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THE PHILOSOPHY OF NATURE AND NATURAL SCIENCE FROM A THOMIST VIEWPOINT

THE title of this study contains three terms which require some clarification: "philosophy of nature," "natural science," and "Thomist." The first two, of course, cannot be very much clarified at this point, since it is the purpose of the entire article to discuss their distinction one from the other. We ought, however, to begin with some kind of nominal definitions to indicate where the regions in question are to be found on the general map of knowledge. We might start by saying that the philosophy of nature is that knowledge of the physical universe which is sought by philosophers, while natural science is that kind of knowledge of the same physical universe which is sought by scientists. This scarcely seems sufficient, even as a merely nominal definition; but it is difficult to say more without immediately launching into the main theme. So we shall go on to our third term—"Thomist." What makes one a Thomist could quite well be the subject of another article, or perhaps a book. But briefly, to me a Thomist in the philosophy of nature is one who has adopted St. Thomas' philosophical perspective of matter and form, together with his general view of order and difference in knowledge based on differences in what is known, on levels of intelligibility and differences within those levels within the object itself, or what is saying the same, within being itself. This study is an attempt to use these Thomistic notions in order to see some distinctions and relations between the philosophy of nature and the natural sciences. Conspicuous by their absence, however, will be the usual collections of textual references to St. Thomas; for this is written from a Thomist viewpoint and not from that of St.

Thomas himself, who did not, it seems to me, have a fair chance to express himself completely on a problem which was not properly clarified until hundreds of years after his death.

I. Ancient Viewpoints and Thomist Counterparts

The question of the precise relationship between the philosophy of nature and the natural sciences is the subject of much discussion among Thomist philosophers at the moment. This question has been with us ever since the clear distinction (at least *de facto*) between philosophy and the natural sciences began to emerge. Just when this distinction first appeared cannot be ascertained with certitude, although we have the testimony of Simplicius to the effect that Plato posed the problem of "saving" the astronomical phenomena to Eudoxus.[1] The process of differentiation has been extremely gradual. It began to appear in Aristotle as an already accomplished fact in at least one realm—that of astronomy.[2]

The problem of the relationship of astronomy and philosophy is discussed in some detail by Geminus, a peripatetic of the first half of the first century B. C., in a text which has been transmitted to us by Simplicius.[3] In this text, Geminus states that the astronomer accepts physical principles from the philosopher of nature at the outset of his science and goes on from there.

This view, extended to take in not only astronomy but the other natural sciences as well, has had a rebirth in recent years among Thomists, and is held in one form or another by quite a number of present-day Aristotelians who are Thomists. In this group there is a general tendency to deny the autonomy of the natural sciences and to assimilate them to the philosophy

[1] *Simplicii in Aristotelis De Caelo Commentaria*, edidit J. L. Heiberg, *Commentaria in Aristotelem Graeca*, v. 7 (Berolini, 1894), p. 488 (II, 12, 219a 37-44).

[2] *Beta De Caelo*, 10, 291a 29-32; 11, 291b 21-22; *Lambda Metaphysicorum*, 8, 1074a 14-17.

[3] *Simplicii in Aristot. phys.*, ed. Diels, *Commentaria in Aristotelem Graeca*, v. 9, p. 291, l. 23–p. 292, l. 29.

of nature (and to deny them the status of science insofar as they are not thus assimilated). The common denominator of the groups seems to be the ideal of a single science of nature in which the philosophy of nature is either the principal or the only factor—an ideal which had fallen into considerable disrepute even among Thomists until it was once again enunciated in 1936 by Fernandes-Alonso.[4]

But the view of Geminus is not the only view of the relationship of philosophy and science which may be extracted from ancient writings. Two centuries after Geminus, Claudius Ptolemy conceived of astronomy as a science quite distinct from and independent of the philosophy of nature, astronomy being ordered to "save the appearances" by the use of hypotheses which might or might not be derived from "physical principles."[5] The philosophy of nature itself does not seem to have been very much in the mind of Ptolemy when he wrote the *Syntaxis Mathematica*, but there is evidence that he did admit the truth of some propositions which pertain to the philosophy of nature and not to astronomy.[6] He certainly was in possession of a considerably developed methodology of astronomy, which was ordered toward the construction of a hypothetico-mathematical system based on observation, but itself a construction of the reason.[7] Astronomy is thus not a science of the real as such but rather a geometrical construction to unify and predict phenomena. Ptolemy himself realizes the unreality of his constructions.[8]

This ancient view concerning the nature of astronomy has a much more elaborate counterpart in the positivistic conception of natural science which is in vogue among some Thomists today. According to this view, the natural sciences merely

[4] "Scientiae et philosophia secundum S. Albertum Magnum," *Angelicum* (1936), pp. 24-59.

[5] *Claudi Ptolemaei Syntaxis Mathematica*, ed. J. L. Heiberg (Leipzig 1898). Bk. I, ch. 2, 8; III, 1, 3; IX, 2; XIII, 2.

[6] *Ibid.*, I, 1 (passim); I, 3; XIII, 2 (p. 532, lines 14-19).

[7] I hope to write a paper soon concerning this point.

[8] *Op. cit.*, XIII, 2 (p. 533, line 10-14).

correlate phenomena through constructions of the reason; thus these sciences do not have relevance to the philosophy of nature, which itself is even assimilated to metaphysics by some. This view is, of course, an extremely comfortable one inasmuch as it enables the philosopher to pursue his investigations without much regard for the natural sciences, and the natural scientist to pursue his research without much concern with philosophy. The general tendency of this group, allowing for internal divergencies, is to allow for many natural sciences with a complete cleavage between the philosophy of nature and these sciences. The latter are conceived as being in no way dependent on the philosophy of nature. Indeed such an extreme correlationist view of these sciences seems to be quite reconcilable with a phenomenalist view of nature in which the philosophy of nature, as conceived by Thomists, would cease to exist at all.

Returning once again to Ptolemy and reading the *Syntaxis* closely, we find something more to his overall view of astronomical knowledge than the purely ideal construction that we have spoken of. In the last book of the *Syntaxis*, Ptolemy gives a brief physical interpretation of his constructions on the basis of opinions which properly pertained at that time to the philosophy of nature.[9] He had already stated these opinions in the first book, prior to the construction of his astronomy.[10]

This is as far as Ptolemy goes, but may not one draw out the implications of this idea of philosophical interpretation to astronomical theory? Besides giving a physical interpretation to astronomical theory, the philosopher of nature may himself learn something from the astronomer inasmuch as the observations of the heavens demand a theory far more complex than, say, the homocentric spheres of Aristotle, and seem to demand that the heavenly spheres *penetrate* each other.[11] This requirement of greater complexity and of some new property, of which penetrability is the sign if not the reality, is a *fact*, an ontological *datum*, which is at least of some relevance to the philos-

[9] *Ibid.*, XIII, 2. [10] *Ibid.*, I, 1. [11] *Ibid.*, XIII, 2.

ophy of mobile being. I have, of course, extrapolated from the text of Ptolemy; but the extrapolation seems to be at least suggested. I certainly do not wish to imply that Ptolemy had an explicit notion of the symbolic reference of scientific conceptions to reality itself, but this may well be implied in what he says.

Once again we find an analogous view in modern Thomism, developed by Jacques Maritain. Here the natural sciences (which are termed *empiriological*) are regarded as ideal constructions based on phenomena, the conceptions of which do not resolve into intelligible being but rather into the phenomena themselves.[12] Maritain regards the object of empiriological science as *ens mobile secundum quod mobile aut secundum quod quantum, sub modo definiendi per operationem sensus.*[13] On the other hand, the philosophy of nature is a science which penetrates into the depths of the real itself, on the level of mobile being,[14] and thus its reasonings are about the real world. Maritain sets the object of the philosophy of nature as *ens secundum quod mobile, sub modo definiendi per intelligibilem quidditatem* (*et non per operationem sensus*), *seu sub lumine ontologico.*[15]

In this view, there are many natural sciences, all of which are quite distinct from the philosophy of nature. Some are characterized by their use of mathematical measurement and mathematical models while others develop their conceptions in dependence on what is observed but without much or any use of mathematics.

There is something real, some ontological content, in the " facts " which are the ultimate reference of all our conceptualization and reasoning in the natural sciences; but this ontological content can be disengaged only with the greatest of difficulties, owing to the logical elements which are introduced

[12] J. Maritain, *La Philosophie de la Nature* (Pierre Tequi, Paris), pp. 70-80.
[13] *Ibid.*, p. 131.
[14] *Ibid.*, pp. 70-80.
[15] *Ibid.*, p. 132.

by the very methods employed in obtaining the " scientific fact." [16] Moreover, the scientist, in his process of conceptualization, is not at all concerned with this ontological element *qua* ontological. The concepts and theories which interpret the " facts " refer back to the general assemblage of already ascertained " scientific facts," precisely as observed or measured and not as having intelligible values perceptible to the intellect alone.

This mixture of logical and ontological which is called scientific fact, while clearly neither an adequate nor an intended representation of the reality itself, may yet be taken as a " sign " of the reality [17] by the philosophy of nature, which may interpret such signs in the light of its knowledge of mobile being.[18] Such interpretation is of necessity tentative, sharing in the hypothetical nature of these scientific constructs themselves.[19]

Thus the philosophy of nature must be regarded as having a double aspect. 1) In its essential structure it does not require the knowledge of the natural sciences at its base.[20] However, there is some possibility that scientific facts, once philosophized, may provide new matter for the philosophy of nature and thus broaden its view.[21] But the separation of the ontological from the logical element of such scientific facts in order to obtain " philosophical facts " is difficult to accomplish, as we have said. 2) At any rate, once the philosophy of nature has been elaborated in its essential and general structure, it can turn to the natural sciences to interpret them in its own light. This Maritain terms the " function of integration " of the philosophy of nature.[22]

[16] *Ibid.*, pp. 132-141.

[17] J. Maritain, " Philosophy and the Unity of the Sciences," *Proceedings of the American Catholic Philosophical Association* (1953), pp. 50-53.

[18] *Ibid.*

[19] *La Philosophie de la Nature*, pp. 140-141.

[20] " Philosophy and the Unity of the Sciences," pp. 45, 46-47.

[21] *Ibid.*, p. 45.

[22] *Ibid.*, p. 44. See also *La Philosophie de la Nature*, p. 146.

Thus far we have seen three Thomistic views regarding the relationship of the philosophy of nature to the natural sciences which were foreshadowed in ancient conceptions of the relationship between astronomy and the philosophy of mobile being. This is perhaps of no great doctrinal significance, but it is of interest to observe the correspondence between the " ancient " and the " modern."

II. Some Confusions.

There is yet a fourth view which has had a very great appeal to scientists in modern times and probably in ancient times as well. It has been upheld in perhaps its most extreme philosophical form by C. N. Bittle in *From Aether to Cosmos*.[23] While scarcely deserving the appellation " Thomist," this view may well be here critically considered; for it can provide an occasion for making distinctions which may contribute much to the solution of the problem of the distinction between the philosophy of nature and natural science.

In this view, natural science is seen from its very outset in the framework of a common sense [24] ontology, and is permeated with this ontology in the course of its development.

In such an ontology, the intelligible values of being are but dimly perceived and are therefore capable of being easily confused or lost sight of. As a result, the sign-counterfeits of real being obtained by the natural sciences (constructs) are themselves easly confused with real being. Not that these constructs are considered as indubitably veridical representations of the reality itself, even by the scientists himself. But they are at least regarded as " probable " beings. Thus the proton and the electron and the other constructs of modern physics are considered to be " probably " real precisely as conceived. The impression is produced that there is a gradual convergence in

[23] C. N. Bittle, O.F.M.Cap., *From Aether to Cosmos* (Bruce: Milwaukee 1941).

[24] *Common sense* here may be understood to mean the spontaneous, unreflective judgment of the undisciplined human intellect in the presence of reality.

natural science toward the actual being of the world, while in reality what is being created is a hopeless confusion between logical and ontological elements.

If we add even more ingredients to the mixture that we already have, by attempting to construct a philosophy of nature on the basis of this compounded confusion, as Father Bittle and others have done, we shall in all probability end in failing to see a considerable portion of the intelligible value of mobile being, with a completely distorted view of the mobile universe.

III. Four Knowledges of Nature.

A. *Common sense knowledge of nature.*

The fundamental difficulty here arises from a failure adequately to distinguish and order four kinds of knowledge. First, the unscientific, unphilosophic knowledge of common sense must be carefully distinguished from both natural science and philosophy. The knowledge of common sense is the result of the movement of the undisciplined intellect toward the real; it differs from philosophical knowledge in that it is altogether imperfect, unreflective and confused. Important truths, such as the distinction between real beings and beings of the reason which are founded in the real, are either not seen at all or seen only vaguely. Such knowledge is knowledge of the real, but only of the most primitive kind.

B. *Philosophy of nature (noumenal knowledge of nature).*

Beyond this first plunge of the undisciplined, unreflecting intellect into the real, there is the possibility of a reflective investigation of and "seeing into" the intelligible values of being and of mobile being by a disciplined interest capable of making requisite distinctions and of clarifying to itself at least some of the intelligible content of reality. This philosophic penetration of the real may go in two general directions from its beginning in the presence of mobile being. The intellect, in its drive toward intelligibility and unity, may pursue the

unity of being itself up to its very source, and this is the way of metaphysics. Or it may seek the intelligibility and unity underlying motion, and this is the way of the philosophy of nature. We may say that metaphysics does not study being precisely as mobile but rather precisely as being, while the philosophy of nature studies mobility, or mobile being precisely as mobile.

But matter, the potential principle of mobile being, and the root of its mobility, is also for us a principle of unintelligibility, by reason of its indetermination. Being a principle of multiplicity as well, matter is an immovable obstacle to the intellect in its movement toward the intelligibility and unity of the mobile universe. We must abstract from matter in order to reach our goal, but to do so completely would put us beyond the sphere of mobile being altogether, since the ultimate root of mobility is matter.

How can this dilemma be avoided? First, it is necessary to give up any idea of reaching the ultimate intelligibility and unity of the individual as such, before which matter (individual matter) casts an impenetrable veil. Forsaking the possibility of a philosophical knowledge of the individual in its individuality, we abstract from individual matter. This abstraction enables us to reach a new level on which multiplicity is considerably diminished and on which we can find some intelligibility for our intellects to feed upon. We are still in the realm of the mobile, inasmuch as our conceptions still contain matter; and so we can have philosophical knowledge about the mobile world.

But again, matter is a principle of specific multiplicity and blocks a reduction to complete unity even on this abstract level. It is only in the determinations of matter which are common to either the entire realm of mobile being or large segments of it that we can find sufficient unity to constitute a science. It is possible to know of prime matter and substantial form in general; but the potency of matter is infinite, so that the determinations of matter are infinite—and thus the full meaning

of substantial form necessarily escapes us. We lift up but a small corner of the veil covering the intelligibility of things.

In our efforts to see farther, we are all but frustrated, not only by this element of specific multiplicity, but also by another effect of the matter which enters into the constitution of all things mobile, namely, contingency. Because we live in a contingent universe, it is extremely difficult for us to learn of the determinations of matter. For these must be learned through the activities of things, and these activities may well be the effect of a plurality of causes, which plurality is not necessarily known to us exhaustively. This indetermination in our knowledge of the cause of phenomena is ultimately due to the passivity which things possess by reason of their matter, the principle of their finitude. Because of their limitation, they not only can act but also can be surrounded by other agents which act on them. And this possibility prevents us from attributing activities to uniquely determined agents or even to uniquely determined pluralities of agents. For we can never know, without a complete knowledge of the entire universe, that any activity is determined uniquely by a particular agent or group of agents. We are speaking here not just of a contingency of the individual, but even of a contingency of the species.

Thus we cannot reduce a species to the perfect unity of an intelligible essence, save in a very general way in the four great divisions of mobile being into inorganic mobile being and the three grades of living mobile being. The philosophy of nature may extend its search for the explanation of mobility into these still quite general realms, but it eventually reaches the point where the mass of multiplicity and contingency become too much for the intellect, which itself can reach the intelligible only in seeing necessary unity.

This obstacle, set before the intellect by the very nature of mobile being, cannot be overcome unless we abstract further, this time from all of the sensible determinations of mobile being, from all that by which we may distinguish mobile beings from each other individually and specifically. Only by elimi-

nating the multiple determinations of matter and looking at a common determination, i. e., extension or quantity, can we hope to reduce material being to a completely intelligible and necessary unity. But to do this, to rise to this second level of abstraction, we must leave one of the necessary presuppositions of mobility—the various determinations which the ultimate principle of mobility, matter, can have. But this means that we have left the sphere of the mobile as such altogether; for matter can be a principle of mobility only so long as there are contrary forms to determine it. At the second level of abstraction we can achieve more unity, a more complete science,[25] but only by renouncing our original aim, which was to unify the mobile precisely as mobile.

This possibility, however, of the more complete science of quantity, affords us an opportunity to obtain more detailed and precise scientific knowledge about the multiple world of mobile being *in its quantitative aspects*, as we shall see below.

To summarize concerning the philosophy of nature, we see that it tends toward the real but fails to achieve a complete and necessary unity except on a level which is still quite general. The mobile universe presents a multiplicity to us which is in itself reducible to a unity of knowledge; but this unity is not known to us but in the unity of the Divine Essence. The universe has necessity even in its contingency; but this necessity is not completely known to us—it is known in the necessity of the Eternal Plan, in which God knows even contingents necessarily. To our intellects, the mobile universe, on all but its most general levels, manifests a radical multiplicity and radical contingency, incapable of scientific reduction to unity and necessity. In the presence of the detail of phenomena, the intellect must withdraw in defeat from its initial thrust toward complete objective unity, necessity, and intelligibility.

[25] Whether or not a single mathematical science embracing all mathematical truths is possible we need not decide here.

C. *Phenomenal knowledge of nature.*

What can be done? How can we penetrate farther in our search for the unities and necessities underlying the mobile universe? So far as we know the world at present, it appears that we cannot clearly unveil these unities and necessities in themselves much farther. We can pierce through phenomena to the general nature of mobile reality, but for more detailed scientific knowledge we are safer to remain on the level of the phenomena themselves, which could tell us something about essences but do not clearly reveal their intrinsic intelligibility. The phenomena are *signs* of the essence but cannot lead us into the fullness of the specific essence itself. The intellect may attempt to surround the essence as well as possible, but it cannot often break through the barriers of phenomena to completely grasp the essence itself.

Now " phenomenal knowledge " is the third of the four kinds of knowledge which we spoke of above. It is a knowledge which begins in the multiplicity and contingency of phenomena; and, because it cannot clearly attain the real unities and necessities behind the phenomena, it seeks unities and necessities of a logical kind in conceptual schemes—" constructs " and " hypotheses." It seeks for phenomenal constancies and postulates conceptual necessities to account for these. It will construct unitary logical essences since it cannot grasp the real essences; and it will hypothecate logically necessary general laws since it cannot see through the contingency of the real world to the really necessary laws. Yet these logical essences and laws are not without relation to the real essences and laws; for this knowledge begins in phenomena, which govern the intellect in its formation of these logical beings, and the latter are resolved again into the phenomena themselves. Thus they are " second level signs " of the real essences and laws. They do not even share in the degree of reality which the phenomena themselves possess, but neither do they share in the multiplicity and contingncy of the phenomena.

When the procedure just described may be carried out mathematically, beginning with the "measurement" of the phenomena and proceeding to the development of mathematical constructions and hypotheses, and thence to the verification of these conceptions in new measurements of the phenomena themselves, we have the ideal type of phenomenal science; for in it we have succeeded in substituting mathematical conceptions, with their complete intelligibility and perfect unity and necessity, for schemes which have intrinsic reference to the sensible precisely as qualitatively sensible, with its radical multiplicity, contingency, and unintelligibility.

The precise relationship of such mathematical schemes to the phenomenal world is a subject which I should like to discuss in detail, but lack of space forbids this at present. One might ask questions about the relation of the number derived from measurement to the phenomenal world itself, about the real significance of a functional relationship, and about the relation of the construct and hypothesis to the numbers obtained by measurement and through them ultimately to the phenomenal world. But, unfortunately, these must be here passed over.

But what must be noted about phenomenal knowledge in general is that it tends toward a logical instead of a real unity and necessity. It does not tend toward the intrinsic intelligibility of the real but rather toward an intelligibility constructed by the intellect, which intelligibility resolves back into the very phenomena themselves instead of into mobile being itself. In this respect it differs completely from the knowledge of both philosophy and common sense. For both of these tend toward the intelligible beyond the phenomena, toward the real unity and necessity of being; but phenomenal knowledge remains in the sphere of the phenomena themselves in achieving its logical synthesis.

D. *Integrated knowledge of nature.*

But although the noumenal knowledge of the philosophy of nature stands radically opposed to the phenomenal knowl-

edge of natural science, these two need not and should not be completely isolated from each other. Although the ontological interpretation of the natural sciences in the light of common sense leads to a hopeless confusion of logical and real elements because of the ignorance of common sense concerning necessary distinctions, yet there remains the possibility of an ontological interpretation of the sciences in the light of the philosophy of nature, which *is* cognizant of the necessary distinctions between real beings and beings of the reason with a foundation in reality. While the philosophy of nature must remain poor in its essential core, as we have seen, yet it can enrich itself by turning to the natural sciences and infusing into them its light. It can use these sciences as intruments to prolong its penetration into the real. There are a vast number of scientific facts from which philosophical facts might be extracted. We may merely mention the conservation of energy, the conservation of mass, and the merging of these two into the conservation of mass-energy, the Einsteinian conception of time, the laws of motion, the law of gravitation, etc. Scientific theories may be given a tentative ontological interpretation by the philosophy of nature. The " signs " of the real obtained in the sciences provide us with a multitude of examples with which to illustrate the truths arrived at in the philosophy of nature itself. The philosophy of nature has much to gain by reflecting on the natural sciences and using them to further its own ends. This extension of the philosophy of nature in and by the natural sciences has been termed its " integrative function " and is elaborated upon by Jacques Maritain in the paper earlier referred to which he delivered to the 1953 meeting of the American Catholic Philosophical Association.

This extension of the philosophy of nature through the instrumentality of the natural sciences gives us a new kind of knowledge quite distinct from the essential structure of the philosophy of nature, in a manner similar in some respects to that in which theology is distinct from faith, although the comparison has obvious deficiencies. This is the fourth of the four divisions of knowledge spoken of above.

E. *Summary of division of natural knowledge.*

In summary, our fourfold distinction can be schematized as follows:

UNSCIENTIFIC

1) *Common sense ontology*

SCIENTIFIC

2) *Philosophy* → *metaphysics*
↓
philosophy of nature
} *Noumenal knowledge*

↓

3) *Phenomenal knowledge*

↓

4) *Integral knowledge of nature*

It seems that these forms of knowledge must be clearly distinguished from each other if we are to bring order into the confusion now obtaining between the philosophy of nature and the natural sciences. It is necessary, it seems, to be very clear about placing the natural sciences in themselves in the third division alone. The difference between the movement of the first two kinds of knowledge toward real unity, necessity, and intelligibility, and the movement of the third kind not precisely away but rather *around* the real unity, necessity, and intelligibility has been sufficiently pointed out. The danger of attempting to interpret the natural sciences from an infra-philosophical viewpoint is also clear. With these observations about our knowledge of nature in mind, we may now turn to consider briefly the three opinions concerning the relationship of the philosophy of nature and the natural sciences which we saw at the beginning of this study.

IV. Conclusions Concerning other Thomistic Viewpoints

In the first view, there is one science of nature which, after reaching a general knowledge of the principles of mobile being, seeks to extend itself through the instrumentality of various dialectical techniques. The movement of the intellect is, however, always in the same direction, always toward the same object—mobile being considered in its mobility. This unity of the object means that the philosophy of nature and the natural sciences constitute in reality but one science, which employs diverse methods to achieve its end—as complete a knowledge of mobile being in its reality as is attainable. When multiplicity and contingency become too great for the intellect to overcome, in its drive toward the intelligible unities and necessities of the real, the intellect resorts to dialectical procedures, *knowing the reality* through logical principles extraneous to the reality itself. The dialectic is most satisfactory when it can move on the mathematical level. But although the procedure be dialectical, we arrive at some knowledge of reality through its use. How much is a subject of discussion.

This view, it seems, involves a confusion between the second and third types of knowledge described above in its movement toward the fourth. While there is some cognizance of the distinction between the second and third types, yet there does not seem to be any room in this view for the obvious autonomy which the natural sciences *de facto* possess. One need not be a philosopher of nature in order to be a good scientist. One can erect a great structure of knowledge such as modern quantum theory and know little of being. It seems quite necessary to call this kind of structure either a science or part of a science which is quite distinct from the philosophy of nature; for it has an order between (hypothetical) principles and conclusions, and an object quite distinct from that of the philosophy of nature. Both the philosophy of nature and the special sciences tend toward mobile being; but the philosophy of nature tends

toward it precisely as mobile *being*, while the natural sciences concern themselves with its *motion* and go outside it to achieve an ideal unity which resolves itself back again into the very phenomena themselves. It is in the very nature of mobile being that it present these two aspects, a consequence of its composition from matter and form. There is not merely a difference in methods in the philosophy of nature and the natural sciences. The different modes of conceptualization and reasoning employed in each are dictated by this polarity of matter and form in the very heart of mobile being, and through these different methods we attain different aspects of the reality.

There is, of course, a generic similarity between the philosophy of nature and the natural sciences inasmuch as both are about mobile being. Both concern the same general level of intelligibility in objective reality, the lowest of three such levels. In this respect, the position we are now discussing is pointing out a truth which we have also insisted on, namely, that the philosophy of nature and the natural sciences are necessary complements in our study of the physical universe. The philosophy of nature is exceedingly poor unless it enriches itself with the knowledge of the sciences, infusing its own light into the mass of knowledge provided it by these sciences. The special sciences, considered in themselves, show their practical face much more readily than their speculative aspect—they do not reveal being unless compelled to under the searching light of the philosophy of nature. The light of common sense ontology is altogether insufficient as we have already seen. But the integration of the philosophy of nature and the natural sciences can take place properly only if we are careful to safeguard the integrity of each. We must properly distinguish in order to properly unite.

The fundamental difference in viewpoint between this group of Thomists and Mr. Maritain appears to be traceable to their different conceptions of science. This group seems to be quite intent on the fact that speculative science is a movement *toward the real*; and in the real they find three levels of intelligi-

bility, to which correspond three degrees of intellectual abstraction. At each level the intellect tends to achieve a unity, a science. There are thus three speculative sciences of reality. Mr. Maritain, however, points out that the intellect may, in the presence of a single level of objective intelligibility, employ diverse methods to get at it, methods by which we actually attain different aspects of the real even at the same level. Such a difference in the movement of the intellect, however, is not due to the intellect alone, as we have said, but primarily to the reality itself which can show various faces to the intellect seeking to confront it. The problem is to evolve appropriate methodologies to study these aspects. Because of this, we can have more than one *movement of the intellect* toward the real at the same level of objective intelligibility. The natural sciences and the philosophy of nature are specifically distinct sciences at the first level of objective intelligibility.

But the natural sciences themselves constitute an integral whole with respect to the divisions of physics, chemistry, biology, etc. These parts of the integral whole are multiplied according to the diverse classes of phenomena which may be studied. But all such parts share in the character of natural science in one of two ways, insofar as the particular part in question has attained mathematization or not. This might be regarded as a specific difference of natural science taken as a sub-genus. There is a tendency to transfer sciences from the non-mathematical to the mathematical group through the evolution of appropriate methodologies.

Concerning the ultra-postivistic conception of the natural sciences, and the consequent cleavage between science and philosophy, it must be seen that such a conception of science can legitimately obtain only in a phenomenalist system of philosophy. If there is any intelligibility in the real itself, science cannot be altogether sealed off from philosophy; for both concern the same reality. Each comes to the real in a different way; but philosophy, to which in the last analysis nothing real is foreign, must eventually make use of what is

known about the real in the sciences in order to achieve an integral knowledge of nature.

As has been fairly clear, I have been greatly indebted to Mr. Maritain. I shall not attempt to criticize his position, since I believe that I have accepted it, at least substantially, as I understand it.

In this article I have been concerned with the speculative value of the natural sciences. Their practical value is only too obvious and may sometimes obscure their role in our speculative approach to the problem of mobile being.

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