.*, $\left(X,2^X,P_\omega(\cdot)\right)$), I will be in statistics. This is because

"statistics = theory of probability space with parameters"

That is,

$$\underset{\text{measurement}}{\overset{\text{quantum language (dualism)}}{\boxed{M_{C(\Omega)}\left(O=\left(X,2^X,F\right),S_{[\omega]}\right)}}} \xrightarrow[\text{Elimination of observable O}]{} \underset{\text{probability space with a parameter }\omega}{\overset{\text{statistics (applied math.)}}{\boxed{\left(X,2^X,P_\omega(\cdot)\right)}}}$$

If the reader is familiar with statistics, the above relationship will help in understanding QL. Roughly speaking, when X is all real numbers, QL is almost equal to usual statistics (*cf.* [2]). It should be noted that the relation between statistics and statistical mechanics was, for the first time, clarified in QL (*cf.* Chapter 14 in [2], or [27]).

As I will discuss in the final section, my real purpose is to demonstrate the superiority of QL over statistics. Here, the meaning of "superiority" is "reliability (persuasion)" and not "usefulness." For example, if you discuss Zeno's paradox in terms of statistics, I'm sure no one will pay attention to it. However, I want to believe that if this issue is discussed within QL, it will be persuasive and generally accepted as resolved.

4.11. The Linguistic Turn Ⓘ $\xrightarrow{⑨}$ Ⓚ in Figure 1; Is Logic a Subject of Philosophy?

Many great philosophers (e.g. Spinoza, Hegel, Nietzsche, Husserl, …) are not named in **Figure 1**. This is because their interests are not scientific (*i.e.* quantum linguistic) but theological and literary. That is, philosophy is not only a science. They are rather the majority in philosophy as a whole (*i.e.*, popular among philosophy enthusiasts). This is rather healthy for the way philosophy is. I believe that the great philosophers (Boole, Frege, Russell, Cantor, etc.) listed within Ⓙ in **Figure 1** are rather mathematical and not scientific. Therefore, it might have been fairer to delete Ⓙ as well.

However, the master-disciple relationship between Russell and Wittgenstein is so strong that Ⓙ was not removed. In any case,

(S) They (the philosophers of analytic philosophy) emphasized the "importance of logic".

Also, I agree with the following Dummett's opinion: (*cf.* ref. [33]: Origins of analytical philosophy):

(T) *If I identify the linguistic turn as the starting-point of analytical philosophy proper, there can be no doubt that, to however great an extent Frege, Moore* *and Russell prepared the ground, the crucial step was taken by Wittgenstein in the Tractatus Logico-philosophicus* (=*TLP*) *of 1922*

After all we get Table 5:

However, the table above would lead anyone to think that

(U) Socrates' dream of realizing absolutism (≈scientific truth) was completely frustrated. And in the end, the analytic philosophers brought mathematics as the absolute truth. If it is permissible to bring up mathematics (*i.e.* logic), Pythagoras had already reached "absolute truth" about 100 years before Socrates.

Mathematical logic is certainly one of the great disciplines, but mathematical logic is probably not a discipline that philosophers work on. Thus, I don't understand why so many philosophers supported the linguistic turn: Ⓘ $\xrightarrow{\text{⑨}}$ Ⓚ in Figure 1.

We have accumulated over 2000 years of Platonic, Scholastic and Cartesian Kantian epistemology to achieve Socrates' dream (perfection of scientific thought). It would be foolish to abandon this and switch to logic. That is because logic is not sufficient to describe science (e.g. Newtonian mechanics), though it is powerful enough to describe mathematics. For completeness, Axiom 1 and Axiom 2 of QL (in Section 2.2 before) are not mathematical propositions.

Wittgenstein was as eloquent as Protagoras, leading many philosophers (and philosophy enthusiasts) to believe that analytic philosophy was an attractive philosophy. And thus, he realized the linguistic turn: Ⓘ $\xrightarrow{\text{⑨}}$ Ⓚ in Figure 1.

Here we are faced with the following question

Table 5. Dualism [Plato, scholasticism, descartes, wittgenstein and QL].

Aristotle (monism)	/	/	Hule [eidos]
Newton (monism)	/	/	Particle [(position, momentum)]
Plato (Allegory of the Sun)	actual world	Idea (=sunlight)	Idea world
Scholasticism (Anselmus)		universal	individual
Scholasticism (Thomas Aquinas)	human intellect (universale post rem)	divine intellect (universale ante rem)	Individual (universal in re)
Descartes, Locke, Kant (epistemology)	[A] (=mind)	[B] (=body (≈sensory organ)) (Mediating of A and C)	[C] (=matter)
Wittgenstein (analytic philosophy)		logic	
quantum language	**Measurer** [measured value]	**measuring instrument** [observable]	**System** [state]

(V) Are epistemology and analytic philosophy closely related? (Or equivalently, can logic be derived from QL?)

The next section answers this.

4.12. Fuzzy Logic (="Usual Logic" with the Scientific Definition)

I am not rejecting analytic philosophy outright. I am well aware of the importance of logic in science. I just think that if Wittgenstein is saying that philosophy before analytic philosophy spoke "what I cannot speak about", then it should be refuted.

Now, let us consider "usual logic." A proposition is usually defined as a statement that is either true or false ("T" or "F"). For example, consider Table 6.

Consider the "usual logic" in the table above. Here, ($\#_1$) and ($\#_2$) are clear. The term "big" in ($\#_3$) is ambiguous. Similarly, the term "bald" in ($\#_4$) is ambiguous. And thus, ($\#_3$) and ($\#_4$) are not propositions in the sense of usual logic. And as for the mathematical proposition ($\#_5$), it must be correct, but there is no experiment to verify it. Thus we have the question: the "T" in ($\#_1$) and the "T" in ($\#_5$) are heterogeneous? This discomfort gives birth to fuzzy logic.

In the above sense, the definition of "proposition" is still far from clear. In fact, in Section 38 of ref. [34], Wittgenstein said:

(W) *The basic of Russell's logic, as also of mine in the TLP, is that what a proposition is illustrated by a few commonplace examples, and then pre-supposed as understood in full generality.*

Mathematical logic is a great theory, but it does not guarantee the validity of usual logic. That is, Wittgenstein knew that "usual logic" had no logical basis. Despite some ambiguity, there was probably an atmosphere of optimism in analytic philosophy at the time that nothing serious would happen. Ignoring the problem statement (W) (*i.e.* knowing only the definition of "mathematical logic" and not the definition of "ordinary logic"), analytic philosophy has rushed ahead.

Now let us introduce the fuzzy logic (*i.e.*, the definition of "usual logic"). Table 7 adds fuzzy logic to the Table 6.

Table 6. Truth table (usual logic).

Proposition	Usual logic
($\#_1$): The earth is bigger than the moon	T
($\#_2$): Socrates is alive	F
($\#_3$): The moon is big	not proposition
($\#_4$): Leonardo Danchi is bald	not proposition
($\#_5$): 1 + 1 = 2	T
…	…

Table 7. Truth table (usual logic, fuzzy logic).

Proposition	Usual logic	Fuzzy logic
($\flat_1$): The earth is bigger than the moon	T	T: F = 1:0
($\flat_2$): Socrates is alive	F	T: F = 0:1
($\flat_3$): The moon is big	not proposition	T: F = 0.1:0.9
($\flat_4$): Leonardo Danchi is bald	not proposition	T: F = 0.7:0.3
($\flat_5$): 1 + 1 = 2	T	T: F = 1:0
⋯	⋯	⋯

In the above, "fuzzy logic" can be thought of as the ratio of the many respondents' approval or disapproval, as in Example 2.1 (also, recall that "probability" can be created by "ratio" + "at random"). If so, we can believe that The "T: F" in ($\flat_1$) and the "T: F" in ($\flat_5$) are homogeneous.

The above argument, written in quantum language terms, yields the following definition.

Definition 4.1 [(TF)-measurement (=Fuzzy proposition=QL proposition)] Let $\mathsf{O} = (\{T, F\}, 2^{\{T,F\}}, G)$ be a binary observable (or, (TF)-observable, $\{T, F\}$-valued observable) in a C^*-algebra $C(\Omega)$, and let $\omega_0 \in \Omega$. A measurement $\mathsf{M}_{C(\Omega)}(\mathsf{O}, S_{[\omega_0]})$ is called a (TF)-measurement, which is also called a *fuzzy proposition*(=QL proposition).

Axiom 1 says that the probability that a measured value T is obtained by (TF)-measurement $\mathrm{M}_{C(\Omega)}\left(\mathrm{O}, S_{[\omega_0]}\right)$ is given by $\left[G(\{T\})\right](\omega_0)$. Thus, I say that

- A (TF)-measurement $\mathrm{M}_{C(\Omega)}\left(\mathrm{O}, S_{[\omega_0]}\right)$ is true [resp. fault] with probability $\left[G(\{T\})\right](\omega_0)$ [resp. $\left[G(\{F\})\right](\omega_0)$].

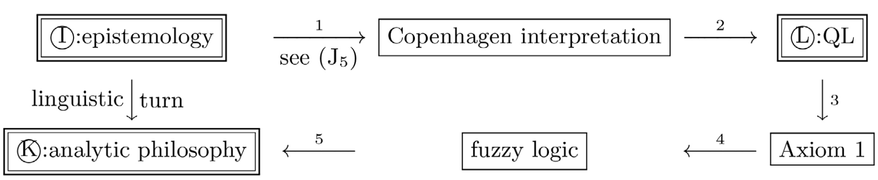
Put $P_i = \mathrm{M}_{C(\Omega)}\left(\mathrm{O}_i = \left(\{T, F\}, 2^{\{T,F\}}, G_i\right), S_{[\omega_0]}\right)$ $(i = 1, 2)$. Define $\neg P_1$, $P_1 \wedge P_2$ and $P_1 \vee P_2$, and prove that the propositional logic holds true (*cf.* Chapter 12 of ref. [1], or refs [35] [36]).

Remark 9. 1): Also, predicate logic (in QL) holds, though it is not so easy. Understanding predicate logic (in QL) is almost equivalent to solving Hempel's raven paradox (see Chapter 12 in ref [1], or [28]).

2): Now we can answer the problem:

(X) Are epistemology and analytic philosophy closely related? (Or equivalently, can logic be derived from QL?)

That is, we have the following.



Seeing the diagram [$\xrightarrow{1} \cdots \xrightarrow{5}$] above (or, Ⓘ $\xrightarrow{⑩}$ Ⓛ $\xrightarrow{⑫}$ Ⓚ in **Figure 1**), anyone can understand that the linguistic turn is inevitable in science. Historically, I agree to $\boxed{\text{Ⓙ: math. logic}}$ $\xrightarrow{⑪}$ Ⓚ, but theoretically, I assert that Ⓚ is derived from Ⓘ. The mystery is "how Wittgenstein came up with the linguistic turn without QL." I can only answer that he is a geniuses. Wittgenstein's book [18] "Tractatus Logico-philosophicus" is too literary to be read scientifically, but I think that it is a philosophical masterpiece that anticipates science (or the second basic science) 100 years later. As mentioned earlier, Descartes, Locke, Leibniz, Hume and Kant were pursuing the Copenhagen interpretation, and all these philosophers must have been geniuses. After all, we see that

$$\left.\begin{array}{l} \overset{\text{Kolmogorov}}{\boxed{\text{probability theory}}} \xrightarrow[\text{foundations}]{\text{mathematical}} \boxed{\text{statistics}} \xleftarrow[\text{foundations}]{\text{scientific}} \\ \overset{\text{Frege, Russel}}{\boxed{\text{mathematical logic}}} \xrightarrow[\text{foundations}]{\text{mathematical}} \boxed{\text{(fuzzy) logic}} \xleftarrow[\text{foundations}]{\text{scientific}} \end{array}\right\} \leftarrow \boxed{\text{QL}}$$

The position of this paper is that scientific foundations are more essential than mathematical foundations. Thus I think that the importance of mathematical logic (e.g., Gödel's Incompleteness Theorem, etc.) is over-emphasized in analytic philosophy.

Remark 10. [The philosophy of science]

Viewed from now, almost 100 years after Wittgenstein, the field of analytic philosophy has diffused in many directions.

However, it is logical positivism and philosophy of science that have moved in the direction of approaching QL. We therefore consider the following

- $\boxed{\text{Wittgenstein}} \xrightarrow{\text{progress}} \boxed{\text{logical positivism}}$ $\xrightarrow{\text{progress}} \boxed{\text{Philosophy of science}} \xrightarrow{\text{progress}} \boxed{\text{QL}}$

In fact, unsolved problems (*i.e.*, Hempel's raven problem, Flag pole problem, etc.) proposed in philosophy of science can be solved in QL (*cf.* Chapter 12 of [1], or [28]). In short, we should think that QL is the completion of philosophy of science. In hindsight, the cause of the failure of the philosophy of science is clear. It was the emphasis on the importance of "logic" and the neglect of "measurement" and "causality", which are the essence of science. Even today, "scientific" and "logical" are often used interchangeably.

It should be recalled that Socrates' dream was to create a language for science (the study of measurement and causality). Even so, the creation of a philosophy with the word "science" in its name foreshadows the near realization of Socrates' dream.

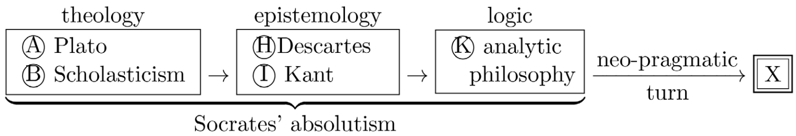
Remark 11. Broadly speaking, the following classifications are obtained.

- $\text{QL} \begin{cases} \text{statistics} & \cdots \text{when } X \text{ is the real line } (cf. \text{Sec. } 4.10) \\ \text{logic} & \cdots \text{when } X = \{T, F\} \end{cases}$

Of course, even without knowing QL, the above classification is familiar to everyone. Statistics is used in scientific disciplines where it can be expressed quantitatively (science, engineering, economics). Conversely, in the humanities, the emphasis is on logic (or, more precisely, "an oratorical art that resembles logic" (see again (W)). Statistics and logic are completely different disciplines in classical theory. However, from the quantum linguistic point of view, the difference of statistics and logic is the that of $X = \mathbf{R}$ and $X = \{T, F\}$.

4.13. Neopragmatic Turn by R. Rorty

R. Rorty (1931-2007), the standard-bearer of neo-pragmatism (*cf.* [37]), asked whether Socratic absolutism still function after analytic philosophy? That is, in the diagram below, what is $\boxed{X}$?

(Y$_1$)


According to Rorty, the role of philosophy is not to pursue Socrates' dream (=to discover eternal and immutable truths or essences), but to transform the self and culture by redrawing the world with a new vocabulary to achieve greater human happiness that is, he thought

(Y$_2$) $\boxed{X}$ = to keep the conversation going rather than to discover objective truths.

I may not understand Rorty's argument correctly, but I agree with his opinion that the role of philosophy is not to discover eternal and immutable truths. QL is not an immutable truth, but a language (or tool) for describing this world quantitatively. QL is not a delicious dish, but ingredients for making it. If so, I may agree to neo-pragmatismic turn. For I think we have been using the term "Socrates' dream" for 2500 years, not caring about the difference between a "dish" and "ingredients". Thus, I conclude that

(Y$_3$) $\boxed{X}$ = QL.

Also, there is a point of view that QL is not a scientific truth, but a language (=instrument) for describing truth, a kind of oratorical art.

In [1], Socrates' dream and Rorty's neo-pragmatism were not emphasized. These will be added to the second edition.

5. Conclusions

The history of physics (=the first basic science) is quite simple. That is,

(Z$_1$) Aristotle → Archimedes → Newton → Einstein → …

We fully understand their accomplishments and realize that they are true geniuses. This is because physics is experimentally testable and incomplete theories are immediately ruled out.

On the other hand, the history of philosophy (=dualistic science = the second basic science) is complex.

(Z$_2$) Plato → Anselmus, Thomas Aquinas → Descates → Locke → Hume → Kant → Wittgenstein → QL

We know they were celebrities and were honored for their accomplishments.

But we do not have a clear understanding of their claims. This is because we cannot experimentally verify their claims. Thus, we do not really know whether they were true geniuses or simply the zeitgeist of their time.

In fact, I used to think this way. In physics, if we proceed with "increasing precision" as our immediate goal, we will certainly make progress. But this is not the case in philosophy. In the realization of Socrates' absolutism (=Socrates' dream), the immediate goal is unknown. In philosophy it is not clear which direction to take. Or rather, Socrates' dream may be an illusion in the first place.

However, the discovery of quantum language (dualism more powerful and beautiful than statistics) has presented us with a new way of looking at the history of Western philosophy. That is, it has revealed the surprising fact (*i.e.*, **Figure 1**) that, starting from Plato's fairy tale, through the theological turn of Scholastic philosophy, Descartes' epistemological turn and Wittgenstein's linguistic turn, the above philosophers (Z_2) led philosophy in the direction of quantum language.

This paper argued that the scientific part of the history of Western philosophy is the history of the great philosophers' attempts to realize Socratic absolutism (*i.e.*, the scientific spirit of Socrates), and that, ultimately, Socrates' dream was realized through quantum language. However, this fact does not imply a victory for Socrates in Protagoras (relativism) versus Socrates (absolutism). That is QL may be a kind of the art of oratory that claims to "argue scientifically".

It is clear that many of the problems that surround us cannot be addressed by science alone. I believe that since ancient Greece, much of philosophy has been dominated by the Protagorean-style arguments, which advances arguments under the guise of being logical and scientific. Moreover, that is not generally a bad thing. Therefore, I expect that the clarification of the meaning of "scientific" by quantum language will have a more positive impact on the Protagorean method.

As mentioned in Remark 8, I believe that the problem of universals (contemporary, statistics vs. QL) is one of the most important and traditional in science (and philosophy). Thus, my real purpose is to facilitate the paradigm shift (from the classical mechanistic worldview (=statistics) to the quantum mechanistic worldview (=quantum language, [1] [2])). However, so far there has been no noticeable response, so there may be a lot to reflect on, such as how to appeal to the public. If QL has not established a firm position, then resolving unresolved paradoxes (e.g., see Remark 4, **Figure 4**) in the frame of QL does not mean that it has been generally accepted. However, compared to the days of Zadeh (*cf.* refs. [15] [16]) a few decades ago, I think the field has become more solid than statistics in terms of theory.

I hope that many talented readers will enter this field and drive a paradigm shift with QL.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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