

## VIII

### MARITAIN'S VIEW ON THE PHILOSOPHY OF NATURE\*

John C. Cahalan  
Wang Laboratories  
Lowell, Massachusetts

What is the philosophy of nature, and what is its relation to empirical science? On these questions, three schools of thought have predominated among North American realists: the school of Jacques Maritain, the school of Laval, under the leadership of Charles DeKoninck, and the school of River Forest and Vincent Smith. I will not attempt to summarize this complex dispute. Instead I will explain and defend Maritain's central positions concerning the philosophy of nature, responding to the objections of his critics. Specifically, I will discuss dianoetic and perinoetic intellection, ontological and empiriological analysis, and the distinction between the philosophy of nature and empirical science resulting from their diverse ways of abstraction from matter.

#### I

Is there any method by which we can arrive at knowledge of truths about nature in addition to the truths known by empirical science? To answer that question, we must first ask in what sense the word "method" is employed. Here the reference is to the method of verification (via iudicii), as opposed to the method of discovery (via inventionis). The method of verification is the method by

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which we determine that a particular statement is indeed true and the opposite false; it provides the control on our assertions. Why is it necessary to approach the question of a philosophical knowledge of nature from this point of view? The most important reason is that knowledge of the truth of propositions is the goal of intellectual endeavor, since propositions are the means by which we conform our minds to reality. Therefore, it is incumbent upon philosophers to be able to give an account of how we manage to separate the true from the false in the torrent of beliefs which do not cease to pour forth from the minds of humans in general and philosophers in particular. It is for this very reason, in fact, that so many believe there can be no knowledge of the physical world other than scientific knowledge. According to this viewpoint, empirical scientists alone seem to have reliable methods of controlling which statements are to be assigned the value of truth.

The question of verification also concerns Maritain. In chapter six of Reflexions sur l'intelligence,<sup>1</sup> he distinguishes the philosophy of nature from empirical science precisely in these terms. And in The Degrees of Knowledge, the distinction between dianoetic and perinoetic intellection is first mentioned in a discussion of the fact that in science, as opposed to natural philosophy, sensibly experienced facts constitute the "medium of demonstration" which exercises "control."<sup>2</sup>

How, then, can we separate true assertions from false? One way of showing that a statement is true is by showing

that its opposite is impossible. We show that the opposite is impossible by showing that it violates a thing's identity with itself, in other words, that the opposite is contradictory. But how can we determine a statement's truth if its opposite is not impossible? We can do so only by reference to what is actually the case. And how do we know which of two possible states of affairs is actually the case? We know only by the evidence of experience. Statements can be verified, therefore, only by one or the other of these methods or by some combination of both: by appeal to the principles of identity or non-contradiction in the case of necessary truths, by experience of what actually exists in the case of contingent truths.

Can a method of verification, however, relying solely on our experience of contingent states of affairs give us knowledge of truths about the physical world other than those available to empirical science? I do not deny that contingent facts enter philosophical arguments. If philosophy verifies its conclusions solely by reference to experience, however, it is hard to see how its conclusions have escaped the notice of scientists. As far as sense experience is concerned, the scientist is given as much information about the physical world as is anyone else. Therefore, in order to give us knowledge of truths other than those of empirical science, philosophy must verify by appeal to truths whose opposites are impossible.

Yet can we expect to have this kind of knowledge about nature? Philosophers like Aristotle, Aquinas and Maritain

thought so. Maritain's position on philosophy's method of verification is well known and is in the background of whatever he says about philosophy as a mode of knowing. In particular, these remarks about the philosophical method of verification will help us to understand what Maritain means by the distinction between dianoetic and perinoetic intellection.

To approach this distinction, let us enter more deeply into a realistic analysis of necessary truths. That analysis stands in sharp contrast to the analysis that other schools of thought have derived from Hume. In the first place, necessary truths can give us information about extra-mental existents, not simply about our concepts, words, and their logical relations. When it is said that the necessary truth of self-evident propositions can be known solely by understanding how the words of these propositions are being used, the reference is not to understanding the contingent facts that certain language-forms happen to be used in certain ways. Moreover, when self-evident truths are described as known through an understanding of concepts, the reference is not to the mental dispositions by means of which we cognize things. The reference is to our acquaintance with the objects that we cognize by means of mental dispositions, the objects which constitute that for which certain language-forms happen, contingently, to be used. This is traditionally known as the objective as opposed to the formal (meaning mental or psychological) concept.

(Henceforth this is what I will have in mind when speaking of concepts.)

The second difference between the realist and post-Humean accounts of necessity is that realists recognize truths whose necessity derives not from logical relations but from causal relations. Events in nature must be caused to occur, and natural causes must behave in certain ways in certain circumstances. This is where knowledge of essence enters the picture. When Maritain describes essence as a locus of intelligible necessities,<sup>3</sup> we should read: a locus of necessary causal relations, relations of effects to their necessary causes and of causes to their necessary effects.<sup>4</sup> Causal necessity is the key to what he says about dianoetic and perinoetic understanding of essence because causal necessity is the key to our knowledge of essence in general. In the traditional formula, the natures of things are known from their activities.

Why? They are known in this manner because a thing behaves according to the dispositions for behavior that its make-up gives it; its behavior, in other words, is determined by its mode of being. The nature of a thing, therefore, is a principle of activity, a locus of dispositions to act in certain ways (relations of a cause to its effects) or to be acted on in certain ways (relations of effects to their causes). That is what a nature is: a transcendental causal relation which is the basis for predicamental causal relations. As we will see shortly, we learn the natures of things by rising from knowledge

of sensible effects to knowledge of what things must be in order to cause those effects through the application to experience of necessarily true causal principles.

This is true of both dianoetic and perinoetic knowledge of natures. The distinction between them, on the other hand, follows from a third and final difference between the realist and the post-Humean accounts of necessary truth. The post-Humean account makes the necessary co-extensive with the analytic. Analytic truths, truths known from an understanding of terms, include truths which realists would call self-evident and truths derivable from the self-evident; for the latter are likewise known from an understanding of terms, not exclusively from an understanding of their own terms, but from an understanding of their own terms plus the terms of the statements from which they are derived. It follows that on the post-Humean view, there can be no such thing as a truth which is incapable of being false but which we are not able to recognize as such solely from an understanding of terms.

Realists, however, recognize a category of truths described as self-evident in themselves but not to us.<sup>5</sup> Actually, it is misleading to describe these truths in terms of self-evidence rather than in terms of necessity. For the whole point is to distinguish what is incapable of being false, which is ultimately an ontological consideration, from what we are able to recognize as incapable of being false by acquaintance with the meanings of words, an epistemological consideration. When we describe a truth

as self-evident or as analytic, we are referring to the causal process by which we come to know its truth. When we describe a truth as necessary, we say something about the truth itself, not about our knowledge of it. We are saying that its opposite would be impossible. From the first difference between the realist and post-Humean accounts of necessity it follows that "impossibility" here does not mean that the truth of the opposite would require us to affirm or deny the same thing. Rather, it would require the same thing to be and not to be what it is. If necessary truths were concerned only with the logic of our words and thought processes, they would be co-extensive with the analytic, and contradiction would be exclusively a matter of affirming and denying the same thing. If there are necessary truths concerning extralogical things, however, then the necessary need not be co-extensive with the analytic, for contradiction refers, primarily, to a thing's both being and not being what it is.

In the perspective of causal necessity, for instance, it might well be the case that for heat to exist and yet not to have the ability to expand solids, heat would have both to be and not to be heat. The nature of heat on this hypothesis would be a transcendental causal relation such that, in the absence of any interfering cause (which would be such only through the transcendental causal relation which constitutes its nature), heat will produce this effect as long as it is what it is. And if there are necessary causal relations, it may be the case that water could

fail to freeze at 32° F under standard atmospheric pressure if and only if water was not water, atmospheric pressure was not atmospheric pressure or heat was not heat. In general, to say that what a thing is is equivalent to a locus of necessary causal relations is to say that if these relations did not hold for a thing of a certain nature, then the thing would also not be of that nature.

The ontological contradictions that would follow if these causal relations did not hold need to be graspable by us through our understanding of the meanings of words like "heat," expands," "solids," "water," "freezes," "pressure," or of any other words. In such a case, we could only have what Maritain calls perinoetic knowledge of a locus of necessary relations, that is, of an essence. As I plan to argue in a forthcoming work, there follow from self-evident principles necessary truths telling us that events, like the expansion of solids and the freezing of water, must be brought about by the presence of causes sufficient for the events to occur and that if a change has not always been occurring, it can occur only if previous changes have brought sufficient causes for it into existence. These truths tell us, as well, that if two successive circumstances are similar with respect to causal factors which were sufficient to cause an event of kind E in the first circumstance, then an event of kind E must occur in the second circumstance, provided no interfering causal factors are present. However, these truths do not tell us which specific effects in our experience are necessarily related to which specific causes, for our knowledge of these truths



is extraneous to our acquaintance with the objects to which I refer with words like "heat," "expands," "water," etc.

These principles, however, do license us to look for causal relations between experienced events by noting what changes do or do not follow previous changes. Arising from such investigations is the certitude that it is unreasonable to believe the opposite of some causal hypothesis. For example, derivation from the self-evident does not tell us that it is impossible for there to be a fourth causal factor, in addition to the natures of water, temperature and pressure, in the freezing of water. Yet we can know that it is unreasonable to believe in the existence of such a factor since the only reasonable bases for the belief in the existence of anything are experience and principles concerning things without which what is experienced would not exist, in other words, necessary causal principles. Neither the variation of the circumstances we experience nor any necessary truth point to another factor in the freezing of water.

On the other hand, experiential investigations regulated by causal principles derivable from the self-evident do make it unreasonable to believe that necessary causal relations do not hold between heat and the expansion of solids; between temperature and pressure and the freezing of water. In knowing that these necessary causal relations hold, we also know something of what these necessary causal relations are and, hence, something of what these natural

essences are. (The nature of water is, among other things, a readiness to freeze in certain specific circumstances.) It would be incorrect to think that what Maritain means by perinoetic intellection is knowing that a nature exists without knowing what it is. As he recognizes,<sup>6</sup> we cannot know that a thing exists without in some manner knowing what it is; otherwise our knowledge would be vacuous.

When I know that there is a necessary causal relation between heat and the expansion of solids, I know something of what heat is, namely, a transcendental relation to the production of this effect, and something of what solids are, namely, a transcendental relation to behave thus as a result of the causality of heat. Natures, again, are sources of activity, and to know them as such is to know them as they are. In discussing perinoetic intellection, Maritain even goes so far as to say that primitive men

... have an intellectual discernment, ... very precise and very exact, of 'what are' the beings of nature with which they have to deal.<sup>7</sup>

The difference between dianoetic and perinoetic intellection, as he repeatedly tries to make clear, is not a question of knowing or not knowing essence. What else would there be to know other than bare, unspecified, existence? There are, however, different ways of knowing essence. One of them he calls dianoetic, the other perinoetic.

What, then, is the difference between these ways of knowing essence? To know that a necessary causal relation holds between the things for which we use the words "A" and

"B" is not the same as knowing that necessary causal relation in itself. To know a necessary relation in itself we must know that its opposite is excluded from possibility. That requires knowing from our acquaintance with what are referred to by "A" and "B," and perhaps other words, that if this relation did not hold, something referred to by one of these words would both be and not be what it is. When we know that denying a causal relation would require the referent of some word both to be and not to be what it is, then our acquaintance with the referent of that word is acquaintance with it precisely as a predicamental or transcendental causal relation. On the other hand, just knowing that it is unreasonable not to believe that a necessary causal relation holds is not the same as knowing that it is impossible for this relation not to be what it is. (Nor is the former knowledge identified with understanding the meanings of terms precisely as transcendental or predicamental causal relations, as will be explained in the next section.) In short, to know a necessary causal relation in itself is to be able to verify it by resolution to truths known from an understanding of their terms. That is dianoetic intellection. Knowledge of essence which falls short of this is perinoetic intellection.

I have argued that Maritain's distinction between dianoetic and perinoetic intellection follows from the difference between the methods of verification in philosophy and empirical science.<sup>8</sup> But there is more to Maritain's account of these modes of intellection than we have so

far discussed. In order to show how the rest follows from the difference in methods of verification, I now turn to a consideration of another distinction, the distinction between ontological and empiriological analysis.

## II

To see the connection between these two distinctions (dianoetic-perinoetic intellection and ontological-empiriological analysis), let us begin by asking why we cannot have dianoetic knowledge of phenomena. What are phenomena? We can define them, consistently with Maritain's definition,<sup>9</sup> as objects which are distinguishable from another by sense knowledge alone. The senses alone, for example, are able to distinguish the blue color of one piece of litmus paper from the red color of another piece; but it is not by means of sensory operation alone that we distinguish alkalis from acids. Sensory operation alone can distinguish the third mark from the second mark on a calibrated scale; but the senses alone do not reveal the significance of measurements.

Now to the extent that our terms are defined by reference to such sensibly distinguishable objects, acquaintance with the meanings of our terms is not sufficient for us to know that the opposite of a causal hypothesis is impossible. Why? This is the case for two reasons, one of which is mentioned by Maritain himself, while the other follows from principles he recognizes. First, the occurrence of any event characterized by sensibly distinguishable features will be multiply caused.<sup>10</sup> Any number of causes must

cooperate to bring about the event of my seeing a red line coinciding with the third black mark on a white scale. Therefore, my understanding of words whose meanings are sensibly distinguishable objects is in no way sufficient for me to assign a cause of a specific nature to a specific effect or an effect of a specific nature to a specific cause. Only considerable experience viewed in the light of general causal principles can license me to do that.

The second reason is a consequence of the existence of chance, something of which Maritain is aware, along with the rest of the realist tradition.<sup>11</sup> It is a necessary truth that, assuming the qualifications mentioned in the last section are kept in mind, similar causes have similar effects. But the converse is not necessarily true. The effects of causes acting according to necessities inscribed in their natures can have chance characteristics not traceable to the natures of the causes taken individually. And among such chance characteristics of the effects of a cause can be the fact that its effects are similar in some way to the effects of another cause. The same litmus paper presently perceived as pink can be perceived as red either as a result of being dipped in acid or as a result of being in a red light. Now human knowledge advances by moving from data of which the senses are aware to an understanding of the causes of that data. But the fact that similar effects can have dissimilar causes makes it impossible to assign specific causes to specific sensible effects solely from

the acquaintance with those effects that allows me to make them objects of concepts.

Hence, dianoetic intellection of necessary causal relations is not possible in the case of sensibly distinguishable objects, the details of phenomena, or in the case of theoretical terms defined by reference to such objects. No truth known from its terms alone, nor any set of such truths, connects the theory of heat as the energy of moving molecules with such sensible objects as the feeling of warmth or the coincidence of a colored line with one of the series of marks on what we call a thermometer.

If there is nothing in the intellect, however, that is not first in the senses, how is dianoetic intellection of causal relations in nature ever possible? My answer will have two parts. First, in dealing with the problem of how our intellectual knowledge derives from sense experience, realists have failed to grasp the implications of their own doctrine that the genus is only logically distinct from its species. This means that the generic and specific concepts are ways of articulating a datum of experience which differ from one another with respect to their logical properties, but not with respect to the extralogical reality which they articulate. Thus from any experience from which we can derive specific concepts like red, green or blue, we can also derive the generic concept color, and anything we can describe as canine, equine or human we can also describe as animal. As these examples illustrate, the difference between generic and specific

concepts is only one of such logical characteristics as greater and lesser explicitness and vagueness. Whatever information is conveyed by "color" is conveyed by "red," but "red" conveys more information than does "color." I will describe this logical relation between generic and specific objective concepts as the logical inclusion of the genus in the species. Since the genus and species differ only logically, the same experience from which we derive a specific concept allows us to derive the generic concept.

How does this help us to solve the problem of achieving dianoetic intellection of natural causal relations? From the experience of a particular change, for example, litmus paper changing color in solution, we can derive the meaning of many words. Awareness of any of these meanings will not be sufficient for us to assign the details of this effect to their specific causes; we cannot verify by resolution to the self-evident what causes the change in color.

Yet logically included in the concept of any particular change is the general concept of change. Logically included in the concept of any particular subject of change, here the paper, is the general concept of subject of change or material cause of change. And logically included in the concept of material cause is the general concept of cause, which embraces other types of causality as well. We cannot verify by resolution to the self-evident what efficient causes make litmus paper change color. From our acquaintance

with more universal objects, however, such as change, subject of change and cause in general, we can verify by resolution to the self-evident that whatever undergoes a change does so only because something other than itself, the efficient cause, exists. In other words, insofar as concepts make reference to sensibly distinguishable objects, they cannot reveal necessary causal relations. Yet logically included in such concepts are more universal concepts, derived from the same data of experience, which can reveal necessary causal relations, but only very general, not specific, causal relations.

We have already seen why the more specific concepts cannot reveal necessary causal relations. Now let us ask what it is that enables more general concepts to do so. The answer to this question is the second part of the explanation of how dianoetic intellection derives from sense experience. When terms are defined by reference to sensibly distinguishable objects, we have what Maritain calls empiriological analysis. Those general concepts which reveal necessary causal relations are not empiriological but ontological concepts. What does this mean?

From the sense we acquire not only our awareness of sensibly distinguishable objects, but also our awareness of the real, as opposed to merely imagined or conceived, existence of things. Existence is not something the senses can distinguish from other objects in our perceptual fields; nor is it just a less explicit way of articulating one sensibly distinguishable object as opposed to another. Sensibly



experiencing an object, however, as opposed to merely imagining it or conceptualizing it, allows us to judge that the object is in that state which is the ultimate presupposition (on the part of the cause) and the ultimate term (on the part of the effect) of all causal relations, i.e., real existence.

Once existence has entered our intellectual knowledge by means of judgment, we can construct definitions, not by reference to sensibly distinguishable objects, but explicitly in terms of relations of various kinds to the objective value "existence." For example, "being" means that which exists; its meaning is a function of that of "exists." "Essence" is the answer to the question "What is it?" with respect to that which exists; in other words, it refers to a way of existing, a form which existence can take. "Accident" means that which exists in another (another existent); "substance" means that which does not exist in another. A "necessary causal relation" holds when we have really distinct beings, one of which would not exist without the other. These concepts illustrate what Maritain means by ontological analyses: definitions which distinguish things from one another by diverse relations to existence.<sup>12</sup>

Compare the distinction between substance and accident to that between male and female. As defined above, the distinction between substance and accident pertains to beings as beings, that is, as existents, while the distinction between male and female pertains to beings, not as beings, but as sexual. Sexuality is itself a mode of being. But when

we construct concepts telling us what distinguishes sexual from non-sexual beings we do not do so by reference to existence or concepts derived from it.

Among the concepts logically included in our concepts of sensible objects are ontological concepts. We could not recognize this without the judgment of existence, but once having made existence our object, we are able to see that concepts like "something existing," "something in another," and even "something without which another thing would not exist" articulate the same data or experience as do concepts of sensibly distinguishable objects, though with less detail.

The same sense experiences that allow us to distinguish sensible objects allow us to make judgments of existence. The senses are able, for example, to distinguish things in motion and rest relative to one another. When something is observed going from rest to motion, we who are able to conceptualize things in relation to existence can articulate both the motion and the things undergoing the motion as existents, as other than one another (since the things was observed to exist without the motion), as related such that the thing undergoing the motion is something without which the motion would not exist, a necessary cause of the motion.

Thus, the ontological character of these concepts enables them to reveal necessary causal relations. Recall that the impossibility of the opposite case in the ontological sense means that the opposite would require the same things both to be and not to be. In other words, the

contradictory is impossible because it is excluded from the possibility of existing. The understanding of ontological terms allows us to recognize this because these terms are "existence" itself or are terms whose meanings are explicit relations to existence. In particular, causality and its cognates are ontological concepts. A thing is a cause only if it provides some other thing either with existence itself or with some condition necessary for existence. To recognize a necessary causal relation as such, therefore, is to employ ontological concepts. That which empiriological science knows are necessary causal relations, but empiriological analysis cannot recognize these relations as such because the meanings of empirical terms do not reveal them, as we have seen.<sup>13</sup> It is the philosopher of science (and all scientists should also be philosophers of science to this extent) who by means of ontological concepts recognizes that what the scientist knows are necessary causal relations.

The concepts employed by dianoetic intellection are ontological, and this explains why Maritain can describe its manner of knowing essence as knowing an essence in itself<sup>14</sup> or knowing a quiddity quidditatively.<sup>15</sup> To know an essence in itself is to know it as a capacity for existence, a possible way of existing, since that is what essence is. That kind of knowledge is dianoetic knowledge, knowledge verified through the impossibility of the opposite. For this manner of verifying reveals that the opposite excludes the possibility of existing by requiring something

not to be what it is. In other words, where knowledge verified in this manner concerns essences, we have knowledge of essences precisely as capacities for existence, or ontological knowledge. Perinoetic intellection also gives us knowledge of essences. But since it does not distinguish things from one another by different relations to existence, it does not conceptualize essences precisely as diverse capacities for existence. Thus, Maritain is right in saying both that the phenomena in terms of which empiriological analysis distinguishes things are beings<sup>16</sup> and that perinoetic intellection does not attain "differences of being."<sup>17</sup> Perinoetic intellection does not conceptualize by diverse relations to existence because it verifies by means of contingently occurring observable events, rather than by the impossibility of the opposite. Therefore, it must define its terms by reference to objects which the senses are able to distinguish. That is what Maritain means by saying that the possibility of observation takes the place of essence in empiriological definitions.<sup>18</sup> Ontological analysis constructs concepts of objects as possible existents in order to verify them by the fact that the opposite is excluded from the possibility of existing; empiriological analysis constructs concepts by reference to objects distinguishable by possible observations in order to verify them by the contingent occurrence of observable events.

Since we must rely on sense experience for information about natures other than our own, our ontological and

dianoetic knowledge of them is confined to their most general features. We have only empiriological and perinoetic knowledge of their specific differences. Therefore, let us take the example of "rational animal" as the definition of man. How does it illustrate the ontological character of dianoetic knowledge? In particular, why does rationality make man a substance of a kind different from irrational animals, and why is rationality what Maritain calls a property of man "in the philosophical sense"?<sup>19</sup>

First, what does it mean to say that the difference between rational and irrational animals is substantial while the difference between those humans who can whistle "Dixie" and those who cannot is only accidental? Since substance and accident are ontological concepts, the question can be given a precise meaning in terms of necessary causal relations conceptualized ontologically. It makes no sense otherwise.

The accidents of a substance must have their ultimate source either in the substantial form of that substance or in some efficient cause exterior to the substance, for instance, an efficient cause which disposed the matter that received the substantial form. In saying that the difference between people who are and people who are not able to whistle "Dixie" is only accidental, we are saying that it can be accounted for, not by powers caused by their substantial forms, but by modifications of those powers traceable to exterior agents. Where such a difference is not traceable to an exterior agent, we have different kinds of substantial form. In saying that the difference between animals that

can and cannot reason is substantial, we are saying that behind the differences between the uses we make of reason, differences that may be accounted for by accidents received from exterior sources, there is an underlying ability for which we cannot so account.

When a difference in abilities is recognizable as a sign of distinct kinds of substantial forms, moreover, the ability is a property in the philosophical sense, and it can be said that we know the substantial nature in itself, though through the property. An ability which is caused by the substantial form is a necessary effect of that form, that is, a property. Were it not a necessary effect, the reason why a particular thing has that ability would have to be found outside its substantial form, since the form alone would not be sufficient to cause it. Thus, when we know that an ability is a necessary effect of a substantial form we have knowledge of that form in itself since that form is, by its identity with itself, a transcendental causal relation to this effect.

On the other hand, since phenomena do not reveal necessary causal relations, they cannot give us knowledge of properties in the strict sense or of the substantial forms from which they emanate. Rather, phenomenal regularity, which verifies our empirical knowledge of necessary causal relations, takes the place of knowledge of natures in themselves. In other words, the nature is known not only by its effects, which are signs of it but in its effects,<sup>20</sup> in the regularities which made

it unreasonable to believe the opposite of a particular causal relation. Such knowledge is "circumferential"<sup>21</sup> to essences as that without which the existence of their effects would not be possible.

### III

More than one kind of knowledge demonstrates by resolution to the self-evident, and both metaphysics and the philosophy of nature employ ontological analysis. These considerations, then, do not provide the last word on how the sciences are to be distinguished. Here I will explain realism's criterion for the distinction of the sciences. Then I will use this criterion in a demonstration of Maritain's position on the specific distinction between natural philosophy and empirical science.

The Aristotelian-Thomistic tradition is justifiably referred to as the realist tradition because it recognizes the identity between an object of knowledge (something that is the term of a knowledge relation) and a thing (something that exists extramentally). This identity does not preclude, but calls for, diversity in what is true of a thing considered as an object of knowledge and what is true of it considered as a thing. What is universal as an object of concept, for instance, is individual as an extramental existent. Diverse kinds of knowledge are to be distinguished by differences in their objects considered as objects, as Aquinas pointed out.<sup>22</sup> If the sciences were to be distinguished just by differences pertaining to things as things, why should we not recognize

a different science for everything or for every distinct truth known about things? To prevent this, it is from the point of view of what pertains to objects of knowledge as objects of knowledge that the distinction between sciences must be approached.

This is not to imply that no facts about things in their status as things are pertinent to their status as objects. On the contrary, the distinction between a thing and object is a logical distinction only, not a separation. Where characteristics of things as things are causal in relation to their aptitude for being known, differences in what belongs to things as things can cause differences in what belongs to them as objects. The fact that some things can and other things cannot exist, as things, apart from matter is decisive for distinguishing metaphysics from the philosophy of nature. This fact about things as things enters the discussion about the distinction between these disciplines, however, only because it is pertinent to their objects considered as objects. Mathematics deals with objects that are no more capable of existing apart from matter than are the objects of the philosophy of nature. Yet this fact about the extramental existence of their objects does not reduce these disciplines to unity since differences pertaining to their objects solely as objects of diverse methods of definitions render mathematics and natural philosophy essentially distinct types of scientific knowledge.

In agreement with Aquinas, all parties in the realist dispute about natural philosophy and empirical science



believed in approaching the distinction of the sciences from the point of view of what pertains to the objects of science considered as objects of science. They were also of one mind on the specific characteristic of the objects of scientific knowledge that diversifies the sciences: immateriality. Diversity between sciences results from diverse ways in which the objects of scientific knowledge are removed from sensible matter, that is, from the concrete conditions of physical existence which have their roots in the causality of prime matter.

In particular, the diverse immateriality which distinguishes the objects of various sciences is immateriality characterizing the objects of different modes of defining, different ways of articulating the things we experience by means of concepts. For it is as the objects of concepts that those things given in sense experience become objects of understanding. Different modes of defining, therefore, constitute different ways of making the objects of experience objects of rational knowledge. To put it another way, the premises of our arguments are made up of concepts; and the self-evident causal principles which function as the premises of demonstration are known to be necessary by acquaintance with their concepts. Therefore, to different modes of concept-formation or definition there correspond different kinds of principles through which the conclusions of our arguments become objects of knowledge. (For natural philosophy and empirical science, of course, the diversity of principles

resulting from diverse modes of concept-formation, ontological and empiriological, is such that one can and the other cannot demonstrate from self-evident truths.)

We will see shortly how it can be said that the objects of diverse modes of defining differ with respect to immateriality. But all parties to our dispute were agreed that, since matter is a principle of unintelligibility, diverse kinds of immateriality constitute diverse kinds of intelligibility. And since scientific intellection is achieved through concepts, the sciences are distinguished by the kinds of immateriality which characterize their modes of defining. The issue is not what kind of materiality or immateriality pertains to the objects known by natural philosophy and empirical science as things existing outside the mind. It was agreed that these disciplines study the same things. The issue is what kind of abstraction from sensible matter pertains to their objects as objects of the definitions by which these sciences cognize them.

There was also agreement that the philosophy of nature and empirical science belong to the same genus of knowledge as do geometry and arithmetic, and metaphysics and theology. Both the philosophy of nature and empirical science deal with things that can neither exist apart nor be understood apart from sensible matter. (That is what distinguishes natural philosophy from metaphysics.) But the question is whether there is any specific difference, from the point of view of abstraction from sensible matter, between their

objects considered as objects, in other words, any difference in immateriality between the modes of defining by means of which they make material things objects. To settle this question, let us examine some actual definitions from these disciplines.

First, let us consider two definitions from the philosophy of nature: the definition of prime matter as the subject of substantial change and the definition of motion as the act of what is in potency insofar as it is in potency. Each of these definitions is a complex concept constructed out of more basic concepts: the concepts of substance, change and subject of change in the first case, the concepts of act and potency in the second case. Although neither prime matter nor motion (as opposed to instantaneous change) can exist apart from matter, the object of each of the more basic concepts out of which these definitions are constructed can exist apart from matter. Substance can exist apart from matter; so can change and subjects of change; so also can potency and act. The same is true of other concepts that enter into the philosophy of nature's definitions: form, agent, end, accident, principle, power, operation, quality, relation, privation, etc. In other words, the philosophy of nature makes objects of things which cannot exist apart from sensible matter by means of definitions constructed from concepts whose objects can exist apart from sensible matter.

Now let us consider some definitions from empirical science. Momentum is mass multiplied by velocity; mammals

are animals whose females secrete milk. Again, we meet complex concepts constructed out of more basic concepts. But here the objects of the more basic concepts: mass, velocity (rate of locomotion), animal, female, secretion, milk, cannot exist apart from sensible matter. The list could go on: density is the quotient of the mass divided by the volume; chromatin is the deeply staining material in the nucleus of cells; electrolysis is the decomposition of a compound in solution by the passage through it of an electric current; a hormone is a chemical secretion carried from one gland or organ of the body to other tissues via the blood stream; a geode is a spherical rock containing a hollow that is crystallized. In each case, a complex concept is constructed out of other concepts whose objects cannot exist apart from sensible matter.

Hence, the philosophy of nature and empirical science have modes of defining which differ from each other precisely in their reliance on concepts whose objects can or cannot exist apart from matter. Because natural philosophy defines by concepts which are functions of existence, it defines by concepts whose objects can exist apart from matter; because empirical science defines by concepts of sensibly distinguishable objects, it defines by concepts whose objects cannot exist apart from matter. Both disciplines study things that cannot exist apart from matter. But to objects in the philosophy of nature, considered as objects made by a particular mode of defining, there pertains an immateriality which does not pertain to objects in empirical science.

Because of the way they are defined, the objects of mathematics belong to a genus of intelligibility different from that of the objects of natural philosophy and empirical science. And because of the way they are defined, the objects of natural philosophy belong to a species of intelligibility different from that of the objects of empirical science. (Another way to put it would be that the philosophy of nature, unlike empirical science, explains material things by means of causal factors and causal relations that can exist apart from matter, the causal factors and relations with which it constructs its definitions of material things.)

When both physical and extraphysical concepts are employed in the construction of a complex definition, we can determine whether the definition belongs to philosophy or to empirical science by asking whether it is concepts of the physical or extraphysical kind that are used in the definition to distinguish the definiendum from other things. For that which distinguishes the definiendum from other members of its genus is the formal element in a definition.<sup>23</sup> Therefore, the immateriality characterizing the way the definitions of a science distinguish its definienda from other things will be formal in relation to that science, and diverse immateriality in the distinguishing of things will constitute specifically distinct sciences. If the sciences could be sufficiently differentiated by the immateriality of their generic concepts, why should not all sciences belong to metaphysics, since metaphysical concepts are logically

included in all others as the more general in the less general?

One cannot distinguish the philosophy of nature from empirical science as we have just done unless he or she already knows that the objects of certain concepts can exist apart from matter. But the distinction between these disciplines, if true, remains true whether one recognizes that truth or not. Therefore, it makes no difference to the truth of that distinction when we learn that something exists apart from matter. If I do not yet know that immaterial things exist, I cannot know that these two disciplines are specifically distinct according to the traditional criterion, but my ignorance does not prevent them from being distinct.

Moreover, my ignorance of the specific distinction between philosophy of nature and empirical science does not prevent me from knowing truths belonging to either of these disciplines. It only prevents me from knowing that these truths fall into different categories of knowledge. By the traditional criterion, I cannot know that a truth from the philosophy of nature like:

1. Substances subject to change are composed of prime matter and substantial form.

and a truth from empirical science like:

2. The speed of light in a vacuum is constant whatever the motion of its source.

belong to distinct modes of knowing unless I know the truth of:

3. There are immaterial beings.

But I can know the truth of either (1) or (2) without knowing the truth of (3). (3) is not pertinent to the discussion of how I know whether (1) and (2) belong to disciplines whose objects are characterized, as object, by diversity in immateriality.

## NOTES

1. Jacques Maritain, Réflexions sur l'intelligence et sur sa vie propre, 2nd edition. (Paris: Nouvelle Librairie Nationale, 1924), pp. 177-9. Hereafter referred to as Réflexions.
2. Jacques Maritain, Distinguish to Unite or The Degrees of Knowledge, trans. Gerald B. Phelan, (New York: Charles Scribner's Sons, 1959), p. 55. Hereafter referred to as Degrees. Do not be misled by a difference between Maritain's terminology and mine. On the page cited, immediately after he says experience does not "formally constitute the medium of demonstration" for natural philosophy, Maritain speaks of natural philosophy "verifying" its conclusions in sensible fact. By "method of verification," I mean what Maritain calls the "medium of demonstration." The same distinction occurs on p. 53 where Maritain says natural philosophy "verifies" in experience but "rises, through formal resolution to first intelligible truths known in themselves, to a consideration of essences and the necessities they imply." (Translation corrected.) Here formal resolution to first principles constitutes what I am calling the method of verification.

My use of "verify" is, of course, the common one. What Maritain means by it in this context (he uses it in the standard sense elsewhere) is not entirely clear. The situation is complicated by the fact that this use is based on his interpretation of a difficult phrase in Aquinas ("deduci ad," In Boethius De Trinitate, q. VI, a. 2) which Aquinas in turn got from Boethius. And although it is related to verification in the ordinary sense, what Aquinas appears to mean by that phrase is not identical with it. He is discussing judgment. Regarding judgment, there are two things to be considered: an ontological aspect which is the conformity with things that makes the proposition we are judging true, and an epistemological aspect which is the way we are made aware of the conformity (verification in the ordinary sense). The question of conformity seems to be what Aquinas had in mind, not simpliciter, but with respect to the sphere in which that to which a proposition conforms is found to exist, the sphere of things knowable by the senses or intellect or representable in the imagination.

For some reason, this reading seems not to have occurred



to Maritain, and he is left with the epistemological aspect of judgment. Then when he comes to discuss methods of demonstrating in such non-experimental sciences as philosophy and mathematics, because he wishes to be consistent with what he has interpreted Aquinas to be saying, he is forced to invent a distinction between the "medium of demonstration" and the method of "verifying the conclusions."

3. Jacques Maritain, The Philosophy of Nature, trans. Imelda Choquette Byrne, (New York: Philosophical Library, 1951), p. 19. Hereafter referred to as Philosophy of Nature. Cf. Degrees, p. 25.
4. See Degrees, pp. 23-24, and further; also A Preface to Metaphysics, (New York: Sheed and Ward, 1939), pp. 107-25. Hereafter referred to as Preface.
5. See Aquinas, Summa Theologiae, I-I, q. 2, a. 1.
6. See Degrees, p. 424, where Maritain is quoting Aquinas, In Boethius De Trinitate, q. 6, a. 3.
7. Degrees, p. 208.
8. One exception must be made to the statement that when necessary causal relations are known by reduction to the self-evident, we have dianoetic intellection, knowledge a locus of necessary causal relations in itself. The existence of God as the first cause of motion can be demonstrated by the impossibility of motion's existing in the absence of an uncaused cause of motion. We have dianoetic intellection of the objective concepts making up the self-evident truths employed in the demonstration of God's existence. But we cannot have dianoetic intellection of God as the cause of His effects as we can have dianoetic intellection of a natural agent as the cause of its effects. In each case, a cause is made known through its effects. Yet here again, we find a difference in the manner in which the nature of the cause is known. The mode of being of natural causes is commensurate with that of their effects since natural causes are, in their own turn, effects of causes prior in being to them. Further, the necessary causal principles which allow us to move from knowledge of the effect to knowledge of the cause apply just as much to natural causes as they do to natural effects. Therefore, the mode of being of natural causes does not exceed our manner of knowing them.

The uncaused cause is not an effect, nor does He come under principles telling us to account for the existence of things in terms of prior causes. Therefore, effects cannot make His nature known to us in a manner commensurate with His mode of being. From necessary

causal principles we learn that the objects of certain concepts, like goodness, power, unity, intelligence, do belong intrinsically to God's nature. However, this is not knowledge of God's nature in itself since the uncaused manner in which they exist in God exceeds the manner in which we come to know that they exist in God.

9. "Phenomena are not special things; a phenomenon is not ... a certain stratum of knowable reality distinct from something else which is the thing in itself ... Phenomena are simply the aspect in the formal object of primary determination, in the sphere of fundamental intelligibility proper to the first degree of abstractive visualization, which meets with a mode of defining and conceptualizing, an objective light that proceeds by resolution into sensory operation." (Philosophy of Nature, p. 137.)
10. See Réflexions, p. 179.
11. See Degrees, pp. 25-30; Preface, pp. 133-41.
12. "Existence is the term as a function of which metaphysics knows everything that it does know." (Existence and the Existent, trans. Lewis Galantieri and Gerald B. Phelan, /New York: Pantheon Books, 1948./, p. 31). What Maritain says here about metaphysics is true of ontological analysis in general.
13. See Degrees, pp. 25-34; 138-65.
14. Degrees, p. 33.
15. Degrees, p. 208.
16. Degrees, p. 160; Philosophy of Nature, p. 137.
17. Degrees, p. 206.
18. Degrees, p. 149.
19. Degrees, p. 206.
20. See Degrees, p. 207.
21. Degrees, p. 205.
22. St. Thomas Aquinas, In Boethius De Trinitate, q. V, a. 1.
23. See Aquinas, De Ente et Essentia, ed. Baur, Chapter 3.

MARITAIN ON THE RELATIONSHIP BETWEEN  
THE PHILOSOPHY OF NATURE AND MODERN SCIENCE

COMMENTARY ON  
"Maritain's Views on the Philosophy of Nature"  
by John C. Cahalan

Richard J. Blackwell  
Saint Louis University  
Saint Louis, Missouri

Let me begin by saying that I do not conceive the role of the commentator as one who uses the occasion to deliver another distinct paper on the topic at hand. We have all sat through such distracting experiences at other Conferences, and I have no intention of following that sort of pattern here. Rather, the role of the commentator is to focus attention on some of the more central notions of the paper just delivered, for the purpose of stimulating and organizing the discussion which is to follow. Granting this, the best approach seems to be the Socratic stance of questioning what was said, and why it was said, to bring out its fuller implications and to aid in assessing its values. My comments were written in this Socratic spirit, and I ask that you receive them accordingly.

I should mention, first, that Professor Cahalan's paper in its typed version is considerably longer than could be delivered in the allotted time; however, my reflections are based on the paper as a whole and thus may go beyond what was just presented. At any rate, it is

clear that the central theme of Professor Cahalan's paper is the interpretation of Maritain's notion of the philosophy of nature and related issues. My comments will be organized around three questions within this focus of Cahalan's paper:

1. What are we to make of the suggested standard for the determination of truth, or for verification, in the philosophy of nature?
2. How should we interpret the relation of generality to specificity which Cahalan uses to sort out the contributions of the philosophy of nature and the empirical sciences respectively?
3. What is the operative notion of modern empirical science which is employed in this paper, and how acceptable is this notion?

As a preamble to the first question I should remark that when I first began reading Professor Cahalan's paper, I expected to find considerable discussion of the first degree of formal abstraction and of the distinction between essential and nominal definitions. These topics are discussed, of course, but not as prominently as the question of how truth is established in the philosophy of nature. Professor Cahalan uses the venerable distinction of the via inventionis vs. the via iudicii, and concentrates on the latter. The modern analogue here is Reichenbach's distinction between the context of discovery vs. the context of justification (which has come under increasing scrutiny in the past few years), again, with the second half of the distinction receiving the lion's share of attention. In both authors the central issue then

becomes, "How do we distinguish true assertions from false ones?" It is worth quoting Cahalan on this directly:

One way of showing that a statement is true is by showing that its opposite is impossible. We show that the opposite is impossible by showing that it violates a thing's identity with itself, in other words, that the opposite is contradictory. But how can we determine a statement's truth if its opposite is not impossible? We can do so only by reference to what is actually the case. And how do we know which of two possible states of affairs is actually the case? We know only by the evidence of experience. ... in order to give us knowledge of truths other than those of empirical science, philosophy must verify by appeal to truths whose opposites are impossible.<sup>1</sup>

Some clarification of these two standards of truth would be helpful. Does Professor Cahalan intend to claim that the former alone is adequate for the philosophy of nature and that the latter alone is adequate for empirical science, as the last sentence quoted seems to say? Or does the philosophy of nature use both norms of truth, while empirical science appeals only to the evidence of experience?

Cahalan goes on to specify that the analytic standard of truth here is not to be taken as referring to linguistic or logical appeals to formal consistency. The point, rather, is that an ontological appeal must be made in the sense that if the philosophical statement were not true, then something would both be and not be what it is, in the ontological sense of these terms. Philosophic truth is thus to be determined by a resolution of conclusions into self-evidently necessary causal and ontological principles. Now, how is this "resolution" to be understood? Does Professor Cahalan see the

conclusions of the philosophy of nature as related deductively to metaphysical principles, so that we may trace this relation in reverse to ontologically necessary truths? This seems to be one possible reading of the paper. Or are these necessary truths found more directly within the philosophy of nature? If so, a more detailed appeal to essential definitions of natural species seems to be in order, which in turn implies that a more prominent role be given to sensory experience in the philosophy of nature than the quotation above seems to indicate. At any rate, I would like to ask Professor Cahalan to address again for us this question of truth determination in the philosophy of nature to clarify these points.

My second theme relates to the notions of generality vs. specificity in comparing the philosophy of nature to empirical science. Two distinct criteria seem to be used to distinguish dianoetic from perinoetic knowledge. The question is, how does Professor Cahalan understand their interrelationship? He says, "...the same experience from which we derive a specific concept allows us to derive the generic concept."<sup>2</sup> It would be consistent to add that the reverse relationship does not obtain since the more specific cannot be derived from the more generic without the addition of further empirical content. At any rate, using this distinction, the philosophy of nature is understood to deal with the more generic concepts and the empirical sciences with the more specific concepts in this hierarchy. Does this mean that a genus-species relation is seen between these two forms of

knowledge? This seems not to be the case, since a second criterion is also used. The dianoetic knowledge of the philosophy of nature conceptualizes things in nature in terms of their being modes of being, while the perinoetic knowledge of empirical science conceptualizes the same things in terms of sensible qualities. Thus, modes of conceptualization become central. How are these modes to be related to the generic-specific relationships of these same disciplines? At what point in the descent from generality does dianoetic knowledge transform into merely perinoetic understanding, and why does it transform at this point? Is this a sliding borderline through time so that the range of the dianoetic may increase, or is it a fixed barrier? Would it be possible in principle for much, or even all, of present perinoetic knowledge to be converted to the dianoetic form with the passage of time?

These modes of understanding are used by Maritain, of course, to distinguish the sciences as abstract disciplines. Could not the same person as an investigator, whether he be philosopher or scientist, conceptualize his experience differently at various times in terms of modes of being or modes of sensible qualities? If so, the writings of such an investigator could not be blanketly classified as either scientific or philosophical; rather, each investigation would need to be judged separately. In short, by providing examples only at the far extreme from this gray middle area, the double criteria of generic-specific and modes of conceptualization create some problems regarding the status of the borderline

between the philosophy of nature and empirical science as distinct.

Thirdly, I would like to raise some questions about the conception of empirical science which is operative in Maritain's analysis. To use the most straightforward terms, I find him conceiving empirical science in almost unqualified positivistic terms. The adequacy of such a conception is much more questionable now that it was in the 1930's when Maritain's writings on this topic were taking form. Thus in Professor Cahalan's paper we find empirical science repeatedly described as restricted to the study of phenomena, as dealing almost exclusively with sensible qualities and their correlations, as being primarily, if not exclusively, inductive in method, as eschewing all references to modes of being or to entities and events more fundamental than sensible phenomena.

Now, this conception of empirical science is very close to the program enunciated by the Vienna Circle and its later advocates in Carnap, A.J. Ayer, and Reichenbach. The most interesting point, however, is that the past half century of the history of the philosophy of science has clearly shown the bankruptcy of this model of science. It is now rather commonplace to hear philosophers of science state that logical empiricism has collapsed as an account of science, even though to date they have adopted no identifiable alternative epistemology. The reason for this collapse is quite instructive in the present context. A basic commitment of the positivist program was to allow no non-analytic concepts



into science unless they could be traced back to, and defined in terms of, sensible qualities, or in Maritainian terms, unless traceable back to perinoetic knowledge. Innumerable devices were introduced to accomplish this reduction to sensibles: various versions of the verifiability principles, Carnapian reduction sentences, Ramsey sentences, rules of correspondence, contextual definitions. They all failed; and this program has been abandoned. The reason they failed is that counterfactual conditionals, disposition predicates, and especially the theoretical non-observable entities and events which are involved widely throughout the sciences as explanatory concepts cannot be reduced to sensible qualities.

What this shows is that, over and above sensible properties, modern empirical science contains a host of non-sensibles as ineliminable concepts. Furthermore, it is necessary to emphasize that these are also non-analytic and non-mathematical in character. Otherwise the positivists would have had no difficulty, since these concepts would then have conveniently fallen on the left side of the analytic-synthetic distinction, and thus would have been non-problematic for their program.

Now, if the long recent history of these developments shows that empirical science contains an irreducible component of disposition concepts and theoretical non-observable entities and events, then a conception of science as purely phenomenal, correlational, inductive, and limited to sensible qualities must be incorrect. It is understandable

that someone may have so understood science in the 1930's, but it is much more difficult to defend this notion now. The emergence of the biological sciences, especially theoretical molecular biology, as one of the leading edges of modern science, also tends to make mathematical physics less of a universal paradigm than it used to be.

In raising these questions about about how empirical science is conceived in the Maritainian tradition, I am not claiming that these theoretical parts of science are thereby instances of dianoetic knowlege in science, nor do I deny this. I simply do not know what to claim. Let me give one example to illustrate the problem and my perplexity about it. On pages 17-18 of the unabridged version of his paper\* Professor Cahalan states, "Another self-evident principle is that nothing becomes an F which does not have the potentiality for becoming an F." How does this apply to the genotype which precisely is a genetic potentiality which can be actuated in various ways as it reacts with its environment in the genesis of the phenotype? Is this type of scientific knowledge dianoetic or perinoetic? It seems to deal with the genotype conceptualized as a set of potentialities as modes of being. How does one apply and judge Maritain's justly famous distinction at this level of specificity? Whatever the answer to such questions are, it seems to me that Maritain's contemporary followers would advance their position considerably by rethinking his original

\*Professor Cahalan eliminates this passage in the abridged version of his paper. (Editor's note)

notion of empirical science, as limited to knowledge of the real through sensible qualities, in the direction of expanding the notion of science to include theoretical non-observables. What effects this would have on the central distinction of the dianoetic and the perinoetic I am unable to say. But I do believe that an epistemology which takes modern empirical science to have no non-analytic content beyond the correlation of sensible qualities is burdened with a conception of science which is not only positivistic in spirit but also unrealistic in the light of what has happened in the history of the philosophy of science in recent years.

#### NOTES

1. (Editor's Note) See pages 186-7 of this publication.
2. (Editor's Note) See page 199 of this publication.

THE PHILOSOPHY OF NATURE, EMPIRICAL SCIENCE, METAPHYSICS

COMMENTARY ON  
"Maritain's View on the Philosophy of Nature"  
by John C. Cahalan

Joseph M. Graham  
University of St. Thomas

The first effort to articulate a formal distinction between the philosophy of nature and science is to be found in the presidential address of the British Association for the Advancement of Science given in 1834. Science was described in this address as the empirical and materialistic tradition which had its modern roots in the Baconian ideal and which had become the accepted dogma of great numbers of scientists following the triumph of Newton. This mechanistic and empirical concept was contrasted with the Naturphilosophie tradition, which owed its origin essentially to the thought of Leibniz, and which was embraced by the German Romantics and particularly by Hegel. The distinction constituted an effort to dissolve a long standing dispute which had resisted solution or reconciliation.

The two traditions were radically at odds in their perceptions of nature, in their basic conceptions of physical science, in their methodology, and, particularly, in their conclusions. By labelling the views of their adversaries "philosophy," while retaining the terms "science" for their own views, the mechanistic materialists hope to solve the

confrontation by removing their adversaries from the realm of discourse. Those who refused to accept the atomistic and mechanistic vision of reality, and who continued to view the physical real as in any sense intelligible by reason of its intrinsic principled structure, could hence be dismissed as philosophers - where philosophy was now regarded by the triumphant mechanists as failed science.

As Doctor Cahalan points out, Maritain accepts this radical distinction between the physical sciences and the philosophy of nature but seeks to find grounds of distinction other than that described above. He attempts to defend the claims of modern science while at the same time seeking to restore the authentic truth of a philosophy of nature which owes its origin to Aristotle rather than to Leibniz. For Maritain, the philosophy of nature and empirical science constitute specifically distinct modes of knowing, since they have different ways of abstracting from matter. He argues that both the philosophy of nature and the physical sciences begin with sensible experience. They differ, however, because the philosophy of nature, which is dianoetic, terminates in a knowledge of essences, while the physical sciences, which he characterizes as perinoetic, reach such essences only in a peripheral and unarticulated fashion. The empirical sciences somehow know necessary causal relations but do not recognize them as such.

Cahalan argues further that, according to Maritain, the statements of the philosophy of nature are verified ultimately by appeal to the principle of identity or non-contradiction.

Truths of the philosophy of nature are necessary to the extent that such resolution is possible. In Maritain's judgment, propositions in the physical sciences are ultimately verified by appeal to sensory observation and, hence, are not immediate in the sense required for necessary truths. The opposites of such statements are not self-evidently impossible. Hence, all scientific statements remain open to the possibility that their opposites may be true. The physical sciences deal with phenomena qua phenomena, i.e., objects which are distinguishable from one another by sense knowledge alone. The philosophy of nature, on the other hand, concerns itself with the being of sensible things. Thus, they are distinct yet complementary modes of knowing. The physical sciences are inadequate for a full understanding of nature and require completion by the philosophy of nature, specifically by the philosophy of nature of Aristotle.

Cahalan's paper presents us with an insightful presentation of Maritain's position and constitutes a genuine advance on this distinction in terms of his conception of the ground of necessary and non-necessary propositions. Questions nevertheless remain regarding the nature of modern scientific knowledge and its relation to the philosophy of nature of Aristotle. Indeed, the very distinction of science and philosophy demands commentary.

Neither Aristotle nor St. Thomas were aware of any such distinction between science and philosophy, nor, indeed, was anyone else prior to the nineteenth century. It is significant that Newton's monumental treatise was entitled The

Mathematical Principles of Natural Philosophy. Maritain

recognizes this but insists that the scientific revolution of the seventeenth century gave rise to a new type of knowledge and "constituted one of the most authentic advances ... that thought has accomplished in the course of modern times."<sup>1</sup>

If modern science is a post-Renaissance discovery, it could not possibly be known either to Aristotle or to St. Thomas. But is the modern understanding of science a post-Renaissance discovery? As early as Parmenides, at least, the Greeks distinguished between that knowledge of the necessary which is reached by the intellect and knowledge which begins and ends in sensory experience and has as its object the mutable qua mutable. Plato terms the first type of knowledge, i.e., knowledge of what cannot be otherwise, science, while the second is labelled opinion, i.e., a type of knowledge for which the opposite could equally well be true. For Plato, necessary knowledge related to the forms, and hence he judged that all knowledge of the world of motion and change must be opinion and not science.

Aristotle insists that a scientific understanding of nature is possible. The principles are abstracted from the content of sensory experience and the intellect is able to reason to true conclusions from these principles. The physical world is intelligible and thus open to the understanding of the human intellect. At the same time, the judgment reached in the science of nature must be verified by

reference to the evidence presented by the senses. Aristotle's concept of physical science is both empirical and intellectual.

Aristotle's achievements in the physical sciences hardly need defense. They constitute the cornerstone of all scientific achievements. As late as the nineteenth century Darwin could state that Aristotle was the greatest biologist who ever lived. One would have to conclude either that Aristotle was doing science in the modern sense of the term without being aware of it, or else that he was fully cognizant of a type of knowledge which never went beyond the limits of the sensible and which generated propositions that, by definition, were never more than probable. In his judgment this knowledge was not scientific at all because it did not touch intelligible necessities. There is abundant evidence for concluding in favor of the second alternative. In Aristotle's judgment, such knowledge could not be termed science at all because science is necessary knowledge. St. Thomas agrees wholeheartedly.

The scientific revolution of the seventeenth century was not based, in fact, upon a uniquely different way of knowing the physical real. It was rather the triumph of a renascent Pythagoreanism which had its roots in twelfth century Oxford and fifteenth century Italian universities, accompanied by revival of the ancient mechanistic Atomism stimulated by the publication of the De Rerum Natura of Lucretius. Both of these views were metaphysical to the core, and both antedated the work of Aristotle. Aristotle



had studied, commented on, and finally rejected both views of reality as contrary to the nature of things. Indeed the prime movers of the seventeenth century revolution understood that their views were fundamentally contradictory to those of Aristotle. Not only is Galileo's Dialogue on the Two Chief Systems of the World a defense of Copernicus; it is also a concerted effort to demolish the foundations of Aristotle's scientific work. Such examples could be multiplied.

If modern science is born of a scientific tradition which is radically at odds with that of Aristotle, and remains so to the present day (if we are to believe its current apologists), it seems difficult to understand how these divergent conceptions of the physical real can be regarded as complementary. Maritain argues that modern science and Aristotle's philosophy of nature are in fundamental harmony and that they do not need to be reconciled, since a natural harmony exists between them. This he argues, despite the fact that modern science denies a purpose in nature, rejects objective formal causes, denies genuine causal efficacy and conceives of matter in a way which is fundamentally opposed to Aristotle's conception and to that of St. Thomas as well. It should be noted that in so doing modern science remains consistent with its origins in mechanism and Pythagoreanism.

The basically positivist conception of science defended by Maritain is offered little defense by philosophers of science today because of the failure of its premises. The verification principle has sunk without a trace. It is only

by declaring the physical sciences to be deontological, however, that he is able to leave room for a valid philosophy of nature which is both ontological and causal. If the physical sciences are concerned with what is, in the effort to grasp the underlying causes, and if the causes of material being are multiple, then science will only be fully successful when it accepts the existence and intelligibility of the mutable real and when its explanations take account of all of the operative causes in nature. Above all, only when scientists admit once more that there is purpose in nature and that, as Aristotle insisted, a true understanding of the causes of motion and change terminates in an understanding of that purpose, will the damage done by the triumph of three hundred years of mechanistic materialism begin to be reversed. By their true understanding of the nature of the physical real, Thomists have an enormous contribution to make to the future of scientific knowledge. Aristotle took what was true from Democritus and Pythagoras and absorbed it into a much more encompassing synthesis based upon a true understanding of the principles of nature. It would seem the task of his twentieth century disciples to duplicate that feat.

We are uniquely advantaged at this point in time to perform this task. The proud tower of mechanistic materialism has been overthrown and nothing has been erected in its place. Materialism has lost scientific credibility because, as an intellectual tradition, it has revealed its bankruptcy. The vast expansion of that area of science

which is both physical and mathematical and which St. Thomas characterized as mediate science demands integration within a realist philosophy of nature and metaphysics. St. Thomas here can be our guide. Biology and psychology, devoid of true principles, have degenerated into Evolutionism and Behaviorism. The social sciences have become positivistic and pragmatic. Political theory has succumbed to a crass Macchiavellianism.

It is urgently required that these sciences be rescued from the quicksands of materialism and restored to sanity. Above all, it must be recognized, as indeed its defenders insist, that the scientific tradition which has captured the intellect of the Western world is in fundamental opposition to the vision of Aristotle. To accept the one is necessarily to bring into question the intellectual legitimacy of the other. Only when this recognition takes place can the followers of Aristotle and St. Thomas begin to play their full role in the modern world.

#### NOTES

1. Jacques Maritain, The Degrees of Knowledge, trans. under the supervision of Gerald B. Phelan, (New York: Charles Scribner's Sons, 1959), p. 199.