MARITAIN'S PHILOSOPHY OF THE SCIENCES

By Yves R. Simon

THE upholders of the Thomistic revival which began late in the nineteenth century were soon confronted with the following challenge: Because the philosophical principles of Thomism had been established at a time when positive science was in its infancy, it was asserted that Thomism was forbidden ever to deal successfully with the problems of our time. There could be no provision made in the system of St. Thomas for the interpretation of either the results or the spirit of modern science, both of which influence so deeply the very statement of our philosophical problems. The collapse of Aristotelian physics had entailed the general ruin of the Thomistic philosophy; against this verdict, rendered at the time of Galileo and Descartes, there could be no appeal. Thomism was at best a remarkable phase in the development of Western thought. If something of it could be revived, it was a certain inspiration, a certain aspiration, a certain frame of mind, but not any part of the systematic synthesis actually known under the name of Thomism.

Such was the only possible attitude for those who did not believe that any part of philosophy is independent of the data of positive science. Less radical-minded persons were willing to make an exception for metaphysics, considering that our knowledge of the one, the true, and the good is little affected by what happens in physics and mathematics. But when there is a question of cosmology, psychology, even of logic, the restoration of a philosophy conceived in the Middle Ages was deemed plainly impossible. The result was a number of eclectic constructions in which St. Thomas was permitted to supply a few general truths but not any refined and detailed achievement

On the other hand, scholars convinced of the perennial truth of St. Thomas's philosophy were engaging in an ambiguous task: that of finding points of agreement between the teaching of St. Thomas and that of modern sciences. In the domain of

psychology in particular, there is quite a literature about St. Thomas corroborated by the most modern and positive research.

As a matter of fact, in order to know how far Thomism was affected by modern developments in the positive sciences, a group of preliminary questions had to be investigated. What about the object of philosophy? Has philosophy any distinct object? What about the unity of philosophy? Is philosophy a science or not? One science or several? What is the significance of the distinction between philosophical and positive knowledge? Is it a necessary and everlastingly indispensable distinction, or a merely provisional one? What about the kind of truth that belongs to philosophy? To positive knowledge? Is it the same or not? All these questions have received invaluable elaboration from the critical research whose climax was the publication, in 1932, of *The Degrees of Knowledge*.[1]

The pioneers of the Thomistic revival had rather vague ideas about the nature of the disciplines which some of them practiced with great ability. It seems that they were not particularly interested in problems pertaining to the specification of philosophical sciences. Today we consider it a paradox that Thomists have ever accepted a division of philosophy which was initiated by Wolff, consolidated by Kant, popularized by the Eclectics of the school of Cousin, and was fundamentally at variance with that upheld by St. Thomas. Our old masters undertook the restoration of the Thomistic philosophy without having asked themselves what conception of philosophy and of its divisions a philosophy must adopt in order to be consistently Thomistic. Rediscovering the genuine Thomistic concept of philosophy, reasserting it against many sorts of eclectic combinations—this is a task that Maritain has carried out with an uncompromising spirit of exactness and accuracy.

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[1] Main writings of Maritain concerning the philosophy of sciences: *Réflexions sur l'intelligence*, Paris, 1924, Ch. 6 and 7; *Distinguer pour unir ou les Degrés du savoir*, Paris, 1932 (English translation, *The Degrees of Knowledge*, Scribner's, New York, 1938); *La Philosophie de la nature*, Paris, 1935; *Science and Wisdom*, Scribner's, New York, 1940; *Scholasticism and Politics*, Macmillan, New York, 1940, Ch. 2.

It is now currently known that the whole doctrine of St. Thomas concerning the theory of science and philosophy is commanded by the distinction of three orders of speculative abstraction. In an early treatise, the *Expositio super Boetium de Trinitate*, St. Thomas develops, explains, and justifies the tripartite division of theoretical knowledge which had been outlined by Aristotle. Some theoretical objects are such that they can neither exist nor be thought of without matter, i. e., apart from the principle which makes things both perishable and observable. Others are such that they can be thought of without any reference to sensible qualities and the principles of mobility, although they cannot exist except in corruptible and observable subjects. Finally, some theoretical objects are determined by such a law of abstraction that they can both be thought of and exist apart from matter. The general division of theoretical knowledge based upon the consideration of the orders of abstraction is most profoundly objective, since it proceeds from the characteristics of the scientific object as such. Theoretical knowledge is primarily divided into *physics*, *mathematics*, and *metaphysics*.

This primary division which is the indispensable foundation of all Thomistic speculation about science and philosophy was strangely disregarded by the Thomists of the nineteenth century. According to the categories set up by Wolff, their metaphysics falls into a general metaphysics, and a special metaphysics itself divided into three disciplines: cosmology, psychology, natural theology (the latter being designated, to make things worse, by the absurd term "theodicy"). Such a conception upsets radically concepts which play an essential role in the Thomistic synthesis. Considering the philosophy of the world (cosmology) and the philosophy of the soul (psychology) as parts of metaphysics is, from a Thomistic point of view, completely nonsensical; for the whole observable world, including the human soul which is the form of a perishable body, belongs to the order of objects which can neither exist nor be thought of apart from matter.

Maritain has devoted unflagging effort to the restoration of

the concept of philosophy of nature. Badly discredited in the nineteenth century by the romantic *Naturphilosophie,* this concept had never been satisfactorily defined, inasmuch as the disciples of Aristotle never succeeded in distinguishing clearly philosophy of nature from positive science. St. Thomas uses promiscuously the expressions *philosophia naturalis, scientia naturalis, physica.* The problem is whether there is room within the first order of abstraction for more than one approach to the physical world.

In this connection, the Thomistic tradition includes possibilities of which the Thomists themselves were not sufficiently aware. Each order of abstraction admits of an inner differentiation. The great commentator of St. Thomas whom Maritain knows so well and loves so dearly, John of St. Thomas, points out with his usual clarity that within one and the same order, various degrees of abstraction determine so many distinct sciences. For instance, within the second order the Thomists distinguish the degree of abstraction proper to geometry and the higher degree proper to arithmetic. Within the third order of abstraction three degrees and correspondingly three sciences are distinguished: logic, metaphysics, theology. John of St. Thomas explains that the abstraction which defines an order is an initial one and consists in the disregarding of some sort of material data: individual matter in physics, sensible matter in mathematics, all matter in metaphysics. Once this initial abstraction is effected, the mind has entered into an order of intelligibility which should not be compared with a bi-dimensional plane but rather with a tri-dimensional space. For within this sphere of intelligibility the mind still enjoys the freedom of moving up and down in such a way as to reach various degrees of terminal abstraction.

Ancient Scholastics had only vague hints of the inner differentiation of the first order of abstraction. Applying to the first order the principles which had satisfactorily accounted for the inner differentiation of the second and third was to be attempted. Maritain restored and purified the Thomistic concept of philosophy of nature through a mere elaboration of an undeveloped aspect of historical Thomism.

Every representation concerning the observable world shows a dualistic or bipolar character inasmuch as it refers to an intelligible object expressing itself through a stream of sense appearances, and to a stream of sense appearances stabilized by a center of intelligibility. This bipolar character of the physical object and its representation is clearly suggested by the traditional definition of physics as the science of the *ens mobile seu sensibile*. The physical object is both intelligible (*ens*) and observable (*mobile seu sensibile*). Neither of these opposite characteristics can be disregarded without its specific nature being destroyed. Leave out the words *mobile seu sensibile* and we are no longer dealing with something physical. Leave out the word *ens* and we fall below the level of intellectual knowledge.

Yet physical thinking, while bound to adhere to the two aspects of its object, can put a particular emphasis on either one. If the emphasis is put on *ens*, we have a form of knowledge both ontological and physical, a philosophical physics, a philosophy of nature. If the emphasis is put on *mobile seu sensibile*, we have a discipline of a physical and non-ontological character, an empiriological science. This point must be insisted upon: the privilege granted to either pole of the physical object is only a matter of emphasis. The philosopher of nature is not a metaphysician, and his definitions ought to imply some reference to data of sense experience. On the other hand the empiriologist is not a mere dealer in sense experiences, for the observable regularities with which he deals owe their constancy and their consistency to their being organized by some *ratio entis*. In this connection it is fitting to stress the felicitous character of this newly coined expression, *empiriological* sciences. Speaking of empirical sciences is objectionable, though customary, since empiricism is said in contradistinction to scientific knowledge. Empiriological sciences are not mere empiricism, but a system of experience organized by an essential reference to a principle of intelligibility, ἐμπειρία μετὰ λόγου.

How physical thinking organizes itself around either pole of its object can be best evidenced by investigating the way physical definitions are constructed and justified. A typology

of physical concepts is the real key to the opposition between philosophy of nature and positive science.

Let us try a rigorous ascertainment of the meaning of a word found both in philosophical and in positive contexts. The example chosen may be very simple. To the question *what does the word man mean?* the answer will be "rational animal"; now, none of the elements of this definition presents a character of irreducible clarity. Take one of them, for instance, animal. What does this word mean? A correct definition would be: "a living body endowed with sense knowledge," and these are so many terms which badly need clarification. Take one of them, for instance, "living." I would say that a body is a living one when it moves itself, when it is the active origin of its own development. If we go any step farther, we go beyond the limits of physical thought. In order to render the idea of life clearer, we would have to define it as self-actuation. The concept of self-actuation does not imply any reference to the proper principles of corruptible and observable things: it is a metaphysical concept. Its elements are identity and causality. Identity is the first property of being. Causality can be analysed into potency and act. Identity, potency, and act are so many concepts directly reducible to that of being, which is, in an absolute sense, the first and the most intelligible of all concepts. We have reached the ultimate term of the analysis, the notion which neither needs to be nor can be defined and which does not admit of any beyond.

This is the kind of analysis that the word *man* suggests when it is used in certain contexts. Everybody would agree that a discourse which demands such an analysis is a philosophical one. But the same word *man* is often used in contexts which neither demand nor could stand such an analysis. I happen to find the word *man* in a treatise on zoology: explaining it in the way we did just now would seem perfectly ridiculous. An analysis whose term is the concept of being has obviously nothing to do with the behavior, the method, the spirit and the principles of the whole discipline we call zoology. Should a univocally-minded philosopher try to enlighten a zoologist by giving him explanations about self-actuation as a particular

form of relationship between potency and act, no doubt the zoologist would burst into laughter and declare that all these stories are perfectly nonsensical for him as a scientist.

The zoologist would be right and the philosopher would be univocally-minded. Both philosopher and zoologist consider man, but they have a different way of defining objects and of answering the question *what does it mean?* For the zoologist, man is a mammal of the order of Primates. How would he define such a term as mammal? A vertebrate characterized by the presence of special glands secreting a liquid called milk. How is milk defined? In terms of color, taste, average density, biological function, chemical components, etc.

Here the ultimate and undefinable element is some sense datum; it is the object of an intuition for which no logical construction can be substituted and upon which all the logical constructions of the science of nature finally rest. In some cases, the explanation of a positive definition quickly demands recourse to sense experience. This often happens in the least elaborated parts of science. The elaboration of scientific concepts generally postpones the time when the recourse to sense intuition appears indispensable. But sooner or later it always imposes itself unmistakably. It is the possibility of being ascertained through sense experience which gives the concept its positive meaning. Every concept is meaningless for the positive scientist which cannot be, either directly or indirectly, explained in terms of sensations.

The philosophy of nature can be defined as a physical consideration whose conceptual instruments call for an ascending analysis, positive science as a physical consideration whose conceptual instruments call for a descending analysis. The very opposition of the two analyses provides an invaluable rule for the determination of the point of view prevailing in our studies about nature. Let us think of the ambiguous literature which stands on the borderline between philosophy and positive science. When a philosopher informed of positive science or a scientist interested in philosophy considers philosophical problems raised by the study of positive questions, the philosophical and the positive point of view appear successively in his ex-

positions; generally the writer is not aware of the shift. The resulting confusion can easily be removed provided we carry out the analysis of a few key concepts. According as this analysis goes up or down, according as the concept demands to be explained in more and more characteristically ontological terms or in terms which refer more and more directly to definite experiences, we know whether we have to do with a philosophical or a positive treatment.

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This description of positive science as a consideration of the *ens mobile seu sensibile* which puts the emphasis upon *mobile seu sensibile* and centers around the observable aspects of things throws a novel light on the notion of the science of phenomena. Let us have a glance at the adventurous history of this notion.

At the dawn of Greek philosophy, a science of phenomena is deemed impossible both by Parmenides and by Heraclitus. Science demands an unchangeable and necessary object; the phenomenal universe shows only a stream of changing appearances. The phenomenon, owing to its mutability, is thoroughly uncongenial to the spirit of scientific knowledge. This negation persists in Plato. The phenomenal world is the object of a merely opiniative knowledge; science finds its object in a transcendent world of numbers and ideas.[2] With Aristotle the picture is quite different. Aristotle realizes that there are immutable types immanent in the physical world: these are universal natures which reveal themselves through the regularities that are observed in the very order of phenomena. Accordingly, the phenomenon no longer has the character of an enemy of scientific thought. It is the phenomenon which, through its regularities, leads the scientific mind to its object: the universal types of things, their essences, their forms of being. The science so defined is a philosophy of nature, an ontology of the physical world. It does not reach its end until it is able to answer the question " What *is* the thing under consideration? " Neither Aristotle nor any of his Thomistic followers has ever construed

[2] It goes without saying that in this sketch we content ourself with pointing out major features of the systems under consideration.

the unwarranted idea of an intuitive perception of essences. Yet their scientific ideal is definitely attached to the disclosure, the understanding of the intelligible types immanent in the observable world. However essential may be the observation of phenomena in such a science, this science is by no means a science of phenomena. It is exclusively, or rather claims to be—for Aristotle did in fact perform great achievements in empiriological disciplines—a science of the essences located beyond the phenomena.

It can be safely said that the science of phenomena did not receive any epistemological charter before Kant. The charter it was given by Kant is an idealistic one. Hardly conscious of its nature in the era preceding the Kantian *Critique,* the science of phenomena, from then onward, was to be acknowledged as a distinct and fully legitimate epistemological species. But how is the old problem answered in the *Critique* of Kant? What sort of solution is given to the difficulty resulting from the sharp conflict between the requirements of the scientific spirit—necessity, universality, intersubjectivability—and the most obvious characteristics of the phenomenal world, its endless diversity, its thorough unsteadiness? There can be no doubt about it: the principles which, according to Kant, organize nature, do not lie in nature, but in the mind. The scientific object, with its characteristics of orderliness, determination, and universality, results from the application of mental categories to the diversity of sense-experience data.

Most men of science, ever since the Kantian reformation, have assented to the fundamentally idealistic view that the characteristics of the scientific object, its aptitude to fit in an intelligible system and, above all, to comply with the requirements of causal identification, are a proper effect of the constructive or synthetic activity of the mind. This stubborn adherence to an idealistic justification of positive science conflicts strikingly with the spontaneous realism of scientific thought. Men of science, willingly or not, receive their philosophical ideas from philosophers; they could not rid themselves of idealistic prejudices while philosophers were teaching idealism as the only doctrine that may account for the un-

questionable ability of the mind to treat in an orderly and causal manner the universe of phenomena.

In his dealing with phenomena, Aristotle has no other purpose than that of utilizing their regularities in order to know essences. Maritain calls *dianoetical intellection* the act of the mind which penetrates an essence and perceives what the thing is. For instance, the philosophical definition of man as analysed above expresses an intellection which, inexhaustive and non-intuitive though it is, has succeeded in penetrating the whatness of human nature. We know that such a triumph of the theoretical intellect is a rare achievement. In most cases we cannot disclose the essences of sensible things in their specificity, we cannot accomplish a dianoetical intellection of their whatness. All we can do is to distinguish them through a definition calling for a descending analysis. The intellection expressed by such a definition does not imply any penetration of the physical essence, it only implies a circumscription of it within a steadily connected ensemble of observable regularities. Nobody can say what the essence of silver is; yet silver is a perfectly distinct chemical species. The undisclosed essence called silver is clearly and certainly distinguished from any other essence [3] by the system of observable regularities which taken together belong exclusively to it. In this connection let us call attention to a difficulty often experienced by positive scientists when they try to give their definitions a logically satisfactory form. We include in the definition of silver the property of melting at 960.5° centigrade, the property of boiling at 2000°, etc. But in the proposition, silver melts at 960.5°, what does the subject, silver, refer to, if not to something which is specified precisely by the fact that it melts at 960.5°? The vice of circularity seems inevitable. The statement that silver melts at 960.5° resembles very much the statement that a black cat is black. Or, if we wish to avoid mentioning the predicate in the logical subject, we are confronted with a host of predicates hailing upon nothingness as a subject. In fact a subject is not

[3] I abstract from the question whether an empiriological species like silver coincides with an ontological species, or is merely a sub-determination of a broader ontological species.

lacking, but whereas the many predicates belong to the order of phenomena, the subject belongs to another order. Throughout the chapter of chemistry which constitutes a definition of silver, a certain ontological x unreflectingly designated by this name, silver, is present, though undisclosed, to the mind. The logically satisfactory definition of silver would be: x melts at 960.5°, boils at 2000°, etc.; we give the name of silver to the hidden essence which we circumscribe by this steadily connected set of observable regularities. Whereas the being of things is successfully penetrated by the dianoetical intellection used in philosophy of nature, it is only circumscribed by the *perinoetical* intellection of empiriological science. The intelligible element which enables empiriological knowledge to transcend empiricism is not revealed to the mind; it is neither constructed by the mind nor imposed by it upon the phenomenal matter. It is grasped by the mind inside a system of phenomenal regularities, circumscribed by this observable system and never disengaged from it. Thus the science of which Aristotle had no clear notion —although he practiced it a great deal—, the science which has for its object the phenomenal regularities themselves, is defined as possible on a realistic basis. The orderly character of the phenomena is guaranteed by the ontological x which is confusedly grasped together with them by the empiriological analysis. With Maritain, the science of phenomena was given for the first time a justification which owed nothing to the idealistic interpretation of the mind's activity.

It is clear that in this conception a positive science of nature can exist independently of any mathematical treatment of natural phenomena. The Kantian statement that " the amount of genuine science found in each department of natural knowledge cannot be greater than the amount of mathematics found in it " shockingly conflicts with the fact that most important developments whose scientific character can hardly be questioned seem to be by nature refractory to mathematical forms (in biology and psychology especially). Whenever the mind seizes an essence, a *ratio entis,* albeit in the blind way proper to the perinoetical intellection, a genuinely scientific treatment remains possible. Any universal and necessary form of being,

however obscure may be the way it is grasped, constitutes a matter to which the mind can apply the principles of scientific thought, that is, causal and explanatory schemes. With great care Maritain pointed out that causal ideas and principles, when applied in empiriological sciences, have to be reshaped or refashioned. The concept of efficient cause, for instance, is originally an ontological concept, that is, a concept, defined by reference to being; in this original condition it is not directly applicable outside the ontological order. When we go down to the empiriological level, the concept of being undergoes a transformation. Here, being no longer appears as the lighted spot of the thing under consideration, but merely as an undisclosed principle of orderliness which guarantees the steady character of the phenomenal regularities upon which light is concentrated. Causal concepts have to undergo a transmutation completely analogous to that undergone by the concept of being. This operation can make them hard to recognize, and this is how some extreme forms of positivism have been able to construe the ideal of a purely legal science which would owe nothing to causal concepts. But it is well known that the spontaneous development of positive sciences has constantly given the lie to this ideal limit of positivism.

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Considering again the current contention that Thomism cannot account for modern epistemological developments, let us now remark that it refers especially to the mathematical aspect of modern science. Did not the Cartesian reformation consist in the substitution of a mathematical interpretation of the physical world for the Aristotelian interpretation of nature in terms of ontology?

The mathematical treatment of physical nature was not totally unknown to ancient and medieval Aristotelianism. Astronomy, optics, and acoustics are referred to in the works of Aristotle and his medieval followers as so many *mixed sciences*, whose form is mathematical and whose matter is physical. In this connection, it is necessary to correct current statements concerning the lack of explicit distinction between philosophy

and positive science in ancient and medieval philosophers. Old Aristotelians failed to distinguish clearly two types of thought, corresponding to distinct degrees of abstraction within the first order, and the term *physicus* is taken by them as entirely synonymous with the term *philosophus naturalis*. In that sense it is true that up to the modern era philosophy embraced all sciences of nature. But this holds only so far as positive research assumes purely physical ways. Ancient and medieval philosophers seem to be rather keenly aware of a discrepancy between the ways proper to the *philosophia naturalis* and those proper to physico-mathematical sciences. Whereas it never occurs to them to set in opposition the *physicus* and the *philosophus naturalis*, they currently set in opposition the *philosophus physicus* and the astronomer, thus showing some realization of the non-philosophical character of the mathematical interpretation of nature.

Maritain describes the epistemological crisis which broke out at the time of Galileo and Descartes and is still so far from being settled as a *tragic misunderstanding*.[4] When the historic conflict between the Aristotelian physics and the new physics opened, both sides were equally convinced that this was a conflict between two philosophies of nature. The physico-mathematical science founded by Descartes was taken by its very founder as a philosophy of nature and the only possible one. The decadent Aristotelians with whom Descartes was confronted did not even think that the Cartesian world-picture was possibly a physico-mathematics sophisticated into an ontology. Then it happened that the Cartesian mechanism achieved the obliteration of the old distinction between the philosopher of nature (*physicus*) and the mathematical interpreter of nature (*astronomus, musicus* . . .). When we reread the great work of Newton significantly entitled *Philosophiæ Naturalis Principia Mathematica*, we realize that the Newtonian science, once considered by positivists as the archetype of positive knowledge, was far from having rid itself of ontological ambitions.

[4] See *The Conflict of Methods at the end of the Middle Ages*, THE THOMIST, Oct. 1941.

Thanks to his felicitous description of a non-philosophical approach to the physical world within the first order of abstraction, Maritain found himself in a favorable position to investigate the principles of physico-mathematical knowledge and to account for the increasingly complete autonomy which marked its latest developments. In this undertaking, Maritain had at hand two effective instruments: one was his theory on perinoetical intellection and descending analysis; the other was the conception of the mathematical object as a *preter-real* entity always affected by some *conditio rationis* and which often turns out to be a mere *ens rationis* with a foundation in the real.

It is comparatively easy to see how the law of the descending analysis which prevails in all fields of positive knowledge applies to the mathematical interpretation of nature. Whereas in the case of a non-mathematical positive science the law of descending analysis amounts to the necessity of resolving all concepts into observable data, this law, when applied to a science of physico-mathematical type, signifies the necessity of resolving all concepts into *measurable* data. Nothing makes sense for the positive scientist in general except what can be explained in terms of observations. Nothing makes sense for the physico-mathematician except what can be explained in terms of measurements. A great deal of confusion often results from the fact that the philosopher of nature and the physicist use the same terms without in most cases being aware of their referring to widely different objects. One and the same term refers to the being of things when used by the philosopher and, when used by the physicist, to the aptitude of things to be the matter of accurate measurements. No wonder that such widely different points of view give birth to statements which in appearance conflict sharply. The conflict generally vanishes as soon as we understand that identical words convey typically different concepts and refer to distinct objects. The clearest example we can think of is furnished by the recent discussion about the determination of natural phenomena. Many philosophers and scientists attribute to the so-called indeterminism of modern physics revolutionary consequences with regard to our philosophical conception of the natural and even of the human

world. Yet it should be remarked that the point of reference used by the physicist in his definition of determinism is quite distinct from the point of reference used by the philosopher in the definition of a concept which bears the same name. True to the law of ascending analysis which is that of all philosophical thought, the philosopher considers that an event is determined when in some way or other it happens necessarily; necessity itself is defined as the property of that which cannot be otherwise than it is. The reference is ontological; the concept explains itself in terms of being. A concept so defined makes absolutely no sense for the physicist. Being and the possibility of being otherwise are not things which fall under his measurements. Accordingly, in order to be of any real use in physics the concept of determinism has to be reshaped so as to satisfy the following proportion: the determinism of the physicist is to the determinism of the philosopher as *the measurable* is to being. Thus we are led to realize that whereas the philosopher understands by *determined event* an event which follows from its causes in such a way that it cannot fail to happen, the physicist understands by *determined event* an event whose coordinates at the time t can be accurately calculated on the basis of an initial system of spatio-temporal data. The determinism of the physicist is an *empirio-metrical* determinism.

Because of the intervention of the mathematical *ens rationis* the gap is wider between philosophy of nature and physico-mathematics than between philosophy of nature and the other parts of positive science. In so far as physics is a formally mathematical science, in so far as it obeys the law which is that of its form, it participates in the indifference of mathematics to the reality of its object. This consideration accounts for the particular form taken in our times by the old conflict between science and common sense.

The congeries of current notions that we call common sense is far from being homogeneous. Maritain distinguishes in it a system of images and a rudimentary ontology. The imagery of common sense expresses mostly the laziness of uncultured intellects and their willingness to content themselves with cheap

representations. No wonder that this imagery has always conflicted with science and generally with every form of rational thinking. But inasmuch as physics incorporates *entia rationis* and follows the mathematical tendency to treat indifferently *entia rationis* and *entia realia*, even the sound part of common sense, its ontology, may enter into conflict with the most sound scientific speculations. The concept of relative simultaneity, for instance, appears very shocking to common sense; common sense unhesitatingly believes that the question whether two events happen at the same time must be answered by yes or no. Ontologically considered, simultaneity is absolute. Yet the concept of relative simultaneity makes sense if referred to definite possibilities of accurate measurements; this reference is thoroughly unfamiliar to common sense. Relative simultaneity is a physico-mathematical *ens rationis* founded in the real and inescapably imposed upon the mind of the physicist by the very nature of his scientific point of view.

From this it does not follow that the constructions of the physicist should be considered as mere " hypotheses " or conventions incapable of apprehending the real in any way. Maritain would not agree with the superficial statement that the philosopher has never to worry about agreements or disagreements with the physicist, on the ground that philosophy and physics are two separate domains of thought. His epistemological pluralism is by no means absolute. Let us give an idea of the distinctions which should be made and of the phases which should be surveyed in order to appreciate the bearing of physical theories with regard to the knowledge of the real.

1. The principles previously developed make it clear that a concept may be a genuine expression of the real without pertaining to the ontological type. A description of a non-ontological character is not thereby deprived of real bearing. Real, being, knowledge are so many analogical terms. An ontological description is more real than a non-ontological one, yet a non-ontological description may well be a description of the real.

2. Even within the first order of abstraction the mind often uses fictitious constructions in its approach to the real. Yet, so long as we remain within the first order of abstraction, the

realistic spirit of science is not held in check. Except for possible failures, fictions never play more than a transitional role; they are used as mere means in view of achieving a representation of the real which cannot be brought about in a more direct fashion.

3. As soon as positive science assumes a mathematical form, something entirely novel takes place. The very nature of mathematical abstraction renders mathematical thought indifferent to the reality of its object. Consequently physico-mathematical science, in so far as it yields to the attraction of its mathematical form, tends to make no difference between *ens reale* and *ens rationis*.

4. Should this tendency prevail without check, it could be said truly that physical theories do not trace phenomena to their real causes and cannot tell anything about the real course of physical events. Such is apparently the conception of physics upheld by Pierre Duhem. For Maritain this interpretation, though not without basis, amounts to an oversimplification. As a matter of fact, the attraction exercised on physics by its mathematical form is not unchecked. If the form is mathematical, the matter remains physical and accordingly there is in the very structure of the science a counteracting tendency to stick to the real and to look for explanations by real causes. Actual science is probably a compromise between these two opposite and complementary tendencies.

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However incomplete it may be, this exposition sufficiently shows that for Maritain the problem of the relationship between science and philosophy does not admit of any easy solution. Maritain is quite aware of the great improvements in knowledge which can be expected from the cooperation of the philosopher and the scientist; but he does not seem to believe that such a cooperation can ever work smoothly and without frictions. The vast ensemble of our knowledges of nature—philosophical, empiriological, empiriometrical—is apparently destined to present everlastingly a spectacle of restlessness, of precarious equilibrium, with sharp conflicts breaking out in times

of crisis. Such a lack of harmony would be sufficiently accounted for by the psychology of the scientist and that of the philosopher. It is difficult, not to say impossible, for each of them not to be biased by his own *habitus* to the point of being unable to understand his partner. But even if a perfect philosopher were also a perfect physicist, or vice versa, there still would be within the mind provided with such *habitus* ground for conflicts between the two visions of the world. Maritain says that there is some melancholy in the realization that no complete continuity can be established among our various approaches to the natural world. It is not the least merit of his extensive and profound exploration of the most diverse fields of rational activity to have removed the optimistic illusion of a perfect harmony among the functions of the mind.

Compared with the teaching which prevailed of Thomistic textbooks thirty years ago, Maritain's philosophy of sciences appears as a tremendous novelty. Yet whoever is familiar with the physical and epistemological writings of St. Thomas will admit that no Thomist has ever written a more authentically Thomistic book than the *Degrees of Knowledge*. This great work testifies that the most living and timely expression of Thomism is not reached through eclectic combinations, but through a faithful and consistent adherence to the principles of St. Thomas. How does it happen that several philosophers, consistently faithful to St. Thomas, can do no better than voice lifeless truths, badly handicapped in the struggle against living errors? I think I understood what is wrong with these respectable thinkers when Maritain not long ago pointed out, in a letter to me, that the commentators of St. Thomas have the arduous duty of disentangling the precious stuff, bit by bit and indefatigably, from the vast amount of gangue in which it is hidden. Then, alluding to some persons whom we know well, he added: "They believe they have just to crack the shell to get the nut."

University of Notre Dame,
Notre Dame, Indiana