Chapter III

Metaphysical Interpretations of Science

[section 1]
Every proposition of science, no matter how abstract it may be, must be checked finally by sense observations that can be described in common sense language. However, on the other hand, the general principles of science have become more and more remote from common sense as science has progressed. Aristotelian mechanics was almost on the common sense level; in Newtonian mechanics statements occur which are fairly remote, like the law of inertia, according to which a body abandoned to itself will move into the infinite along a straight line relative to a system of reference that we do not know precisely. In the theory of relativity we are told about masses which increase without the addition of other pieces of matter. There are bodies that do not obey the laws of Euclidean geometry, etc. This continuously increasing gap between common sense concepts and the general concepts of science has given the philosopher a great deal of difficulty, as well as the scientist who grew up with some traditional, though unconscious, philosophy. The departure from common sense has been one of the main reasons why dissatisfaction with science has arisen, and why the feeling has grown that science is "dehumanized." It is interesting to examine the opinion of men who were equally interested in and versed in science and philosophy on the issue of the role of common sense and philosophy.

We shall find a widely held opinion that philosophy has always attempted to stay on the level of common sense, while for science the further and further departure from common sense has been an important and progressive tendency in its growth and evolution.

There were two great turning points in the history of science, the transition from mechanical to mediaeval science, around 1600, characterized by the names of Galileo and Newton and, around 1900, the transition from Newtonian science to 20th century science which is characterized by the theory of Relativity (Einstein) and the Quantum Theory (Planck, Bohr, Heisenberg, and others). Each of these turning points was also a strong [?] departure of what was regarded as common sense at that period. Around the year 1900, the second great turning point in the history of science and philosophy, one of the most prominent thinkers was Charles S. Peirce. [note 1] In his classification off the sciences he suggests a very revealing distinction between philosophy and the special sciences like physics, biology, etc.

As class I of the classification he proposes mathematics.

Class II is philosophy which deals with positive truth, indeed, yet contents itself with observations such as come within range of every man's normal experience, and for the most part in every waking hour of his life. These observations escape the untrained eye precisely because they permeate our whole lives, just as a man who never takes off blue spectacles soon ceases to see the blue tinge. Obviously, therefore, no microscope or sensitive film would be of the least use in this class (i.e. philosophy). The observation is an observation in a peculiar, yet perfectly legitimate, sense.

Peirce stresses explicitly the point that the advances in the special sciences do not contribute much to the advance of philosophy. "If philosophy glances now and then

at the results of special sciences, it is only as a sort of condiment to excite its own proper observation." If, for example, we learn from twentieth-century science that a very large quadrangle cannot have four right angles that fact lies far beyond our common sense experience; but this broad generalization may serve to stimulate us to investigate more carefully the common sense concept of a quadrangle.

In class III are, according to Peirce, "the special sciences, depending upon special observations, which travel or other exploration, or some assistance to the senses, either instrumental or given by training together with unusual diligence, has put within the power of the student.

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According to Peirce there is in the formulation of every science some result of philosophy, because we have to start every special investigation by exploring how far we can go by using only common sense concepts and common sense laws. Peirce writes [note 2: to section 246]

Philosophy, whose business it is to find out all that can be found out from the universal experiences which confront every man in every waking hour of his life, must necessarily have its application in every other science. For be this science of philosophy, that is founded on those universal phenomena as small as you please, as long as it amounts to anything at all, it is evident that every special science ought to take that little into account before it begins to work with its microscope, or telescope, or whatever special means of ascertaining truth it may be provided with.

Peirce divides philosophy into "Phenomenology, the ultimate analysis of all experience," "normative sciences, which investigate what ought to be, [" ?] and finally metaphysics [note 3. to ??] The attitude of metaphysics towards the universe is, according to him, merely that of the special sciences. However, it is to be distinguished from sciences like physics or psychology by the fact that it confines itself to those parts of physics or psychology which can be established "without special means of observation." These are, of course, specific [peculiar?] parts which differ greatly from the rest. This makes the specific difference of metaphysics from physics.

According to scholastic philosophy "a statement of metaphysics" was assumed to be seen with the "eye of the intellect." [note 4] Then one may call it a "truth of being." However Peirce strongly stresses the point that metaphysics, like philosophy in general, is based on pure common sense experience and does not use the technique developed by science. Peirce also stresses the point that metaphysics is distinguished from the special sciences "by its confining itself to such parts of physics as can be established without special means of observation, But these are very peculiar parts, extremely unlike the rest." Peirce gives a very instructive example from which we can learn what, according to him, is a scientific and what is a philosophical solution of a question. Since the period of Epicurean philosophy in old Greece, one of the most important theories about the structure of matter is "atomism" according to which matter consists of small solid lumps between which there is a large empty space. But there has been, at least since Descartes, another theory according to which the whole world space is filled with a subtle liquid; there is no empty space, an where the existence of solid particles (atoms) had been assumed, there are actually vortices of liquid. If we wish to decide

scientifically which theory is preferable, we would try to derive logically from each of the two theories conclusions that could be checked by sense observations. If the two theories lead to different sense observations, we can by direct observation decide whether matter is divided into small lumps or fills space continuously. From the philosophical point of view a decision cannot be reached unless we "look at the alternative with our inner eye and see which is the true one." This means, in other words, that we can try to find out which alternative, atoms or vortices, discontinuity or continuity, is nearer to our common sense experience, nearer to the experience of our every day life. Peirce writes that "the question must evidently depend upon what we ought to conclude from everyday unspecialized observation." This means that we have to decide whether atoms in a void or vortices in a fluid are more plausible to our common sense experience. This recommends the same methods as those by which Francis Bacon decided in favor of the Ptolemean system rather than the Copernican. [section 3]

From Peirce we learn a very important point: metaphysics is not based upon the results of modern science; it does not need, for instance, twentieth-century theories; it can draw all its conclusions from the theory that presents in the most practical way our every day life experience, and this theory is the doctrine of common sense. We find that even the most fervent advocates of metaphysical insight, provided that they have good judgment about scientific method, will agree that metaphysics is not based upon science but upon common sense. We may quote the judgment of Jacque Maritain, one of the most prominent scholars and thinkers, who follows the philosophy of St. Thomas. [note 5: to Preface to metaphysics] He writes:

The knowledge of Common Sense is a natural spontaneous growth, the product, so to speak, of rational instinct, and has not yet attained the level of science. Nevertheless, this infra-scientific knowledge is more universal than that of various particular sciences. It possesses a certain metaphysical value inasmuch as it attains the same object as metaphysics attains in a different fashion. Common Sense is therefore a rough sketch of metaphysics, a vigorous and unreflective sketch drawn by the natural spontaneous instinct of reason. This is why Common Sense attains a certain though unscientific knowledge of God, human personality, free will, and so on.

While metaphysics is based directly on common sense, the path leading from common sense experience to the principles of quantum theory or relativity is a long and arduous one. All concepts of metaphysics are very close to the concepts we use to describe our everyday experiences, and which we call common sense concepts, while the main concepts of theoretical physics are very remote. To understand this we can take an example from geometry. The expression of "straight line" used in non-Euclidean geometry, or of "mass" used in relativity theory, or of "momentum" in quantum theory can be connected with observational concepts like "red," "warm," "round," only by a long chain of rather difficult arguments. We shall clarify the situation when we discuss the "metaphysical interpretations" of particular physical theories. However, at this point we shall recall how a French logician and philosopher, E. Goblot, described this particular relationship between science and metaphysics, which is very different from the way in which it has been traditionally envisioned by scientists as well

as philosophers, who have not given sufficient thought to the behavior of scientists and the actual behavior of philosophers [note 6 to cite]. Goblot writes: "Physicists and Metaphysicians arrive at principles of physics which are very different from each other." Here again occurs the dichotomy described by St. Thomas. The principles of the physicists are formulated in terms which allow one to deduce, by means of operational definitions, statements about sense observations. The nature of the terms used is irrelevant to physicists. The metaphysician prefers formulations that have a direct meaning in the domain of common sense experience, or that can be interpreted by close analogy in the domain of common sense experience. Goblot continues:

[section break??] Physicists start from concepts by means of which one can construct all other concepts; they arrive at these principles at the end of long research work and of profound analysis. The metaphysicians start from the simplest beings and the most palpable facts, taking their first elements from most common experience.

Like Peirce, he strongly stresses the point that metaphysics is not based upon science in its recent form but upon common sense experience or, to speak precisely, upon the system of statements by which our daily life experiences are presented in the most practical way. Metaphysics consists in a general view upon our common experience or, when it is concerned with advanced science, it does not offer any view of the principles of contemporary science, but on the analogies to these principles in the domain of common sense experience. From these considerations it follows that metaphysics is much nearer to the concrete facts of our experience than physics, which makes us of very abstract concepts like "the straight line" of non-Euclidean geometry, "the particle without trajectory," of quantum theory, etc. Goblot goes on:

It is theoretical physics which is really abstract: it is metaphysics that allows a piece of empiricism, It may seem that metaphysics, which flatters itself that it proceeds a priori, deserves the reproach of empiricism while physics, an experimental science,, is shown to be perfectly rational.

Goblot saw the empirical nature of metaphysical knowledge in the fact that all metaphysical prepositions, although verbally referring to "knowing by the inner eye," refer actually to phenomena in our common sense experience while the principles of quantum theory cannot be interpreted as direct descriptions of our daily experience. As we shall see later on, one can give "metaphysical interpretations of quantum theory," which attempt to find in our common sense experiences some analogies to the principles of quantum theory.

Goblot also recognizes clearly that the "seeing with the intellect" claimed by metaphysics is actually a disguised appeal to common sense experience. He says:

Despite its rationalist and aprioristic tendencies, metaphysics in its search for the real cannot attain it without an appeal, at least a disguised one, to experience, since only experience can teach us what is.

From all these considerations, it can clearly be seen that the "man in the street,"

whose thoughts are fully restricted to common sense, will be more inclined to accept the "intuitions" of metaphysics than the scientist will be. H. V. Gill, an advocate of Thomistic philosophy, writes [note 7 to cite]

The fact that a few "specialists" call in question some intuition generally accepted by men does not present a valid reason for doubting its truth. The specialist is, indeed, perhaps the one whose view or first principles should be taken most cautiously. Before anyone becomes a specialist he must recognize the first principle on which specialist knowledge has been based.

The author means to prove that a scientist before going to work has to accept the "first principle" as advanced by the metaphysician because such principles are based upon common sense and no science can develop without accepting the doctrine of common sense. The argument seems to confuse two different ways in which common sense is connected with science. As we have seen, again and again, all experimental observations are described in the language of common sense and hence, all science is based upon common sense. However, these statements are certainly metaphysical statements.

The metaphysical interpretations arise when we look in the domain of common sense for analogies to the general principles of science. For instance, we may interpret Newton's gravitation as a tendency of masses to attract each other, or the law of inertia as a passivity, an inert character of masses not to change its state without being forced to it. This "metaphysical interpretation" of Newtonian mechanics adds nothing to the conclusion which is drawn from Newton's laws. Hence, the work of the scientist is by no means based upon these metaphysical interpretations. They are by no means conclusions drawn from common sense statements, nor inductions or generalizations based on common sense statements, but pictures in the language of common sense that have for a purpose the counteracting of the dehumanization of science. Gill argues: "The very fact that the scientist denies the need of accepting first principles would seem to be a confession of want of confidence in his own assertion." This statement by an advocate of Thomistic metaphysics is very instructive, because it reveals the misunderstandings that have arisen and persisted between scientists and philosophers. They have their basis in the lack of a common language that covers the whole domain of science and philosophy, physics and metaphysics.

We have attempted in this book to find this common language, by defining as clearly as possible the place of common sense on one side, and of scientific principles on the other. Then we can see clearly that the "first principles" of metaphysics are common sense illustrations of the general principles of science, but by no means the basis upon which science itself is built. We have learned to underscore the fact that metaphysical statements are not generalizations of scientific statements and, therefore, metaphysics is not a kind of super-science or superior type of knowledge. On the other hand, it would be a misunderstanding to say that the metaphysical statements of science do not serve any useful purpose. They "humanize" the principles of science: they counteract the dissatisfaction of which we spoke previously [int. cross ref, ch II, sections 1-4], and contribute in this way to the well-being of the scientist and the "consumer" of science. This point has been recognized by many advocates of

traditional metaphysics.

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One of the most prominent contemporary advocates of Thomistic metaphysics, Jacques Maritain [note 8: to ref The Degree of Knowledge], writes:

It is true that metaphysics brings no harvest in the field of experimental science.... Its heuristic realm, as the phrase goes, is nil.... This universe in which metaphysics issues...is not intelligible by its dianetic or experimental means... it is not connatural to our powers of knowledge, it is intelligible only by analogy.

In order to emphasize his principle point, that metaphysics has a purpose that is fundamentally different from the purpose of science, Maritain concedes to the enemies of metaphysics the point that "metaphysics has no heuristic value whatever." This is obviously exaggerated. By "humanizing" the principles of science, by linking their content with other activities of the human mind, interest in scientific research is stimulated. It is certainly true that the metaphysical interpretations do not produce any conclusions about observable facts which had been unknown about them, but they help integrate science into the whole of human enterprise.

Alfred North Whitehead, who more than anyone else in our period combines mastership in science and philosophy, gives much attention to this point in his book Adventures in Ideas. [note 9 to ref] He reveals the intellectual situation that could arise in our culture, if science were presented and taught from the scientific aspect, as presented in part II of this book. This would mean restricting the presentation of science to the logico-empirical argument; one would present, as we did in the presentation of geometry, only the system of axioms, the logical conclusions drawn from this system, and the operational definitions of the occurring terms. This could exclude all information about the historical context in which that system of axioms had developed. It would exclude the social, educational, and religious aims which that system had been supposed to serve. Speaking about geometry, if one means by science not just geometry but also psychology, sociology, etc. this restriction to the purely scientific aspect is actually not serving the cause of science as a whole.

Whitehead writes [note 10: to ch 7, sect. 7 of Adventures]

The intimate timidity of professionalized scholarship circumscribes reason by reducing its topice [?topics?] to triviality, for example, to bare sensa and tautologies.... The world will again sink into the boredom of a drab detail of rational thought, unless we retain in the sky some reflection of light from the sun of Hellenism.

Whitehead stressed, as had Maritain, but in a subtler way, the fact that metaphysics or philosophy in its state of separation from science cannot be directly helpful to the special sciences. He writes: "A philosophic system, viewed as an attempt to coordinate all such intuitions is rarely of any direct importance for particular sciences." He describes with vigor and ardor, however, the actual use of this philosophy to the scientist. "Even from the view of the special science," he continues,

"philosophy systems, with their ambitious aims at full comprehensiveness, are not useless. They are the way in which the human spirit cultivates its deeper intuitions."

He describes in a psychologically lucid way the actual effect of these systems upon the scientist: "Such systems give life and motion to detached thoughts. Apart from these efforts at coordination, detached thoughts would flash out in idle moments; illuminate a passing phase of reflection, and would then perish and be forgotten." Philosophy attempts to give an interpretation of science which alleviates the dissatisfaction produced by the "dehumanization," which has been deplored so much by men interested in individual and political education. The ancient and mediaeval philosophers, as well as their contemporary followers, have attempted to provide the satisfaction that had not been provided by science by digging deeper than science had done, and by penetrating by means of the "eyes of the intellect" to the ultimate causes of things and their final explanations."

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Maritain described this hope[note 11: to M's The Range of Reason]:

There must be a science, a knowledge, where the intellect... may engage in the inside task, within the workings of knowledge and where it may develop freely its most profound aspirations, the aspiration of the intellect as intellect.... Such knowledge directly concerns the being of things intelligibly grasped, it is philosophical and metaphysical knowledge.

Maritain describes very well how the scientific method, by proceeding from the common sense aspect of things to a system of mathematical symbols, prevents us from approaching the inner being of things. This argument is correct only if what the metaphysician calls the "inner being of things" is an analogy to some domain of common sense experience. By formulating general principles outside the domain of common sense, "science works," Martain asserts, "against the grain of the natural tendency of the intellect." He explains very correctly why all philosophical schools which take their cue from scientific knowledge, "positivism, old and new, and kantianism do not understand that metaphysics are authentically sciences, that is to say, fields of knowledge capable of certitude which is demonstrable, universal and necessary." The reason for this lack of understanding is that "they do not understand that the intellect sees." "In the eyes of the Kantians and the Positivists, the senses alone are intuitive, the intellect serving only to connect and unify." And here Maritain certainly did hit the salient point. According to the typical procedure of modern science, every principle has to be verified by checking its consequences with sense observations. A metaphysical statement, according to Thomists like Maritain, may also be verified by checking its consequences by, one might say, intellectual observations. Maritain calls this procedure of checking occasionally "the mystery of abstractive intuition." or "the mystery of analogical intellection." The last expression hints somehow that the mystery turns out to be the description by an analogy in the domain of commmon sense experience.

Whatever one may say in praise of "seeing with the intellect" as "looking from the inside instead of from the outside," the problem arises in all these cases: how can we describe the results of our "inside track"? Then it becomes obvious that these results are actually analogies from the domain of our daily experience and are formulated in

common sense language.

Certainly, these metaphysical interpretations are given in a language that is much less abstract and less general than the language of science and much closer to the language we are using in our everyday life. There is, as a matter of fact, no language in which we could formulate our knowledge that we acquire by the act of "knowing with the intellect." One well-known Thomist philosopher, G.B. Phelan [note 12 to ref] writes:

When the intellect of man is confronted with <u>being as being</u>, it is dazzled, and can only hope to see it by gazing upon its analogical reflection or participation in the things that are.

Prominent advocates of Thomistic metaphysics are well aware of the fact that "seeing with the intellect" yields only "analogical reflections" of the real being; by "analogical reflections" we mean, practically, an analogy in the domain of common sense experience. This use of the term <u>analogy</u> originated in theology, from the custom of speaking of "God's will" or "God's finger" without giving to these expressions their literal sense; if we speak, for instance, of God's will's producing God's deeds, this sentence is an analogical reflection of a sentence according to which human will produces human deeds. We recall also how Maritain characterized metaphysical knowledge; as we quoted at the beginning of this section, he stressed the point that the universe is intelligible to metaphysical inquiry by no direct logical or empirical procedure, but what can actively be done is the pointing out of analogies within the domain of common sense experience.

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In modern physics we understand by "physical law" a system of relations between symbols (the axioms), including the operational definitions as well as of the relations. This system implied logically statements about observable facts.. The axiomatic system and the operational definition imply, in this way, relations between observable facts. This system as a whole is now called "the laws of physics." We also speak, of course, of a "law of gravitation," "law of inertia," etc. Strictly speaking, these "laws" as isolated statements do not imply any statement about observable facts, but they are part of the structure that we call "the laws of physics."

If we enumerate these laws, we are certainly using a language that describes these laws as pieces of legislation, as parts of a code of laws. This way of speaking originates in the analogy between the universe and a human society. As the behavior of any human society is regulated by laws, the behavior of the physical universe is regulated by "physical laws." The abandonment of this analogy by modern science is one of the chief reasons for the dissatisfaction with modern science which we described previously.

The replacement of the "laws of nature" by a formal system of axioms is the central issue in the complaints about "dehumanization." In traditional metaphysics a major effort has also been made to prove by "metaphysical insight," "by penetrating the physical world with the eyes of the intellect," that the uniformities in the world of our sense observations are due to "genuine laws" in the sense of the ancient analogy

between the universe and a human society. We shall discuss these "proofs" later on in this section on "Thomistic Philosophy." We shall see that what has been called "results of metaphysical intuition" can in most cases also be interpreted as the result of efforts to find analogies with the world of common sense experience. The search for these analogies manifests itself with great clarity in the efforts to give "metaphysical interpretations" of the concept of "physical law" or more generally "law of nature."

We may take as a starting point the alternative interpretations discussed by Alfred North Whitehead. According to him, at the present time there are four prevalent main "doctrines" concerning the laws of nature: 1. the doctrine of laws as immanent; 2. the doctrine of laws as imposed; 3. the doctrine of laws as observed order of succession; and 4. the doctrine of laws as conventional interpretations.

It is easy to see that none of these four "doctrines" can be confirmed in a scientific way. We cannot derive from them facts which could be checked by observation, and they would differ from each other according to which of the four doctrines we started from as our fundamental hypothesis. If we look at "causality" from the scientific aspect, the law of causality asserts the existence of laws in nature. The existence of law means the possibility of building up formal structures of a simple type from which we can derive the phenomena that are actually observed. As physical law is certainly not an "observed order of succession" as the third doctrine asserts. The laws of physics, the recurrent series of events, certainly do not refer directly to observation. No "observed order of succession" is given to us by our experience. As we learned, the law of causality is not a law that concerns the succession of observations, but one that states we can build up a formal system from which a uniformity in the realm of observation can be derived. There is no "observed" order of succession, but an order in the succession of symbols that have been invented by the scientist in order to establish this order.

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If we say flatly that a law of nature is a uniformity in the succession of observed facts, we do not correctly present the scientific concept of physical law, but an analogy to some fact of our every day life. If we consider, for instance, a familiar experience like the regular succession of days and nights, or of the seasons of planting and harvest, we can describe this type of common sense experience correctly as an "observed order of succession." But if we should claim to have characterized by these events the actual characteristics of physical laws we would be very wrong in saying that they deal with "observed succession." If we characterize the laws of nature in this way, we advance a metaphysical interpretation of this concept. We interpret the very general concern of "physical law" by a small range of phenomena when we interpret it by the successions of observed events. Whitehead called this interpretation of physical laws the "great Positive doctrines.... It tells us to keep things observed, and to describe them as simply as we can. This is all one can know. Laws are statements of observed facts." However, as we have just pointed out, this "positivist" doctrine is actually a metaphysical interpretation. In the twentieth century the name Positivism has rather been used to denote the "scientific aspect." In order to avoid confusion, the expression "logical positivism" has been introduced. This point will be elaborated later on, when we shall present those lines of philosophical interpretation that have been influential in our

own century.

If we examine now the direction that law is either "immanent" or "imposed," it is obvious that these two concepts do not at all belong to the scientific aspect, but are two metaphysical interpretations. By the doctrine that Law is immanent "is meant," according to Whitehead, "that the order of nature expresses the characters of the real things, that the physical objects behave according to their real nature." As we learned in discussing causality, the "real nature of things" cannot be observed, and what really happens is that we observe order in our observation and set up mathematical patterns by which this order can be described. Since David Hume it has been clear that by saying "the Laws are immanent" nothing is added to the result of observation and logical deductions. What is added is an analogy with common sense experience. The physical changes in material bodies are compared with changes in human individuals and human society which have their sources in the inner constitution, with the physiological and psychological structure of the human being participating in these changes. The common sense language says that man is directed by his "mind" or by his "interior." On the other hand, the doctrine that "Laws are imposed" means that the world consists of four parts. Outside the region where physical laws are valid there are regions that are not subjected to these laws but have imposed these regularities upon our physical world. This means particularly an analogy to the daily life situations in which a lawgiver imposes laws upon a population. To characterize the distinction in a simple way, let us consider the orbit of the sun around the earth. We can say either that the sun is driven by a god or spirit that is inside the sun or perhaps identical with the sun, or that it is driven (as it is assumed in the Bible) by a God who is outside the physical universe. In the first case, we say that the law of motion is immanent; in the second it is imposed. It is obvious that in both cases we have to do with metaphysical interpretations which are actually illustrations of scientific statements by comparison with familiar types of human behavior. We see from all these considerations that the purely scientific aspect of physical law has been regarded as a part of the general "dehumanizing" trend in modern science. All the metaphysical interpretations: that the laws are immanent; that they are imposed; that the laws are observed rules of succession—they all have in common the fact that they bring a human element into the concept of law, and attempt to make science more satisfactory to the non-scientist who is, above all, interested in the effect of science upon human conduct.

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Quite a few scientists have claimed that the metaphysical interpretations of science are rather "misinterpretations" which are given by authors who have no real understanding of the intricate physical theories of the 20th Century like Relativity Theory and Quantum Theory. However, quite frequently, such interpretations were given by the very authors who had discovered or, exactly speaking, produced these new theories. It is perhaps instructive to give a glance to the example of W. Heisenberg [note 13 to ??] who is one of the most prominent authors of Quantum Theory and who, in particular, is the "discoverer" or maybe "inventor" of the "uncertainty principle."

According to the theory the "position of a moving particle" is not a property which the particle has by itself. Only within a specific environment a "particle with a position" can be described. The same thing is true for the "velocity of a particle." Expressions

like "this particle has this and this position" or "this particle has this and this velocity" are not statements about isolated particles, but statements about readings on instruments of measurement. Such readings can only be made unambiguously if the arrangement of the observational instruments with respected to physical systems of reference are precisely described.

Heisenberg explains this state of affairs occasionally in a more humanized or personalized way by saying that physical science does not describe the particle by itself but rather the act of observing and measuring the particle. In a more general way, Heisenberg writes: "The object of research is no longer nature itself, but man's investigation of nature." He continues this argument by stressing that the picture of nature does no longer mean what it used to mean in the era of Newtonian science. Today, according to him, science does no longer try to give a picture of nature which exists independent of man, it gives merely a "picture of our relationship with nature."

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Heisenberg writes bluntly [note 13]: "The scientific world-view has ceased to be a scientific view in the true sense of the word." This way of speaking seems to set a green light for unscientific and antiscientific world-views. Actually this and similar formulations have been employed for the justification of spiritualistic views and for the support of traditional interpretations of religion. If we take these formulations as expressions in our daily life language we can, according to Heisenberg, proceed to the statement that "for the first time in history modern man on this earth now confronts himself alone." Heisenberg thinks [?] this statement [?] man's struggle with the dangers which surround him. While previously man has been only threatened by savage animals, by diseases, hunger and violent forces of nature, in our age man is only threatened by other men who claim the right to the goods of the world. In this way the relation of uncertainty in physics leads to a statement about the position of man in the physical universe. It is, of course, debatable whether there is really a logical and empirical chain of argument which leads from the relation of uncertainty in physics to statements about the struggle of man with the dangers in the world. It may be that this result can only be achieved by formulating the scientific laws (like the uncertainty relation) firstly [?] in the language of our daily life, by a kind of common sense analogy, and to draw conclusions within this common sense language. In this way we could not achieve an actual result of science but only a result of a popularized presentation of science. What we call "popularized science" is, essentially, a presentation of science by an analogy which is formulated in the language of our daily life. There is no doubt that such popularization of science is helpful for the understanding of science for the layman and for the beginner, but it is dangerous to draw philosophical results from these analogical formulations. We shall see later [cross ref to be deleted?] that this metaphysical thinking was the characteristic of mediaeval scholastic philosophy and strongly antagonistic to scientific thinking.