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The Atom - Old And New

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THE ATOM - OLD AND NEW

by

Charles McCarthy

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submitted to the Department of Philosophy
of Carroll College in partial fulfillment
of the requirements for the Degree of
Bachelor of Arts.

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The purpose of this thesis is to clearly set forth the relationships which have existed and must still exist between the all-embracing science of philosophy and the particular and specialized physical sciences. In order to illustrate this we choose to study something which is, first: necessary to both philosophy and to the natural sciences, and second: that it has a history that may be examined in both its philosophical and scientific aspects over a long period of time.

The being which best fulfills these two requirements is the atom. The atom appears in history as far back as the dawn of ancient philosophy, and has continued with it even to the present time. Its importance to the physical sciences need hardly be mentioned, for the modern explanation of a great number of physical phenomena is based upon atomic theories. Its importance in philosophy is shown by the fact that it was introduced into philosophy in an attempt to explain one of the most basic and important problems in philosophy, that is, the problem of change.

In order to best fulfill our purpose we shall divide this work into three chapters. The first chapter will be a chronological summary of the different atomic ideas prevailing throughout the history of philosophy and of the problems facing the philosophic atomists. In the second chapter we shall study hylomorphism in order that the reader might understand the Scholastic view of the problem of change. In the third chapter, we shall endeavor to evaluate and co-ordinate the findings of modern physical sciences with the philosophic doctrines of the Schoolmen.
CHAPTER I

Not all of the Ancient Greeks were concerned with the problem of the atom, but in order to understand the philosophy of those who were concerned with this problem it will be necessary for us to look into the philosophy of the former in order to know the basic problems which confronted all of them.

Before entering into this, however, we shall here answer a question which might enter the mind of the reader. Namely, why do we start with the philosophy of the Greeks and not with that of a previously existing culture. The reason for this is that the atom was introduced into philosophy in order to try to solve the basic problems of that day by means of an explanation of something that was known to everyone, that is, material being. For before about 600 B.C. all phenomena was probably explained by means of myths and fables and imaginary gods. Thus, before this time there is no evidence of a philosophy as such i.e., as a reasonable explanation of all natural phenomena.

For in order to advance in the direction of philosophy, of more scientific conception of sense experiences, the Greeks had to cut themselves loose from myths and fables which gave arbitrary solutions of phenomena and thus can never lead to a rational explanation.¹

Another reason for the beginning of philosophy at this time is the probability that the Greeks, by colonization, were able to obtain

new knowledge from other civilizations.

However, it remains obviously subject to reasonable doubt whether the loss of faith in myths and fables was the principal factor in the birth of philosophy. It is even highly probable that colonization brought the Greeks in contact with valuable data of ancient Asiatic civilizations.²

Nevertheless, whatever the reasons may be, it appears that the Greeks were the first to have developed a science of philosophy. We say science of philosophy because it is true that all peoples in all ages have a philosophy of life, but the Greeks were the first to formulate a philosophy which was explained by means of facts, laws, and principles unified into a system. As we said before, we have chosen the atom as our study because of its historical value and also because the ancient Greeks were interested in the reasonable ultimate explanations of things, which had foundations in natural phenomena. Therefore, from the very beginning of philosophy we find in it the aspects of what today are called the physical sciences. Thus, from the very beginning, philosophy and science can be seen to have very intimate and necessary relationships.

PART I The Philosophy of Ancient Greece

The oldest Greek philosopher whose doctrine is partially known is Thales of Miletus (about 600 B.C.). The problem which held his attention was the problem of unity and multiplicity. In him we find the universal endeavor, which characterizes all science, to reduce the manifold of the phenomena to a certain unity. Thales thought that there must once have been a single primary matter from which everything has been derived by a gradual differentiation. We may call this the philosophic aspect of his ideas. However, he does not stop at this general aspect, but indicates water as the primary matter. This we may conveniently consider as the more scientific or

² Ibid.
physical aspect of his theory.3

Why Thales chose water as the primary matter is unknown, and for our study rather unimportant. What is important is the definite connection between the philosophical and scientific implications which he applied to his theory.

Heraclitus (480 B.C.)

Heraclitus was very much concerned with the problem of permanency and change.

Profoundly struck by the continuous change to which all being is subject, so that nothing remains identical with itself, Heraclitus thought that the only thing which really is, properly speaking, is change itself. To be is to change. Therefore, the primary matter from which everything is made must be a principal of change.4

Now according to Heraclitus the only thing which could properly fulfill the requirements for this basic principal is fire.

For fire does not remain identical with itself even for a single instant. It may appear to remain the same, yet it is always in a process of becoming, because it is forever composed of different burning matter.5

The fact that fire remains apparently the same is important for his choice of fire as prime matter. One of the big difficulties facing the philosophy of Greece was the problem that centers around the apparent contradiction between the data of experience and the postulates of reason. Now fire would explain this contradiction, because it has an appearance of identity with itself and a reality of continuous change.

3 Van Nelsen, op.cit., p. 12.
5 Ibid., p. 13.
Heraclitus gives us a suggestive comparison to illustrate these two aspects: in a river the water which flows by is forever different so that the river does not for a single moment remain identical with itself; yet it makes an impression of being something permanent.

Parmenides (about 500 B.C.)

Reasoning as follows, Parmenides started with the statement: all that is, together forms the being. This statement is historically known as the principal of Identity, and is also expressed in the following formula: Being is. Now, so reasons Parmenides, that which is must be one, i.e., it must possess unity, for if it were manifold there would have to be something which divides it. But outside of being, nothing is. Therefore, there is nothing which can divide being, and therefore, being is one. This one being is also unchangeable. For what could be the meaning of change? It could mean either the transition from one kind of being to another kind of being or the transition from non-being to being. There is no other alternative. That is the dilemma which faces the human mind when man investigates the possibility of change. Now continues Parmenides, both members of the dilemma lead to the same conclusion, namely the impossibility of change.6

It is apparent that Parmenides is radically opposed to the theory of Heraclitus. Parmenides also was concerned with the problem of permanency and change, but while Heraclitus sought the essence of everything in change so that there can be no permanent unchangeable reality, Parmenides' speculations produced exactly the opposite result. According to him reality is unchangeable, and change is nothing but an illusion. The importance of Heraclitus and Parmenides to our study is not so much in their theories but what resulted from their theories, i.e., the impressions which they made upon their Grecian contemporaries, caused these contemporaries to try to settle the problem by setting forth theories of

6 Ibid., p. 16.
their own upon the same subject. Among these were the first atomic theories.

Democritus (born about 500 B.C.)

Whether or not his atomic theory is chronologically the oldest cannot be established with certainty, but we will start with Democritus because his theory has exercised more influence upon later times than any other Greek atomic theory.

Democritus was greatly influenced by the theory of Parmenides, yet there was one point which Democritus could not accept, namely that all change is nothing but an illusion. To say that this was not true meant he would have to contradict Parmenides, but from Democritus' atomic theory it is clear that he had the constant intention of following Parmenides as closely as possible. Therefore the big problem which faced Democritus was to make room for change while retaining as much as possible the principles of Parmenides. He solves this problem as follows:

All apparent change ultimately rests upon local motion. Motion of what? The answer to this question led Democritus to the conclusion that the being of Parmenides is not one, but divided into a number of beings, each of which, however, in itself is unchangeable and indivisible. (atopos, atom)

The question may be asked how these atoms are separated from each other, for, according to Parmenides; outside being there is nothing, hence being is one. Democritus solved this by stating: "Nothing is, just like being is," Taken literally this answer would be very startling. It would seem a glaring contradiction in terms since nothing by definition is that which is not. Democritus, however, did not mean it literally. Nothing, for him, means the void, and being, the full, i.e., what is full of atoms. Thus Democritus' solution practically amounts to a surrender of the absolute uniformity of all being, because for him to be means either to be atom or to be void. By admitting the void Democritus explained not only that the atoms could be separate, but also that they could move. Hence change is nothing but the union or the separation of intrinsically unchangeable atoms. They are capable of juxtaposition but they can never
fuse into a new whole. Neither can they be divided into two parts. The only possible change consists in a differentiation of position of the atoms by union with or separation from other atoms in the sense indicated above.

In order to make intelligible the enormous multiplicity of apparent changes Democritus introduced the following hypothesis about the properties of atoms:

1) They are infinite in number, qualitatively absolutely identical, and distinct only by shape and size. Whatever differences we perceive in things are based upon the differences in size and shape of the atoms, and above all, upon the differences in their position. A change in a thing is based upon a change in the position of its atoms.

2) Motion is a primitive property of atoms. Like the atoms themselves, it is eternal and incorruptible. Hence the atoms are ceaselessly in motion, but this motion can be changed by pressure and percussion.7

Empedocles (about 450 B.C.)

The importance of Empedocles for us is based upon his apparent conception of the four elements as smallest parts, although he did not arrive at a fully developed theory of smallest parts. According to Empedocles the primordial beings are four qualitatively different primitive constituents of everything, namely air, fire, earth, and water. He says all becoming and corruption, all motion and change, can be reduced to the commingling and separation of these four elements which in themselves remain unchanged. Everything else is nothing but an illusion. To quote his own words:

Birth, properly speaking, does not occur in anything mortal nor does any mortal end in a corrupting death. Only commingling takes place and the separation of the commingled. Birth is nothing but the name which man uses to indicate this process.8

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7 Ibid., pp. 18, 19.
8 Ibid., H. Diels, op. cit., fragment 8.
Anaxagoras (about 450)

According to Anaxagoras the primitive beings are an unlimited number of qualitatively different primitive substances which he calls seeds. These seeds are eternal and incorruptible. Thus his theory, just as those of Democritus and Empedocles, contain an element borrowed from Parmenides. Anaxagoras also added that every substance contains all possible kinds of seeds and is named after the kind of seeds which predominate in it.

From this brief study of Democritus, Empedocles, and Anaxagoras it is easily seen that the influence of Parmenides is very great among them. All three maintain in his own way the fundamental principle of Parmenides, that all being is immutable. They all differ from Parmenides by reducing change to a separation and commingling of primitive substances in order to make change intelligible. Moreover and perhaps most important they all added their bit to the physical aspect of philosophy, and in their own way planted the seeds of a good deal of speculation and controversy, which, as we shall see, has continued down through the ages even to the present.

Another point we must make here is that the philosophies of these men were all very basically materialistic. They were the first attempts to solve all the problems which face the world by a theory of purely physical existence of beings. Because of this purely materialistic view these theories were attacked by other thinkers from their very beginning. Among the first and greatest of these was Plato.

Plato (427-347 B.C.)

Plato believed in two worlds, one of pure ideas and the other of
shadows cast by these pure ideas. Before the soul enters the body it
dwells in the world of pure ideas where it was able to contemplate them.
Although this contemplation is lost when the soul is united to the body,
the memory of these ideas remains in it. By the perception of the world
of shadows this memory is revived because the shadows are images of the
pure ideas.

Mathematics plays an outstanding role in Plato's system.

If ever, then certainly in mathematics, man is convinced that he is
dealing with clearly defined concepts. Even in an imperfect realiza-
tion of a triangle, for instance, in an imperfect drawing, he is
able to read the properties of the perfect triangle.\(^9\)

Therefore, it was possible for Plato to justify himself by taking the
Pythagorean view that the sensible world must be explained by means of
mathematics.

In a certain sense therefore the world of mathematical entities
forms a kind of intermediary between the suprasensible world of pure
ideas and the world of material reality. Plato had already utilized with
some success this concept in matters referring to astronomy. The reason
for his success was that the orbits of celestial bodies can be observed,
so that there is an immediate connection between the theoretical idea and
the observed phenomena. In the theory of elements however, such a direct
connection was missing. Thus Plato found few supporters of his theories.
However his work did prove valuable eventually because the rapid progress
of the mathematical treatment of scientific problems which occurred at
the time of the Renaissance was due greatly to the revival of Platonism.\(^{10}\)

\(^9\) Van Nelsen, op. cit.
\(^{10}\) Ibid., p. 29.
Aristotle (384-322 B.C.)

In contrast with the theories of Plato, those of Aristotle were more successful in refuting the teaching of Democritus. As we have seen, the people of the time had come to look for an explanation of all things by means of something concrete, something sensible. Plato had given them an answer that looked good in the abstract field of mathematics but which failed when put to the test of tangible reality. Relatively speaking, Plato had applied himself very little to physical science, and although his anti-materialistic philosophy was in perfect contrast to that of Democritus, it did not go far enough to attack it in any details. With Aristotle however this is not true, for, as Plato’s gaze is continually turned towards the heaven, Aristotle’s also contemplate the earth, and he explicitly formulated a theory of nature which avowedly tried to solve the problems raised by Democritus. Repeatedly Aristotle mentions Democritus’ doctrine, to attack it. However we must bear in mind that Aristotle did not attack the theory of smallest parts in particular but rather the entire philosophical system which Democritus had formulated with its basis in his theory of smallest parts. This has important bearing in our study for because of it a great deal of work in the field of the physical sciences was, if not postponed at least retarded for several centuries. If Aristotle had paid a good deal more attention to the theory of smallest particles, even if only to refute this theory, then at least the study of Aristotle would have aroused a good deal of interest

11 Ibid., p. 30.
in this problem in later periods. Aristotle was mostly interested in refuting the philosophy of Democritus in general and as a result of his great influence on succeeding ages, the atomic theory of Democritus was presumed to be a theory which was false. The way that Aristotle refutes Democritus is for the most part by giving a different answer to the dilemma which was postulated by Parmenides. To go into this answer, is at this time beyond the scope of this work, later we will take up the scholastic theory of matter and form which parallels in great part that of Aristotle.  

Brief sketch of the philosophic atom from Aristotle down to the 17th century.

For our purposes then the philosophy of this period can be summed up rather briefly. Due to the coming of Christianity, natural philosophy was to become quite obscured because the church was primarily interested in that part of philosophy which deals with morality, namely ethics. The theory of smallest parts was as a consequence for the most part neglected entirely. Those few who did pay any attention to this theory, accepted it almost exactly as Democritus had first expounded it. Very little was added. The Church opposed its patent materialism. Moreover, the philosophic teachings of Aristotle dominated the Schools of Europe up until the 17th Century.


14 Ibid., p. 49.
Seventeenth century Atomism.

In our effort to show how the concept atom has changed from its predominantly philosophical aspect into one which has come to be regarded in its purely physical surroundings, the 17th century occupies a very special place. For it is in this century that this great transition takes place, and although physical science did not reach independent recognition in this century, it was well on its way. To briefly survey this period we shall study the works of the two most important men of this time in connection with the theory of atoms, Descartes and Boyle.

Rene Descartes (1596-1650)

Not without reason does every historian of philosophy begin a new period with Descartes. For the atomic theory of Descartes, as the rest of his work, is original in outline and execution. As in philosophies preceding, that of Descartes retains the close connections between general philosophic and scientific ideas, however, his approach to the explanations of problems is different. "Because I could not find anybody whose views seemed worth of my support and preference above others, I was constrained, as it were, to construct my view of life by consulting only my own reason."15 Hence, he says, he was forced to construct his own, beginning and building all on his famous methodic doubt.16 By the methodic doubt in natural philosophy he decides what is clear and self-evident in regards to material being. He says that the only things


perspicuous in matter are mathematical proportions. Therefore, the only thing which is real in matter is extension. Thus for him matter and extension are the same. Since mathematics is the science of extension it is the only science which can tell us anything about matter and its properties.

Also he says that the concept "void" is a contradiction of terms. For where there is space there is extension and therefore matter. He explains the apparent lack of material beings in some places as follows:

At the beginning of the world all matter was divided into particles of equal size. These particles were in constant motion and filled all space. Now this is possible only if the motion is circular, and the original form of the material particles is not spheric, because spherical objects naturally leave some "empty" space. As a result of the original motion some particles were gradually ground into a spherical form, but this does not cause any difficulty because the resulting intermediary space become filled with these "grindings." 17

From this brief account of Descartes' doctrine of smallest parts it is easy to see what an important role the physical properties of a being plays in comparison with the theories we have seen earlier. Although his doctrine is basically philosophical, the realization of the importance of a physical explanation which can in some way be verified by observable phenomena is beginning to appear.

His corpuscles are characterized by differences in mass, in amount of motion, etc., properties, therefore, which can be expressed in definite measurements and treated mathematically. However arbitrarily Descartes may have proceeded in the derivation of his different kinds of corpuscles, he finally arrived at corpuscles endowed with exactly the properties which could be used by contemporaneous mechanics. Hence Descartes could make an attempt to express mathematically the laws which govern the motions and the collisions of particles. 18

17 Van Melsen, op.cit., p.95
18 Ibid., pp. 96, 97.
Thus for the first time we see a proper physical setting for the problems beginning to develop. Democritus' theory of atoms had contained some very fertile physical initiatives but which unfortunately were not properly evaluated by the Greeks, whose attention was centered on the philosophic setting of the problems. However, as we shall see this was not so in the 17th and following centuries.

Robert Boyle (1626–1691)

Boyle is the first who can properly be called a physicist. His predecessors were primarily philosophers. Their knowledge of physical science was frequently slight. With Boyle however this is not true.

In Robert Boyle we encounter a scholar who primarily, and more or less methodically, aimed at an independent physical science, just as Galileo and Newton had aimed at independence in the fields of mechanics and astronomy.¹⁹ Yet Boyle could not form a completely independent physical science because the attitude of the times was still predominantly influenced by the theories of Aristotle. Also Boyle was forced to use language that was proper to philosophy and thus the very statement of his ideas often gave rise to philosophical implications. However he did set the stage for the complete break from philosophy.

His importance in this regard is threefold. First, he set down certain criterion to be used in order to validly determine whether or not a given particle or particles were really elementary parts or only a combination of other elementary parts.²⁰ Secondly, he added some very

¹⁹ Ibid., p. 99.

²⁰ Ibid., pp. 100–101.
important knowledge to the field of chemistry through his experimentation, especially with the laws governing the properties of gases. His third and most important contribution is that which he made as regards the Aristotelian concept of form.

Substantial forms were a great problem for Boyle. For the contemporary Aristotelians, in order to explain any unknown phenomenon, simply resorted to some unknown form. We must note here however that the concept form had acquired a far different meaning than it ever had for Aristotle. It had become an independent being which by its presence dominated supremely the reaction of the elements. Boyle had different ideas about the concept of form.

Since an aggregate or convention of qualities is enough to make the portion of matter it is found in what it is, and denominate it of this or that determinate sort of bodies; and since those qualities, do themselves proceed from those more primary and catholic affections of matter, bulk, shape, motion, or rest, and the texture thence resulting, why may we not say, that the form of a body being made up of those qualities united in one subject, doth likewise consist in such a convention of those newly named mechanical affections of matter, as is necessary to constitute a body of that determined kind. And so, though I shall for brevity's sake retain the word form, yet I would be understood to mean by it not a real substance distinct from matter, but only the matter itself of a natural body, considered with its peculiar manner of existence; which I think may not inconveniently be called either its specific or its denominating state, or its essential modification, or if you would have me express it in one work, its stamp. For such a convention of accidents is sufficient to perform the offices, that are necessarily required in what men call form, since it make the body such as it is, making it appertain to this or that determinate species of bodies, and discriminating it from all other species of bodies whatsoever.

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One may object to this explanation of form by saying that a thing which is but the sum total of its components has no true unity, but is only an aggregate, an accidental being. However Boyle does not think that this objection is conclusive and confirms explicitly that a compound body is not an accidental being but a being with essential unity.

In the notion that divers learned men have of an ens per accidens, namely, that it is that which consists of those things quae non ordinantor ad unum, (which are not joined together into a unity), it may be said, that though we do not admit substantial forms, yet we need not admit natural bodies to be entia per accidens; because in them the several things that concur to constitute the body, as matter, shape, situation and motion ordinatur per se et intrinsice (tend immediately and intrinsically) to constitute one natural body. But if this answer satisfy not, I shall add, that for my part that which I am solicitous about is, that what nature hath make things to be in themselves, not what, logician or metaphysician will call them in the terms of his art; it being much fitter in my judgment to alter words than to affix a wrong nature to things, that they may be accommodated to forms of works that were probable devised, when the things themselves were not known or will understood, if at all thought on.

Aristotle had introduced his concept of form as a philosophic concept in a fundamental philosophic problem in order to explain the possibility of change. But it had become a concept which was used in season and out of season, especially to explain all kinds of details in physical phenomena. As an answer to the question, how change in matter is possible, the appeal to a fundamental composition made sense, but it was nonsense to answer a question such as "Why is a body hard?" with the formula "because of its form." We want to know why this body is hard or that one is soft. Hence the concept form was useless to explain the differences in behavior of bodies which interests the physicist. Now

24 Ibid., p. 487.
since the question raised by Boyle belonged primarily to the physical order, the philosophic concept of form could hardly be of any use. The answer to his questions had to be in terms which have reference to sensible and measurable properties. Therefore, let us briefly summarize Boyle by saying that for him two things are certain: first the properties of bodies must be explained by their composition and secondly though the bodies be a compound, nevertheless they are still truly a single unit or one. Boyle's theory is the outcome of the practical need for a reasonable explanation of contemporaneous physical and chemical problems. His predominant interest in the terms he borrowed from his predecessors is not in their original philosophic meaning, but in their usefulness for his physical theory.

The Modern Era

More than anything else the atomic theory after the 17th century was in great need of better physical insights. Thus the men concerned almost completely with this purely physical side, left philosophy as such to the philosophers. Yet each man is somewhat of a Democritus inside himself, and nothing which he does can be left out of the general mode of thought by which he governs his life. For it is by very nature that a man uses his powers of intellection to unify all the scraps of information he gains and try to build them into a composit theory of ultimates. Every man is necessarily a philosopher of sorts. Although these men of the modern era were chemists, physicists, mathematicians

25 Van Melsen, op.cit., p. 106.
26 Ibid., 107-109.
and so on, and left philosophy as such to the philosophers, still there is an undercurrent of thought which dominates the thinking of these men and in many instances leaks over into the field of philosophy. The two most general of these modern undercurrents are mechanism and dynamism. For the present we shall leave these two concepts, and examine the scholastic doctrine of hylomorphism, as an explanation of ultimates. We shall return to mechanism and dynamism in the following chapter.
CHAPTER II

HYLOMORPHISM

As is apparent from the preceding chapter, the different theories which have been propounded in regard to the atom have been laid down for the express purpose of giving a reasonable explanation of just what occurs when a physical change takes place in corporal bodies. As we shall show in the next chapter, all of these theories with the exception of Aristotle's, have some basic errors which make them unreasonable in the light of sensible facts, and therefore must be disregarded in favor of a system which offers a better explanation. We take some exception to Aristotle, he is not correct in all of his philosophic endeavors, however he still offers the best known theory explaining the problem of change. His theory was accepted and added to by St. Thomas and the scholastic philosophers in general and is known to us today as the Hylomorphic Theory.

We must not fall into the mistake of thinking that this theory has been proven beyond all shadow of a doubt, lest we end up in the same boat as the Aristotelean Commentators, who accepted his words on faith.

"Many believed that once and for all he (Aristotle) had discovered the truth. Hence their main occupation was to study his books and to comment upon them in order to explain obscure passages and to assign to new discoveries a suitable place in the framework of Aristotle's philosophy."¹

Therefore, we must not say that the Hylomorphic theory contains everything

¹ Van Melsen, op. cit., p. 46.
that is to be known about matter and form. For although "Hylomorphism offers a philosophical rather than a physical explanation of the constitution of the universe, it is intent upon finding rational grounds for the observed facts of changes and motion."²

Observing these facts in the job of all the different branches of science for without them we can have no rational grounds on which to base the explanation of the constitution of the universe. Moreover, if the findings of science do not verify the Hylomorphic theory then it must be adjudged accordingly.

It is well to remember, however, that Hylomorphism is but a theory and as a theory, it has value only in so far as the progressive findings of science bear it out. Cosmology is the philosophy of physical nature. The attitude, that Cosmology is pure metaphysics and may ignore the conclusions of trained and reputable scientists, is an improper approach to the problem and is contrary to the spirit of Aristotle and St. Thomas. These geniuses based their hylomorphic theory on the best knowledge of their age and they propounded the theory precisely as an explanation of the scientific data as they knew them. In the face of contradicting facts, they were, as their works prove, the first to abandon a prevailing theory.³

We mention this because with the advent of Nuclear Physics, the explanations of the hylomorphic theory may seem to be inadequate in the light of certain facts known about the internal structure of the atom. This does not mean that the hylomorphic theory is wrong, but rather that it does not go far enough to explain certain properties which the particles of the atom are known to possess. A theory has been proposed which

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² A Realistic Philosophy. K. F. Reinhardt, Ph.D. Stanford, University; The Bruce Publishing Co., Milwaukee.

is said to explain the phenomena of the atom better than the hylomorphic theory. This theory is known as Hylosystemism.4

The decision between hylosystemism and hylomorphism depends upon which of the two theories can give the most logical and rational explanation of the physical facts manifested by natural bodies (elements and compounds). This was, and still is the purpose for which they were devised. Every hypothesis rests upon some fundamental assumptions. These assumptions will be either verified or refuted by subsequent discoveries. If these discoveries bear out more and more (as they should) the primary assumptions, then the hypothesis is strengthened and gradually nears verification. If, however, these discoveries, as they increase in number and accuracy tend to show that the primary assumptions are incorrect, the hypothesis is weakened and may finally be discredited entirely. If the primary hypothesis or theory following increased and perfected knowledge, must be bolstered by an auxiliary hypothesis or theory, it is usually a sign that the original assumptions were inaccurate or untrue.5

Yet for the purposes of this work the two theories can be reconciled, because in all their basic respects they agree, and differ only in secondary aspects.

Hence an element is an ultimate body; it does not consist of other bodies, but other bodies (compounds) consist ultimately of elements and originate from them. This is also the concept of an element in the science of today, so that the philosophical concept of Aristotle and St. Thomas and the physical concept of modern scientists are in accord.6

The secondary respects by which these two theories differ is centered around the problem of the nature of hylons. Hylons are the heterogeneous sub-elemental and sub-atomic particles of matter, namely, electrons, protons, neutrons, and possibly positrons.7 Therefore, we

4 Ibid., pp. 315-342.
5 Ibid., pp. 326-327.
6 Ibid., p. 318.
7 Ibid., p. 318.
can consider the two theories to be in complete agreement because for our work we will be concerned only with those problems of the natural minima and not with those parts of matter which cannot exist independently of a unified whole of which they are a part. By natural minima we mean those parts of matter that are the smallest parts of one specific kind of matter, which are capable of acting as a unit. For example protons would not be considered as natural minima, because by the very nature of a proton it must be in some way or another, united with other members of the hylon group.

The hylomic parts (electrons, protons, neutrons) are real parts which combine to form a whole (the atom molecule), and this whole is certainly more than the mere numerical sum of its constituent parts. Their union effects a real energy system which acts as a functional unit. Just as a house is more than the sum of all the bricks and strips of wood, so the atom is more than the sum of the electrons, protons, and neutrons.

The important thing to note here is that this hylomeric constitution is a natural constitution due to the natural tendencies of the subatomic particles to unite and not through some extraneous compulsion.

In order that the reader may better understand the difference existing between hylomorphism and hylosystemism, a brief comparison will be made of the two systems at the end of this chapter.

In the hylomorphic theory there are two basic components which comprise each and every bodily being. These two co-principles are primary matter and substantial form. Primary matter is the material and indeterminate principle and substantial form is the formal and determin-

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3 Ibid.
9 Ibid., p. 325.
First of all, prime matter is the substrate common to all bodily being. It is matter without form, i.e., it is without a determining principle which makes it a certain kind or species of a thing. It is potentially all things but it is actually nothing. For all matter that we know of is some kind of a being. Now all of these beings are informed beings since they are of a type or species or kind. Yet they will have something in common in as much as they are all bodily substances. This thing which is their common denominator is what we call prime matter. But primary matter cannot exist of itself for it is pure potentiality and as such could not have any actuality. We cannot conceive of prime matter as existing by itself, for when we have an idea of being we must have an idea of some kind of a being. Since prime matter is potentially all material being, then it cannot be of any one kind in itself. Therefore we say that primary matter can exist only in so far as part of its potentiality has been actualized. When this potentiality has been actualized then it is no longer primary matter as such but rather informed matter or secondary matter. Now secondary matter is primary matter that has had part of its potentiality actualized. Thus it is "actualized potency, i.e., it is contained in a real body as one of its constituent elements."¹⁰ Yet we said that prime matter is the common substrate of all bodily being. For any bodily being is still capable of becoming any

¹⁰ Reinhardt, op.cit., p. 59.
other being and can also return to its original state of being. For instance an atom of oxygen can unite with two atoms of hydrogen to form a new substance, water. The only substance which is present then is the water and the substance of oxygen and hydrogen have disappeared. Yet the water can be decomposed and once again we will have the substances of oxygen and hydrogen. Therefore we can say that these two substances are virtually present in the actual substance of water.

Thus we can say that "Primary or primordial matter is an incomplete corporeal substance, undetermined but determinable, capable of receiving any kind of substantial form."\(^{11}\) It is a passive and indeterminate substantial principle which is the subject of all substantial determinations and substantial changes, and which remains changeless in itself under such changes.

**FORM**

By form we mean, that which determines a thing, sets it in its being, in its essence, in its accidents, in its actuality. Any determining element in a reality is a form.

There are two kinds of forms, accidental form and substantial form.

An accidental form is any reality which determines and modifies a complete substance such as quantity, quality, activity, and so on; it makes the substance to be so or so, for example hot, hard, colored, magnetic, etc. A substantial form is that reality which determines a being in the line of substance and constitutes either the whole or a part of its essence.\(^{11}\) In material substances or bodies, the substantial form is that part-substance which determines primary matter.

\(^{11}\) Bittle, *op. cit.*, p. 289.
and which, combined with primary matter, gives to a body its specific nature.  

To illustrate the differences in these two kinds of form let us take for example the forms of a piece of clay. All of the essential notes which go to make this thing clay, are what constitute the substantial form. That is all those things which contribute to the "clay-ness" of this being, and which make it essentially this kind of a being instead of some other kind of being. Accidental forms on the other hand do not contribute to the essence or definition of the being. For instance red clay and green clay differ only in their color and not in the substance itself. For it is still clay no matter what the color, size, shape etc. Also, when for instance a statue is made from a piece of clay its substantial form is still that of clay and only its accidental form is that of a statue. Thus we can see that a being can have only one substantial form but many accidental forms.

CHANGE

In order to understand what is meant by change we must first see how prime matter and substantial form depend upon one another for their existence. First of all prime matter is uniformly the same in its nature throughout the universe, and is dependent upon substantial form for its existence and specific determination. For prime matter cannot exist unless it exists as some kind of being. At the same time a kind or species cannot exist as a universal but must be present in the individuals of that species. Therefore the substantial form is incapable

12 Ibid., pp. 200-201.
of existing alone, for it requires union with matter to give it existence.

Therefore the substantial form is called the principle of specification and matter the principle of individuation. However matter and form must not be thought of existing things, each ready to be united with the other. "For forms do not pre-exist to the matter which they in-form, nor has prime matter any existence of its own; existence comes with the actual union of the matter and form, and is actively referable to the form."\(13\)

We must think of matter and form as two co-principles, incompletely substantial but which by nature are ordained for a substantial union, which together constitutes a complete bodily substance.

Change is the transition from potential to actual being. For this transition two requirements must be met. First that there is in existence some bodily substances and second that this substance is capable of becoming some other kind of bodily substance. This second requirement is evident from what we have already said about prime matter. The first however may not be quite so clear. Therefore we must note the difference between change and creation. As we have seen change is the transition from potential to actual being. But pure potentiality cannot exist in itself and therefore for any bodily being to exist it must have some actuality. Still since bodily beings are contingent beings, they must have some starting point at which time they came into their initial or first type of being.

This is where creation comes in. For creation means that a body

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comes into existence as this one particular thing, without having contributed in any way to its own being. For example an acorn contributes to the becoming of an oak in that it is potentially an oak. For the becoming of an oak it is necessary that it previously existed as an acorn. However in the creation of a being, there is no previously existing material being which has in it this potentiality, which is necessary in the changing of a being. Therefore creation must be attributed to some other being which is above and beyond any and all material substances.

There are two types of changes, substantial change and accidental. By substantial change we mean that all of those things which go to make this being this kind of being, disappear, and in their place arises a new set of determining principles which make it a new kind of a being. For example if we burn a lump of coal the form of coal disappears and in its place arise the forms of water, carbon dioxide, coal tars etc. Yet we can see that even though the forms of all these beings are different, still they all have something in common, namely bodily being. Thus we can conclude that in every substantial change there is something which changes (substantial form) and something which remains the same (primary matter).

By an accidental change, we mean such superficial modifications in the mechanical and physical properties of bodies as do not affect or destroy their substantial unity. For example when a house is painted, it has undergone a change, for as before it was brown, now it is white.

14 Reinhardt, op. cit., p. 60.
But still it is the same house. None of the things which made it a house have been changed. The same is true when we change water into ice or steam. In this case some of its properties are lost and others gained but still it is composed of exactly the same substance. In other words it does not lose its substantial form but only its accidental form.
CHAPTER III

CONCLUSION

In this chapter we shall try to evaluate the contributions of the various ages to the concept of the atom, in the light of what we have seen in the first two chapters. We shall also try to show what relationships, if any, should exist between the natural sciences and philosophy.

First of all we must make a distinction between a physical science and the science of philosophy. Any science is the orderly knowledge of things in their causes. A science consists of a comprehensive body of established principals and laws with their legitimate conclusions, woven together into a unified system. Therefore since both philosophy and the natural sciences, are sciences, they have in their essence, something which gives them a common denominator whereby it is possible for them to be linked together. Where the two differ is in their point of view of the subject matter being studied. For instance in the study of material beings the chemist will look for such things as solubility, melting point, valence, atomic weight, reactions etc. Physical science is concerned with material being in its immediate, proximate causes, of his particular science.

Philosophy is concerned with the ultimate causes principles of all beings.

1 Bittle, op.cit., p. 6.

Therefore we can say that Philosophy is the study of beings in their ultimate causes while physical sciences deal with beings in their proximate causes. To make this distinction is very important for although the philosophical viewpoint is not determined by physical sciences (in fact Philosophy judges Physical sciences, for it judges all human cognitional activity), yet the natural sciences supply the data by which Philosophy of nature must use in order to come to valid conclusions. By valid conclusions we mean those which have their basis in the factual findings of our senses. As we can see then, natural philosophy is dependent upon the physical sciences. In the same way however the natural sciences, are also dependent on natural philosophy. As we have said every man is somewhat of a Democritus. For man is a reasoning animal and as such has a tendency to look at things in connection with their ultimates. Man does this, whether consciously or unconsciously, by his very nature. Therefore if a person is to be able to place particular facts into their proper position as regards the whole he must have some knowledge of the laws, principals, and causes of the universe in the light of the ultimate reasons which lay beyond these laws, principals and causes.

Now from what we have been saying, two things should stand out in the reader's mind. First, philosophy is to a certain extent dependent upon science and second, science is to a certain extent dependent upon philosophy. With this in mind then let us go on to the evaluation of the various ages as regards their contribution to the atomic concept. We shall begin once again with a study of the ancient Greeks. First of all

3 Van Melsen, op. cit., p. 200.
it might be asked, of what value are their speculations to us today? We can answer this from both the philosophic and the scientific point of view. From the physical point of view their importance lies most of all in the fact that due to their attempts to explain problems that were basically philosophic by the use of the observed phenomena found in material beings, they thus became the founders of natural science. Their importance from the philosophic viewpoint is that in tying up a physical concept such as that of the atom with problems which were basically philosophical, they were laying the groundwork for what we have come to know as the philosophy of nature. What is more, from the viewpoint of both science and philosophy they made a very important contribution by bringing to light and expressing their theories on such a basic problem as that of change. It is fairly easy to see the importance of this in philosophy, but perhaps not quite so easy in science. One could ask how does this have any consequences for a science of today, due to the fact that the Greeks were interested in change in general while today science is interested only in concrete and particular changes? We shall answer this as follows:

Why do we call all these concrete changes, changes? Only because they possess a common element, i.e., an element which is found in all cases of change. Otherwise to speak of change would simply be an abuse of language and a cause of confusion. Of course, such an abuse of language does occur occasionally, but it remains exceptional. Let us illustrate this with a very modern example, the so-called process of dematerialization.\(^4\) Since it was discovered only in the

\(^4\) This is sometimes called creation and annihilation in the physical sciences, but the terms are not used in the strict philosophical sense. J. D. Stranathan, The "Particles" of Modern Physics, New York, Toronto: The Blakiston Company, Inc., 1942. p. 374.
twentieth century, it certainly is something of which Aristotle did not even dream. Nevertheless in this process we speak of change in just the same sense in which Aristotle spoke about change. For the concept change expresses at the same time two elements, namely, a thing-remaining-what-it-is and the thing-being-different. That which first was such is now different. Hence the scientist says: the electron is changed and transformed into gamma quanta, because he sees a special connection between this electron and those gamma quanta. He explains, for example, the energy of the latter corresponds exactly to the mass energy of the electron. In other words, nothing has totally disappeared, nothing was annihilated to be replaced shortly after by something else which has nothing in common with the former. The physicist is profoundly convinced that the gamma quanta came from the electron, and this is the reason why he calls this process a change. Accordingly, he calls dematerialization a change because this phenomenon exhibits all the essential characteristics of change; in other words, this concept of change is available before its new concrete application. However, this answer does not yet settle the issue, for one may make the objection: Do you want to assert that from the very beginning all concepts are immutably fixed? We certainly do not make any such claim, for obviously it is not true. Nearly, all modern physical concepts come gradually into existence and were subject to frequent change. But the concept of change is not a physical concept if by this term we mean a concept which could come into existence only within the frame of natural science. It is far more primary, and forces itself upon our attention as a concept which is needed even for the classification of our most primitive experiences. Without the concept change no human knowledge is possible, and consequently neither any knowledge of natural science.

Another great contribution of the Greeks which bears mentioning is the tremendous stimulating influence which they have had on both science and philosophy since their time. For example someone might say that the theory of Thales of Miletus, i.e., that everything is composed of water, or the theory of Heraclitus, i.e., that everything is composed of fire, is ridiculous in the light of what is known today in the natural sciences about the composition of matter. Nevertheless no matter how ridiculous it may seem to us it is very important for.

We owe our better insights to the fact that we took our starting

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point from the less good insights of our predecessors. Because they proposed certain theories and hypotheses it was possible to check and to correct them if faulty.6

As we have seen, the problems which the Greeks were interested in are the same problems which confront us today. The debt which we owe the Greeks therefore, is due to the fact that they are the ones who did the initial work on these problems and in this they enabled their followers to work on these problems with greater knowledge and facility. For as we can see the science of nature proceeds by successive stages. For example chemistry could be developed only when various physical methods of measurement had been learned. The physics of the seventeenth and eighteenth century was possible only when the more mathematical methods of differential and integral calculus had been developed. Biology could open new vistas only when physics had given it the microscope as a tool. In other words traditional problems receive new solutions as more is learned about these problems. "Thus we see everywhere in the science of nature either a successive rising of new problems or a more profound solution of the same problems."7

Let us then sum up the value of the Greeks (insofar as this work is concerned), by saying: First, materially they contributed a few things, but these things are rather insignificant as far as science is concerned. Second, they produced a stimulating effect which was beneficial both to science and philosophy. Third, they supplied the link, by their work upon the various theories of atoms, by which science and

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7 Ibid., p. 203.
and philosophy could have some common ground, and thus originate a philoso-
of nature.

The next period we shall consider is that from the time of Christ untill the seventeenth century. As we said before this period was one in which the philosophy of nature had fallen considerably into the back-
ground. The reason for this was the primary interest of the Church in the other branches of philosophy. However, as we said, man is still curious about the things in nature and therefore, even during a period such as this, the physical sciences were bound to progress. But if the Church had taken a more active part in the physical sciences it could well have meant that much greater strides would have been taken in this progress. For an example of what we mean let us look briefly at what was known as Alchemy. Alchemy is the medieval science of chemistry, and through this science a good deal was learned about such things as the extraction and purification of metals. However, many of the alchemists were not particularly interested in the welfare of humanity but rather in their own personal gain. We are not trying to say that all of the alchemists had these intentions but evidently there were a great number who did.

While among the alchemists there were some genuine enthusiasts, the annals of this queer practice are filled with accounts of charlatans and spurious adepts who, with a deluge of glib words but only a drop of truth, turned alchemy into one of the greatest popular frauds in history. The writings of these avaricious devils and honest fools are a meaningless jargon of cryptic terms and strange symbols. Their public demonstrations of transmutation were often clever enough to fool the most cautious. Many came to witness the making of gold from

8 King and Caldwell, op.cit., pp. 5, 6, 7.
lead and iron, convinced that it could be done. For had they not seen iron vessels, plunged into certain natural springs containing copper salts, emerge covered with the red metal? It was a matter of common knowledge that a dark dirty ore could be heated until all its impurities were destroyed and a bright shiny metal was obtained. Traces of silver and gold had been found in many ores. Then why could not the further heating of these ores yield larger quantities of the precious metals? In fact, with sufficient treatment, it ought to be possible to change the ore entirely into lustrous gold. Simple enough questions in the light of their ignorance of chemical facts. Besides, nature was performing marvelous transmutations every minute of the day as food was changed into blood, and sugar into alcohol.9

Therefore let us say that the greatest mistake of the alchemists was not in the work they were doing but rather in the ends for which they pointed this work. However, do not think that the middle ages were without men who were competent in the field of science, for this is not the case.10 Yet due to the influence of medieval philosophy it was not easy for the scientist of that time to receive just recognition for his competence, and so the purely scientific work of many of these men was looked upon as being rather trivial and unimportant. As an example let us look at Roger Bacon (1214—c. 1294). Today Bacon is called the father of experimental science.11 In his own day, however, he was not regarded with such high esteem. In fact his death drew so little attention, that its date is not even recorded.12 There are many reasons for the unpopularity of

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9 Crucibles, by Bernard Jaffe, Simon and Schuster Inc. Copyright 1930. King and Caldwell, op.cit..

10 For a list of such men see the Foundations of Catholic Belief, Brother Bernard Alfred, F.S.C., La Salle Bureau, 122 West 77th St., New York, N.Y., Copyright 1942.

11 Ibid., p. 237.

Bacon, most of which are unimportant for this work. One of them, however, is important to us and that one is the fact that he was a great advocate of the scientific method. Because of this "Bacon never attained even a momentary success. The age was not yet tired of metaphysical speculation." There are several other reasons which caused the loss of success for Bacon but we bring this one out to illustrate our point.

Therefore, let us now briefly summarize the middle ages. It was a period in which a good deal of scientific knowledge was brought to light. Yet it is highly probable that much more of this knowledge would have been gained if it were not for the overemphasizing of philosophy, to the near exclusion of natural science. Also the stimulating effect initiated by the Greeks had not been continued. As a result if it did not keep scientific endeavors at a minimum at least it caused them to be looked upon with indifference and sometimes contempt. But let us not be too harsh on the philosophers of that time for as we have said before "in the late Middle Ages it was thought that science had reached its perfection with Aristotle. Hence, study of science meant the study of the logical connection between universally accepted fundamental thesis and their deductions in terms of Aristotelian philosophy."14

Let us now continue to the last period of our study. In the first chapter a distinction was made between the seventeenth century and the modern era. However to make this distinction now is quite unnecessary. In the first chapter we made this distinction in order to show the

13 Turner, op.cit., p. 337.
14 Van Melsen, op.cit., p. 123.
transition which occurred in the seventeenth century. But once this switch had come about, the problems we are interested in, remain about the same.

As we have seen the seventeenth century was of great importance due to the fact that science at last was able to free itself from the tenacious hold of Aristotle and Scolastic philosophy in general, and to finally find a respectability which was its just due. Therefore let us now look to the things that the scientist has accomplished with his new found freedom.

From the point of view of material goods it would be ridiculous to try to prove the value of the physical sciences. For all one has to do is look about him. The radio, the automobile, medical development, atomic energy and thousands of other things all have come to us through the work of the physical sciences. Because of scientist, things that in the Middle Ages would have been looked upon as the product of a wild imagination, have become everyday necessities of life. Therefore we can conclude that the physical sciences without any control by philosophy have fully justified themselves. Or have they? As far as the materialistic viewpoint is concerned, they have. But can we look at any particular subject from the purely materialistic viewpoint. Man is not just a bundle of material parts. He is composed of both matter and spirit, body and soul. That which makes man different from all other beings here on this earth is this spiritual part of his composition. His soul raises him above and differentiates him from all other bodily beings. Therefore to look upon a subject without looking at the consequences that this subject has upon his soul, is a grave injustice to the integrity of the
human being. We must look then, not only at the material value of a particular subject, but also to the spiritual value. Therefore let us look at science from another point of view. Namely that of the effects which science has produced upon the intellect and will of man.

First of all let us see what contributions science has made to such things as our colleges and universities, or to economic, sociological and governmental policies. In the material sense, once again the contributions have been great. The lighting, heating and equipment in our buildings, refining methods and transportation in economics, the everyday utilities we use in our homes which raise our standard of living in society, the protection our government affords us by the use of new and improved weapons; all of these and many more are the result of the great progress in science. But how about such things as the godlessness in our educational system, the perversion of capitalism for excessive personal gain, the loss of moral values in society, the government under which the people exist for the state, not the state for the people, are these and many things like them, a part of the great progress of science. Before we answer this question, let us return briefly to our study of the atom.

Just as in philosophy there are theories which try to explain the ultimate ends of all being, so in science there are theories which try to explain the properties of material beings. The important difference between the two kinds of theories is in the purpose for which they exist. For just a moment let us look a bit farther into just what a scientific theory is.

Imagination is brought into play in scientific procedure. The scientist speculates regarding particular phenomena and their behavior.
Such a speculation is termed a hypothesis. The hypothesis then is
tested by experimentation and more facts regarding a given phenomenon
and behavior are obtained, which lead to a verification of the hypo-
thesis or to its modification and correction. As proof is obtained
the hypothesis becomes a theory. A theory is not a permanent con-
clusion but is changed and modified as experimental results are
obtained which are not readily explained by the theory. Theories
are useful in that they allow one to anticipate and predict the
results of further experiments and aid in the discovery of new phen-
omena.15

The same is true of philosophical theories, and as is readily seen they
are important to both fields. However, a theory, just like anything
else can lead to trouble if improperly extended. As an example witness
the theory of modern Mechanical Atomism. This theory arose in the early
part of the Eighteenth century.16 It began as a scientific theory and
not as a philosophical theory. At about this time Isaac Newton posited
his law of attraction as a universal law which applies to all bodies.
"All bodies, even the smallest particles, attract one another with a
force proportional to their mass and inversely proportional to the square
of their distance."17 From this law both scientists and philosophers
formulated new theories (although not completely new), as to the nature
of change. Among these theories was that of the mechanical atom. The
true scientist accepted this theory for just what it was, a theory. He
worked on it through experimentation, until either he could prove or dis-
prove it. As history has shown us the scientist has disproved it.

15 King and Caldwell, op.cit., p. 2.
16 Newton Henry Black, An Introductory Course in College Physics,
17 Van Melsen, op.cit., p. 1141.
This theory maintained that all change could be attributed to the external forces of attraction which exist between the different bodies. Nuclear physics has proven that there are forces within the nucleus itself, which cannot be attributed to outside forces, nor controlled by them. Therefore science has rejected this theory. But what about philosophy? Has it rejected this theory? In answering this we must keep in mind that the data of nuclear physics was not available to the philosopher and the scientist of the early eighteenth century. Therefore for the scientist it was a perfectly good theory at this time. In philosophy however it was not so good because of what was known about the nature of things even at that time. For instance it maintained that everything can be reduced to homogeneous atoms and mechanical, local motion. From what we have seen in the preceding on matter and form, such a proposition would be impossible even if the scientific aspects of this theory had not been disproven. For how could such a theory explain such a thing as a substantial change. For each kind of being, is different in its essence not merely in the accidental location of its parts, one to another. Nor can the powers of a living organism be attributed to a group of homogenous atoms whose only power lies in their mutual relationship. In a theory such as this, all beings would have to be essentially one for they would have nothing by which to differentiate themselves. Living and non-living beings would have no essential difference, nor would they have any purpose for their existence. For a mere haphazard grouping does not give reason or direction to a being. There is, and

18 Reinhardt, op. cit., p. 56.
indeed must be, an intrinsic principle of law and order which arranges the atom according to a definite plan and design. Mechanism however, is helpless in explaining the presence of "types" found in nature.\textsuperscript{19} Therefore we can conclude that this theory, even before it was disproved by the physical sciences was in error both philosophically and scientifically.

The theories of dynamism, energism, electronism and aetherism are also philosophic theories first proposed by scientists.\textsuperscript{20} That some so-called philosophers played an intimate part in the production and fostering of these theories cannot be denied but neither can the part played by the purely physical scientist. Just what is wrong with each of these theories is a problem which is beyond the scope of this work to go into. In brief we declare that in some way each of these theories, either in its essential propositions or in its connotations, leads to pure materialism - a philosophical absurdity.

Going now to our original question, namely, can science be held responsible for such things as godlessness, perverted capitalism, immorality, and the absolute state. From what we have seen of the philosophic theories of the scientists, it is evident that they have given rise to modern materialism, sensism, skepticism, predominating the modern scientific world. Therefore we can say that these qualities are at least partly due to these theories.\textsuperscript{20} But can we say that science as science

\textsuperscript{19} Bittle, \textit{op. cit.}, p. 252.

\textsuperscript{20} For other reasons for these qualities in the modern world, see Thomas P. Neill, \textit{Makers of the Modern Mind}, Milwaukee: The Bruce Publishing Company, 1949.
is responsible for this present day materialism? The answer to this is no. For science as such is completely indifferent to the ultimate constitution of the universe. The complete sphere of scientific concern belongs strictly to the proximate constitution of bodily being. The question of a pure materialistic conception of all beings is a problem of the ultimate constitution of things, and as such falls within the field of metaphysics, and does not concern the physical sciences at all.

Therefore let us try to come to some conclusions regarding the relationship between science and philosophy. First of all philosophy does depend upon science and hence cannot be indifferent to the findings of science, for it must utilize and explain these findings if we are to have a proper evaluation of the physical universe. Second, science must depend upon philosophy, inasmuch as science as such needs a guiding hand in order to give it direction and purpose. Third, philosophy and science working properly and harmoniously together, in the search for truth, will avoid the evils which as we have seen, can come about when there is an overemphasis put upon one or the other. Finally, although science and philosophy must work together, let them be separate and distinct for they are completely independent, formally, by their very nature. To illustrate this point let us paraphrase Dr. Thomas P. Neill.

It was six men of Indostan
To learning much inclined
Who went to see the Elephant
(Though all of them were blind)


That each by observation
Might satisfy his mind.

Each man, the fable runs on, took hold of the elephant at a different
place, and each concluded from his limited experience what sort of
animal this wondrous elephant was. One bumped against its side; so
he decided that "the elephant is very like a wall." Another took
hold of its tusk and therefore concluded that it was "very like a
spear." A third thought the elephant was similar to a snake, be­
cause he had grabbed its squirming trunk. The fourth who clasped it
by the knee, thought it "very like a tree." Another felt its ear and
thought it like a fan; and the sixth blind man, grabbing its tail,
concluded it was "very like a rope."

And so the men of Indostan
Disputed loud and long
Each in his own opinion
Exceeding stiff and strong,
Though each was partly in the right
And all were in the wrong.

In the first place, the six men of Indostan argued loud and long
about an animal none of them had even seen. Each had become a specialist
on one part of the elephants anatomy; each was therefore competent to
talk about his specialty, but none was qualified to generalize correctly
about the elephant as an animal. Each was therefore partly right, but
all were wrong. Because none of the men could step back a few paces to
see the whole elephant, the six fields of specialization created confu­
sion about the animal as a whole. But there must be the seventh man, who
views the whole elephant.

Now if we let the elephant represent all material being, the six
blind men represent the different physical sciences and the man with
vision represent metaphysics, it becomes obvious that there must be a
meeting of minds in order to come to correct conclusions as regards the
problems concerning matter. The only place where such a meeting of minds
could possibly take place is in the field of philosophy.
BIBLIOGRAPHY


