

PART THREE

SCIENTIFIC SCHOOLS OF THOUGHT IN
PHILOSOPHY OF SCIENCE

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I. GENERAL INTRODUCTION

The development of schools of thought provides a particularly apt locus for the study of the cognitive and institutional constraints affecting the processes of change in academic science. Arising in opposition to the status quo, a new school both introduces innovations into the accepted idea system of a discipline or specialty and challenges the authority structure of its field. In its attempt to further a new conception of the goals, methods, and criteria of evaluation of its intellectual field, a school of thought can strive to establish an independent right to legitimize scholarly research and thus also to bypass or overthrow the existing scholarly elite. Sometimes, in attempting to achieve authority, those who proclaim a new school can lay more stress on the distinctiveness of their goals, methods, and criteria than intellectual history may determine is warranted.

This definition of schools of thought differs somewhat from those suggested by Crane^[1] Krantz^[2] and Weisz^[3], but it avoids the normative overtones that are unavoidable when schools are defined as closed groups of scientists contravening the norms of open and public science. At the same time, this definition leads to questions about the strategies scientists use in promoting their idea systems and allows us to study the institutional and cognitive constraints and the opportunities for divergence within academically institutionalized sciences.

Although sociologists and Philosophers of science generally agree that some form of exchange of recognition for contributions plays a central role in the organization of scientific work and fuels the quest of scientists for innovations, there is no general agreement on the manner in which the value of contributions is

assessed collegially, on the strategies chosen by scientists to accumulate rewards (or credibility or credit), or on the uses to which reputations can be put.

In this section of our study, we are going to be considering some of the schools of thought in the History and Philosophy of Science that have influence the growth and development of science since inception. More specially, we shall be paying close attention to those schools of thought that have, in these contemporary times, greatly influenced the mode of thought in the Contemporary scientific enterprise. These schools of thought include: Realism, Rationalism, Empiricism, Idealism, Materialism, Pragmatism and Determinism.

In considering the various thought pattern of these schools of thought, we shall among other things, seek to find the origin of these thoughts, we shall also seek to find out what influenced these mode of thoughts, the impacts of these thoughts to the ideas and scientific discoveries of the time in question. We shall also consider briefly, some of the challenges associated with these thoughts during the time of it greatest impact. We shall ultimately consider how these modes of thoughts continues to influence the present dispensation of the scientific enterprise.

II. IDEALISM IN SCIENCE

Idealism is the metaphysical view that associates reality to ideas in the mind rather than to material objects. It lays emphasis on the mental or spiritual components of experience, and renounces the notion of material existence

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1. A definition / Conceptual Clarification

In philosophy, Idealism offers an explanation of reality or human experience in which ideal or spiritual elements are central.^[4] Idealism is a term with several related meanings. The term entered the English language by 1796, it often suggests the formation and influence of ideals, the importance of principles, values and goals as well as present realities, perhaps a tendency to represent things as they might be rather than as they are. In the arts, similarly, idealism affirms imagination and seeks to portray a mental conception of beauty, a standard of perfection, in distinction from naturalism and realism.^[5]

Any philosophy that places importance on the ideal or spiritual realm in its account of human existence may be termed "Idealist". Metaphysical idealism is

an **ontology** that holds that reality itself is essentially spirit or consciousness or, at least, that abstractions and laws are more basic to reality than the things we perceive. **Epistemological** idealism is the view that reality can only be known through ideas, that only psychological experience can be apprehended by the mind.¹⁴

Schopenhauer noted the ambiguity of the word "idealism", calling it a "term with multiple meanings"¹⁵ but focussing on the relationship between our ideas and external reality, rather than (like Plotinus's, or Hegel's "idealism") on the nature of reality as such. Kant defined it as "The assertion that we can never be certain whether all of our putative outer experience is not mere imagining".¹⁶ Philip J. Neujahr would "restrict the idealist label to theories which hold that the world, or its material aspects, are dependent upon the specifically cognitive activities of the mind or Mind in perceiving or thinking about (or 'experiencing') the object of its awareness."¹⁷

Notable modern western idealist philosophical movements include; early idealists such as George Berkeley and Gottfried Leibniz, the late 18th-19th century German idealists, including Immanuel Kant, G. W. F. Hegel, Johann Gottlieb Fichte, Friedrich Wilhelm Joseph Schelling and Arthur Schopenhauer, and mid 19th-early 20th century British idealism, a species of absolute idealism whose leading figures were T.H. Green, F. H. Bradley and Bernard Bosanquet, succeeded by J. M. E. McTaggart, H. H. Joachim, J. H. Muirhead and G. R. G. Mure.

2. Plato's Idealism

One of the earliest proponents of this school of thought is Plato. Idealism to Plato is the view that the only reality is the ideal world. A well known exponent of this view was Plato, a philosopher in ancient Greece (428-347 B.C.). Plato believed that the physical world around us is not real; it is constantly changing and thus you can never say what it really is. There is a world of ideas which is a world of unchanging and absolute truth. This is reality for Plato. Does such a world exist independent of human minds? Plato thought it did, and whenever we grasp an idea, or see something with our mind's eye, we are using our mind to conceive of something in the ideal world. There are a number of proofs of this ideal world. The concepts of geometry, such as the concept of a circle, which is a line equidistant from a point, is something which does not exist in the physical world. All physical circles, such as wheels, drawings, etc. are not perfectly round. Yet our mind has the concept of a perfect circle. Since this concept could not come from the physical world, it must come from an ideal world. Another proof is that from moral perfection. We can conceive of a morally perfect person, even though the

people we know around us are not morally perfect. So where does someone get this idea of moral perfection? Since it could not have been obtained from the world around us, it must have come from an ideal world. Platonism has been an extremely influential philosophy down through the centuries.

Idealism is the metaphysical view that associates reality to ideas in the mind rather than to material objects. It lays emphasis on the mental or spiritual components of experience, and renounces the notion of material existence. Idealists regard the mind and spirit as the most essential, permanent aspects of one's being. The philosophical views of Berkeley, Christian Science, and Hinduism embrace idealist thought as they relate it to the existence of a supreme, divine reality that transcends basic human understanding and inherent sensory awareness.¹⁸

Idealism as an **ontological or epistemological** doctrine holds that reality, or what can count as reality for human beings, is determined by mind. The various ways of specifying the basic role of mind ontologically or epistemologically yield various forms of idealism. As an *ontological* doctrine idealism can hold that reality is basically mental in nature; the physical world is an expression of this mental reality. An argument for the position that what one takes to be material is actually spiritual is that what is actual is process or activity, and mind or spirit is the model of activity. In this sense, *metaphysical idealism* is contrasted with *materialism*. An example is the doctrine of Gottfried Wilhelm Leibniz (1646–1716) that reality consists of active substances, or monads.

As an **epistemological doctrine**, idealism can hold that humans do not have access to a mind-independent reality. However, an epistemological idealism along this line can easily be transformed into an ontological one to the effect that there is no mind-independent reality. Idealism in this sense is contrasted with *realism*. The position of George Berkeley (1685–1753) that *esse est percipi* (to be is to be perceived) could be read as an example of an epistemological idealism with radical antirealist claims, which amounts to an ontological *immaterialism*. But Berkeley also argues that sensible things exist independently of human beings in that they exist in the mind of God (*theistic idealism*).

An ontological idealism can hold precisely that there is a reality *beyond* the physical world of sense experience, and this transcendent reality is the basic or true one in that it accords actuality to the relentlessly changing world of sense experience. Humans have access to the ultimate reality beyond the world of sense experience through higher forms of mind, but the true or divine reality transcends the human mind. This form of metaphysical idealism is thus an ontological *realism* (claiming that reality is independent of the human mind). The classic example of a

metaphysical idealism as a *transcendent* idealism is the doctrine of the world of ideas in Plato (428–347 B.C.E.).

Epistemological idealism can be reformulated as *transcendental idealism*. The critical philosophy of Immanuel Kant (1724–1804)^[10] not only attacks dogmatic metaphysical positions that imply that humans have access to things in themselves beyond the world of sense experience, but also Berkeley's subjective idealism^[11] (as Kant takes it to be), which dissolves reality into what humans experience. Instead, according to Kant, space and time, and the categories (e.g., the category of causality) are, as structures of the human mind, also conditions of possibility for the experience of the world. However, this opens the problem that reality is on the one hand "reality-for-us," while on the other hand an ultimate reality beyond this reality is postulated. This problem is dealt with by Johann Gottlieb Fichte (1762–1814), Friedrich Wilhelm Joseph von Schelling (1775–1854), and Georg Wilhelm Friedrich Hegel (1770–1831), whose various positions are collectively labelled *German Idealism*.

3. German Idealism

Absolute idealism in Hegel^[12] seeks to overcome the Kantian split between the world of sense experience and ultimate reality (thing-in-itself) without returning to a dogmatic position. Hegel points out that in having an experience, human understanding of the world and human self-understanding can be changed. This possibility of self-transcendence implied in experience cannot be accounted for if ultimate reality is placed beyond the limits of experience. Hegel's absolute idealism solves the basic task of German Idealism left over by Kant, namely, to account for both freedom inherent in rationality (autonomy) and the embodiment of that freedom. While Fichte emphasizes the activity of the human mind as a productive activity, Schelling sets out to overcome this (as he called it) *subjective idealism* in Fichte by combining a transcendental philosophy and a philosophy of nature. In Hegel's absolute idealism, mind (*Geist*) transcends the divide between freedom and nature by coming to itself through nature and history. Accordingly, Hegel's idealism is not to be captured by the opposition between idealism and materialism, or between realism and antirealism.

As the complex position of Hegel indicates, idealism needs to be reformulated in opposition to its traditional forms. Basically, idealism concerns the problem that human access to reality must tell something about that very reality. From the brief outline above one can extract the insight that in relating to reality human beings are doing something. Thinking is an activity. Humans only relate to reality in interpreting it. This does not imply, however, that reality is what people interpret it to be or that reality is a mental construction. If mind were basic in this sense,

people would not be able to discuss the reality of the mind. Instead the crucial argument could be the following: A comprehensive theory of reality must be able to account for the reality of mind and self-consciousness that it itself presupposes. Following this line of argument, idealism could be reformulated as a response to reductive forms of *naturalism* in that it points to the presupposition that human beings as subjects relate to the world, and only as self-interpreting animals are they able to form theories about the world in which they live. The task is to account for both the embodiment of mind and this presupposition of mind.

The question of idealism is thus not only the basic question of science concerning the reality of interpretations and models of reality. Idealism also concerns religious questions about the place of human beings in the world. Religion need not be interpreted along the lines of an idealism that posits a second world beyond the world of sense-experience. A reformulation of idealism as outlined above can instead draw upon the understanding to be found in religion that human consciousness reflects the problem of the embodiment of consciousness itself.

4. Hegel's Absolute Idealism in Relation to science

Absolute idealism or Hegelianism has influenced the Humanities to a great extent. In German they are called "Geisteswissenschaften" and in Dutch "Geesteswetenschappen", a direct influence of the Hegelian notion of spirit (*Geist*). In sociology for instance the position of important sociologist Ralph Dahrendorf is inspired by Hegel.

Lately American historian Francis Fukuyama was inspired by an alleged thesis of Hegel, namely the End of History, to write an immensely popular book. That Hegel proclaimed the end of history though is a myth popularized by the Russian-born French interpreter of Hegel, Alexandre Kojève.

In many philosophic circles it is accepted that the philosophy of nature Hegel proposes is outdated, though it was state of the art when he proposed it. A full one third of Hegel's library consisted of hand books on natural science. Currently contributors like Houlgate argue that Hegel's philosophy of nature warrants closer attention and has been unjustifiably relegated to the dust bin of philosophy.

5. Idealism in the Philosophy of Science

Nicolas Malebranche, though a student of Cartesian rationalism, disagreed that the existence of the external world is dubious and known only indirectly and declared instead that the real external world is actually God. For Malebranche we directly know internally the ideas in our mind. Externally, we directly know God's

operations. This kind of idealism led to the **pantheism** of Spinoza.

Idealist notions took a strong hold among physicists of the early 20th century confronted with the paradoxes of **quantum physics** and the **theory of relativity**. In *The Grammar of Science*, Preface to the 2nd Edition, 1900, **Karl Pearson** wrote, "There are many signs that a sound idealism is surely replacing, as a basis for natural philosophy, the crude materialism of the older physicists." This book influenced **Einstein's** regard for the importance of the observer in scientific measurements. In chapter 5 of that book, Pearson asserted that "...science is in reality a classification and analysis of the contents of the mind...." Also, "...the field of science is much more **consciousness** than an external world."

Sir Arthur Stanley Eddington, a British astrophysicist of the early 20th century, wrote in his book *The Nature of the Physical World*; "The stuff of the world is mind-stuff";

The mind-stuff of the world is, of course, something more general than our individual conscious minds.... The mind-stuff is not spread in space and time; these are part of the cyclic scheme ultimately derived out of it.... It is necessary to keep reminding ourselves that all knowledge of our environment from which the world of physics is constructed, has entered in the form of messages transmitted along the nerves to the seat of consciousness.... Consciousness is not sharply defined, but fades into sub-consciousness; and beyond that we must postulate something indefinite but yet continuous with our mental nature.... It is difficult for the matter-of-fact physicist to accept the view that the substratum of everything is of mental character. But no one can deny that mind is the first and most direct thing in our experience, and all else is remote inference.^[14]

Ian Barbour in his book *Issues in Science and Religion* ^[15] (1966), p. 133, cites Arthur Eddington's *The Nature of the Physical World* (1928) for a text that argues **The Heisenberg Uncertainty Principles** provides a scientific basis for "the defense of the idea of human freedom" and his *Science and the Unseen World* (1929) for support of philosophical idealism "the thesis that reality is basically mental".

Sir James Jeans wrote;

"The stream of knowledge is heading towards a non-mechanical reality; the Universe begins to look more like a great thought than like a great machine. Mind no longer appears to be an accidental intruder into the realm of matter... we ought rather hail it as the creator and governor of the realm of matter."^[16]

In an interview published in *The Observer* (London), when asked the question: "Do

you believe that life on this planet is the result of some sort of accident, or do you believe that it is a part of some great scheme?", Jeans replied;

"I incline to the idealistic theory that consciousness is fundamental, and that the material universe is derivative from consciousness, not consciousness from the material universe... In general the universe seems to me to be nearer to a great thought than to a great machine. It may well be, it seems to me, that each individual consciousness ought to be compared to a brain-cell in a universal mind."^[16]

"What remains is in any case very different from the full-blooded matter and the forbidding materialism of the Victorian scientist. His objective and material universe is proved to consist of little more than constructs of our own minds. To this extent, then, modern physics has moved in the direction of philosophical idealism. Mind and matter, if not proved to be of similar nature, are at least found to be ingredients of one single system. There is no longer room for the kind of dualism which has haunted philosophy since the days of Descartes."^[16]

"Finite picture whose dimensions are a certain amount of space and a certain amount of time; the protons and electrons are the streaks of paint which define the picture against its space-time background. Traveling as far back in time as we can, brings us not to the creation of the picture, but to its edge; the creation of the picture lies as much outside the picture as the artist is outside his canvas. On this view, discussing the creation of the universe in terms of time and space is like trying to discover the artist and the action of painting, by going to the edge of the canvas. This brings us very near to those philosophical systems which regard the universe as a thought in the mind of its Creator, thereby reducing all discussion of material creation to futility."^[16]

Bernard d'Espagnat is a French theoretical physicist, philosopher of science, and author, best known for his work on the nature of reality. He wrote a paper titled "The Quantum Theory and Reality" according to the paper:

The doctrine that the world is made up of objects whose existence is independent of human consciousness turns out to be in conflict with quantum mechanics and with facts established by experiment.^[17]

III. REALISM IN SCIENCE / SCIENTIFIC REALISM

"To be is to be perceived." In other words, what exists does so because it is perceived, and is not perceived because it exists.

GEORGE BERKELEY

1. Introduction

Realism is the doctrine that existence is separate from conceptions of it. People may think and talk of different entities, but the entities themselves have a reality that is logically independent of thought and language. This may seem a matter of common sense; surely chairs and tables do not exist only in so far as one thinks of them, or perhaps perceives them. People do not conjure things into existence through their minds, in the way that dreams create a world that vanishes when one wakes up. Yet to appeal to common sense is to appeal to the philosophical views of previous generations that have gained common currency. The position itself needs some philosophical justification. Dr. Samuel Johnson is supposed to have dealt with Bishop George Berkeley's idealism by simply kicking a stone and exclaiming "I refute it thus!": This is hardly an argument.

No-one doubts that our current scientific theories are enormously successful in terms of both prediction and manipulation of empirical phenomena. But a theory need not be true in order to be successful, and the history of science may even give us grounds to expect wholesale abandonment of our theoretical claims in the future. Do we have warrant to believe that our most successful scientific theories are (at least approximately) true? Is there any sense to be made of the notion of scientific progress? And if not, what are the alternatives?

The scientific realism debate naturally intersects with a number of other important issues in the philosophy of science: questions over the so-called scientific method for example have an immediate bearing on the justification of, and hence our belief in, a scientific theory

Debates about scientific realism are centrally connected to almost everything else in the philosophy of science, for they concern the very nature of scientific knowledge. Scientific realism is a positive epistemic attitude towards the content of our best theories and models, recommending belief in both observable and unobservable aspects of the world described by the sciences. This epistemic attitude has important metaphysical and semantic dimensions, and these various commitments are contested by a number of rival epistemologies of science, known collectively as forms of scientific antirealism. This article explains what

scientific realism is, outlines its main variants, considers the most common arguments for and against the position, and contrasts it with its most important antirealist counterparts.

This notwithstanding **Scientific realism** is at the most general level, the view that the world described by science is the real world, as it is, independent of what we might take it to be. Within **philosophy of science**, it is often framed as an answer to the question "how is the success of science to be explained?" The debate over what the success of science involves centers primarily on the status of **unobservable entities** apparently talked about by scientific **theories**. Generally, those who are scientific realists assert that one can make reliable claims about unobservables (viz., that they have the same **ontological status**) as observables.

2. History of Scientific Realism

Scientific Realism is related to much older philosophical positions including **rationalism** and **realism**. However, it is a thesis about science developed in the twentieth century. Portraying scientific realism in terms of its ancient, medieval, and early modern cousins is at best misleading.

Scientific realism is developed largely as a reaction to **logical positivism**. Logical positivism was the first philosophy of science in the twentieth century and the forerunner of scientific realism, holding that a sharp distinction can be drawn between observational terms and theoretical terms, the latter capable of semantic analysis in observational and logical terms.

Logical positivism encountered difficulties with:

- The verification theory of meaning (for which see Hempel (1950)).
- Troubles with the analytic-synthetic distinction (for which see Quine (1950)).
- The theory ladenness of observation (for which see Kuhn (1970) and Quine (1960)).
- Difficulties moving from the observability of terms to observability of sentences (for which see Putnam (1962)).
- The vagueness of the observational-theoretical distinction (for which see Maxwell (1962)).

These difficulties for logical positivism suggest, but do not entail, scientific

realism, and lead to the development of realism as a philosophy of science.

Realism became the dominant philosophy of science after positivism. **Bas van Fraassen** developed **constructive empiricism** as an alternative to realism. Responses to van Fraassen have sharpened realist positions and lead to some revisions of scientific realism.

Critical Realism arose in German philosophy in the late nineteenth and early twentieth century's as a reaction to **idealistic and phenomenalist** types of philosophy. **German critical realists** took account of Immanuel Kant's (1724–1804) view of the subjectivity of knowledge but denied that this precludes access to "things-in-itself." In American philosophy, critical realism designates a movement initiated by **Roy Wood Sellars** (1880–1973) in 1916. It purported to integrate insights of both idealism and new realism, which was a naïve realist reaction to idealism. Through the work of **Wilfrid Sellars** (1912–1989), **Roy Wood Sellars's** son, critical realism influenced scientific realism, which arose in the 1950s in opposition to positivistic **phenomenalism**. Scientific realism basically claims that mature scientific theories are approximately true (in the sense of corresponding to the external world) and that their postulated central entities really exist.

The term **critical realism** was introduced into the dialogue between science and theology in 1966 by Ian Barbour. Barbour used the term to cover both scientific realism and a theological realism that takes seriously the cognitive claims of religion, that is, religion's claims to convey knowledge of a mind-independent divine reality. Subsequently Barbour pointed to the cognitive role of metaphors, models, and paradigms in scientific as well as religious language. His ideas were later assimilated and elaborated by Arthur Peacocke, John Polkinghorne, J. Wentzel van Huyssteen, and others. Actually, critical realism has been the dominant epistemology in the dialogue between science and theology for several decades. However, since the 1990s the transfer of critical realism from science to theology has increasingly been disputed, mainly on the ground that it does not, or does not sufficiently, do justice to the specific nature of theology.

3. What Scientific Realism Is

Traditionally, scientific **realism** asserts that the objects of scientific knowledge exist independently of the minds or acts of scientists and that scientific theories are true of that objective (mind-independent) world. The reference to knowledge points to the dual character of scientific **realism**. On the one hand it is a **metaphysical** (specifically, an ontological) doctrine, claiming the independent existence of certain entities. On the other hand it is an epistemological doctrine

asserting that we can know what individuals exist and that we can find out the truth of the theories or laws that govern them.

Opposed to scientific **realism** (hereafter just '**realism**') are a variety of antirealisms, including **phenomenalism** and empiricism. Recently two others, instrumentalism and constructivism, have posed special challenges to **realism**. Instrumentalism regards the objects of knowledge pragmatically, as tools for various human purposes, and so takes reliability (or empirical adequacy) rather than truth as scientifically central. A version of this, **fictionalism**, contests the existence of many of the objects favoured by the realist and regards them as merely expedient means to useful ends. Constructivism maintains that scientific knowledge is socially constituted, that 'facts' are made by us. Thus it challenges the objectivity of knowledge, as the realist understands it, and the independent existence that **realism** is after. Conventionalism, holding that the truths of science ultimately rest on man-made conventions, is allied to constructivism.

Critical realism is a philosophical view of knowledge. On the one hand it holds that it is possible to acquire knowledge about the external world as it really is, independently of the human mind or subjectivity. That is why it is called *realism*. On the other hand it rejects the view of *naïve realism* that the external world is as it is perceived. Recognizing that perception is a function of, and thus fundamentally marked by, the human mind, it holds that one can only acquire knowledge of the external world by critical reflection on perception and its world. That is why it is called *critical*.

Realism and antirealism propose competing interpretations of science as a whole. They even differ over what requires explanation, with **realism** demanding that more be explained and antirealism less.

4. Realism in Contention with Idealism

Realism is in fact most often opposed to idealism. The latter claims that all reality is a construction out of mental processes. As Berkeley (1685–1753) said in his *Treatise Concerning the Principles of Human Knowledge*, "To be is to be perceived." In other words, what exists does so because it is perceived, and is not perceived because it exists. The latter would be the realist position. Yet Berkeley's position not only makes all reality mental, it also restricts what can exist to what is within the range of someone perceiving it. Berkeley met this by appealing to the omniscience of God, so that everything is perceived by God, and therefore exists. The danger is that God is removed from the picture; this is a move empiricism tends to encourage. The view then becomes one that ties reality to actual or

possible human experience. This, in turn, makes reality **anthropocentric**. What humans cannot perceive cannot exist. Since contemporary physics wishes to deal with subatomic particles and other unobservable entities, such as, say, the interior of a black hole, this does not seem to give an adequate account of the assumptions of present-day science.

Although realism may be classically opposed to idealist tying of existence to mind, realism comes in many shapes and sizes. It can be a global, metaphysical doctrine, or it can be limited to particular areas of human activity. One could be a realist about the objects of scientific investigation, but not about the concerns of morality. **The main point of realism, though, is always to pull apart the fact of existence from issues concerning how anyone can know what exists.** Ontology and epistemology should not be confused. (So-called critical realism tends to link the two). The metaphysical realist will stress the objectivity of the "world" or whatever exists. It cannot depend in any way on the way people think about it or discover it. Even scientific realism may seem realist in its insistence on the independent reality of the objects of science. It can, however, become antirealist when it asserts that only the objects of science can exist. In other words, existence is then restricted to what lies within the scope of actual or conceivable science. Because that must be human science, **reality** is being artificially restricted to what is within the scope of human capabilities to discover.

5. Analysis

On closer inspection, critical realism as a view of scientific and theological knowledge comprises three theses:

1. *Metaphysical realism*, which holds that there exists a mind-independent reality. In scientific realism this reality is the material world; in theological realism this reality is the material world and also, primarily, God.
2. *Semantic realism*, which holds that science and theology contain propositions, that is statements capable of being true or false in the sense of correspondence to the reality to which they refer. In scientific realism the focus is on propositions about unobservable entities; in theological realism the focus is on propositions about God.
3. *Epistemic realism*, which holds that it is possible to put forward propositions that are approximately true, that some propositions actually are approximately true, and that belief in their approximate truth can be justified. In scientific realism this applies primarily to theories and theoretical propositions about unobservable entities; in theology it applies to propositions and theories about God.

The first thesis distinguishes critical realism from idealism and positivism, but also from Hilary Putnam's (b. 1926) "internal realism,"³⁶ which defines reality as a function of human conceptualization of the world. The second thesis distinguishes scientific realism from an instrumentalism that regards statements about unobservable entities as useful fictions without propositional content. Similarly, it distinguishes theological critical realism from the Wittgenstein-inspired view of religious language as mere expression or recommendation of a way of life. The third thesis distinguishes critical realism from a skepticism that affirms the first and second theses but denies that it is possible to acquire justified approximate knowledge of a mind-independent reality. On the other hand, the qualification "approximate" entails a dissociation from the naïve realist claim that reality is as it is perceived.

6. Main features of scientific realism

Scientific realism involves two basic positions. First, it is a set of claims about the features of an ideal scientific theory; an ideal theory is the sort of theory science aims to produce. Second, it is the commitment that science will eventually produce theories very much like an ideal theory and that science has done pretty well thus far in some domains. It is important to note that one might be a scientific realist regarding some sciences while not being a realist regarding others. For example, one might hold realist attitudes toward physics, chemistry and biology, and not toward economics, psychology and sociology.

According to scientific realism, an ideal scientific theory has the following features:

- The claims the theory makes are either true or false, depending on whether the entities talked about by the theory exist and are correctly described by the theory. This is the semantic commitment of scientific realism.
- The entities described by the scientific theory exist objectively and mind-independently. This is the metaphysical commitment of scientific realism.
- There are reasons to believe some significant portion of what the theory says. This is the epistemological commitment.

Combining the first and the second claim entails that an ideal scientific theory says definite things about genuinely existing entities. The third claim says that we have reasons to believe that the things said about these entities are true.

Scientific realism usually holds that science makes progress, i.e. scientific theories

usually get successively better, or, rather, answer more and more questions. For this reason, many people, scientific realist or otherwise, hold that realism should make sense of the progress of science in terms of theories being successively more like the ideal theory that scientific realists describe.

7. Characteristic Claims

The following claims are typical of those held by scientific realists. Due to the wide disagreements over the nature of science's success and the role of realism in its success, a scientific realist would agree with some but not all of the following positions.^[11]

- The best scientific theories are at least partially true.
- The best theories do not employ central terms that are non-referring expressions.
- To say that a theory is approximately true is sufficient explanation of the degree of its predictive success.
- The approximate truth of a theory is the only explanation of its predictive success.
- Even if a theory employs expressions that do not have a reference, a scientific theory may be approximately true.
- Scientific theories are in a historical process of progress towards a true account of the physical world.
- Scientific theories make genuine, existential claims.
- Theoretical claims of scientific theories should be read literally and are definitively either true or false.
- The degree of the predictive success of a theory is evidence of the referential success of its central terms.
- The goal of science is an account of the physical world that is literally true. Science has been successful because this is the goal that it has been making progress towards.

IV. RATIONALISM IN SCIENCE

I come to praise rationalism, to point out the great power it has had in human history, and to suggest for you an agenda for the future. It is useful to begin with defining "rationalism". I submit that "rationalism refers to an epistemological criterion that seeks to test claims to truth by reference to reason and experience". Rationalists have looked to the scientific method as the best exemplification of this criterion.

PAUL KURTZ

1. Introduction

Rationalism is the term used to describe writers and philosophers who have privilege scientific reason and logical thought over and above everything else. The Rationalists in America were very much influenced by the Enlightenment that was happening in the 18th century in Europe. However, unlike the Enlightenment's great thinkers and philosophers, the Founding Fathers of America attempted to put the philosophy of the Enlightenment to actual use. This is most likely directly related to the fact that American Rationalists evolved out of the tradition of **Puritanism**, not the class structure and Feudalism of Europe.

Rationalism is based on the concepts of logic and scientific reasoning, but the Rationalists themselves were not scientists as we think of the term. Science in the 18th century was not a profession – it was a hobby. Wealthier Americans who had gone to the universities went back to their homes and began to categorize the flora and fauna of their home regions. Not because they were biologists, but because somebody had to do it, and it might as well be them. Most American science was based on figuring out how to do things more efficiently (and profitably). Rationalists used the scientific method of identifying the problem, hypothesizing a solution, and testing the hypotheses until you reach a satisfactory conclusion. Benjamin Franklin became one of America's great scientists, but almost everything that he invented (bifocals, lightning rods, Franklin stoves, etc) were designed to solve specific problems. He was not just "puttering around" or doing experiments willy-nilly.

One side effect of rationalism was that it led to questioning – of everything. Instead of following tradition simply because it had always been done that way, rationalists questioned the traditions and made the necessary changes based on what they observed. Thus, because of the rationalist world view, instead of

automatically setting up a government like every other government in Europe, the Founding Fathers asked what sort of government made the most logical sense.

One other significant element of rationalism is their view of religion. As is often pointed out in church/state discussions today, the Founding Fathers made reference to God on a regular basis. However, their view of God and religion was NOT the same as the Puritans. The vast majority of the Founding Fathers and other leading Rationalists were Deists. They believed in God, but it was not a God who was involved in human affairs. The metaphor that was commonly used was the God was like a Clockmaker who had made the universe, wound it up, and was letting it wind down. By referencing God, they were referencing the very notion of a rational, planned universe. Man's role was to try to make proper use of what God had created, whether it be in political structures, daily life, or even scientific observation. Studying the world scientifically wasn't in defiance of religion, it was to better understand what God had created.

In this study we intend to focus more on finding how this school of thought has influenced the scientific enterprise.

2. A Background Study to Rationalist Thoughts

If rationalism is to be defined, in part, as the belief that at least some of our knowledge of the world is gained by pure reason alone, prior to experience, then science, as the main example of human knowledge, should be a focus of discussion in philosophical debates over rationalism. Although the traditional characterization of modern philosophy as a debate between the British empiricists and the continental rationalists that was superseded by Kant has been widely acknowledged to be problematic for various reasons, recovering the scientific influences on modern philosophers will be the key to discussion here. Descartes and Leibniz were scientists as much as they were philosophers, and Locke explicitly claimed to be representing scientists. Hobbes, Berkeley, and Kant, who, unlike Descartes and Leibniz, are classified purely as philosophers, also engaged in scientific studies, albeit with mixed success. Furthermore, in both the early modern and in later periods, scientists such as Newton, Boyle, Herschel, Helmholtz, Duhem, Mach, Poincaré, and Einstein all wrote on philosophical topics. To a great extent, the philosophical debate between rationalism and empiricism took place within science.

The fact that the philosophical debate over rationalism and empiricism followed in the wake of the establishment of modern science does not seem accidental. The new science was taken to be the best, if not the only way, to discover the true

nature of the world, most significantly expressed in laws of nature in mathematical form. Perhaps some claims of the newness of modern science and of its overwhelming superiority to scholasticism are simply overstated rhetoric, but nevertheless, both sides of the philosophical debate over rationalism and empiricism embraced modern science. Since the distinctive trait of modern science is taken to be its combination of experiment and the application of reason, especially mathematics, to the study of nature, it may seem paradoxical that the philosophical debates over rationalism and empiricism should arise, given that modern science could be viewed as the ideal compromise between rationalism and empiricism. In fact, the roles of reason and the senses in knowledge and in the formation of ideas are at stake in the philosophical debates over rationalism and empiricism precisely because of the inconsistent claims made about their roles in the new science. These debates can be seen as having been born out of the methodological reflections on the relative roles of experiment and reason in creating the success of the new science.

The rationalist claims that some part of scientific knowledge about the physical world is *a priori*-known through reason or intellectual intuition-while the empiricist claims that knowledge about things in the world can only be obtained through experience. Both sides accept the ability of the mind to formulate and to understand representations of nature and acknowledge the role of perceptual knowledge in science and in everyday experience, but empiricists claim that reason is limited to what Hume calls the "relations of ideas,"²⁰⁰ that is, the defining of one term by means of another, or the discovery of the logical consequences of propositions²⁰¹. It is important to note that a rationalist need not be committed to *a priori* knowledge of the existence of anything, nor of the properties of any individual object, but rather only to general claims about the nature of things in the world. For example, a rationalist might claim that geometry expresses the real nature of space and the things in it, so any triangle (or even something that approximates to a triangle) in nature must have certain characteristics that we can discover *a priori*. Once we know that a triangle is a three-sided figure, we can use pure reason to show that the sum of the three angles of any triangle must be equal to two right angles.²⁰² Rational intuition is claimed to tell us how the world must be, since the general principles and laws that the rationalist claims to discover are not contingent facts.

The burden of proof for the rationalist is explaining what rational intuition is and why we should think that it will reliably tell us something about the world. A consideration of thought experiments that purport to give an *a priori* justification of claims about the physical world will be part of the basis of this discussion. Even if thought experiments seem to lead to reliable knowledge about the world, the

rationalist cause also carries the burden of explaining the overthrow by later science of various principles that were claimed to be *a priori*, necessary, and known with certainty. A consideration of some of the philosophical response to the development of non-Euclidean geometries will be the basis of this discussion. The burden of proof for the empiricist in this argument, especially after Kant, is to show how science can exist without any *a priori* knowledge. While Kant **limited reason** and acknowledged that experience is the main source of scientific knowledge, he also argued that there is a residual element of *a priori* synthetic knowledge, what we might now call the theoretical elements of a science, that cannot be eliminated. For example, Kant argued **mathematics is both a priori and synthetic**,^[9] that is, it tells us more than Hume's relations of ideas convey. Since mathematics is clearly central to science, it becomes a major stumbling block to the empiricist claim that there is no *a priori* element in science. This suggests that a good way to investigate rationalism in science is to ask whether there are some elements of science that are intractably *a priori*. Mathematics, a few fundamental principles or laws of nature, and other theoretical elements of science seem to be good candidates for *a priori* knowledge for which the empiricist will need to provide an account. Thus, the focus of this chapter will be on a few illustrative examples of potentially a priori sources of knowledge in science: thought experiments, mathematics, and theory in science.

3. Historical Background

Since the Enlightenment, rationalism is usually associated with the introduction of mathematical methods into philosophy, as in **Descartes, Leibniz, and Spinoza**^[9]. This is commonly called **continental rationalism**, because it was predominant in the continental schools of Europe, whereas in Britain **empiricism** dominated.

Rationalism is often contrasted with empiricism. Taken very broadly these views are not mutually exclusive, since a philosopher can be both rationalist and empiricist^[9]. Taken to extremes the empiricist view holds that all ideas come to us through experience, either through the external senses or through such inner sensations as pain and gratification, and thus that knowledge is essentially based on or derived from experience. At issue is the fundamental source of human knowledge, and the proper techniques for verifying what we think we know.

Proponents of some varieties of rationalism argue that, starting with foundational basic principles, like the axioms of **geometry**, one could **deductively** derive the rest of all possible knowledge. The philosophers who held this view most clearly were **and Gottfried Leibniz**, whose attempts to grapple with the epistemological and metaphysical problems raised by Descartes led to a development of the

fundamental approach of rationalism. Both Spinoza and Leibniz asserted that, *in principle*, all knowledge, including scientific knowledge, could be gained through the use of reason alone, though they both observed that this was not possible *in practice* for human beings except in specific areas such as **mathematics**. On the other hand, Leibniz admitted that "we are all mere in three fourths of our actions"^[9]. Rationalism is predicting and explaining behavior based on logic.

a. René Descartes (1596–1650)

Descartes thought that only knowledge of eternal truths – including the truths of mathematics, and the epistemological and metaphysical foundations of the sciences – could be attained by reason alone; other knowledge, the knowledge of physics, required experience of the world, aided by the **scientific method**. He also argued that although **dreams** appear as real as sense experience, these dreams cannot provide persons with knowledge. Also, since conscious sense experience can be the cause of illusions, then sense experience itself can be doubtful. As a result, Descartes deduced that a rational pursuit of truth should doubt every belief about reality. He elaborated these beliefs in such works as *Discourse on Method*, *Meditations on First Philosophy*, and *Principles of Philosophy*.^[9a] Descartes developed a method to attain truths according to which nothing that cannot be recognized by the **intellect** (or **reason**) can be classified as knowledge. These truths are gained "without any sensory experience", according to Descartes. Truths that are attained by reason are broken down into elements that intuition can grasp, which, through a purely deductive process, will result in clear truths about reality.

Descartes therefore argued, as a result of his method, that reason alone determined knowledge, and that this could be done independently of the senses. For instance, his famous dictum, *cogito ergo sum*, is a conclusion reached **a priori** and not through an inference from experience. This was, for Descartes, an irrefutable principle upon which to ground all forms of other knowledge. Descartes posited a metaphysical **dualism**, distinguishing between the substances of the human body ("*res extensa*") and the **mind or soul** ("*res cogitans*"). This crucial distinction would be left unresolved and lead to what is known as the **mind-body problem**, since the two substances in the Cartesian system are independent of each other and irreducible.

b. Baruch Spinoza (1632–1677)

The philosophy of Baruch Spinoza is a systematic, logical, rational philosophy developed by him in the seventeenth century in Europe. Spinoza's philosophy is a system of ideas constructed upon basic building blocks with an internal

consistency with which Spinoza tried to answer life's major questions and in which he proposed that "God exists only philosophically."¹²⁷¹ He was heavily influenced by thinkers such as **Descartes** and **Euclid**¹²⁷² and **Thomas Hobbes**¹²⁷³ as well as theologians in the Jewish philosophical tradition such as **Maimonides**,¹²⁷⁴ but his work was in many respects a departure from the **Judeo-Christian** tradition. Many of Spinoza's ideas continue to vex thinkers today and many of his principles, particularly regarding the emotions, have implications for modern approaches to psychology. Even top thinkers have found Spinoza's "geometrical method"¹²⁷⁵ difficult to comprehend: Goethe admitted that he "could not really understand what Spinoza was on about most of the time."¹²⁷⁶ His *magnum opus*, *Ethics*, contains unresolved obscurities and has a forbidding mathematical structure modeled on Euclid's geometry. Spinoza's philosophy attracted believers such as **Albert Einstein**¹²⁷⁷ and much intellectual attention.

c. Gottfried Leibniz (1646–1716)

Leibniz was the last of the great Rationalists who contributed heavily to other fields such as **mathematics**. He did not develop his system, however, independently of these advances. Leibniz rejected Cartesian dualism and denied the existence of a material world. In Leibniz's view there are infinitely many simple substances, which he called "**monads**" (possibly taking the term from the work of **Anne Conway**).

Leibniz developed his theory of monads in response to both Descartes and **Spinoza**. In rejecting this response he was forced to arrive at his own solution. Monads are the fundamental unit of reality, according to Leibniz, constituting both inanimate and animate things. These units of reality represent the universe, though they are not subject to the laws of causality or space (which he called "**well-founded phenomena**"). Leibniz, therefore, introduced his principle of **pre-established harmony** to account for apparent causality in the world.

d. Immanuel Kant (1724–1804)

Immanuel Kant started as a traditional rationalist, having studied the rationalists Leibniz and Wolff, but after studying David Hume's works¹²⁷⁸, which "awoke [him] from [his] dogmatic slumbers", he developed a distinctive and very influential rationalism of his own, which attempted to synthesize the traditional **rationalist** and **empiricist** traditions.

Kant named his branch of epistemology **Transcendental Idealism**, and he first laid out these views in his famous work *The Critique of Pure Reason*.¹²⁷⁹ In it he argued that there were fundamental problems with both rationalist and empiricist dogma. To the rationalists he argued, broadly, that pure reason is flawed when it

goes beyond its limits and claims to know those things that are necessarily beyond the realm of all possible experience: the existence of God, free will, and the immortality of the human soul. Kant referred to these objects as "The Thing in Itself" and goes on to argue that their status as objects beyond all possible experience by definition means we cannot know them. To the empiricist he argued that while it is correct that experience is fundamentally necessary for human knowledge, reason is necessary for processing that experience into coherent thought. He therefore concludes that both reason and experience are necessary for human knowledge.

4. In Praise of Rationalism

From the various presentations we have made so far in the previous pages, we want to end our entry here with a presentation by Paul Kurtz, a professor *Emeritus of Philosophy, State University of New York at Buffalo; and Chairman, Council for Secular Humanism; and also Chairman, Committee for the Scientific Investigation of Claims of the Paranormal, a presentation made at the Inaugural address of the 2nd International Rationalist Conference 7-21 January, 2000 –Trivandrum, India.*¹²⁸⁰ In the presentation, the professor made the following remarks:

I submit that "rationalism refers to an epistemological criterion that seeks to test claims to truth by reference to reason and experience".

Rationalists have looked to the scientific method as the best exemplification of this criterion. In science, all hypotheses and theories, in principle at least, are to be verified by reference to experimental evidence and validated by rational principles of consistency and coherence. This may be broadly characterized as "critical thinking"; here we seek to test beliefs and hypotheses by the process of reflective inquiry. This methodology is not subjective or private; for the reason and evidence brought to support a hypothesis or theory should be open to examination by all qualified investigators, who can replicate the results. Rationalism is objective, though its hypotheses and theories are related to human interest. If a claim lacks sufficient evidence and reason to support it, say the rationalists, then we ought to either reject it or suspend judgment. Rationalism thus goes hand in hand with skepticism: that which you cannot validate or verify you ought not to accept. Using this powerful method, humankind has extended the frontiers of scientific knowledge in the past four centuries.

The rationalist criterion is truly radical, even revolutionary; but it lays down a criterion that many people find very difficult to live by. In fact, the bulk of humanity

at one time or another has considered rationalists most dangerous, for by questioning the cherished beliefs they have threatened the sacred cows of society. That is why many of the defenders of rationalism - Socrates, Bruno, Galileo, M.N.Roy, Sakharov - have been exiled, jailed, excommunicated, or executed. Regrettably many of the belief systems that have been handed down from generation to generation - the great religions, for example, Islam, Judaism, Christianity, Hinduism - have little or no basis in empirical fact. They may have served a function when they originated, but have since lost that. A good case in point of the persistence of traditional ideas and the difficulty in overturning them is astrology. Its basic premises have been totally refuted by modern astronomy: that the time and place of a person's birth influences his future destiny has never been confirmed by the evidence; yet countless millions of people still believe in its prophecies.

Rationalism has deep roots in human civilization. Its first use appeared with the growth of philosophy in classical Greece and Rome, with the Charvaka materialists of ancient India, and the Confucians of China. The rediscovery of philosophy among Islamic thinkers (such as Averroes) and Western philosophers (Descartes, Spinoza, Kant, etc.), led to the development of a new methodology of science. It was soon recognized that speculative reason by itself is insufficient to establish a truth claim; and that ideas must be tested by their relationship to observation (Bacon, Locke, Berkeley, and Hume). Concept and percept, reason and experience, each play a role in testing ideas.

In the modern world rationalism has made major strides for it was related to pragmatism, i.e., theories have consequences and may be tested by their applied results. This led to the rapid development of technology, especially during the Industrial Revolution of the eighteenth and nineteenth centuries and the Information Revolution of the twentieth century. This has increasingly expanded the powers of humans over nature. It has led to the tremendous benefits to humankind: improving nutrition and health, reducing poverty, enhancing education and literacy, contributing to human happiness. Indeed, I would argue that the rationalist outlook has made the most important contribution to human well-being and progress. In enabling us to shed the chains of mystification it puts us in cognitive touch with reality.

5. Rationalism in Today's Faith

The challenging question to be raised at the dawn of the twenty-first century is, How far can rationalism be extended? Can it be applied to religion, ethics, political and social policies? Modern rationalists, of course, do indeed wish to extend the methods of science and reason to these areas of human concern. Here we run into

profound obstacles, for people are willing to use rational criteria only so far, but when it endangers their cherished beliefs, it is viewed as downright wicked or dangerous.

We have encountered enormous obstacles to applying rationalism to religion. The origins of the ancient religions are buried by the sands of time, and they have been transmitted from generation to generation because of custom and tradition, authority, emotion and faith.

Three recent dramatic religious events illustrate the perennial power of religious faith in human culture. The first is the huge annual assembly of Islamic pilgrims drawn to Mecca every year. Photographs of the estimated three million devotees who were in Mecca in recent pilgrimages show that they have come from all walks of life and from all classes. The second impressive annual event are the millions of Hindus in India who congregate at the Ganges River in accordance with ancient religious rituals. At the most recent event, an estimated ten million people appeared at the Kumbha Mela festival in the small city of Haridwar for prayer and purification. And the third is the re-exhibition at the cathedral of Turin of the shroud that Jesus was allegedly wrapped in and buried. A huge throng of visitors have come from all over the world to view the Shroud of Turin.

Skeptical doubts can surely be raised about the claim that the pilgrimage to Mecca will guarantee Muslim believers entrance to heaven and/or that bathing in the Ganges River will bestow special spiritual benefits. These are sheer acts of faith drawing upon ancient traditions that scientific rationalists have maintained have little basis in empirical fact. There is no evidence that the performance of ritualistic acts of spiritual contrition, either by visiting the Kaaba in Mecca and encircling it three times, or by bathing in the water of the Ganges, will achieve a blessed state of Paradise for Muslims or Atman for Hindus. To point out to the devout disciples of these two ancient religions that the recommended rites are contradictory or have no basis in fact generally fall on deaf ears.

Similarly for the Shroud of Turin, which, according to the best available scientific evidence, was a forgery made in Lirey, France, in the fourteenth century. Interestingly, it was condemned as such at that time by the bishop in the area, for it was used to deceive thousands of pilgrims seeking cures for their illnesses. Moreover, portions of the Shroud were carbon-14 dated by three independent laboratories, all of whom reported that it was not nineteen hundred years old, but probably fabricated approximately 700 years ago. These reports were published in the scientific literature and received widespread attention in the press; and skeptical scientists applauded the forensic evidence, which clearly stated that the image on the Shroud was not due to a miracle, but could be given a naturalistic

causal explanation. Yet, much to the surprise of rationalists, who thought that they had decisively refuted the proponents of the faith, the Shroud industry has returned with full force and vigor again proclaiming that the Shroud was the burial garment of Jesus Christ.

6. The Reality of Rationalism Today

One reason why it is so difficult to question ancient religious beliefs is because of their relationship to deep-seated institutional practices, and often they are justified because of the moral structures they support. A whole way of life of a culture often presupposes religious foundation. Some religionists claim that there are two magisteria, faith and reason, and that science cannot deal with ethics, only religion can. A rational critique of supernaturalism is truncated unless it provides at the same time an alternative ethics. I think rationalists can argue that ethical judgements, in principle at least, are amenable to rational and empirical criticism, and that moral ethical values can be modified in the light of reason. There is a long philosophical tradition that does establish practical reason as a basis for ethical decisions.

Rationalism needs to be supplemented by humanism, however, for it is humanism, first and foremost, that presents a set of ethical values. If the claims of divinity and superstition are found to be lacking -and I think they are - then the foundations of traditional religious morality are undermined. The new frontier for rationalism is to help develop a new ethics appropriate to the postmodern global community in which we live based upon reason and science, not alien to them. This ethic focuses on individual happiness and fulfillment, some autonomy of choice, and self-determination.

This may be difficult to achieve everywhere, for some sectors of the globe are in different stages of social development. Parts of the world are economically backward, existing on an impoverished subsistence level. Other parts of the world have entered an industrial phase. Still others have become postindustrial information and service societies.

How do we apply rationalism to these diverse social conditions? The basic question for both humanism and rationalism is to deal with political and social problems. The ideologies of the nineteenth and twentieth centuries no longer apply fully to the twenty-first century. We have become a global planetary society, and thus there is an urgent need for fresh thinking.

7. Conclusion

Can rationalism help us in formulating wise social politics? If in the sciences we

seek to test hypotheses objectively, can similar tests be applied to political and social policies? I think that we have no other option than to try to use the method of critical thinking to solve social problems. All too often political, economic, and social policies are mired in ancient traditions, based upon appeals to authority and power. But we need, especially in democratic societies, to publicly debate the best policies to pursue. And this depends on an educated electorate capable of making informed decisions, an open free market of ideas, and access to the media. I submit that the agenda for the rationalist-humanist movement in the future should be on the ethical and political level.

We have amply demonstrated that rationalism has been a powerful instrument of progress in science and technology, contributing enormously to the betterment of humankind. We now need to demonstrate its efficacy in ethics and the social order. Often religious intransigence wedded to authoritarian moral creeds and entrenched social systems are obstacles to rationalism. Nevertheless, the rationalist revolution must be extended to these broader areas of human concern. If and when they are, I believe even more profound and positive improvements of the human condition will ensue.

V. EMPIRICISM IN SCIENCE

What the mind (nous) thinks must be in it in the same sense as letters are on a tablet (grammateion) which bears no actual writing (grammenon); this is just what happens in the case of the mind.

ARISTOTLE, *On the Soul*, .

...the mind is a "blank slate" at birth. All of one's ideas are derived, either directly or indirectly, from either sensation (the source of one's knowledge of external objects) or reflection (the source of one's knowledge of one's mental processes).

JOHN LOCKE

1. Introduction

The term *empiricism* describes a philosophical position emphasizing that all concepts and knowledge are derived from and justified by experience. Empiricist disagree on the nature of experience, including whether it is individual or social and whether sense experience is to be emphasized. Empiricism often is associated with other positions, including *nominalism*, *naturalism*, *materialism*, *atheism*,

secularism, humanism, behaviorism, and **emotivism**.

Empiricism usually contrasts with views that truths can be derived from tradition, Scripture, revelation, intuition, or reason. Empiricists often have a special attitude toward mathematics, acknowledging its role in understanding the world yet denying that it gives direct truths about the world apart from experience. In the last third of the twentieth century, Anglo-American discussion has tended to contrast empiricism with holism or coherentism.

Classic empiricism: Despite earlier roots, empiricism really began with the seventeenth- and eighteenth-century British philosophers John Locke (1632–1704), George Berkeley (1685–1753), and David Hume (1711–1776). Locke rejected the existence of innate ideas, including truths of religion and morals and held that the mind is a “blank slate” at birth. All of one’s ideas are derived, either directly or indirectly, from either sensation (the source of one’s knowledge of external objects) or reflection (the source of one’s knowledge of one’s mental processes). Berkeley, holding that perception requires a perceiver, developed a theory that required individual minds and God as perceivers of the world. Hume pushed empiricism in a skeptical direction, questioning beliefs in causation, self, and God.

Early in the twentieth century, the Vienna circle of logical positivists made a major impact on philosophy in England and the United States. They used empiricism as a criterion for meaning, holding that the only meaningful propositions are either tautologies (including mathematical statements), which tell nothing about the world, or else statements that are empirically verifiable. Logical positivism ran into two problems: It was difficult to state the principle of verification precisely, and it had a self-contradiction at its heart because the criterion of meaning is neither a tautology nor empirically verifiable. Thus the criterion of meaning seems to be meaningless. The later holism of American philosopher W. V. O. Quine (1908–2000) also challenged the positivist distinction between tautologies and empirical statements, pointing out that meanings may vary so much between contexts that the dichotomy is hard to maintain.

We shall dedicate the next few pages to the study of the empiricist mode of thoughts and its relevance in the field of science and the philosophy of science.

2. Definitions of Empiricism

Empiricism is defined as the view that knowledge comes from experience via the senses, and that science also flourishes through observation and experiment²⁹⁴.

Empiricism is a philosophical doctrine that all knowledge is derived from experience. Such a position is opposed to rationalism, denying as it does the

existence of innate ideas.

Empiricists hold that all ideas are derived from experience, that knowledge of the physical world can be nothing more than a generalization from particular instances, that it can never reach more than a high degree of probability.

John Stuart Mill was the first to treat the subject, and among its other leading advocates have been John Locke, George Berkeley, and David Hume.

3. History of Empiricism

Within historiography, empiricism refers to empiricist historiography, a school of documentary interpretation and historical teleology derived from the works of Leopold von Ranke. In the study of the history of Empiricism it will interest you to know that there are variations that has been indicated to capture the various epochs in the history and development of empiricism.

a. Classical empiricism

The notion of *tabularasa* (“clean slate” or “blank tablet”) connotes a view of mind as an originally blank or empty recorder (Locke used the words “white paper”) on which experience leaves marks. This denies that humans have **innate ideas**. The image dates back to **Aristotle**

Aristotle’s explanation of how this was possible, was not strictly empiricist in a modern sense, but rather based on his theory of **potentiality and actuality**, and experience of sense perceptions still requires the help of the **active nous** he thought. These notions contrasted with **Platonic** notions of the human mind as an entity that pre-existed somewhere in the heavens, before being sent down to join a body on Earth as contained in the Plato’s *Phaedo* and *Apology*. Aristotle was considered to give a more important position to sense perception than Plato, and commentators in the middle ages summarized one of his positions as “*nihil in intellectu nisi prius fuerit in sensu*” (in Latin “**nothing in the intellect without first being in the senses**”).

This period also refers mostly to the epistemological work of St. Thomas Aquinas of the 13th century who also adopted the thoughts of Aristotle that all forms of knowing come from induction. This belief later influence most of the church (Roman Catholic beliefs)

b. Modern empiricism

Also known as traditional empiricism. David Hume, John Locke and George Berkeley were among the British philosophers who rejected the theory of innate ideas. Theories of the existence of innate ideas were the subject of much debate

between the Continental rationalists and British empiricists in the seventeenth century. From the late eighteenth century onwards, empiricists were critical of Immanuel Kant's doctrine of the *a priori* as positing innate ideas, while proponents of innate ideas rejected Kant's doctrine of intuition and deduction as not innatist, but part of a rationalist doctrine. Modern empiricism contends that all knowledge must be attained through internal and external sensations.

c. Radical empiricism

William James was a proponent of one form of radical empiricism. Radical empiricists believe that *all* human knowledge is purely empirical. More specifically, the radical empiricists are much like ordinary empiricists (rejection of the metaphysical, etc.), but unlike the ordinary empiricists, radical empiricists like James include subjective knowledge as being a source of empirical information also, due to the mere fact that it is experience, and thus should be included. Like **Henri Bergson**, radical empiricists tend to reject distinctions between the "inner" (subjective) and "outer" (the so-called objective).

d. Moderate empiricism

According to moderate empiricism, apart from empirical also *analytical* and only analytical sentences have the right to a place in science. It holds that the only claims or propositions that can be justified *a priori* are those which are analytic.

e. Naïve empiricism

Naïve empiricism holds that scientists should approach a problem with no preconceived expectations or assumptions which have not been previously studied and justified using the scientific method. It stresses the importance of relying on empirical observations about the world and not our interpretations of those observations.

f. Constructive empiricism

According to this view of science, coined by Bas C. van Fraassen (*The Scientific Image*, 1980), we should only ask that theories accurately describe observable parts of the world. Theories that meet these requirements are considered "empirically adequate". If a theory becomes well established, it should be "accepted". What that means is the theory is believed to be empirically accurate, used to solve further problems, and used to extend or refine the theory.

4. Empiricism and Science

Empiricism was a precursor of logical positivism, also known as logical empiricism. Empirical methods have dominated science until the present day. It laid the

groundwork for the scientific method, which is the traditional view of theory and progress in science.

Logical empiricism also known as *logical positivism or neopositivism*) was an early 20th century attempt to synthesize the essential ideas of British empiricism (e.g. a strong emphasis on sensory experience as the basis for knowledge) with certain insights from **mathematical logic** that had been developed by **Gottlob Frege** and **Ludwig Wittgenstein**. Some of the key figures in this movement were **Otto Neurath**, **Moritz Schlick** and the rest of the **Vienna Circle**, along with **A.J. Ayer**, **Rudolf Carnap** and **Hans Reichenbach**. The neopositivists subscribed to a notion of philosophy as the conceptual clarification of the methods, insights and discoveries of the sciences. They saw in the logical symbolism elaborated by **Frege** (d. 1925) and **Bertrand Russell** (1872–1970) a powerful instrument that could rationally reconstruct all scientific discourse into an ideal, logically perfect, language that would be free of the ambiguities and deformations of natural language. This gave rise to what they saw as metaphysical pseudoproblems and other conceptual confusions. By combining Frege's thesis that all mathematical truths are logical with the early Wittgenstein's idea that all **logical truths** are mere linguistic **tautologies**, they arrived at a twofold classification of all propositions: the **analytic** (a priori) and the **synthetic** (a posteriori).^[6] On this basis, they formulated a strong principle of demarcation between sentences that have sense and those that do not: the so-called **verification principle**. Any sentence that is not purely logical, or is unverifiable is devoid of meaning. As a result, most metaphysical, ethical, aesthetic and other traditional philosophical problems came to be considered pseudoproblems.^[6]

5. Empiricism in The Science-religion Dialogue

As for science-religion issues, the topic of empiricism relates to virtually every question. For example, ideas on God, the soul, heaven, or reincarnation will be greatly influenced by a person's stance toward empiricism. That stance will also affect a person's ideas on the questions of the worth of tradition, revelation, scripture, or reason in religion and ethics. Related questions are whether the divine or the sacred as a quality of natural processes can be appreciated or responded to, as some "religious naturalists" hold, and whether such awareness is a complement to or an extension of a more strict empirical method. Another approach is to ask whether religious ideas can be vetoed by empirical procedures, whether they must be strictly based on or may be more loosely informed by them, or whether science and religion are such distinct orientations that neither can interfere with the other. Writers such as Douglas Clyde Macintosh and Henry Nelson Wieman have attempted to treat theology as an empirical study. The

success of this depends on how one conceives God and also empirical method.

6. Criticisms of Empiricism

In the past couple of decades quantum mechanics, constructivism, and Thomas Samuel Kuhn's *The Structure of Scientific Revolutions* have created some challenges to empiricism as the exclusive way in which science works and should work. On the other hand, some argue that theories such as quantum mechanics provide a perfect example of the solidity of empiricism: the ability to discover even counter-intuitive scientific laws, and the ability to rework our theories to accept these laws.

a. Kuhn's *The Structure of Scientific Revolutions*

One of the most famous challenges against empiricism is **Thomas Samuel Kuhn's** *The Structure of Scientific Revolutions* (1962), which built upon Norwood Russell Hanson's *Patterns of Discovery* (1958). In this, he argues that theory change is actually developed through paradigm shifts, where a new idea is offered that doesn't follow on existing theories but instead offers a unique, creative solution to existing problems. Scientific thinking, in Kuhn's view, goes through revolutions, instead of gradual theory development through testing and experimentation. After the revolution occurs, scientists can see things they weren't able to see before in the former framework. Kuhn also questioned whether scientific experimentation is truly unbiased and neutral since the experimenter had previous theories and preconceptions which could affect what experiments are chosen and the way in which the results are interpreted. Kuhn also questioned whether we can trust the reliability of our senses, and cited the famous illusions printed in Hanson's 1958 book.

b. Constructivist epistemology

Knowledge and reality is actively constructed by the individual, not passively received from the environment. There are many forms of constructivism, such as social constructivism and cultural constructivism.

c. Quantum mechanics

Addresses the question whether experience can be used to determine an ontological reality. For example, the Many-worlds interpretation, one of the answers to the EPR paradox, argues that there are multiple versions of every observed object in every possible observable state, existing in a state of quantum superposition. If every observable entity within our reality has a counterpart in an alternate state, then our experience of these entities does not indicate any ontological reality.

VI. MATERIALISM IN SCIENCE

"...materialism is the philosophy of the subject who forgets to take account of himself".

SCHOPENHAUER

1. Introduction

Materialism belongs to the class of **monist ontology**. As such, it is different from ontological theories based on **dualism** or **pluralism**. For singular explanations of the phenomenal reality, materialism would be in contrast to **idealism**, **neutral monism** and **spiritualism**.

Despite the large number of philosophical schools and subtle nuances between many, all philosophies are said to fall into one of two primary categories, which are defined in contrast to each other: **Idealism**, and **materialism**. The basic proposition of these two categories pertains to the nature of reality, and the primary distinction between them is the way they answer two fundamental questions: "what does reality consist of and how does it originate?" To idealists, spirit or mind is primary, and created matter secondary. To materialists, matter is **primary** and mind or **spirit** is secondary, a product of matter acting upon matter.¹⁹¹

The materialist view is perhaps best understood in its opposition to the doctrines of immaterial substance applied to the mind historically, famously by **René Descartes**. However, by itself materialism says nothing about how material substance should be characterized. In practice, it is frequently assimilated to one variety of **physicalism** or another.

Materialism is often associated with **reductionism**, according to which the objects or phenomena individuated at one level of description, if they are genuine, must be explicable in terms of the objects or phenomena at some other level of description — typically, at a more reduced level. *Non-reductive materialism* explicitly rejects this notion, however, taking the material constitution of all particulars to be consistent with the existence of real objects, properties, or phenomena not explicable in the terms canonically used for the basic material constituents. **Jerry Fodor** influentially argues this view, according to which empirical laws and explanations in "special sciences" like psychology or geology are invisible from the perspective of basic physics. A lot of vigorous literature has grown up around the relation between these views.

Modern philosophical materialists extend the definition of other scientifically observable entities such as energy, forces, and the curvature of space. However philosophers such as **Mary Midgley** suggest that the concept of "matter" is elusive

and poorly defined.^[38]

Materialism typically contrasts with **dualism**, **phenomenalism**, **idealism**, **vitalism** and **dual-aspect monism**. Its materiality can, in some ways, be linked to the concept of Determinism, as espoused by **Enlightenment** thinkers. It has been criticized as a spiritually empty philosophy.

During the 19th century, **Karl Marx**, influenced by **Hegel** and early **positivists**, extended the concept of materialism to elaborate a *materialist conception of history*, which goes beyond metaphysics to apply to sociology and political economy, centered on the roughly empirical world of human activity (practice, including labor) and the institutions created, reproduced, or destroyed by that activity

2. Definitions and Conceptual Analysis

In **philosophy**, the theory of **materialism** holds that the only thing that **exists** is **matter**; that all things are composed of *material* and all **phenomena** (including **consciousness**) are the result of material interactions. In other words, matter is the only substance.

To many philosophers, not only is 'physicalism' synonymous with 'materialism', but they use both words to describe a position that supports ideas from physics which may not be matter in the traditional sense (like anti-matter or gravity). Therefore much of the generally philosophical discussion below on materialism may be relevant to physicalism. Also related are the ideas of methodological naturalism (i.e. "let's at least do science *as though* physicalism is true") and metaphysical naturalism (i.e. "philosophy and science should operate according to the physical world, and that's all that exists"). The philosophical alternatives to materialism are some forms of monism (besides the materialistic monism), dualism and idealism.

Materialism is the philosophical stance that "all that exists", or is real, is material - that is, it consists of the various forms of **matter** and **energy** as we know them, and, possibly, other forms of "material" that we just simply don't know about yet. The word is usually used by creationists and their use is usually vaguely defined.

Materialism, which is generally supposed to be related to science, is of different nature. Materialism is based on BELIEF that the models constructed in science are something more than models, that they are... reality! In this sense materialism is no different from any other types of belief systems which can neither be proved, nor rejected.

Materialism only says that reality can be explained imminently (as opposed to

imminently [from the word "emanate"] as in, from a source like the Mind or God), with reference to only a single ontological substance (one type of "stuff"). Nothing to do with status of the models of science, which can and have been wrong in the past. Materialism might perhaps say that the "stuff" that science talks about, the referent of science, is the only "stuff" there is, but not that the models of science "are" reality.

Ontological materialism is the belief, or assumption, that only material matter and energy exist. For the ontological materialist anything immaterial must be the product of the material. In principle all immaterial phenomena must be reducible to (explicable by) natural laws.

Methodological materialism is neither a belief nor an assumption but a restriction on method. Briefly stated it holds that a non-material assumption is not to be made. Science, for example, is necessarily methodologically materialist. Science wishes to describe and explain nature. Diversion into the "supernatural" begins to describe and explain matters that are not natural and obfuscate the natural.

Methodological materialism is a defining characteristic of science in the same way that "methodological woodism" is a defining characteristic of carpentry. Science seeks to construct natural explanations for natural phenomena in the same way that carpentry seeks to construct objects out of wood. In operating in this manner neither discipline denies the existence of supernatural forces or sheet plastics, their usefulness or validity. The use of either supernatural forces or sheet plastics is simply distinguished as belonging to separate disciplines.

Many scientists are also ontological materialists. **Richard Dawkins** espouses ontological materialism when he claims a completeness of science.

Both forms of materialism are very closely related to **philosophical** and **methodological naturalism** and at first glance seem almost identical. Materialism and naturalism differ only in that while naturalism assumes or studies the *observable*, materialism assumes or studies the *observable and material*. The difference is very, very small.

3. History of Materialism

a. Axial Age

Materialism developed, possibly independently, in several geographically separated regions of **Eurasia** during what **Karl Jaspers** termed the **Axial Age** (approximately 800 to 200 BC).

In **Ancient Indian philosophy**, materialism developed around 600 BC with the works of Ajita Kesakambali, Payasi, Kanada, and the proponents of the Cārvāka school of philosophy. Kanada became one of the early proponents of atomism. The Nyaya–Vaisesika school (600 BC - 100 BC) developed one of the earliest forms of atomism, though their proofs of God and their positing that the consciousness was not material precludes labelling them as materialists. The atomic tradition was carried forward by **Buddhist atomism** and the Jaina school.

Xun Zi (ca. 312–230 BC) developed a **Confucian** doctrine oriented on realism and materialism in Ancient China. Other notable Chinese materialists of this time include Yang Xiong and Wang Chong.

Ancient **Greek philosophers** like **Anaxagoras** (ca. 500 BC – 428 BC), **Epicurus** and **Democritus** prefigure later materialists. The Latin poem *De Rerum Natura* by Lucretius (ca. 99 BC – ca. 55 BC) recounts the **mechanistic** philosophy of **Democritus** and **Epicurus**. According to this view, all that exists is matter and void, and all phenomena result from different motions and conglomerations of base material particles called "**atoms**" (literally: "indivisibles"). *De Rerum Natura* provides mechanistic explanations for phenomena such as erosion, evaporation, wind, and sound. Famous principles like "nothing can come from nothing" and "nothing can touch body but body" first appeared in the works of Lucretius.

b. Common Era

Later **Indian materialist Jayaraashi Bhatta** (6th century CE) in his work *Tattvopaplavasimha* ("The upsetting of all principles") refuted the **Nyaya Sutra** epistemology. The materialistic Cārvāka philosophy appears to have died out sometime after 1400 AD.¹

In early 12th-century al-Andalus, the Arabian philosopher, Ibn Tufail (Abubacer), wrote discussions on materialism in his philosophical novel, *Hayy ibn Yaqdhan* (*Philosophus Autodidactus*), while vaguely foreshadowing the idea of a **historical materialism**.¹⁹¹

c. European Enlightenment

Later on, **Pierre Gassendi** represented the materialist tradition, in opposition to **René Descartes'** attempts to provide the **natural sciences** with **dualist** foundations. There followed the materialist and atheist Jean Meslier, Julien Offroy de La Mettrie, Paul-Henri Thiry Baron d'Holbach, Denis Diderot and other French Enlightenment thinkers; as well as Ludwig Feuerbach, and, in England, the pedestrian traveller **John "Walking" Stewart**, whose insistence that all matter is endowed with a **moral** dimension had a major impact on the philosophical poetry of **William Wordsworth**.

Schopenhauer wrote that "...materialism is the philosophy of the subject who forgets to take account of himself"¹⁶¹ He claimed that an observing subject can only know material objects through the mediation of the brain and its particular organization. The way that the brain knows determines the way that material objects are experienced. "Everything objective, extended, active, and hence everything material, is regarded by materialism as so solid a basis for its explanations that a reduction to this (especially if it should ultimately result in thrust and counter-thrust) can leave nothing to be desired. But all this is something that is given only very indirectly and conditionally, and is therefore only relatively present, for it has passed through the machinery and fabrication of the brain, and hence has entered the forms of time, space, and causality, by virtue of which it is first of all presented as extended in space and operating in time."¹⁶¹

d. Marx's materialism

In mid-19th century Europe, there emerged a new **philosophical and political** theory called **Marxism**. The founder of that theory, **Karl Marx**, interpreted the world and its laws by highlighting the materialistic aspects of life as vehicles of world history, and that is why his theory is called *materialistic*.

Karl Marx and **Friedrich Engels**, turning **Hegel's idealist dialectics** upside down, came up with two distinct concepts: **dialectical materialism** and a materialist account of the course of history known as the *materialist conception of history*, later labeled **historical materialism**.¹⁶¹ Marx regarded the base material of the world as **productive forces** and their corresponding social relations (mainly class relations, e.g. between serfs and their lord, or between employees' and their employer). As an expression of these basic social relations, all other ideologies form, including those of science, economics, law, morality, etc.

Marx and Engels used the term "**materialism**" to refer to a theoretical perspective that holds the satisfaction of everyday economic needs is the primary reality in every epoch of history. Opposed to German idealist philosophy, materialism takes the position that society and reality originate from a set of simple economic acts which human beings carry out in order to provide the material necessities of food, shelter, and clothing. Materialism takes as its starting point that before anything else, human beings must produce their everyday economic needs through their physical labor and practical productive activity. This single economic act, Marx believed, gives rise to a system of social relations which include political, legal and religious models.

Scientific socialism holds that social mores, values, cultural traits and economic practices are not the property of some immutable natural law (as in idealism), but

are products of the social environment and are thus relative to the specific form of social organization in existence. These social relations are determined by material forces in society, such as the productive forces, natural environment and the level of technology.

e. Scientific materialists

Many current and recent philosophers—e.g., Daniel Dennett, Willard Van Orman Quine, Donald Davidson, John Rogers Searle, and Jerry Fodor—operate within a broadly physicalist or materialist framework, producing rival accounts of how best to accommodate **mind—functionalism, anomalous monism, identity theory** and so on.^[41]

Scientific 'Materialism' is often synonymous with, and has so far been described, as being a **reductive materialism**. In recent years, **Paul and Patricia Churchland** have advocated a radically contrasting position (at least, in regards to certain hypotheses); **eliminativist materialism** holds that some mental phenomena simply do not exist at all, and that talk of those mental phenomena reflects a totally spurious "**folk psychology**" and **introspection illusion**. That is, an eliminative materialist might suggest that a concept like 'belief' simply has no basis in fact - the way folk science speaks of demon-caused illnesses. Reductive materialism being at one end of a continuum (our theories will *reduce* to facts) and eliminative materialism on the other (certain theories will need to be *eliminated* in light of new facts), **Revisionary materialism** is somewhere in the middle.^[42]

4. Defining Matter

The nature and definition of matter - like other key concepts in science and philosophy - have occasioned much debate. Is there a single kind of matter which everything is made of (hyle), or multiple kinds? Is matter a continuous substance capable of expressing multiple forms (**hylomorphism**),^[43] or a number of discrete, unchanging constituents (**atomism**)?^[44] Does it have intrinsic properties (**substance theory**),^[45] or is it lacking them (**prima materia**)?

One challenge to the traditional concept of matter as tangible "stuff" came with the rise of field physics in the 19th century. However the conclusion that materialism is false may be premature. Relativity shows that matter and energy (including the spatially distributed energy of fields) are interchangeable. This enables the ontological view that energy is **prima materia** and matter is one of its forms. On the other hand, the Standard Model of Particle physics uses **quantum field theory** to describe all interactions. On this view it could be said that fields are

prima materia and the energy is a property of the field.

According to the dominant cosmological model, the **Lambda-CDM model**, less than 5% of the universes energy density is made up of the "matter" described by the Standard Model of Particle Physics, and the majority of the universe is composed of **Dark Matter** and **Dark Energy** - with no agreement amongst scientists about what these are made of.^[46] This obviously refutes the traditional materialism that held that the only things that exist are things composed of the kind of matter with which we are broadly familiar ("**traditional matter**") - which was anyway under great strain as noted above from **relativity** and **quantum field theory**. But if the definition of "matter" is extended to "anything whose existence can be inferred from the observed behaviour of traditional matter" then there is no reason *in principle* why entities whose existence materialists normally deny should not be considered as "matter".^[47]

While it is believed by many physical scientists that the concept of matter has merely changed, rather than being eliminated, some have taken a more extreme position. For instance **Werner Heisenberg** once said "The ontology of materialism rested upon the illusion that the kind of existence, the direct 'actuality' of the world around us, can be extrapolated into the atomic range. This extrapolation, however, is impossible ... atoms are not things.". Likewise, some philosophers feel that these dichotomies necessitate a switch from materialism to **physicalism**. Others use the terms "**materialism**" and "physicalism" interchangeably.^[48]

5. Objections, Criticism and Alternatives to Materialism

The professor of Philosophy at the University of Notre Dame **Alvin Plantinga** criticises it, and the Emiriti Regius Professor of Divinity **Keith Ward** suggests that materialism is rare amongst contemporary UK philosophers: "Looking around my philosopher colleagues in Britain, virtually all of whom I know at least from their published work, I would say that very few of them are materialists."^[49]

a. Scientific rejection of materialism

Some modern day physicists and science writers such as **Paul Davies** and **John Gribbin** have openly expressed how scientific finds in physics such as **quantum mechanics** and **chaos theory** have disproven materialism. In their 1991 book **The Matter Myth** in the first chapter titled **The death of materialism** they wrote:

Then came our Quantum theory, which totally transformed our image of matter. The old assumption that the microscopic world of atoms was simply a scaled-down version of the everyday world had to be

abandoned. Newton's deterministic machine was replaced by a shadowy and paradoxical conjunction of waves and particles, governed by the laws of chance, rather than the rigid rules of causality. An extension of the quantum theory goes beyond even this; it paints a picture in which solid matter dissolves away, to be replaced by weird excitations and vibrations of invisible field energy. Quantum physics undermines materialism because it reveals that matter has far less 'substance' than we might believe. But another development goes even further by demolishing Newton's image of matter as inert lumps. This development is the theory of chaos, which has recently gained widespread attention.

Paul Davies and John Gribbin, *'The Matter Myth'*,

Chapter 1^[34]

b. The challenge of physics

The conceptual foundations and scientific background of all **materialistic systems** of the eighteenth and nineteenth centuries was the notion of matter as conceived by classical physics, that is, as **Isaac Newton** (1642–1727) described it, "matter formed in solid, massy, hard, impenetrable, moveable particles" and "mass" being its numerical measure. These particles, whether of atomic or macroscopic size, move through space according to the strict laws of mechanics. The development of modern physics in the first quarter of the twentieth century led to a radical modification, if not complete disintegration, of this classical framework, a process often characterized as the "dematerialization of matter." The traditional representation of atoms, for example, as minute billiard balls complying with the classical laws of motion proved incompatible with the principles of modern physics, which is based on the theory of relativity and quantum mechanics. Einstein's famous mass-energy relation, for example, symbolized by $E=mc^2$, and a simple consequence of the special theory of relativity, is often interpreted as expressing the convertibility of mass or matter into energy or inversely of energy into matter.

Werner Heisenberg's (1901–1976) Uncertainty Principle, one of the axioms of quantum mechanics, whether interpreted as expressing the essential property of material particles never to have simultaneously a definite position and a definite velocity, or whether regarded as reflecting only a limitation on the measurement, as well as **Louis de Broglie's** (1892–1987) related principle of wave-particle duality, showed that the ontology of classical physics, on which those materialistic

doctrines were grounded, can no longer be maintained. Quantum field theories, which have become the most important tools in understanding the microscopic world, suggest that matter is merely some arrangement of properties of space-time itself, all elementary particles being described as manifestations of quantum mechanical fields.

Modern physics thus presents a serious challenge to **conventional materialism**. Perhaps the most acceptable answer to this challenge has been given by the philosopher **Herbert Feigl** ^[35] in his response to Norwood Russell Hanson's paper ^[36] "The Dematerialization of Matter," published in 1962 in the periodical *Philosophy of Science*. "I grant," says Feigl, "the abstract, unvisualizable character of most physical concepts, classical or modern. But I insist that physics deals with happenings in spacetime, and that associated with those happenings there are aspects of mass, charge and motion which leave at least *some* characteristics of old-fashioned matter unaltered"^[34].

c. Religious and spiritual objections

According to the *Catholic Encyclopedia*, materialism denies the existence of both deities and "souls."^[37] It is therefore incompatible with most world religions including **Christianity, Judaism and Islam**.

In most of **Hinduism and Transcendentalism**, all matter is believed to be an illusion called **Maya**, blinding us from knowing the truth. Maya is the limited, purely physical and mental reality in which our everyday consciousness has become entangled. Maya gets destroyed for a person when they perceive **Brahman** with transcendental knowledge.

Kant argued against all three forms of materialism, **subjective idealism** (which he contrasts with his "transcendental idealism"^[38]) and **dualism**.^[39] However, Kant also argues that change and time require an enduring substrate,^[40] and does so in connection with his Refutation of Idealism^[41]

Postmodern/poststructuralist thinkers also express a skepticism about any all-encompassing metaphysical scheme. Philosopher Mary Midgley,^[42] among others, argues that materialism is a self-refuting idea, at least in its eliminative form.

VII. PRAGMATISM IN SCIENCE

...it is in the fruits of our beliefs, and not the roots, that the truth resides

WILLIAM JAMES 1907.

1. Introduction

On the other hand, a philosophy may during its career experience an era of resurgence and renewed vitality. Some new interest, some insoluble practical problem, some nagging human difficulty, perhaps some empirical discovery (Darwin? Freud? Pavlov? Einstein?), may result in making a specific philosophy particularly insightful, or appropriate, or revealing, or adequate, or enlightening, or persuasive, or whatever it is that promotes adherence to a philosophy.

It is in this sense that I think pragmatism is peculiarly fitted to meet the philosophic needs of the Twentieth Century, and, in particular, to be the philosophic foundation for some of the knowledge obtained, and some of the problems posed, by the outlook of modern science. It is this latter which I wish to document.

1. Let me begin with the notion of "Reality" entertained by pragmatism. (I shall speak, incidentally, as if there were a unified theory called "pragmatism." Of course there is not; pragmatism is characterized more by a method or approach than by a body of doctrine; and there is often substantial disagreement among the pragmatists about that doctrine.) Previous philosophers had quite generally believed in some kind of Absolute Reality, basically unalterable, often spiritual in nature, perhaps friendly, perhaps indifferent to man, but in any event independent of human existence, and, in some undefined sense, more "valid" and important than any human experience. The pragmatists all called attention to a certain plasticity or malleability of what may be called "the real." Peirce wrote of the universe as "undergoing a continuous growth from nonexistence to existence ... The reality of things consists in their persistent forcing themselves upon our recognition."¹⁶² James said that "anything is real of which we find ourselves obliged to take account in any way."¹⁶³ For Schiller also ontology is conditioned upon epistemology:

Before there can be a real for us at all, the Real must be knowable, and the, notion of an unknowable reality is useless, because it abolishes

itself. The true formulation therefore of the ultimate question of metaphysics must become - What can I know as real?¹⁶⁴

And for Dewey, the human activity of inquiry reconstitutes or transforms a problematic existential situation into a clarified one; this is an interactive determination of "the real."¹⁶⁵ There are two fundamental realizations of modern physics to which this pragmatic view of reality is singularly appropriate. First is the insight that the concepts which the physicist uses to determine what shall be regarded as "real" are selected by him from among many possibilities. There is no implacable irresistible "Reality" which compels his choice. As Einstein puts it,

... the "real" is in no way immediately given to us. Given to us are merely the data of consciousness: and among these data only those form the material of science which allow of univocal linguistic expression. There is only one way from the data of consciousness to "reality," to wit, the way of conscious or unconscious intellectual construction, which proceeds completely free and arbitrarily... We are free to choose which elements we wish to apply in the construction of physical reality. The justification of our choice lies exclusively in our success..¹⁶⁶

And Poincaré has emphasized that even so "primary" a quality of the world (to use traditional terminology) as mass is no more than a "device of the understanding":

Masses are coefficients which it is found convenient to introduce into calculations. We could reconstruct our mechanics by giving to our masses different values. The new mechanics would be in contradiction neither with experiment nor with the general principles of dynamics ... But the equations of this mechanics would not be so simple.¹⁶⁷

Thus the terms and concepts by which we structure into a coherent "Reality" the "big blooming buzzing confusion" into which we are born reflect the pragmatist emphasis on the role of man in constituting Reality.

This centrality of human action is more strikingly evident in another aspect of modern science. Physicists agree that to speak of "the electron" (or any of the other subatomic particles) as if it existed in clear isolation from the techniques of the physicist, is to use a figure of speech. "The velocity of the electron at a particular time and place" is a phrase which by itself is not fully meaningful. That is so, not because there is an objectively determinate electron which eludes us, but

because it is constituted by the modes of observation and interpretation of the scientist. "The electron" is in no sense a thing; it is a hypothetical construct, or a logical construction, or an inferred entity, or a postulated entity. It is not part of the raw material of existence. When the physicist "looks at it," so to speak, he alters it. Nature can no longer be described as independent, or external, or unalterable, but only as-revealed-and-determined-by-man's-questions. Clearly this is the pragmatist view of "the real." Dewey said that scientists accepted "the consequences of their Experimental operations as constituting the known object,"^[161] rather than as disclosing a prior Reality.^[162]

2. Early Developments

The emergence of the experimental analysis of behavior was accompanied by a distinctive and evolving set of scientific practices that, for better or worse, have generally fallen under the term *radical behaviorism*. Major proponents include: Day,^[163] and Skinner,^[171] As a set of verbal practices, radical behaviorism has been one of the ways that the behavior-analytic scientific community has been distinguished from more traditional varieties of psychological science.

The task of defining, clarifying, describing, exploring, and extending the implications of radical behaviorism is useful in a number of ways. Beyond the immediate purposes of making assumptions, goals, explanatory practices, and related issues explicit and open to critical review e.g., Leigland,^[172] it is useful in responding to critics who have misunderstood and misconstrued the results or implications arising from radical behaviorism or the field of behavior analysis (e.g., Koch,^[173]; see also Staddon,^[174] and commentaries), as well as providing a basis upon which new conceptual or methodological proposals generated within the field may be evaluated, and in general, allowing the future development of the scientific field to take place "self-consciously"^[175].

Although its origins can be traced further back^[176], the last decade has seen accelerating growth of a literature of radical behaviorism (e.g., Chiesia,^[177]; Lattal,^[178]; Leigland,^[179]; Smith,^[180]; Todd & Morris,^[181]. This literature has served to describe the historical context of radical behaviorism, to follow its systematic implications, and to explore relations between radical behaviorism and other areas of science and philosophy. Important themes have been found in common with radical behaviorism and the ordinary-language philosophy of the later Wittgenstein^[182], as well as similarities with a generic interpretation of phenomenology in the sense of "the study of phenomena"; a consequence of Skinner's interest in staying at the

level of one's observations without appealing to standard forms of reductive theory^[183]. Other sources have documented important relations between Skinner's systematic views and Machian positivism e.g., Day^[184]; Marr,^[185]; Smith,^[186] and pragmatism e.g., Day,^[187]; Hayes & Brownstein,^[188]

3. Current Trends

Pragmatic themes have appeared in the behavior-analytic literature in part because it is clear that Skinner's views on the goals of science, as well as his general view of truth, could be described as strongly pragmatic in character^[189]. More recently, the term *pragmatic* has appeared in discussions of behavior-analytic science as a contextualistic worldview^[190]. According to the taxonomy of worldviews described by Pepper^[191], a characteristic of contextualism is a pragmatic truth criterion of *successful working*, which may be contrasted with, for example, the mechanistic world view with correspondence as its truth criterion. Contextualism has been described as the philosophical foundation of behavior analysis (at least in the context of Pepper's taxonomy; e.g., Hayes et al.,^[192] although Pepper's mechanism-contextualism distinction has also been the subject of criticism^[193]. Nevertheless, contextualism has been and continues to be a useful way to summarize some of the salient features of behavior analytic science.

Although many behavior analysts may thus associate pragmatism with Pepper's contextualism and with such standard phrases as *successful working and effective action*, there are much broader issues to be considered in relating pragmatism to behavior analysis. **Pragmatism, as it has developed in academic philosophy, is a sophisticated and complex set of views;** it is not a singular, unitary, organized system (any more than is behaviorism or cognitivism; for an excellent overview,^[194] Further, pragmatism is neither a philosophy of science nor a philosophy of psychology, but is instead a philosophical perspective that evolved in the context of and in response to a variety of traditional issues in academic philosophy. As such, the agenda of philosophical pragmatists will likely appear somewhat alien to behavior analysts who are mainly interested in basic and applied science. Nevertheless, a number of themes described by pragmatists are clearly relevant to natural science in general and to behavior analytic science in particular.

The most prominent advocate of philosophical pragmatism in recent years has been Richard Rorty. His 1979 book, *Philosophy and the Mirror of Nature*, and

subsequent writings have been central to contemporary philosophical discussions on the implications of pragmatismTM (191). While reviewing one of Rorty's 1991 book, *Objectivity, Relativism, and Truth: Philosophical Papers Volume 1*, a book that emphasizes issues of pragmatism and natural science, and reveals a number of important thematic similarities between Rorty's pragmatism and Skinner's radical behaviorism as could be found stated in the works of Lamal's, review of Rorty. We shall hope to glean further into the scientific methodological rubrics that this school of thought has to offer. The book is a collection of philosophical papers written in the 1980s, and is organized into three sections. The first section concerns a **pragmatic perspective on natural science** and its relationship to the rest of culture. The second section explores and extends certain pragmatic themes arising from the work of Donald Davidson, a contemporary philosopher who has been interpreted by Rorty and others as contributing to pragmatic philosophy in substance if not in name. The third section examines issues of liberal democracy from a pragmatic perspective. One of the things that we shall be doing in this study is to extract from these works mentioned above, the relations of radical behaviorism in the scientific system.

4. Definitions and Conceptual Analysis

Originating with **C.S. Peirce** and **William James**, pragmatism is a philosophical movement embracing different proposed solutions to problems in the epistemology and logic of natural science. Pragmatists believe that the rational justification of scientific beliefs ultimately depends on whether the method generating the beliefs is the best available for advancing our cognitive goals of explanation and precise prediction. So characterized, scientists can be, and have been, pragmatists simply for believing that the fruits of good scientific method generally produce, better than any other method, explanations and precise predictions, thereby allowing for successful human adaptation relative to various interests. Such success, they say, justifies the method and indicates the basic purpose of science.

One way to express more succinctly the pragmatic principle (PP) implied by all this is as follows: Assuming that *P* is a proposition about the world,

PP A person is justified in accepting *P* as true

(a) if *P* is either soundly inferred directly by inductive or deductive inference from other known or justified beliefs; or

(b) if when *P* is not so soundly inferred, there is some real possibility that accepting *P* as true will tend to be more productive of explanations and

precise predictions than would be the case if one had accepted instead either the denial of *P* or nothing at all.

Applying (b) of PP, for example, pragmatists are sympathetic to accepting the inductive method itself as the most reliable way of providing justified beliefs about the world simply because, while there is no deductive nor inductive justification for induction within science, nevertheless there is no good reason not to accept it either, and accepting it tends to produce explanations generating reasonably precise predictions of sensory experiences, and thereby other beliefs whose adoption and applications allow navigating our world more successfully. Those who deny PP are not pragmatists.

Is pragmatism the optimistic expression of the industrial era, deemed to be vanishing in the postindustrial society, or is it a serious philosophical alternative to traditional rationalism and empiricism, idealism and realism? What is labeled *pragmatism* ranges from the philosophy of nineteenth-century American scholar Charles Sanders Peirce (1839–1914), who claimed inquiry for truth's sake, to Richard Rorty'sTM (b. 1931) twentieth-century neo-pragmatism, which claims, in an antirealist spirit, that criteria of evidence are not objective but only conversational constraints. Most pragmatists, however, try to find a middle way between metaphysical realism and relativism, between dogmatism and skepticism, by using the pragmatic maxim. This maxim holds that in order to ascertain the meaning of an idea one should consider the practical consequences that might conceivably result from it.

Belief is considered to be guiding people's actions in that it is a habit, a disposition to behave. Its opposite is doubt, which, unlike René Descartes's methodological doubt, is involuntary and unpleasant, usually caused by some surprising phenomenon that is inconsistent with one's previously accepted beliefs. Inquiry starts when humans, like other organisms, strive to obtain an equilibrium with their environment, the inquiry manifesting itself in new habits and revised beliefs. Successful inquiry results in a stable viewpoint, but only temporarily stable, seen in the long run. Sophisticated inquirers will therefore always be motivated to further inquiry, transforming the primitive homeostatic process into scientific inquiry.

5. Major Proponents of Pragmatism

a. Universalizing pragmatism: John Dewey

American philosopher John Dewey (1859–1952) was deeply influenced by Peirce's idea of scientific method and inquiry, but Dewey broadens it to take on universal scope. He conceives of the scientific method simply as the way people

actually think, or ought to think. Unlike Peirce, Dewey also emphasizes the immediacy of experience, generally characterized in terms of its aesthetic quality, as felt immediacy and, as such, basic and irreducible. Cognitive experience is the result of inquiry. The process starts when a person encounters some difficulty, proceeds through the stage of conceptual elaboration of possible resolutions, and results in a final reconstruction of the experience into a new unified whole. With this idea, Dewey and other pragmatists question what are labeled "**spectator theories of knowledge**," according to which knowledge is a kind of passive recording of antecedent facts. Instead, knowing is seen as a constructive conceptual activity, anticipating and guiding our adjustment to future experiential interactions with our environment. The classical ontological distinctions in philosophy between mind and body, between means and end, and especially between fact and value, therefore cannot be ascribed an absolute status but should rather be functionally and contextually understood. Consequently, Dewey rejects the idea of truth as correspondence of thought to unknowable things-in-themselves. Instead, it is a matter of successful adjustment of ideas to problematic situations. For that reason, Dewey prefers to talk about warranted assertability.

b. Pragmatism in science: W. V. O. Quine

Like all pragmatists, the neo-pragmatist W. V. O. Quine (1908–2000), one of the leading American philosophers of the twentieth century, also rejects the idea of reaching the balance between language, truth, and reality once and for all as an unusable fiction. He develops the idea of the interactivity between conceptual invention and discovery of content in the sense that the conceptual system as a whole has to pass the test against experience. There is no guarantee that any kind of truth could be excepted from a future process of revision. Since there is no unique method of finding truth, nor any universal language for finding the final conceptualization of the world, there is no way of talking about reality as such. Nevertheless, for Quine, the danger of relativism is illusionary. What has been obtained in scientific research through epistemological and ontological decisions is absolutely binding, although in the future it will probably have to be modified or even given up. In what way there will be a change, however, lies beyond present cognitive abilities.

c. Pragmatism in religion: William James

The objection of subjectivism and relativism is also directed against nineteenth-century American philosopher William James's (1842–1910) conception of truth. Unlike Peirce (and to some extent Dewey), James does not focus only on the empirically testable consequences of a belief. He rather shifts the emphasis to

what the consequences of a person having a belief are. True beliefs work. Not surprisingly, this conception of truth has been taken as a straight identification of truth with utility. James, however, distinguishes between the different ways that different beliefs work. Concerning empirical judgments, "true" means "verified through observation and experiment." Thus, the accusation of identifying truth with utility cannot be applied to empirical judgments. Neither does it affect a priori truths since they are truths that one is prepared to accept in the sense of conceptual presuppositions by means of which one talks about reality. Only concerning a third kind of truths—moral, aesthetic, and religious ones—is the pragmatic identification of truth and usefulness valid. The kind of judgment involved here cannot be empirically verified. The truth-value of such judgments is given by their practical working in life. If religions shall be more than idle talk, they have to have practical consequences for the people who choose them; they have to work psychologically satisfactorily in their lives. James defends people's right to have religious beliefs if the choice between believing them and disbelieving them is unavoidable, and if they offer a real option, even though religious beliefs cannot be decided on the basis of empirical evidence.

d. Pragmatism in science and religion

In one specific sense there is, according to pragmatism, no difference between science and religion. Both activities have to be understood in relation to the kind of beings human are. Neither science nor religion can address reality as independent of human experience. However, whereas science deals with experimental, observational experience, religion concerns existential experience. A theory is empirically adequate if it enables people to generate testable hypotheses and thereby maintain what is true in the observable world. Religions and their secular counterparts are existentially adequate if they provide people with conceptions of life at its best so that, in the tension between how life is and how it could be, they can attain a feeling for good and evil, right and wrong, and thus generate values and meaning, and express what is true in their lives.

6. Pragmatism as a Tool for Scientific Methods

In this section we shall be considering so pragmatic solutions to the problem of induction, and the problem of scientific explanation.

a. Pragmatism and the Problem of Induction

We reason inductively when we infer that all *Xs* are *Ys* because all past observed *Xs* were also *Ys*. Such an inference assumes that the future will be like the past, or that the unexamined members of a class will be like the members already

examined. Hume claimed that we have neither an inductive nor a deductive justification for believing that the future will be like the past. Any inductive justification of induction based on the fact that past futures were like past pasts would be circular. Also, sometimes, past futures were not like past pasts. Moreover, there can be no deductive proof that the future will be like the past, because it is logically possible that the future will not be like the past. Nor should we argue that there is a principle of uniformity in the world that can both explain our past success in predicting the future and guarantee that success in predicting that the future will be like the past. At best, that argument shows only that a principle of uniformity held in the past; the question is whether such a principle of uniformity will continue to hold in the future. Pragmatists agree with Hume's conclusion that there can be no inductive or deductive justification of induction. Nonetheless, pragmatists have offered at least three distinct solutions to Hume's problem.

Peirce offered the first. He granted that while inductive inference can yield false conclusions, the method of induction is justified as the only reliable method for establishing reliable beliefs about the world because repeated application of inductive reasoning will eventually lead to the true answer to any answerable question. Peirce argued that all inquiry assumes that there is a correct objective answer to any answerable question and that inquiry pursued indefinitely long under inductive reasoning *will* reach this one true irreversible answer^[90]. Without that assumption no inquiry will proceed. Thus believing in the *general* reliability of induction to lead sooner or later to the truth was, for Peirce, something we have to do. Without a method to predict accurately our sensory experiences, our beliefs would not satisfy the proximate end of scientific inquiry, which is not, according to Peirce, to find the truth but rather those beliefs we *sincerely think to be true* by applying a method that guarantees objectivity. For Peirce, evolutionary forces drive us to the method that best enables us to establish beliefs relieving the discomfort of not knowing what to believe, and only inductive reasoning can do that trick. Is Peirce's defense persuasive?

Hume could accept that all inquiry proceeds on the assumption that there is a final objective answer to any answerable question, and then note that the assumption itself is an inductive conclusion based on an examination of all past cases of inquiry. That leads us back into the vicious circle of trying to justify induction inductively. Either that or Peirce was avoiding the necessity of an infinite regress of justification by implicitly asserting that all reasoning begins with certain assumptions that cannot be justified except by their practical consequences for promoting cognitive success. But then, Hume would reply that unjustified assumptions are unjustified assertions, and however intuitively acceptable they

may seem, any conclusion based on them will be unsound.

To this **Humean** reply, contemporary pragmatists often respond, and this is the second pragmatic defense of induction, that unless we start with assumptions we are unable to justify, except to say there is no good reason to doubt them as reliable sources of belief, not only will we end up with no justified belief or knowledge, but we are also implicitly faulting inductive inference for not being infallible. This, for example, is the justification proposed by Nicholas Rescher^[91]. Nor, for these pragmatists, can we establish the validity of induction *a priori*. Rather induction can, and should, be justified pragmatically by directly seeing whether, when simply adopted, the fruits of induction facilitate the attainment of the primary goal of science in generating good explanations and accurate predictions. If the skeptic demands more than this, then Rescher, like Peirce, locates the demand, in a **Cartesianism** that mistakenly regards every empirical belief as doubtful until justified as infallible.

The third pragmatic response to Hume came initially from Reichenbach^[92], and is more recently defended by Brian Skyrms^[93] and Wesley Salmon^[94]. According to Skyrms, this proposal affirms that if any method succeeds in forming reliable beliefs about the world, the inductive method will^[95]. The reason, frequently noted, why we should accept this view is simply because of the self-correcting nature of induction. If we find any method other than induction successful in producing generally reliable beliefs, then induction will sanction it.

Hume could respond to this pragmatic defense by agreeing that *if* any method succeeds, the inductive method will succeed; but then Hume could ask how we could be justified in accepting the antecedent. Showing that any method *will* provide reliable empirical beliefs will presuppose, and not show, that the future will be like the past. Here pragmatists will again reply that Hume is blaming induction for not being deduction.

b. Pragmatism and the Problem of Explanation

Many philosophers of science insist that if we wish to explain why something occurs at some time we must appeal to true law-like generalizations. They implicitly assume that there is a way the world is, and its being what it is, is causally and logically independent of the existence and cognitive activities of minds. On this view, explanations are truth-seeking instruments, or attempts at *understanding* how things really are and why they are what they are. Hence the premises of explanatory arguments must be true. In advancing their classic deductive-nomological (**D-N**) model of explanation, Hempel and Oppenheim

argued that in order to explain why something occurs in the way it does, we must appeal to true law-like generalizations, followed by a true statement of the current initial conditions under which the law designated by the statement of law applies. The event to be explained is then explained as the deductive conclusion of the statement of law and the conditions under which it applies. It is also a feature of this model that a good explanation is one we could have used to predict the *explanandum event* prior to its occurrence. If a proposed explanation does not do as much, then it fails to be explanatorily relevant^[100].

There are well-known criticisms of the D-N model on the grounds of scope and relevance^[101]. Invariably, critics of the D-N model do not question that the goal of an explanation is to find the truth, and that explanations are adequate only if they provide a true understanding of the causes of the phenomena to be explained. But there are pragmatists who, as instrumentalists, have challenged the received view.

For example, van Fraassen, in advancing constructive empiricism, has argued that the goal of science, and hence of scientific explanation, is not truth, but rather empirical adequacy, meaning thereby that theoretical science is not necessarily concerned with finding the truth as much as in confirming proposed hypotheses. As soon as we attain to the latter, we may accept the hypothesis as true, but, of course, it may not be true^[102].

For pragmatists such as van Fraassen explanation is less a matter of seeking truth than it is of satisfying cognitive and non-cognitive needs for adaptation via precise predictions of sensory experience. Explanation is also regarded as context-sensitive: depending on one's purposes or goals, different explanations of the same event may be adequate, and the adequacy or completeness of an explanation should be judged relative to different goals and purposes^[103].

The difference between what Salmon and van Fraassen regard as the goal of an explanation has its roots, as Salmon himself acknowledged, in what each regards as the purpose of an explanation. Van Fraassen's view is that if we ask practicing scientists what they seek, the answer will be *empirical adequacy* first and foremost. Classical pragmatists generally agree.

Other radical pragmatists will take issue with van Fraassen's pragmatic instrumentalism for countenancing even the possibility that one's theories and explanations might be true in the usual sense of "true," or with van Fraassen's claim that knowledge or true beliefs about observed phenomena are necessary if we are to confirm theories or explanations.

c. Conclusion

If there is a defensible pragmatic position on the problem of induction, it is that induction is justified because it generally leads to beliefs reliable for allowing successful adaptation, even though there is strictly no inductive or deductive proof of the validity of induction as a source of knowledge. But that proposal requires defending the view that the primary purpose of inquiry is to establish beliefs that allow us to adapt successfully to our environment. That goal seems more defensible to most pragmatists than having the goal of attaining the truth as the end of belief-formation. Moreover, there is the claim of several pragmatists that denying that induction leads to knowledge is to condemn induction for failing to be deduction.

On the question of theoretical entities, although there is no distinctively pragmatic position, the most attractive pragmatic proposal may well be the non-realist instrumentalism of van Fraassen and others on the question of the external world and the existence of theoretical entities. Doubtless, if we think pragmatists typically adopt some form of warranted assertibility theory of truth, or abandon truth wholesale for some form of verificationism as adequate, but fallible, for the purposes of science, that would tend to render van Fraassen's position problematic for countenancing true statements at the common-sense level and then too the possibility that some theoretical claims are true.

Finally, turning to scientific explanation, there is a distinctively pragmatic position countering all variations on, and emendations of, the D-N model. Insofar as we can see all pragmatists holding to some warranted assertibility theory of truth, combined with a deep fallibilism, we can view them as abandoning truth traditionally understood as a necessary condition for adequate statements of law. Truth, platonically understood, may well be abandoned as necessary for statements of law if so doing still allows for successful prediction under warranted but fallible generalizations. This last point may turn out to be the core pragmatic proposal along with a van Fraassen-like instrumentalism regarding the existence and nature of an external world and theoretical entities.

7. Criticisms / Anti Pragmatist

A persistent objection to pragmatism is that knowledge requires truth, just as epistemic justification requires truth-conduciveness, but neither is reducible to utilities associated with successful prediction. There is, anti-pragmatists say, a difference between believing what best serves the goal of predictive success and believing the truth; and the goal of inquiry is to find the truth rather than what it is best for us to believe. Two pragmatic responses to this objection permit

distinguishing two types of pragmatist.

The first response, advanced by Richard Rorty and others, consists in affirming that the **objection assumes that truth is certifiably attainable**, that we can sometimes decisively show which of our beliefs are true rather than simply justified by appeal to currently acceptable standards of rational justification. But that, says Rorty, we cannot do, and so truth is a myth, no less than knowledge that would require either truth, or the strong likelihood of truth^[104] This is **radical pragmatism**, often called cultural relativism in epistemology.

The second response, advocated by John Worrall^[105], asserts that pragmatism is free to emphasize the utility of beliefs as the criterion for their acceptance as true without abandoning the idea that some of them are in fact true. That a system of beliefs may allow successful adaptations is consistent with thinking plausibly that the reason it has such consequences is because at least some of those beliefs, or beliefs implied by them, succeed in correctly describing the world, even if fallibly and incompletely. So even if we cannot determine which of our beliefs are true, we can avoid making a mystery or a miracle of scientific progress by urging that the success we so often find in our theories and predictive hypotheses is there simply because some of them, at least in part, are true. This we can call **non-radical pragmatism**.

VIII. DETERMINISM IN SCIENCE

1. Introduction

Determinism is not just causality. Determinism goes far beyond causality, and certainly much farther than psychological science requires.

Many scientific psychologists embrace determinism without realizing what it means. That, at least, is the distinct impression left with me after the dramatic debate about **free will** and determinism I had with a friend in the University of Ibadan, Nigeria which took place after a keynote address we listened to at a big annual conference of the Society for **Personality** and Social Psychology, a while ago..

Plenty was said to support determinism - but it seemed quite irrelevant. The gist seemed to be, in psychology we study causes, so we have to believe in determinism. This is wrong to the point of being silly.

Determinism is a belief in the inevitability of causation. Everything that happens is

the only possible thing that could happen. The chains and networks of causes are so powerful and inexorable that every outcome is inevitable. We are already locked in to everything else that is going to happen in the entire future of the universe. If you knew all the causal principles and had enough information about the present, you could predict the future with 100% accuracy. The universe resembles a giant machine, grinding alone exactly as it must inevitably continue to do, following rigid rules. That is determinism.

2. What exactly is Determinism?

Determinism is the theory that all human action is caused entirely by preceding events, and not by the exercise of the Will. In philosophy, the theory is based on the metaphysical principle that an uncaused event is impossible. The success of scientists in discovering causes of certain behavior and in some cases affecting its control tends to support this principle.

In other words, the view that every event has a cause and that everything in the universe is absolutely dependent on and governed by causal law: Since determinists believe that all events, including human actions, are pre-determined, determinism is typically thought to be incompatible with free will.^[106]

Invariably, Determinism has also been defined as the philosophical belief that every event or action is the inevitable result of preceding events and actions. Thus, in principle at least, every event or action can be completely predicted in advance, or in retrospect.

To a determinist, there are no counterfactuals. Nothing that didn't happen could possibly have happened. Everything that did happen was the only possible thing that could have happened at that point in time and space, given the causes.

That is why determinism and free will strike most people as incompatible beliefs (even though in recent decades a growing group of philosophers have embraced some form of '**compatibilism**' that preserves a watered-down notion of free will while also embracing determinism). The essence of free will is that the person really could do more than one possible response to a given situation. To a determinist, that is wrong. **Causes**, including unconscious causes, are operating to bring the person inevitably to what he or she will eventually do. The appearance of multiple options is an illusion, to a determinist.

3. The Idea of Making Choices

To a determinist, all choice is illusory. The literal meaning of choice is that there are