

# THE PRINCIPLE OF OPERATIONISM

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## I. Introduction

In the nineteenth century, metaphysics predominated the philosophical thought. Among the many great philosophers, Hegel was the most influential one at that period. Hegel's influence was so important that the philosophical activities of the twentieth century were considered as the counter-reaction of the Hegel's metaphysical thought. For example, all the great philosophers, Dewey, Russel and Moore, had been troubled and confused by Hegel, and finally they were all against Hegel's confusing metaphysics. This led to the development of Empiricism—a new trend of philosophy basing on the requirement of empirical meaning.

Empiricism is now developed into a fuller theory by the Vienna Circle philosophers, Schlick, Carnap and others. Besides

the Empiricism, Pragmatism and Instrumentalism were developed at the same time. Both theories put emphasis on experiential meaning. The idea of Operationism emerged under this circumstance.

The formal theory of Operationism is formulated by the American physicist P. W. Bridgman (1882-1961), though the basic idea is not necessarily due to him. In 1928, Bridgman published his book *'The Logic of Modern Physics'* in which he discussed the operational character of concepts and how this view was applied to physics. In 1954, in a discussion with Bergmann, Hempel, Lindsay, Margenau and Seeger, Bridgman claimed that the operational concept he proposed was to solve the problems he encountered in the physics problems of electrodynamics and dimensional analysis. He then presented the crude idea of Operationism

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Note: In studying the first chapter of Freshman Physics, one might probably come across the term 'Operational Definition' (e.g. in Alonso's Physics p. 18) which is likely just skipped through by most students. But the underlying principle of the operational view—or generally referred to as 'Operationism'—is so important that it greatly affects the basic concept of contemporary physics. So this article on 'Operationism' presents a general survey into both the physical and philosophical aspects of Operationism, and it serves to arouse the interest of the readers of 'Space-Time' into the philosophical basis of physics.

It is interesting to note that the formulator of Operationism, a physicist named Percy Williams Bridgman, is the Physics Nobel Prize Laureate of 1946. Besides, many great physicists, such as Rudolf Carnap, Karl Popper, Hans Reichenbach, Ernst Mach, Gustav Bergmann, Ernest Nagel etc., have had invaluable contributions to the Philosophy of Science. This is an encouraging fact to those physics students who are also interested in philosophy.

A short bibliography is attached to this article for those who are interested, and extensive bibliographies can be found in those books.

in the book *'The Logic of Modern Physics'*, and later developed it into a fuller theory.

## II. Basic Principles

In order to describe the physical phenomena, a system of language has to be used. Every term in the language of science has to be operationally defined as required by the Operationism. So that an operational definition of a term is a rule under which an operation is performed and a certain characteristic result is always obtained. For example, we define velocity of a body as the distance travelled by the body in unit time. In virtue of this definition, we can carry out an experiment to measure the number of meters travelled by the body in one second. So the velocity of the body is defined according to this empirical operation.

Operations can be classified as instrumental and symbolic. By instrumental operation, we mean that we actually carry out the operation through observation and measurement. While for symbolic operation, we do not actually perform the operation by experiment, but rather we just carry it out in mind. We can now state the basic principles of Operationism:

1. Meanings are operational. Every term is considered meaningful only when the definition of the term allows an operation to be carried out, otherwise the term is meaningless.
2. Every scientific term should be defined by means of one unique operation. In this way, when different operations give the same result, the two operations are regarded as corresponding to different concepts.

3. Every hypothesis or theory is meaningful only when all the terms it consists are operationally defined. So that the hypothesis can be tested by an operation. Hypotheses or questions which cannot be tested by operations are rejected as meaningless.

From the above principles, we see that the central idea of Operationism is that any scientific statement is significant only when it can be tested by experiments.

## III. Criticisms

Since Operationism puts emphasis on experimental result, so that any statement can be tested. The complete process of the experimentation is objective, no subjectivity is involved. This gives a criterion of testing the truth of any statement. Contrasting to the traditional metaphysics for which there is no absolute truth, the so-called metaphysicalysical problems are in fact no problems in the context of Operationism.

This is also the reason why metaphysics is attacked by most contemporary philosophers; and its fate of being discarded is obvious. Despite the great advancement of Operationism, there are still problems remained to be solved. Firstly, an operational definition requires that under specified observable conditions S, a characteristic observable response R is always resulted. But in practice, many quantities cannot be actually measured, so an operational definition of a concept Ras to be construed as ascribing the concept to all those cases that would exhibit the characteristic response if the test conditions should be realised. But in attributing this disposition, an inductive risk is involved, so an operational definition

of this kind is said to be not safe. Secondly, there is no clear indication of what a symbolic operation is, and it is difficult to distinguish between good and bad operations. Finally, there is no definite rule of introducing nonobservable terms into theoretical constructs on the basis of observational vocabulary of science.

#### IV. Influences

Operationism has great influences on both philosophy and science. Firstly, we consider the impact of Operationism on philosophy. The traditional metaphysics constructs its theories through speculation and takes no notice of the experimental verification. Now Operationism requires that every theory must have empirical meaning before it is accepted as a meaningful theory. Under this requirement, all metaphysical problems are meaningless. In fact, metaphysics is declining and will be finally discarded. On the other hand, Empiricism strengthens with Operationism and is gradually accepted and appraised by all philosophers.

Secondly, Operationism also has great influences on both fully developed physical science such as physics as well as the developing social sciences such as psychology. For example, the definitions in physics before the application of Operationism are rather confusing, but now we require that

the definitions must be operational and the experimental method is heavily stressed. This sweeps away many hindrances for the advancement of physics. For the social sciences, they are now liberated from the traditional methods of research and have made vast progress. In recent time, even the historical research employs scientific method and empirical method is emphasized. We can see that this trend is a new bright road for the further development of all knowledge.

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