

opposition to positivism and to idealism. Peirce, the pragmatist, belongs among these. Other realist philosophers include Emile Meyerson, Henri BERGSON, and Alfred North WHITEHEAD. Meyerson held that there was an ontology in all science, as shown by the scientist's commitment to the existence of abiding identities in a changing world. Bergson maintained that science as such presents a geometrized, hence static, view of a world in motion, and that motion can be grasped only by an intuition that lies beyond the techniques of science. Whitehead proposed that the scientist, in advance of his science, commits himself to "half truths" that the philosophers must examine. Using experience in the wide sense given it by James, Whitehead elaborated a philosophy of organism. He used science more to confirm and correct this philosophy than to establish it.

**Scholastic Positions.** With the revival of Thomistic philosophy in the wake of Leo XIII's encyclical *Aeterni Patris*, scholastics began to develop their own distinctive views on the relation between science and philosophy. One of the earliest and most active centers of this revival was the University of Louvain; its dominant figure was Cardinal Désiré MERCIER. As a follower of Aquinas, he subscribed to Thomistic metaphysics; he also accepted a philosophical physics that preceded metaphysics in the pedagogical order. With later generations at Louvain, however, the philosophy of nature, under the name of COSMOLOGY, gradually lost its originality and came to be considered more or less as an applied metaphysics. The most extreme presentation of this view is that of Ferdinand Van Steenberghen, for whom the sciences are subdivided into epistemology, which includes logic; positive science, which includes mathematics; and metaphysics, which includes cosmology, psychology, and even moral science.

Jacques MARITAIN (d. 1973) departed from the position just outlined by his recognition of a philosophy of nature distinct from metaphysics. The philosophy of nature is called by him ontological knowledge, in contrast to the modern sciences, which are called empiriological and are subdivided into empirioschematic and empiriometric. At the physical level of ABSTRACTION Maritain proposed a distinct type of natural science, called empirioschematic; such science, for him, uses so-called qualitative models, like the theory of evolution in biology, as explanatory tools. Empiriometric knowledge, on the other hand, is a mixed or intermediate science, described in principle by Aristotle, Saint Thomas Aquinas, and Cajetan, and roughly equivalent to today's mathematical physics. In such empiriometric knowledge the explanatory tools are quantitative, and the resulting science may be considered terminally physical.

Charles DE KONINCK of Laval University proposed a view denying that Maritain's so-called empiriological knowledge represented a distinct type of science. For De Koninck the modern sciences are dialectical in Aristotle's sense, whereas true or demonstrative natural science, again in Aristotle's sense, is found only in the general philosophy of nature and philosophical psychology (*see* DIALECTICS; DEMONSTRATION). The modern natural sciences are thus dialectical continuations of the philosophical study of nature, where demonstration can be achieved and science thus attained.

The Albertus Magnus Lyceum in the United States, taking its inspiration from Anicetus Fernandez and William H. Kane, agreed with Maritain that mathematical physics is a science distinct from the philosophy of nature. The Lyceum position agreed with De Koninck's in recognizing that empirioschematic knowledge is not a distinct science but a continuation of the philosophy of nature. However, this continuation of the philosophy of nature is regarded as not only dialectical; some of it is said to be demonstrative also. To this extent it continued the philosophy of nature not merely in a dialectical but also in a scientific way.

*See Also:* SCIENCE (IN ANTIQUITY); SCIENCE (IN THE MIDDLE AGES); SCIENCE (IN THE RENAISSANCE); SCIENCES, CLASSIFICATION OF; PHILOSOPHY OF NATURE

**Bibliography:** V. E. SMITH, ed., *The Philosophy of Physics* (Jamaica, New York 1961). J. MARITAIN, *Distinguish to Unite, or the Degrees of Knowledge*, tr. G. B. PHELAN from 4th French ed. (New York 1959). C. DE KONINCK, "Les Sciences expérimentales sont-elles distinctes de la philosophie de la nature?," *Culture* 2 (1941) 465-76. J. A. WEISHEIPL, ed., *The Dignity of Science* (Washington 1961). P. H. VAN LAER, *Philosophy of Science*, 2 v. (Pittsburgh 1956-62). S. STRASSER, *Phenomenology and the Human Sciences* (Pittsburgh 1963). R. MCRAE, *The Problem of the Unity of the Sciences: Bacon to Kant* (Toronto 1961). B. K. MILMED, *Kant and Current Philosophical Issues* (New York 1961). A. J. AYER, ed., *Logical Positivism* (Glencoe, Illinois 1959). S. E. TOULMIN, *The Philosophy of Science* (New York 1953). K. JASPERS, *Way to Wisdom: An Introduction to Philosophy*, tr. R. MANHEIM (New Haven 1960). C. S. PEIRCE, *Philosophical Writings of Peirce*, ed. J. BUCHLER (New York 1955). R. M. PALTER, *Whitehead's Philosophy of Science* (Chicago 1960).

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## PHILOSOPHY OF NATURE

The philosophy of nature, variously referred to as natural philosophy, COSMOLOGY, and the science of nature, is the discipline that treats of the world of nature or the physical universe in its most general aspects. Traditionally it considers such topics as the definition of matter, nature, motion, infinity, time, life, soul, and similar

concepts, and speculates about the elements and component parts of the universe. In the present day, philosophers of nature are faced with two major problems. One is how to distinguish their discipline from metaphysics; the other is to preserve it from being displaced by modern sciences, such as physics, chemistry, biology, and psychology.

While recognizing alternative views of the philosophy of nature, this article devotes major attention to that first propounded by ARISTOTLE in his *Physics*, and subsequently clarified and enriched by Greek, Arab, and Latin commentators, especially St. ALBERT THE GREAT and St. THOMAS AQUINAS.

### Scope of the Philosophy of Nature

Aristotle characterized his study of nature as being both scientific, in contrast to Plato's "likely story," and natural, in contrast to being mathematical or metaphysical. The first claim he justified by delineating the subject of the science, its concern with causes and principles, and its scientific order of development. The second he showed by differentiating the natural from other scientific approaches, particularly the mathematical. This article follows his order in establishing these foundations and in proceeding from them to outline the scope of the entire discipline.

**Subject of the Science.** The claim that the philosophy of nature is scientific can be approached in several stages. First, the subjects considered in the philosophy of nature are said to be known in terms of a universal sensible matter (*see* SCIENCES, CLASSIFICATION OF). The corresponding universal knowledge is abstract, although not in the way in which mathematical knowledge is abstract. Mathematics, in its abstractions, leaves behind the sensible, physical world, while natural science does not. It merely abstracts the universal, or the type, from the individuals that impress themselves upon man's senses; in this respect, physical science stays within the sensible world, although considering only what is general within it. ABSTRACTION from individual to common sensible matter thus constitutes the special intellectual light under which the philosophy of nature views its subject.

Second, this subject itself may be defined in a general way as mobile being, where mobile means capable of being changed in any way. It is by their mobile character that things in the physical world first come to be understood. Water, copper, maple trees, cows, even men are initially known by their behavior, their weight, their combustibility or lack of it, their growth, or other such activities. Thus it is appropriate to characterize physical reality as mobile.

On the other hand, to consider the subject of the philosophy of nature to be "being" as mobile, one would have to presuppose a metaphysics. Until proof is given that there exists at least one immobile being—such as a Prime Mover or a spiritual human soul—reason, unaided by faith, can make no real distinction between being and the mobile. This is why, in the language of Cardinal CAJETAN, the philosopher of nature has to consider mobile being as an unsegregated whole (*totum incomplexum*). In the same vein, Cajetan urges that it would be inappropriate for the philosopher of nature to consider his subject matter to be corporeal reality. That every mobile being is a body has to be itself established in the philosophy of nature.

**Scientific Character.** These considerations raise the question whether there can be a scientific knowledge of a subject such as mobile being. If SCIENCE (*SCIENTIA*) is defined in Aristotle's sense, it is certain knowledge of things through their proper causes (*Anal. post.* 71b 8–12). To fulfill this definition, natural philosophy must initially seek the primary causes or FIRST PRINCIPLES of this subject. Such an objective governs the initial development of natural philosophy, as pursued in the Aristotelian tradition.

An orderly search for these principles is guided in that tradition by the methodological conviction that the mind's natural tendency is to go from the known to the unknown. This explains why, though God is the most universal cause of all reality, man's knowledge of nature, as reached by unaided reason, does not logically begin with Him or with any other metaphysical subject. The search for first principles must stay within the proper order of nature. This again explains why, for Aristotelian Thomists, the study of metaphysics is postponed until after that of the philosophy of nature. Another application is that within the level of physical knowledge, what is best known to man are physical things as grasped in a universal and vague mode; only from such considerations does the mind advance toward notions that are more particular and distinct.

**Order of Invention.** This way of stating the progress of the mind from the known to the unknown is based on the fact that man has an imperfect knowledge of a thing before such knowledge grows more complete. To know a thing imperfectly is to recognize its common features without being able to differentiate it from other things. A GENUS, which includes its SPECIES in a universal and indistinct manner, is more intelligible to man than a species itself. The mind is able to recognize an entity such as a circle or a man (vague knowledge) before it can give a scientific DEFINITION of either (distinct knowledge). As indicated by his speech, a child first tends to

regard all women as “mother” and all men as “father”; then, as his knowledge increases, he is able to put a differential (hence distinct) structure into such notions.

The movement of the mind from general aspects of things toward their more particular features is a progress from what is most intelligible to man toward what is most intelligible in itself. The more generic man’s considerations, the more remote these are from the world of actual being, which is the source of objective intelligibility; again, the more specific these become, the closer man gets to actuality, even though this more actual entitative level is less intelligible for him. This is why, though modern science analyzes nature in a highly specific and detailed way, it is frequently uncertain and hypothetical in its conclusions. In very detailed areas of science, e.g., quantum theory, notions become so hazy that the physicist no longer knows what his mathematics represents and hence no longer knows what he is studying.

**Order in Natural Science.** The methodological approach just outlined has two important consequences, one concerning the order of the subjective parts of the science of nature, and the other concerning the level at which the mind should search for the first principles of physical things.

*Subjective Parts.* In the study of any type of mobile or material being, its most generic level should be examined first: this most generic level is mobile being without regard to its types, such as water, iron, maple tree, dog, or man. Such a procedure avoids repeating the analysis of mobile being in general whenever an analysis of a particular type of mobile being is begun. The subject of this basic study, entitled the *Physics* by Aristotle, is mobile being in general (*ens mobile simpliciter*). After this, the philosophy of nature considers the first and most common type of mobile being, bodies undergoing local motion; this formed the subject of Aristotle’s *On the Heavens*, whose content may be best described as cosmology, the science of the universe at large. In the progress to the even more particular, the next study is that of qualitative change, exemplified in *On Generation and Corruption*, Aristotle’s rudimentary work on chemistry. Finally come the biological works, beginning with a study such as that outlined in Aristotle’s *On the Soul*.

This sequence of books is mentioned here not to defend the content of Aristotle’s cosmology or chemistry, but only to illustrate a formal order for treating the various materials concerning natural things. This issue must be reopened in discussing the relation between philosophy and science. The contents of the *Physics* alone are often described today as the philosophy of nature; although this restriction is not quite accurate, it can be used until further precisions are made.

*Principles of the Philosophy of Nature.* The proper order of invention thus requires a search at the universal level of mobile being for those first principles which, when discovered, assure that the philosophy of nature is scientific in the sense of the *Posterior Analytics*. The result of this search leads to the recognition that in all motion there are three factors: (1) a subject or MATTER; (2) a new qualification of this subject, called FORM; and (3) the previous lack or PRIVATION of this form in the subject able to possess it (*see* MATTER AND FORM). Moreover—and now at a level only slightly less general than before—two kinds of change are recognized: on the one hand, SUBSTANTIAL CHANGE, e.g., the burning of wood, whose subject is called primary matter and whose form is called substantial form; on the other, accidental change, e.g., the splitting of wood, whose matter is called secondary matter and whose form is known as accidental form. Primary matter, substantial form, and the previous privation of such form are the three first principles of all mobile being. The recognition that such principles exist in the world of nature is the clear assurance that a science of the natural world is possible.

**Nature and the Natural.** Aristotle is furthermore at pains to distinguish the meaning of the term “nature.” If the philosophy of nature is a natural science, then he must show that the subject as well as the middle terms for demonstrating about that subject are both natural. He does this by first defining nature.

*Art.* NATURE has several opposite poles to which, in different contexts, it can be contrasted. First of all there is art [*See* ART (PHILOSOPHY)]. In all types of art, but especially in mechanical art, man obviously does something to the given world. He finds iron ready-made but shapes it into a fence. He obtains wool from sheep but sews it into a garment. He cuts wood from a forest but arranges it into a house. All such products of art can undergo changes as in the rusting of the fence, the tearing of the garment, and the burning or collapsing of the house. But second thought shows that the changes take place not because of the artistic form but because of the natural matter. The fence rusts because it is iron, the garment tears because it is wool, and the house burns or collapses because it is wooden. Thus, what is by nature has a principle of motion within itself; what is by art, to the extent that it is art, has its principle extrinsic to it and in human reason.

*Chance.* Another opposite to nature is CHANCE—an interference between two lines of natural causality not determined, by the nature of either, to interfere with one another. Such happens when, say, a cosmic ray strikes a gene and results in the production of abnormal offspring. “Nature is the first principle of motion and of rest in that

in which it is [by contrast to art] primarily and essentially and not accidentally [by contrast to chance]” (St. Thomas, *In 2 phys.* 1.5). In a briefer but less rigorous wording, nature is an intrinsic principle of motion.

**Mathematical Physics and the Physical.** But though the phenomena of art and chance may aid in the defining of nature, the most important modern opposite of the natural or physical is the mathematical, especially the kind of mathematical knowledge called mathematical physics. In listing Aristotle’s major works in natural science, no mention was made of mathematical physics. The reason is that this is not a natural or physical science in its internal structure, as Aristotle explains in Book 2 of his *Physics*. It does not have a strictly physical subject, like water or sheep, but a mixed subject, e.g., sensible lines in optics, where the physical or sensible is compounded with the quantified or mathematical. Moreover, it is only the mathematical component of the mixed subject that the mathematical physicist explains. Evidence for this can be found in the fact that the middle term in a mathematico-physical argument, hence the causal knowledge employed in such an argument, is mathematical (cf. 193b 23–194a 18).

*Physical Subjects.* The philosophy of nature, by contrast, is strictly physical or natural. It studies the mobile world as known through the principles of motion. Whereas the mathematical physicist may measure motion to determine its velocity or acceleration, the philosopher of nature tackles the more fundamental question of what motion is. In a similar fashion, the mathematical physicist measures time, but to define time is a problem in the philosophy of nature. Unlike mathematical physics, which has a mixed subject—materially physical and formally mathematical (St. Thomas, *In Boeth. de Trin.* 5.3 ad 6)—the subject of a genuine philosophy of nature is strictly physical or natural; it is the mobile as such.

*Middle Terms.* Unlike the mathematical physicist, whose mathematical reasons show only “that” something is so without giving the physical “why” (cf. *Summa Theologiae* 2a2ae, 9.2 ad 3), the philosopher of nature uses middle terms that are physical. These middle terms ultimately represent one or other of the four causes (see CAUSALITY). The determination that there are such causes in every mobile being is made in the latter part of Book 2 of the *Physics* (198a 14–200b 9). Therefore, in their middle terms as well as in their subjects, mathematical physics and the philosophy of nature are distinct sciences.

*Physical Interpretation.* Mathematical physics is said, in the language of St. Thomas, to be terminally physical (*In 2 phys.* 3.8), or, in the language of 20th-century philosophers of science, to require physical inter-

pretation. This problem of terminating or interpreting mathematical physics means finding, if possible, a physical reason or model for the facts that mathematical physics knows in only their mathematical reasons. Such interpretation or termination, for Thomists, is external to mathematical physics; it is a function of the philosophy of nature, where the physical causes of material things are properly sought.

**Unity of the Philosophy of Nature.** Having established in Book 1 of the *Physics* that the philosophy of nature is a science and in Book 2 that it is a natural or physical science, Aristotle turns in Book 3 to a definition of MOTION, the fundamental property of mobile being; Book 3 looks, later on, at a possible intrinsic characteristic of motion, that of infinity. Having shown that motion is not infinite but finite and hence measurable, Aristotle turns in Book 4 to the extrinsic measures of motion, PLACE, the measure of mobile being, and TIME, the measure of motion. Motion is divided in Book 5 into its subjective parts and in Book 6 into its quantitative or integral parts. Books 7 and 8 are devoted to the Prime Mover and associated problems (see MOTION, FIRST CAUSE OF).

*Relation to Metaphysics.* In a work devoted to the consideration of the universal causes and principles of mobile being, it is relevant to raise the issue of the universal efficient cause of motion. This is the point where, if the proper order of invention is followed, the philosopher discovers that being need not be necessarily mobile and material. It is this so-called common being, i.e., being as common to both material and immaterial things, that becomes the subject of METAPHYSICS.

*Relation to Modern Science.* To the extent that physics and chemistry are mathematical, they are grouped by Aristotelian-Thomists with the mathematical physics described earlier; similarly, to the extent that biology invokes mathematics, as in the study of genetics, it is treated likewise. However, to that extent that modern sciences are not mathematical but physical—as in parts of chemistry, much of biology, and many notions of modern cosmology—these sciences are regarded as natural and physical. For those who subscribe to the Aristotelian-Thomistic view on the order of learning, i.e., that the mind moves from the universal level to the specific level in its understanding of nature, such sciences become parts of a single physical science that begins at the general level of what is now called the philosophy of nature and reaches to the more specific levels of modern science.

*Disputed Questions.* Yet these are disputed points even for Thomists. Many agree that the modern sciences in which mathematics predominates are affiliated with the “mixed sciences” of Aristotle and the medievals. But there is great controversy as to the place of the natural

sciences in the Thomistic hierarchy of knowledge. Among those who maintain that there is a philosophy of nature distinct from metaphysics, one group envisions a continuation between the philosophy of nature and such sciences, while another maintains that these sciences are themselves, formally distinct from the philosophy of nature. While there is common agreement about where the philosophy of nature begins, there is no consensus about where it ends when compared to modern science. (See PHILOSOPHY AND SCIENCE.)

**Psychology and the Philosophy of Nature.** For Thomists who reject the view that the philosophy of nature is an applied metaphysics, PSYCHOLOGY is considered to be a part of the philosophy of nature. This is in accord with the analyses of St. Thomas in various of his commentaries on Aristotle's texts. What is called philosophical psychology is not about the soul only, as the etymology of psychology (from Gr.  $\psi\upsilon\chi\eta$ , meaning soul) might suggest. It is about the composite, with the soul or form being the principle of the science rather than the subject.

According to Aristotle's ordering, the study of mobile being in general becomes more and more specific until it extends to that type of mobile being that is animate. But the study of the living has no first principles of its own; the principles of living things are still the matter and form discovered in Book 1 of the *Physics*. In any living thing there is simply a special type of form, called a SOUL, producing a special kind of effect in primary matter, rendering the matter not only corporeal but animated in this or that specific way. The study of the animate world thus is a subjective part of the scientific knowledge developed in the more general philosophy of nature.

In the light of the foregoing, it is incorrect to think of the philosophy of nature and philosophical psychology as two coordinate branches, or integral parts, of the science of material things. This misconception is likely to occur when the philosophy of nature is considered in the spirit of Christian WOLFF and labeled cosmology. On the other hand, writers who reject the Wolffian usage often employ the expression philosophy of nature to designate the philosophical study not simply of the inorganic world but of what all mobile beings, lifeless and living, have in common. Such a study should be more accurately labeled the general philosophy of nature; in this understanding, it would be appropriate to regard philosophical psychology as a proper subjective part.

### Method in the Philosophy of Nature

By contrast to mathematical physics, which abstracts from nature only those features that can assume quantitative form, the philosophy of nature methodologically

takes the whole of EXPERIENCE into account. One of the reasons alleged by modern scholars for Aristotle's failure to construct a better mathematical physics was his over-empirical temper; this possibly prevented him from abstracting from the medium through which a body, say a falling body, actually moved. At any rate, the philosophy of nature is through and through an empirical science; its conclusions must be "terminated" as St. Thomas said, or tested, as we would say in a later age, in sense experience. Because it depends so much on experience, St. Thomas locates the philosophy of nature after mathematics and mathematical physics in the order of learning.

**Mode of Discourse.** In regard to other aspects of method, the philosophy of nature, always remaining close to experience, progresses from universal truths—such as those involving mobile being in general—to more particular truths. This progress is called by St. Thomas "the method of concretion" and is further described as "the application of common principles to determinate [types of] mobile beings" (*In lib. de sensu* 1.2). In this descending movement, the philosophy of nature is far from a deductive science of a mathematical or rationalistic type. It does not predict, except in the trivial sense that if  $x$  is a mobile being,  $x$  will have for its first principles primary matter, substantial form, and privation, etc. In progressing by the method of concretion, the philosopher of nature must discover, through experience rather than by deduction, what exists in the mobile world; the application of common principles discovered in earlier experience can then be offered in explanation of what later and more refined experience reveals.

Aquinas contrasts the methods of mathematics with the more discursive method of the philosophy of nature. In mathematics, the mind considers, for instance, the essence of an object such as a triangle; without reverting to experience, it deduces the properties, e.g., the sum of its interior angles. But in the philosophy of nature the mind does not study one thing such as a triangle; in response to experience, it goes from one thing, an effect, to another, e.g., the extrinsic causes. Thus the philosophy of nature proceeds discursively or *rationabiliter*, whereas mathematics is said to proceed "in the mode of learning," or *disciplinabiliter* (*In Boeth. de Trin.* 6.1).

**Use of Induction.** As another aspect of its experiential character, the philosophy of nature establishes its principles by INDUCTION (*In 8 phys.* 3.4). Even in the *Physics*, abstract as it is in contrast to the study of later "concretions," the method is predominantly an inductive examination of the world revealed through sense experience. Such inductions require a pre-inductive dialectic that is not part of the philosophical science of nature. It prepares for induction, and it is this post-dialectical in-

duction that gives the philosophy of nature its experiential mood. There are far more inductions in the *Physics* and in *On the Soul* than there are causal demonstrations. Moreover, when such demonstrations are made, as in the case of the two definitions of motion or two definitions of the soul, the premises themselves are the fruits of induction. Most of the demonstrations are from effect to cause (*demonstratio quia*), not from cause to effect (*demonstratio propter quid*). Since the latter type of demonstration is known as DEDUCTION, and since such demonstrations are not especially characteristic of the philosophy of nature, it would be an error to regard the philosophy of nature as a deductive science. Its method of proceeding discursively (*rationabiliter*) actually involves something quite different.

### Recent Views of Natural Philosophy

The Aristotelian view of the philosophy of nature was commonly accepted until the beginnings of the Renaissance. Then, as modern philosophy and modern science began long periods of development, natural philosophy suffered a steady decline under successive attacks from MECHANISM, EMPIRICISM, and POSITIVISM. The 19th and 20th centuries, however, have witnessed a renewal of interest in this discipline. While differing in many respects from the traditional expositions by scholastics, these new philosophies show some sympathy and accord with the basic theses that had earlier been developed.

**Philosophies of Matter.** Original philosophies of nature, for example, were developed by the idealistic and romantic philosophers of the 19th century (see G. Henne-mann, *Naturphilosophie im 19. Jahrhundert*, Munich 1959). These are important in themselves as well as for their historical bearing. Out of the Hegelian movement came MARXISM, with a philosophy centering on the world of matter. This was given a more or less systematic form in the 20th century, not only by Lenin but by the more recent work of Soviet philosophers. Somewhat as in the strict Aristotelian scheme, Soviet philosophers hold to a general and philosophical study of matter with its opposing principles of thesis and antithesis. Since, among Soviet thinkers, there is only one matter and one view of it, scientific findings are said to verify and reflect the results of the prior and more general analysis by philosophers (See HEGELIANISM AND NEO-HEGELIANISM; MATERIALISM, DIALECTICAL AND HISTORICAL).

**Notion of Nature.** In the West, Aristotle's insistence that mathematical physics does not function as a fully natural science was matched by similar insights of thinkers like Charles S. PEIRCE, Alfred North WHITEHEAD, Henri BERGSON, Pierre TEILHARD DE CHARDIN, and, more

remotely, such 20th-century naturalists as Samuel ALEXANDER, Roy Wood Sellars, and John DEWEY (see NATURALISM). All of these writers had some more or less explicit notion of nature—Peirce's "particular character"; Whitehead's "organism"; Bergson's "élan vital"; and Teilhard's "psychic."

If their language seems too biological and even, as in the last case, psychological, it should be remembered that the term "nature" itself had biological connotations in both its Greek and Latin origins. Softer and analogical meanings can be given to the similar terms of modern philosophers; one need not take as univocal, in all their occurrences, words like "organism," "vital élan," and "psychic." Even with these qualifications, however, much work remains before 20th-century philosophers of nature can be brought into harmony with each other, into agreement with the valid insights of past thinkers, and above all into accord with reality as experienced.

**Duality and Directionality.** Again, the 20th-century philosophers of nature named above attest more or less to a dualistic character of natural things like that explained through primary matter and its form. The naturalists even speak of "levels" of process and "the emergence of novelty," both of which give evidence that in all natural things there is a substratum, differentiated in various ways by what has been called form. But the same thinkers are inclined to take "levels" and "novelty" as something given, rather than to try to explain the given, as do Aristotle, Whitehead, Bergson, Peirce, Teilhard, and the Soviet philosophers.

Finally, all of the 20th-century philosophers of nature named above, including the Soviet theorists and Western naturalists, see directionality in the cosmos. These insights are intimations of the causality of the END (see FINAL CAUSALITY; TELEOLOGY). Whitehead is explicit in regard to the causality of purpose and, contrary to Hume, insists on man's power to grasp EFFICIENT CAUSALITY. Thus, though in different terms and a different context, such a philosopher as Whitehead recognized all four of the physical causes in a more or less conscious way.

Since 19th-century efforts to construct a priori philosophies of nature, such as IDEALISM, or to deny the philosophy of nature, as with positivism, important 20th-century Western philosophers seem to have rediscovered the need for a realistic evaluation of nature, one that considers mobile being at a level more general than the specialized natural sciences and at a level more natural than mathematical physics.

*See Also:* PHILOSOPHY; MATHEMATICS, PHILOSOPHY OF.

**Bibliography:** T. DE VIO CAJETAN, *De subjecto naturalis philosophiae*, ed. C. DE KONINCK and E. GAUDRON (*Selecta Lavalensia*; Quebec 1939). JOHN OF ST. THOMAS, *Cursus philosophicus thomisticus*, ed. B. REISER, 3 v. (Turin 1930–37). V. E. SMITH, *The General Science of Nature* (Milwaukee 1958); ed. *The Philosophy of Physics* (Jamaica, NY 1961). W. H. KANE, “The Nature and Extent of Philosophy of Nature,” *Thomist* 7 (1944) 204–232. J. MARTAIN, *Philosophy of Nature* (New York 1951). F. RENOIRTE, *Cosmology*, tr. J. F. COFFEY (New York 1950). C. DE KONINCK, “Introduction à l’étude de l’âme,” *Laval Théologique et philosophique* 3 (1947) 9–65. A. FERNÁNDEZ-ALONSO, “Scientia et philosophia secundum S. Albertum Magnum,” *Angelicum* 13 (1936) 24–59.

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## PHILOSTORGIUS

Fourth-century Church historian; b. Borissus, Asia Minor, c. 368; d. probably Constantinople, 425 or 433. A layman well read and widely traveled, Philostorgius wrote a church history in 12 books known only through a summary and epitome in PHOTIUS (*Biblioth. Codex* 40), and fragments in Suidas, the *Martyrion* of Artemius by John of Rhodes (ninth century), a *Vita Constantini* (H. Optiz, *Cod. Ang. Gr.* 22), and the *Thesaurus orthodoxae fidei* by Nicetas Acominatus. Philostorgius presented his work as a continuation of the *Ecclesiastical History* of EUSEBIUS OF CAESAREA, and covered the period from 315 to 425. He was, however, obviously an Arian partisan and favored the cause of the neo-Arian heretic Eunomius of Cyzicus. While praising his style and diction, Photius maintained that Philostorgius was frequently inaccurate, particularly when he praised Eunomius, Aëtius of Antioch, and Eusebius of Nicomedia or condemned Acacius of Caesarea in Palestine and Basil of Cappadocia. His history is important for the citation of Arian sources that have not been preserved, for the evidence it offers of the attraction Arianism had for the cultured Greek mind, and for its thesis that the acceptance of the theology of ATHANASIUS OF ALEXANDRIA spelled the destruction of the Roman Empire. Philostorgius mentioned an *Encomium* on Eunomius and a *Refutation of Porphyry* of his own composition, which have not been preserved.

**Bibliography:** *Patrologia Graeca*, ed. J. P. MIGNE, 161 v. (Paris 1857–66) 65:459–624. J. BIDEZ, ed., *Philostorgius: Kirchengeschichte (Die griechischen christlichen Schriftsteller der ersten drei Jahrhunderte* 21; 1913) 1–150. H. OPITZ, *Byzantion* 9 (1934) 535–593. J. BIDEZ, *ibid.* 10 (1935) 403–442. H. HESELER, *ibid.*, 399–402. H. BECKBY, ed. and tr., *Anthologia Graeca*, v. 3 (Munich 1958) 120–121. H. RAHNER, *Lexikon für Theologie und Kirche*, ed. J. HOFER and K. RAHNER, 10 v. (2d, new ed. Freiburg 1957–65) 8:478. J. QUASTEN, *Patrology*, 4 v. (Westminster, Md. 1950–86) 3:530–532. P. BATIFFOL, *Quaestiones Philostorgianae* (Paris 1891). J. MARQUART, *Theologische Literaturzeitung* 38 (1913) 705–709. G. FRITZ, *Dictionnaire de théologie catholique*, ed. A. VACANT et al., 15 v. (Paris 1903–50; Tables générales 1951–) 12.2:1495–98. B. ALTANER, *Patrology*, tr. H. GRAEF from 5th Ger-

man ed. (New York 1960) 274. G. GEUTZ, *Paulys Realenzyklopädie der klassischen Altertumswissenschaft*, ed. G. WISSOWA et al. 20.1 (1941) 119–122.

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## PHILOTHEUS COCCINUS, PATRIARCH OF CONSTANTINOPLE

Patriarchate from 1353 to 1354 and from 1364 to 1376; Byzantine theologian and Hesychast; b. Thessalonica, c. 1300; d. apparently Constantinople, 1379. Born of a Jewish mother in poor circumstances, Philotheus paid for his education by serving as cook to his preceptor, Thomas Magistros. He became a monk on Mt. Sinai, then entered the Grand Laura on MOUNT ATHOS, where he served as abbot and defended the Hesychastic doctrine of Gregory PALAMAS. Although he had been appointed bishop of Heraclea in Thrace, he spent most of his time in Constantinople and was not present for the sacking of his episcopal city by the Genoese in 1352. He was appointed patriarch of Constantinople by Emperor John VI Cantacuzenus (November 1353), but with the fall of the emperor, Philotheus was forced to resign and was imprisoned for treason. Eventually he was allowed to return to his former bishopric of Heraclea, and through the good graces of the high official Demetrius CYDONES was rehabilitated (1363) and reappointed patriarch the following year. He took a vigorous part in the political affairs of the empire, and he strongly opposed the efforts made by the restored emperor John V Palaeologus (1354–76) in favor of union with Rome. This gained him the enmity of Demetrius Cydones, particularly when Philotheus called a synod (1368) to condemn his brother Prochorus CYDONES.

Asserting the independent primacy of his patriarchate, Philotheus canonized Gregory Palamas in the synod of 1368 and declared him a doctor of the Church. Pursuing his ecclesiastical policy, he successfully won the allegiance of the Orthodox Serbs, Bulgarians, and Russians to the empire faced with the Turkish menace, and took repressive measures against Byzantine Catholics. In 1376 he resigned his position as patriarch because of age and ill health.

While still a monk on Mt. Athos, Philotheus seems to have written two tracts against Gregorius Akindynos (d. 1349) in favor of Taborite spirituality; and as bishop of Heraclea he wrote 14 *Kephalaia*, or chapters, against the heresies of Akindynos and the Calabrian monk Barlaam. At the suggestion of Emperor John Cantacuzenus (before 1354) he produced the most imposing of his polemical works, the 15 *Antirrhetica*, or diatribes, against