+ H. D. GARDEIL, O.P.

Introduction to the Philosophy of St. Thomas Aquinas

II. COSMOLOGY

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Foreword

+ OF Aristotle's philosophy none was more promptly challenged by the moderns than his physics or philosophy of nature. Witness, among others, the criticism leveled against it by Descartes. Nevertheless, Aristotle's physical doctrine is an essential part of his philosophy, and the student of Aristotelian thought cannot afford to neglect it. Not a few Scholastic authors have tried to give it a more modern twist, how successfully is not now the point. We have chosen to adhere more closely to the analysis and reasoning which Aristotle himself presents in his text. At the same time we have made note, as occasion called, of certain aspects that could stand improvement, provided this be done discreetly, so as not to undermine the very foundations of this time-honored philosophical edifice. Both history and philosophy would, we believe, be bettered served by such prudent handling. At all events, this volume is not an attempt to modernize the traditional philosophy

of nature, to bring it up to date, as it were. A modern philosophy of nature according to the mind of Aristotle presumedly waits to be written, but it was not what the author set himself.

A second point bears on terminology and the content of natural philosophy. Through the influence of Christian Wolff (1679-1754) it became the fashion to speak of "cosmology" instead of "philosophy of nature" or "natural philosophy." Wolff also popularized the word "psychology." Whether or not one adopts this terminology may be a matter of taste. More important, however, is the sharp cleavage which then came to be made between one and the other, between cosmology and psychology. It is not so in Aristotle; psychology is the orderly continuation of natural philosophy or, if one chooses, of cosmology. Again, in their cosmologies some modern authors include the general study of life. We believe the better place for this is at the beginning of psychology. To put the preliminary notions of life into cosmology leads to excessive isolation of another kind. In the study of man, that is, it has the effect of stranding his mental self from his physiological self. This, too, ill comports with Aristotle's view in the matter.

Lastly, many of the older and still available textbooks on Aristotle's natural philosophy display a great concern to harmonize the scientific notions of their day with Aristotle's thought. Thus, these books were wedded to the fate of the science they sought to "Aristotelize"; they are out of date. Partly on this account we have limited the present study to what is more basic, hence further removed from the swings of fortunes that modern science cannot

escape. This has made for a more abbreviated volume than others in this series on the philosophy of St. Thomas. As an introduction to the traditional philosophy of nature, however, which is its scope and purpose, it is meant to be complete and should be adequate.

Acknowledgments

+ THE volume hereby offered in translation is the second in a series by H. D. Gardeil, O.P., titled *Initiation à la Philosophie de S. Thomas d'Aquin* (Paris: Editions du Cerf, 1953). Previously translated and published has been Volume III, *Psychologie.*[1] Other volumes in the series are: I, *Logique;* and IV, *Métaphysique.* The translation of these is under way.

Acknowledgment is due to Dr. R. A. Kocourek, of the College of St. Thomas, St. Paul, Minnesota, for permission to reproduce his version of *De Principiis Naturae* (The Principles of Nature), which is presented in full as Text II in the readings appended to the volume. Also quoted, with permission, in Dr. Kocourek's rendition is Text I, from St. Tliomas' Commentary on the *Physics.*

[1] *Introduction to the Philosophy of St. Thomas Aquinas:* III, *Psychology;* trans, by John A. Otto (St. Louis and London: B. Herder Book Co., 1956).

For English quotations from Aristotle, I found Ross' *The Student's Oxford Aristotle* (Oxford University Press, 1942) often helpful, but final responsibility for the renderings that appear rests in each case with myself. And, lastly, paragraph numbers for St. Thomas' Commentary on the *Physics* are according to A. M. Pirotta, O.P., *In Octo Libros De Physico Auditu sive Physicorum Aristotelis Commentaria* (Naples: M. D'Auria, 1953).

J. A. O.

Contents

Introduction to the Philosophy

of St. Thomas Aquinas

II. COSMOLOGY

+ CHAPTER 1

Introduction

+ THE earliest Greek thinkers directed their philosophical efforts almost entirely to the investigation of nature, of the world that meets the casual observer. For this reason tradition, following Aristotle's example, awards them the significant title "Physicists"; for from Thales *(ca.* 640-550 B.c.) to Empedocles *(ca.* 500-430 B.C.) and Anaxagoras *(ca.* 500-428 B.C.) Greek thought was primarily engaged in working out an interpretation of the physical universe. True, with Socrates (470-399) the sciences based on self-knowledge, such as logic and moral philosophy, experienced a growth that was scarcely less impressive; but these newer interests did not dampen the ardor of pursuit in the domain of nature. Plato, for example, wrote not only the *Republic* but also the *Timaeus;* and after Democritus *(ca.* 460-400 B.C.) Aristotle again took up, with renewed zest, the tradition begun by the lonians.

In this initial burst of philosophical enthusiasm the human mind had not yet clearly marked off the various

orders of knowledge, so that what these forerunners of Greek thought sought to achieve was as much a *philosophy* of nature as it was a *science* of nature. Doubtless, certain branches of knowledge, geometry and arithmetic for example, soon acquired an independent status because of the practical use to which they could be put; but in the study of nature the Greeks never made a sharp distinction between its philosophical and, as we should say, its scientific aspects. Consequently, in the study of Greek thought the separation of science and philosophy, if made at all, can only be made on a more-or-less basis. The Greeks, we have said, mostly ignored it.

Despite this lack of clear-cut definition as to object and method in each case, the fact remains that the first great strides in both the science and the philosophy of nature occurred in Greece at about the same time, from the seventh to the third century B.C. In the present volume, however, our aim is not to relate the scientific progress of these centuries. Our interest lies in the philosophical aspect of the accomplishment. More precisely, it is focused on the philosophy of nature evolved by Aristotle, since this is substantially the doctrine St. Thomas teaches.

But if for practical reasons we center our attention on Aristotle, we do not intend to obscure the fact—indeed, it cannot be overstressed—that his physical doctrine was not sprouted in an intellectual wilderness, without benefit of pioneers preparing the ground. On the contrary, Aristotle's physics is but the flowering that came after many generations of intensive growth and cultivation. To do justice to all these fertile speculations about nature that preceded and attended Aristotle's own thought would

require a study of its own. Our remarks along this line are admittedly sparse, but enough, we trust, to lend historical perspective to the pre-eminent system of Aristotle's. So much, at least, was necessary, if only because the Aristotelian doctrine, while complete in itself, does not assume full significance without some reference to the philosophical environment that, in one way or another, gave it source and sustenance.

I. THE PROBLEM OF ARISTOTELIAN COSMOLOGY

a) The study of nature, of the physical universe, represents the most highly developed part of Aristotle's philosophy. It is certainly the part to which he devoted his most constant effort. Yet, so many and so great have been the advances of the physical sciences that a modern follower of Aristotelian thought is confronted with a very difficult problem. Briefly it is this.

In Aristotle's view, physics or natural philosophy is the third branch of speculative philosophy, the other two being metaphysics and mathematics. This division is based on differences incident to the object of knowledge. An object can be considered in progressive degrees of separation from matter—or, as Scholastics were more usually to say, according to various "degrees of abstraction." Applied to the physicist or inquirer of nature, this means he studies "the being of nature" but considers it in abstraction of individual characteristics. So, to take a well-worn example, the biologist does not study "this flesh" or "this bone" for what is individual to it, but he tries to discover what flesh or bone has generally.

As St. Thomas was later to explain it, on this level of inquiry abstraction is made from individual matter, *a materia individual^* but sensible matter, *materia sensibilis,* is retained. Hence, this order of knowledge includes the properties reached by sense; it includes, for example, the color and sound and touch of things, but these properties are considered from their common, and not individual, aspects.

On this methodological foundation Aristotle erected his remarkable system of the physical universe. This system not only boasted a sturdy structure; it displayed a mastery of detail to match its architectonic triumph, and for near on two thousand years it commanded the scientific horizon. In the seventeenth century, however, a new dawn of scientific progress opened. Empirical search was pursued as never before, and the mathematical technique was pressed into the pursuit. The combination proved most successful. Soon there was amassed a new store of knowledge not less impressive than the older accumulation and far outdoing it in practicality. Science as we know it had been born, and once ushered into the world, its growth was phenomenal.

Not only was this scientific revolution achieved by methods that were new and, apparently, the complete opposite of the old, but the whole movement had the air of a revolt against the traditional order of science. And here lies the crux of the problem under consideration, in the alleged rift between the old science of nature and the new. For, what we now have is not one but two integral formulations of physical reality, both purporting to be true, yet one picturing it far differently from the other. Is it possible to reconcile these two versions of what appears to be the

same reality, the same world of nature? We believe it is possible, provided that both recognize their limitations. Specifically, the Aristotelian philosophy of nature needs to divest itself of certain nonessentials, which are hangovers from an outdated science and do not affect its substance. Modern science, on the other hand, must forego the claim of being the highest wisdom, the last word on reality, a claim it can make by usurpation only.

b) Tire conditions we have suggested for resolving the "opposition" between the old and the new science of nature go to the heart of the problem. They assume—and this is fundamental—that facts and events of nature can be studied from two different points of view.

One may seek what is most basic in nature, its most universal characteristics and properties, relying for this inquiry on the evidence of ordinary experience. The questions asked are universal in scope. For example, what are the conditions underlying all change and movement? What are the ultimate principles of nature------atoms, elements, matter and form, or whatever else? This is the province of the *philosophy of nature,* and here Aristotle can still be taken as a sure guide.

But one may also set his sights more narrowly, limiting his inquiry to the particular circumstances of particular facts and events, such as the fall of bodies, the workings of magnetic forces, the phenomenon of evaporation, and countless others. This level of investigation, in which phenomena of the kind mentioned are subjected to properly scientific observation and measurement, corresponds to the *science of nature.* In this the advantage is all to the moderns.

The difference between these two approaches has been

enunciated by Jacques Maritain. The philosophy of nature, he observes, does not disregard the objects perceived by sense (objects corresponding to the first degree of abstraction), but it explains them by principles that are broadly speaking ontological or metaphysical; for it employs such notions as corporeal substance, quality, active and passive potency, material and formal cause, and others of similarly "ontological" content. The sciences of nature, on the other hand, generally stick to more concrete notions. Theirs are the concepts of what is physically measurable, of things that lend themselves to verification by experience. And when the sciences go a step further, they do not resort to ontological but to mathematical principles, which fall short of the ontological degree of abstraction.

All which is by way of saying that our concepts of phenomenal nature, of observable facts and events, can be resolved in two ways: one, to quote Maritain, "is the upward resolution toward intelligible (as compared with sensible) being. In this process the sensible object is not lost sight of, but its presence is not focal. It lies in the background, where it continues to minister to intelligible being, in which it is included by connotation. The other is the downward resolution toward the sensible and observable object itself. In this process, being is not entirely left out (without this, no thinking remains). But being, or the idea of being, now ministers to the sensible object, especially to its measurable aspects. Its role here is that of an unknown or unobserved, which nevertheless assures the constancy of sensible determinations and measurements, and makes it possible to assign stable limits to the object perceived by the senses. This, in truth, is the method of

resolving concepts in the experimental sciences. It is the resolution or analysis which I call *empiriological* or *spatio-temporal,* whereas to the other I give the name *ontological* (in the widest use of the word)." [1]

Accordingly, the manifestations of nature can be explained on two levels, one philosophical and the other scientific in the modern sense. This distinction leaves the physical sciences free to progress by methods of their own on their level of investigation, but it also admits of a philosophical consideration of nature in the manner of Aristotle. This would seem to be the correct approach, at least at first glance.

c) In point of fact, however, the respective limits of

[1] "Il suit de là qu'en pareil cas, il y a pour nous deux façons de résoudre nos concepts: une résolution ascendante vers l'être intelligible, dans laquelle le sensible demeure, mais indirectement, et au service de l'être intelligible, comme connoté par lui; et une résolution descendante vers le sensible et l'observable comme tels, dans laquelle sans doute nous ne renonçons pas absolument à l'être (sans quoi il n'y aurait plus de pensée), mais où celui-ci passe au service du sensible lui-même, et avant tout du mesurable, n'est plus qu'une inconnue assurant la constance de certaines déterminations sensibles et de certaines mesures, et permettant de tracer des limites stables encerclant l'objet du sens. Telle est bien la loi de résolution des concepts dans les sciences expérimentales. Nous appelons respectivement *ontologique* (au sens le plus général de ce mot) et *empiriologique* ou *spatio-temporel* ces deux types de résolution des concepts ou d'explication" (Les Degrés du Savoir [4th ed.; Paris: Desclée de Brouwer et Cie., 1946], 287-288).

In a footnote Maritain elaborates on the present meaning of "ontological." In the context it does not refer exclusively to ontology or general metaphysics, a branch of philosophy. What it designates is an explanatory procedure common to all philosophy: "un caractère commun à toutes les disciplines philosophiques" *(ibid.,* p. 288).—[Tr.]

philosophical and scientific investigation are not so easy to determine as might at first appear. The philosopher of nature cannot altogether ignore the discoveries of science; but the scientist himself may not be justified in neglecting what the former has to say about such matters as finality, chance, space and time, and many others. It must furthermore be acknowledged that the aforesaid distinction between the philosophy and the science of nature is not found in so many words in Aristotle.[2] Placing perhaps too much reliance on the deductive or a priori method of studying nature, Aristotle lumps his philosophy of nature with much that we should apportion to the scientist instead of the philosopher. Hence, within Aristotle's own physical doctrine one should distinguish between its philosophical and its scientific content. Its philosophical truth abides,

2 Just how the philosophy of nature differs from the natural or physical sciences is precisely one of the points at issue among present-day Scholastics. Maritain, whose position is well known, at least in the profession, is perhaps the foremost champion of the view that between the natural sciences and natural philosophy there is a basic or irreducible difference; they constitute specifically distinct sciences. See, for example, his *Philosophy of Nature* (New York, 1951), chapter III.

Perhaps not so widely circulated is the opposite view, that the natural sciences, with the possible exception of mathematical physics, are not basically or specifically distinct from natural philosophy, but are so to speak its dialectical extension. For this position one may consult, among others, William H. Kane. O.P., "Abstraction and the Distinction of the Sciences," *The Thomist* XVII, 1 (January, 1954), 43-68; *idem,* "The Extent of Natural Philosophy," *The New Scholasticism* XXXI, 1 (January, 1957), 85-97; ar,d Charles De Koninck, "Les sciences experimentales sont-elles distinctes de la philosophie de la nature?" *Culture* (Quebec: 1941, no. IV), 465-476.—Translator's note.

as will appear in the sequel. The same cannot be said for what concerns the science of his day. This needs to be overhauled from the ground up.

Clearly, then, the task is not easy that awaits the author of a modern cosmology in the manner of Aristotle but without much of the Aristotelian matter. This author must perform a double feat in one. He will have to be constantly separating from the Aristotelian doctrine those portions that are scientifically outmoded, while holding on to those of permanent value. But this is only the half of it. On the foundation of his sifted Aristotle, he must build his superstructure, a theory of the universe that is solely philosophical. Moreover, to accomplish this task he will have to considerably enlarge the Aristotelian foundation, so as to take into account the mathematical techniques of the moderns.

Our scope is more modest. Here and there, to be sure, we have entered reservations to the Aristotelian doctrine. We have also, as occasion required, made note of contemporary theories. But our basic aim has been to give a true account of Aristotle's understanding of the physical world, and mainly of its philosophical content, the abiding feature of his study. As for its nonphilosophical admixture, or the ceaseless succession of ideas in what is now science proper, these questions are outside our principal theme; advertence to them is mostly by obiter dicta.

II. FORMAL OBJECT AND THE DIVISION OF NATURAL PHILOSOPHY

a) *Formal object.*—A basic problem in any science is to determine its formal object, its specific area or aspect of

inquiry. Aristotle's conception of the formal object in natural philosophy is not only clear and precise but bids fair to endure in the future as in the past. The world of nature, he declares, is one of perpetual change, of inherent mutability. To appreciate the whole import of this observation, one must go back to the Greek Physicists, all of whom were struck by this unceasing alternation of ruin and renewal that marks the course of nature. Had not Heraclitus advertised that one could never bathe twice in the identical stream? That all nature was in constant flux? Aristotle, then, was stressing again what others had stressed before. A thing of nature is changeable in its very essence.

Consequently, the formal object of natural philosophy must incorporate this element of instability. To say that natural philosophy studies natural being is not enough; it lacks precision. We add this precision by saying that the formal object of natural philosophy is "being considered under this very aspect of changeableness." In Scholastic phrase it is mobile being, *ens mobile,* which comes to the same. Mobile means changeable, and being *qua* being is not changeable unless it is material, hence a being of nature.

St. Thomas speaks in the same vein; he writes: "The philosophy of nature, which is called *Physics,* treats those things which depend on matter, not only for existence but also in definition. And because everything that has matter is mobile, it follows that *mobile being* is the subject of the philosophy of nature." [8]

[8] "De his vero quae dependent a materia non solum secundum esse sed etiam secundum rationem est Naturalis, quae Physica dicitur. Et quia omne quod habet materiam mobile est, consequens

In these words, which are of prime importance, St. Thomas not only defines the formal object of natural philosophy by "mobility," but traces this mobility to the material constitution of the beings which this branch of philosophy considers. A material thing is by that very fact a mobile or changeable being, whereas an immaterial being is essentially unchanging. Note, further, that in Aristotelian usage "mobile" and "movement" are taken most widely, denoting every possible kind of changeableness or change in the world of nature.

b) *Divisions of natural philosophy.*—Aristotle's physical doctrine can be divided into two major parts. The first, which corresponds to the eight books of the *Physics,* treats of mobile being in general. The other, which includes the rest of his physical works, studies particular kinds of movement and mobile being. This grouping follows a pattern; the sequence is from general observations to particular considerations. And this is as it should be, at least for the orderly presentation of any branch of knowledge.

But the order and object of treatment within each member of this bipartite division, especially within the second, are not so self-evident. Here, in fact, we are on debated, if not debatable, ground. Be that as it may, St. Thomas apportions natural philosophy as follows.

The study of mobile being in general falls under two principal headings: that of mobile being itself, which is studied in *Physics,* I–II, and that of motion, focal theme of the remaining books, III–VIII.

As for the particular kinds of motion and mobile being,

est quod *ens mobile* sit subiectum Naturalis Philosophiae" (In I *Phys.,* lect. 1, nos. 3-4).

these are studied in separate treatises, each centering round a principal type of change and mobile being. Thus, *De Caelo* (On the Heavens) treats of natural beings so far as they are subject to the primary species of motion, which is local motion. *De Generatione et Corruptione* (On Generation and Corruption) considers motion toward form (generation-corruption, alteration, growth-diminution), and also the primary mobile beings, the elements, but only according to their common transformations; their special transformations are the subject of the *Meteorológica* (Meteorology). Other treatises investigate so-called "mixed" mobile beings,[4] some of which are animate, some inanimate. Inanimate mixtures are the topic of *De Mineralibus* (On Minerals), animate mixtures the topic of *De Anima* (On the Soul) and its sequential studies, namely, the *Parva Naturalia* (Minor Natural Works) and a number of animal studies.[5]

Our study, in the main, is confined to motion and mobile being in general; which means it follows the broad outlines of the *Physics,* both in content and procedure. Of Books V and VI, however, we make only very selective examination, for these have mostly to do with special problems that may be put aside in an introductory study. Dismissed with naming, moreover, is Book VII, which appears to be an interpolation. Thus, treated in order are the following topics:

4 In the Aristotelian idea "mixed" bodies, as the name implies, are mixtures or composites of the basic elements, corresponding more or less to the molecular compound of modern chemistry. For additional comment, see the following chapter, pp. 37 ff.—[Tr.]

5 *Ci.* Text I, "Definition and Divisions of Natural Philosophy," p. 164.

Chapter 2: The Principles of Mobile Being (Book I).
Chapter 3: Quantity and Quality in Mobile Being (Cf. *Metaph.* A , 13-14; St. Thomas, *In* V *Metaph.,* lectt. 15-16).
Chapter 4: The Meaning of Nature (Book II, 1-2).
Chapter 5: The Causes of Mobile Being (Book II, 3-9).
Chapter 6: Motion and Its Kinds (Book III, 1-3).
Chapter 7: The Infinite, Place, the Void, Time (Book III, 4-8; Book IV).
Chapter 8: The Prime Mover (Book VIII).
Chapter 9: The Aristotelian Astronomy.

III. BIBLIOGRAPHICAL NOTE

The basic sources for the present study are, of course, Aristotle's physical works, especially the *Physics,* and St. Thomas' respective commentaries. Besides his commentaries, St. Thomas also has several smaller writings relating to natural philosophy, notably *De Principiis Naturae* (The Principles of Nature), by general consensus an authentic composition. The complete translation of this work appears in the Texts appended to the present volume.[6]

Among past writers of the Thomistic School should be singled out John of St. Thomas, whose *Cursus Philosophicus* contains what is still one of the best systematic expositions of the traditional philosophy of nature.[7]

As for English titles, the following list, while far from complete, may be taken as representative: [8]

6 Text II, "The Principles of Nature," pp. 166-185.

7 Cf. John of St. Thomas, *Cursus Philosophicus Thomisticus,* I Pars (De Ente Mobili in Communi), III Pars (De Ente Mobili Corruptibili); nova editio Reiser, II (Turin: Marietti, 1948).

8 English titles are supplied by the Translator.

Kocourek, R. A., An *Introduction to the Philosophy of Nature* (revised ed.; St. Paul: North Central Publishing Co., 1951). This comprises a translation of *De Principiis Naturae,* based on Pauson's critical text, a translation of Books I–II of St. Thomas' Commentary on the *Physics,* and an excellent essay, "The Philosophy of Nature and the Experimental Sciences."

Maritain, Jacques, *Philosophy of Nature,* trans, by Imelda C. Byrne (New York: Philosophical Library, Inc., ww);

---------, *The Degrees of Knowledge* (New York: Charles Scribner's Sons, 1938), a translation of *Les Degrés du Savior.* A completely new English version of the *Degrés* is reportedly under way, but efforts to anticipate details of publication proved unsuccessful.

Phillips, R. P., *Modem Thomistic Philosophy,* I (Westminster, Md.: The Newman Press, 1950).

Smith, Vincent E., *Philosophical Physics* (New York: Harper & Brothers, 1950).

Van Melsen, Andrew G., *The Philosophy of Nature,* Duquesne Studies, Philosophical Series, 2 (2nd ed.; Pittsburgh: Duquesne University, 1954).

Three French works of special note are:

Le Blond, J. M., *Traité sur les Parties des animaux* (Paris: Aubier, 1945), a French translation of *De Partibus Animalium* (On the Parts of Animals). Le Blond's Introduction to Book I is well worth reading.

Mansion, A., *Introduction à la physique aristotélicienne* (2nd. ed.; Louvain, 1945).

Simard, Émile, *La nature et la portée de la méthode*

scientifique (Quebec: Les Presses Universitaires, 1956). This is devoted, in large part, to the understanding of procedure in mathematical physics. To each chapter are appended select readings, truly comprehensive in total coverage, ranging from Plato and Aristotle to Einstein and Eddington.

+ CHAPTER 2

The Principles of Mobile Being

+ ANY science that purports to deal in basic explanation must run its facts back to their utmost source. That is why Aristotle, like his predecessors, begins the study of natural being with the search for its ultimate principles. Specifically, what he wants to know at the outset is the intrinsic principles, the primary constituents; the extrinsic principles, efficient and final cause, are probed later on. Accordingly, the notions set forth in the present chapter approximate what the moderns would generally call a theory of matter.

The chapter opens with a synoptic view of Book I of the *Physics.* Next, we follow Aristotle in his quest of the principles of nature: form, privation, matter. Then, having established the principles universally, we turn for a moment from the *Physics* to *De Generatione,* to consider with

Aristotle the two essential kinds of change, substantial and accidental. This done, we return to Book I to declare the substantial and accidental structure of bodies. The chapter then closes with a comparative review of hylomorphism and other theories of matter.[1]

I. PLAN AND PURPOSE OF BOOK I OF THE *PHYSICS*

As even now indicated, Aristotle's first concern is with the principles of natural being, or rather with their number. Tire principles of nature, he says, "must be either one or more than one. And if one, it must be either immovable . . . or in motion. . . . But if more than one, they are either limited or unlimited in number; and if limited, but more than one, there must be either two, or three, or four, or some other number."[2]

This passage deserves the closest attention; it governs and throws light on all that follows in Book I, which may be outlined under these headings:

1. Presentation of the problem in the matter of principles (chaps, i, 2 to 184 b 22).
2. Refutation of the Eleatic position (chap. 2, continuation, and chap. 3).
3. Critical exposition of the "Physicist" theories (chap. 4).
4. Positive ascertainment of the number of principles:
   a) The principles are contraries (chap. 5).
   b) Necessity of a third term, the subject (chaps. 6-7).
5. Solution to difficulties raised by the Eleatics (chap. 8).

[1] Cf. Text II A, "The Principles," p. 167.

[2] *Phys.* I, 1, 184 b 15-20.

6. Further particulars about the principles, mostly about matter (chap. 9).

As the outline indicates, in the first part of Book I Aristotle makes a critical analysis of earlier doctrines. This analysis, thorough and trenchant, is an achievement by itself. Especially noteworthy are his refutation of the Eleatics and his criticism of Anaxagoras. The Eleatics had denied the very possibility of change, so, in effect, doing away with the problem of principles. Anaxagoras had gone to another extreme, saying that the principles were infinite. Aristotle confronts and dissects these and kindred views, and refuting them, consolidates his own thought. Interesting though it should be to record his every move in this performance, we shall, for brevity's sake, keep our account to the essentials.

II. THE THEORY OF THREE PRINCIPLES

a) *Basic supposition.*—Aristotle assumes the fact of change and motion. "We must take for granted," he says, "that things of nature, either all or some, are in motion. This, as a matter of fact, is clearly evident by induction." [3] The declared foundation on which Aristotle rests his demonstration of three principles, and indeed his entire physics, is the reality of change, a reality of immediate experience. To the Eleatic doctrine of monism and unchangeableness he opposes first and foremost the incontrovertible evidence of experience. Generation and other changes are simply facts, stark and unmistakable. Who was illiterate becomes literate. What was black becomes white. Learning and

[3] *Phys.* I, *2,* 185 a 12-14.

teaching, whitening and coloring are real; we can see them, watch them, do them. Mere things like these are enough to override the Parmenidean denial of change, which, to say the least, is fraught with inconsistencies. By contrast the physics of Aristotle boldly declares itself a doctrine of change and of changeable (mobile) being.

With the acceptance of change or movement goes the acceptance of multiplicity. Being that changes undergoes successive multiplicity and has therefore to be made of more than one element or principle. For that matter, multiplicity, like change itself, is a fact of immediate experience. Accordingly, Aristotle's world is both multiple and changeable. But its truest characteristic is change rather than multiplicity, because only natural being is susceptible of movement proper, which means change, whereas multiplicity is not the sole property of natural being but is found as well in immaterial being, in the world of spiritual substances.

b) *The principles are contraries.*[4]—Having affirmed his position on the question of change and motion, Aristotle proceeds to unfold his doctrine of principles. The first thing he does is to show that they must be contraries. All the early Physicists, he believes, were in agreement on this. His own reasoning in the matter begins, characteristically, with items of obvious experience, like a colored body changing to white.

What are the basic requirements for a colored body changing to white? Common experience shows that this process embraces two terms or footings: the term acquired *(terminus ad quern),* which is whiteness, and the starting

[4] *Phys.* I, 5.

point *(terminus a quo),* which is the original color, or better, the nonpossession of whiteness. In other words, there is a passage from nonwhite to white. Speaking generally, we may designate the ultimate term of this change as *form,* and its point of departure as *privation.* Accordingly, we may say that every change transpires between two opposite terms: one the absence or privation of a given physical determination, the other the real acquisition of this determination, or form. *Privation* and *form,* these, in consequence, are two primary principles of change. In the next heading we shall see that there is still a third.

A close reading of Aristotle's chapter 5, Book I, of which the preceding paragraph is a summary, will show where his preoccupation lay and why he turned to contraries for the explanation of change. What Aristotle sought was two terms or points of reference that would be independent of each other and first in their order—contraries (by the ancient physics) plainly satisfied this condition. But there had also to be some community, some common ground, between the two terms, since white, for example, does not come from whatsoever thing or term, but from nonwhite (which belongs to the same genus *color).* Briefly, what Aristotle wanted to get across was that change is insoluble except on principles that are opposites and independent of each other, yet members of the same genus. Contraries met the test.

c) *Necessity of a third term.*[8]—Contraries alone are not enough to account for change. Change, after all, means to become what one was not, and this implies that in some

8 *Phys.* I, 6-7.

respect one remains what one was. There is a selfsameness that outlives every change, a floor or base that stretches from one term of change to another and successively lodges both. When one term is lost, another is gained. But besides what is lost and gained there has to be something that loses the one and gains the other. If we think of change as a complete break between its terms, then its whole meaning is destroyed and change is indeed impossible.[6]

Contraries, however, cannot supply this continuity from one term to another, as they can neither act on each other nor be born of each other. Besides, substance has no contrary. If, then, contraries were the only principles of change, substance would have to be generated of something that is not substance, a manifest impossibility. In short, every contrariety must rest on something that is without contrariety. Thus, a third term is needed, a *subject,* also called *matter.* This provides the foundation for the process of change as well as for the terms that bound its course. Given a subject, change becomes intelligible. A subject in privation to a form acquires that form; a nonwhite body becomes a white body. This is the meaning of change.

In proving that the principles are contraries plus a sub-

6 As the author indicates, without a third something that bridges the two terms and possesses them both by turn, change is not change, whatever it may be. Failing this third factor we must fall back on the denial of change, dismissing the evidence of sense as an illusion; or, if things are nevertheless thought to be now this and now that, we are logically driven to the idea of the complete annihilation of one term and the outright manufacture (ex *nihilo)* of the other—a position that is only less (or is it less?) extreme than the absolute denial of change.—Translator's note.

ject, Aristotle also takes pains to show that more than three are not necessary and, most of all, that the principles cannot be infinite or unlimited in number. In a word, every change in the physical world requires:

—a subject that undergoes the change: *matter,*

—a determination received by the subject: *form,*

—a precedent absence of this determination: *privation.*

d) *Solution of the Eleatic difficulty.*[7]—Of all his predecessors none taught a doctrine more radically opposed to Aristotle's theory of change and becoming than Parmenides and the Eleatics generally. For this reason Aristotle, having stated his own position, returns now to the refutation of the Eleatics. They, in brief, asserted that becoming is impossible because being cannot come from *being* (this already *is),* and it cannot come from non-being, which, they said, is utter nothingness. Aristotle's answer is that generation or becoming springs both from a kind of being, that of the subject, and from a kind of nonbeing, that of privation. Thus, the Eleatic dilemma is not airtight; it admits of escape.

Aristotle proposes, without elaborating, yet another answer to the Eleatic difficulty, based on one of the most important distinctions in his metaphysics, namely, the distinction of act and potency. Becoming, he notes, is a transition from one mode of being to another, from being in potency to being in act. So, in the earlier example of whitening, what is white in potency becomes white in act. Change, then, is possible because between being and utter nothingness there is an intermediate state, which is potential being or being in potency.

[7] *Phys.* I, 8.

e) *Conclusion.*—As we have seen, change is the distinctive mark of physical being. Three principles—matter or subject, privation, and form—are necessary to account for change. Considered in its essentials, Aristotle's analysis appears beyond questioning, and the scientific advance that would compel a basic revision has not yet been made, nor can one conceive that it will be made in the future. In Aristotelian thought, moreover, the notions of matter, form, and privation are corroborated by their relevancy to other philosophical problems, especially to the individuation of material substances, and to the correlative problem, their multiplication. Additional proof is also seen in the fact that the positive or intrinsic principles of bodies, matter and form, serve admirably to account for the opposition between certain properties of bodies, both in the order of quantity and quality. But the basic evidence remains the simple fact of change.

Accustomed as he is to studying the physical world much differently, the modern scientist, more often than not, confesses to a certain discomfiture in face of Aristotle's conceptions. What he needs to remember is that Aristotle's analysis of nature is in the pattern of his predecessors, and should be understood in the light of their physical doctrines rather than on the basis of present-day physical theories. In particular, the role he assigns to contraries cannot be truly deciphered except against the thought of his predecessors. These men, for all their obviousness, were not without basic insight. To them the world was a vast battleground in which contrary elements, like warm and cold, dry and wet, light and darkness, were pitted against each other; and it was almost inevitable that they should

go a step further and declare opposites, or contraries, the ultimate principles of things and their transformations. The point is that the speculations of an Anaximander, a Heraclitus, or an Empedocles were not lost on Aristotle. If we bear this in mind, his doctrine of contraries ceases to be an oddity and assumes a perfectly normal cast.[8]

III. ABSOLUTE GENERATION AND ACCIDENTAL CHANGES

a) We have spoken of the number of principles required for change. So far the discussion has dealt with change generally, and in Book I of the *Physics* Aristotle does not carry it further. The specific kinds of change and their severally specific principles are investigated in *De Generatione et Corruptione*.[9] "We have to examine," Aristotle there says, "the whole question of absolute generation and absolute corruption, to see whether these changes do or do not occur, and if they do, to determine the conditions thereof; we must also consider the other kinds of change, such as growth and 'alteration.' "[10]

The "examination" which Aristotle pursues in *De Generatione* leads him to the conclusion that there are two basic kinds of generation: *absolute* (or substantial) generation, which means a radical transformation of one thing into another; and *relative* (or accidental) generation, in which the subject or substrate remains essentially what it was but undergoes accidental or nonessential modification.

b) Aristotle's principal concern was with substantial

8 Cf. Text II A, b) "The three principles of generation," p. 169.
9 In particular, chapters 1-5.
10 *De Generatione et Corruptione,* I, 2, 315 a 26-28.

generation; this, above all, had to be affirmed and defended, since it had been imperiled or impugned by two separate schools of thought. One was the school that believed all things are made of the same ultimate element; the other supposed several specifically distinct elements. For the proponents of the first view—Thales, Anaximander, Anaximenes—all change came to mere accidental modification of a primordial substance, water for one, air for another, and whatever element seemed likely to still others. The second group—the Atomists, also Empedocles and Anaxagoras—allowed that substances undergo a degree of innovation, but the change is no more than association or dissociation of pre-existent elements, each retaining its separate and distinct nature. Either way, be the ultimate element one or many, change results in new aggregation, but never in new substance.

Here lay a challenge that Aristotle could not ignore. Not all change or generation is accidental. There is, he insisted, absolute generation, by which the pre-existent substance ceases to be and a completely new substance comes to be. Hence, the underlying principle of the new substance cannot be a substratum having its own determinate nature, or a plurality of elements already invested with specific determination; for then the new substance would not be one specific nature but a composite of two or more. No, the underlying principle can only be a subject or matter that is utterly undetermined. Such matter is necessary because, as we have seen, every generation or change requires a subject, but in absolute generation the subject cannot be a substance, since this is precisely what

changes. The subject must therefore be a principle without any positive determination whatever, a principle to which we give the name "prime matter."

c) One difficulty on this score that troubles moderns does not seem to have worried Aristotle, namely, the practical recognition of substantial changes. For Aristotle, such changes are obvious, typical examples being the birth and death of a living thing and the transmutation, as Aristotle thought, of the basic elements into each other. For example, water in evaporating was thought to become air; and air, in heating, to become fire. Today, we should hardly accept these "transmutations" as convincing proof of substantial change. Nor do we share Aristotle's or his predecessors' certainty of having found the exact number of irreducible, substantial elements. And as for knowing whether this or that variation in the physical appearance of a thing denotes a substantial change, this is usually most difficult if not impossible.

Chemical changes may be more decisive, especially when they leave a marked difference of behavior in their wake. Here a substantial change may well be indicated. But physical and chemical changes aside, birth and death afford unequivocal instances of substantial generation. Dead matter leaps to life, as in nutrition or fertilization and conception, and living matter falls in death. These are facts. There is every reason to consider them substantial changes, and no logical ground to think them otherwise. In birth and death a new substance succeeds the old. To deny this would seem to stultify both thought and reality.

In summary, the physical world registers two basic kinds

of change. It manifests those superficial modifications called accidental changes and commonly seen or detected without difficulty. But it also shows changes that are, in the truest sense, substantial generations and corruptions, issuing in corporeal substances that are completely new.[11]

IV. THE STRUCTURE OF CORPOREAL SUBSTANCES

We have now sketched the principles of change: matter, form, and privation. We have seen that change is either substantial or accidental. With this preparation we may turn to the structure or composition of corporeal substances. Not that the study of change has not already given us an insight to the make-up of natural things, but that we shall now focus attention on the make-up which change supposes and again induces. Change, after all, does not take place in a vacuum. It begins with something and ends with something else. What does it end with? What, in other words, are the intrinsic principles of being? This is our question.

Of the three principles enumerated, one is, so to speak, negative, denoting simply the absence of a receivable determination. This is privation. Though not a real entity itself, privation implies something real, namely, the aptitude of the subject to receive the contrary of what it has.[12]

[11] Cf. Text II A, a) "Matter, form, generation," p. 167.

[12] Privation, it may be noted, is not a mere negation. It implies, as the text observes, a subject's aptitude to receive what it does not have. Thus, the absence of knowledge, which in man is a privation, is only a negation in respect of a tree or anything else that lacks the very possibility of knowledge.—Translator's note.

Privation, therefore, is not a constitutive principle of a natural being, only a principle or condition of its becoming, a starting point. One cannot become what one is, nor what one has not the capacity to become. On the other hand, what is not part of oneself is not a constitutive principle of one's being. Accordingly, only matter and form are intrinsic or component principles of a natural being.

The matter-form composition, however, appears on two levels:

It exists in the union of *prime* matter and *substantial* form, which are the essential principles of natural being and are involved in substantial change, the change that results in the complete transformation of one substance into another.

It exists also in the union of *second* matter and *accidental* form, which is to say, between a substance and its accidents, second matter being the underlying substance that is already composed of prime matter and substantial form. This is the union affected by accidental change, when one accident succeeds another, or at the very least, when an accident is gained or lost, the substance remaining the same.

On this second, and secondary, level matter and form have analogical meaning and are applied to widely differing compositions of being. So, in Aristotelian thought, the matter-form relationship variously exists between the bronze and the statue into which it is cast, between the materials of a building and the arrangement they assume in the completed edifice, between letters of the alphabet and the syllable made of them. These are only a few of

many possible examples. Even between the basic elements and their "mixtures" or compounds one may see a matter-form relation.

The primary meaning of matter and form, however, is not in these analogical applications but respectively in that matter which is called *prime* and in that form which is called *substantial,* and again in the composite thereof. So, what is prime matter, what substantial form, and what the composite?

i. *Matter, Form, and the Substantial Composite*

a) *Prime matter.*—Aristotle tells the meaning as follows: "Matter I call the primary substratum of each thing, from which a thing comes to be but not as an accident, and which remains throughout"[13] St. Thomas translates Aristotle as follows:

> *primum subiectum ex quo aliquid fit per se et non secundum accidens, et inest rei iam factae.*[14]

Matter, then, is the primary subject of each natural thing, an essential principle of its generation. Not only is generation, or becoming, grounded in matter, but matter survives the becoming and inheres in the thing that became, even as it had inhered in the previous thing.

Prime matter's essential property, if one may speak of it having a property, is its complete indetermination, which Aristotle in another context describes in these words: "By

[13] *Phys.* I, 9, 192 a 31-32.

[14] In literal English: "The first subject from which something comes to be as a substance *(per se)* and not as an accident, and which is in the thing then made" (In I *Phys.,* lect. 15, no. 281).

matter I mean that which in itself is neither a determined thing, nor of a certain quantity, nor designated by the other categories by which being is determined."[15] In Scholastic axiom matter is similarly

> *neque quid, neque quale, neque quantum, neque aliquid eorum quibus ens determinatur,*

that is, neither actual substance, nor quality, nor quantity, nor anything else by which being is determined.

An equivalent and more concise expression of matter's utter lack of determination is "pure potency." Matter is pure potency; hence it is not "being in act" (actual being) but only "being in potency" (potential being): *non est ens actu sed potentia tantum.* Matter cannot be actual being, since it is the subject of first act, that act by which a being first becomes actual and receives substantial existence. Were matter in act before receiving a form, it would of itself be a substance, and every supervening act would be no more than an accidental act or form. Once more, then, matter is pure potency. This, without a doubt, is Aristotle's true meaning. It is also the meaning that St. Thomas and his followers were adamant in defending against all who insisted on giving matter a positive determination precedent to form.

If matter is pure potency, then, as Aristotle further observes,[16] matter properly speaking is not "what exists" nor "what is generated"—*non quod existit vel quod generatur;* it can only be "that by which"—*quo*—the composite exists.

[15] *Metaph.* Z, 3, 1029 a 20-21.
[16] *Phys.* I, 9, 192 a 10 ff.

The true subject of existence is the composite of matter and form. It is incorrect, therefore, to think of matter having one existence and form another. Matter and form have the same act of existence.

In itself, moreover, prime matter is said to be "one" in the sense that it does not have actual parts; it is only potentially many. And finally, Aristotle thought matter not only ingenerable but eternal. This notion, eternity, is not essential to matter. Christian thinkers, who knew that matter like everything else was created in time, could abandon this detail without prejudice to the doctrine as a whole.

b) *Substantial form.*—Like prime matter, substantial form is an intrinsic, nonaccidental principle of mobile being. It is the first act of corporeal or physical substance; which means it is the principle by reason of which this substance exists as well as the principle that causes this substance to be one kind of thing instead of another. As the Scholastic formula tells it, substantial form is "that by which a thing is determined to a certain mode of being":

id quo res determinatur ad certum modum essendi.

Form does not exist alone or by itself, and is not generated. In this it is again like matter. Unlike matter, however, forms are not transmitted in the process of generation from subject to subject; rather, they are drawn—"educed" is the knowledgeable word—from the potency of matter, and matter in turn is actualized by the educed form. One important exception should be noted. Christian metaphysics knows of a form that does not originate by eduction from matter. This is the human soul, which is

always created outright by God to be the substantial form of a human body.

Form, we have said, is first act, the act of matter. Form, that is, actuates matter and matter is actuated by form. Yet matter cannot be actuated by more than one substantial form at a time, as the simultaneous plurality of forms would destroy the essential unity of the composite. True, the doctrine of the unicity of form has at various times been hotly contested. But whatever one's stand one thing is agreed. Aristotle, for sure, is all on the side of unicity; and so, with all his mind, is St. Thomas.

c) *The substantial composite.*—From the union of matter and form results the substantial composite, the concrete being we meet in nature. As was said apropos of form, "what exists"—*quod existit*—in nature is not matter or form taken separately, but the composite of the two. So, to speak precisely, the true principle or subject of substantial corruption (change) is the composite (and not matter or form individually), and the true term of substantial generation (becoming) is another composite. Generation and corruption are reciprocal, one always entails the other; hence the axiom *generatio unius corruptio alterius.* In every natural generation and corruption it is a composite that is generated *(quod generatur)* and a composite that is corrupted *(quod corrumpitur).* Obviously, for this meaning of "corrupt" one must take the literal Latin, "to break up."

Not only is the composite "what exists" or has existence, but the composite (and not form or matter separately) is also the subject in which the accidents inhere. Consequently, all the subject's activities are ultimately said of the whole composite, the ultimate, intrinsic principle of all ac-

tivity. Actions, to use the Scholastic phrase, are the suppositi's: *actiones sunt suppositorum*™

The composite of matter and form is, plainly, one being. Its unity is essential or substantial in contrast to the accidental unity of substance and accident or of accidents with each other. How is this unity effected and sustained? Some past (if not present) Scholastics think that there has to be a coupling principle in the composite to bind matter and form together, but just what this should be is again a focus of controversy. Enough for us to remark that in the mind of Aristotle and St. Thomas no such coupler is called for. Matter and form determine and delimit each other directly; their union, because a union of act and potency, is immediate.

Lastly, we note in passing that form, the determining principle of the composite, is ontologically prior to matter. Though composed of both matter and form, a being of nature is principally form. This notion of form's primacy is of the highest importance not only in Aristotle's doctrine of nature but in his whole scheme of philosophy. More of this in the chapter on nature.[18]

2. *Elements and Mixtures (Compounds)*

We have said that corporeal substances are composed, ultimately, of prime matter and substantial form. We have also spoken of second matter and accidental form, which are the immediate principles of accidental change, the change

[17] Accidents inhere in the composite. True, but again with an exception in the human composite. Intellect and will, spiritual accidents, reside wholly in the human soul, and not in the composite of soul and body.—[Tr.]

[18] Chapter 4.

that does not alter the essential being of things. Besides substantial and accidental change, is there any other kind? Strictly speaking, no.

Yet, in *De Caelo* and *De Generatione et Corruptione* Aristotle introduces a type of change that seems neither all one nor all the other. This is the change by which "mixtures" or compounds are produced. The basic structure of the bodies concerned (elements) is affected, yet the process does not appear to be a substantial generation pure and simple. Aristotle, in consequence, notes two kinds of natural bodies, *elements* and *mixtures,* the former more basic than the latter, but both the work of nature. Elements were thought to transform into each other by clear generation. Mixtures were a fusion of pre-existent elements. Because of its obvious parallel to the modern theory of element and compound the Aristotelian doctrine of element and mixture still merits attention.

a) *Elements.*—"Element," says Aristotle, "is the first component of a thing, immanent and of a kind that is indivisible into another kind." [19] Or, in St. Thomas' rendition,

> *elementum dicitur ex quo aliquid componitur primo, inexistente indivisibili specie in aliam speciem.*[20]

St. Thomas singles out four points in this definition:

id ex quo: the element is in the genus of material cause;

primo: it refers to the primary material cause of a thing;

inexistente: it is an immanent or intrinsic principle;

indivisibili: the element is not further divisible into parts that would differ specifically or in kind. It is an immediate composition of prime matter and substantial form; hence

[19] *Metaph.* A, 3, 1014 a 25.

[20] In V *Metaph.,* lect. 4 (textus Aristotelis).

it cannot be further reduced except by substantial corruption, which is necessarily followed by the generation of another element, specifically different.[21]

According to Aristotle there are four basic elements in nature: water, air, earth, and fire. This listing was common in his time. To be noted, however, is that the elements were not the water, air, earth, and fire of everyday experience. These, in Aristotle's meaning, were already compound bodies but named, respectively, after the preponderant element or component. So, in this theory water as we see and drink it is a composite in which the element called "water" predominates. Similarly, in the air, earth, and fire of common experience one element overshadows the other(s) and gives its name to the whole.

All the elements had two notable properties. For each there was a *natural place* toward which it gravitated by an internal force. Fire naturally turned upward and came to rest just below the lunar orbit. Earth moved downward. Air and water shared the intermediate zones. Of these inner thrusts, heaviness and lightness were the outer manifestations.

Tire other feature was in their qualitative texture, which in each case was a blend of two of the contrary qualities. Assuming the basic qualities of nature to be warm, cold, dry, and wet, Aristotle finds them in the following paired associations with the elements:

> fire is warm-dry, with warm predominant;
> air is hot-wet, with wet predominant;
> water is cold-wet, with cold predominant;
> earth is cold-dry, with dry predominant

« Cf. Text II B, c) "Element," p. 176.

These qualities were also the active principles that accounted for the reciprocal alteration of the elements; and when in a given case alteration had reached the necessary point, one element was completely transformed into another by outright, or substantial, generation.

So much for Aristotle's theory of elements. Today many of its finer points are admittedly untenable, though perhaps of interest still to the antiquarian. But this is not to say that its basic insights are similarly dismissible, or that they cannot be integrated with the conceptions of modern science. The modern physicist, to mention one instance, knows of subatomic changes that have all the earmarks of genuine particle-transformation. Surely, this manifestation bears comparison with the transmutation of elements spoken of by the ancients.

b) *Mixtures.*—Besides elements nature affords what Aristotle calls "mixtures," amalgams of several elementary substances, i.e., elements. These complex bodies are unified wholes with specific properties that differ from the properties of individual elements. Aristotle's principal discussion of such bodies occurs in *De Generatione et Corruptione,* where his main purpose is to show that they originate by a process that appears to fall short of outright generation, yet is more than a juxtaposing of pre-existent elements.

Two conclusions emerge from his analysis. First, a mixture is a real fusion of substantial elements, giving rise to a new substance unified under a single substantial form. Secondly, in a mixture the elements survive, but in a "virtual" state, which means they retain a measure of their individual activity and hence of their individual qualities.

In his Commentary St. Thomas recapitulates the notion of mixture as follows: "For there to be a mixture the miscible bodies must be neither completely corrupted nor completely the same as before; therefore, they are corrupted as to form, but remain as to operative power." [22]

Mixtures, then, are more than aggregates; they are true substances. To say they are substances implies they have but one substantial form and originate by substantial generation. What is peculiar to them is that the component elements, instead of being reduced to utter potency, maintain a manner of persistence not found when a substance is completely corrupted, and this survival expresses itself on the plane of activity.[23]

22 "Ad hoc quod sit mixtio necesse est quod miscibilia nec sint simpliciter corrupta, nec sint simpliciter eadem ut prius: sunt enim corrupta quantum ad formas, et remanent quantum ad virtutem" (In I *De Generat.,* lect. 25, no. 12).

23 Neither Aristotle nor St. Thomas means to suggest, however, a third kind of change in addition to accidental and substantial change. What they are saying is that some complex bodies continue to display the properties which their component elements displayed separately. Nor are they implying that for an element there is a third kind of existence, neither actual nor potential but in between. And when they say that sometimes the elements remain *quantum ad virtutem,* as to their operative power, they do not mean that the property of a thing can exist without the thing's substantial form. If a mixture exhibits the same, or some of the same properties found in the elements individually, these properties now spring from the one substantial form of the mixture, and not from the vanished forms of the elements that went into the mixture. Consulted with profit on the notion of mixtures may be Christian L. Bonnet, "Note on the Thomistic Interpretation of Complex Individual Bodies," *The Modern Schoolman,* XXI, 2 (1944), 101-107; *idem,* "The Unity of the Complex Individual Body," *ibid.,* XXII, 1 (1944), 33–43.—Translator's note.

Aristotle's theory of mixtures served him on two counts. It gave him an explanation for the survival, such as it is, of the elements in certain complex substances; and it enabled him to reject the atomistic solution, which regarded mixtures simply as juxtapositions of pre-existent bodies. But though the theory served Aristotle, does it still avail? Its scientific perspective belongs, no doubt, to the past and may be disregarded, but basically the theory seems to stand. Until now, at any rate, there has been no indication that the philosophical analysis, say of the modern molecule or chemical compound, can go much beyond the point Aristotle reached in his analysis of mixtures.

V. CONCLUSION: HYLOMORPHISM AND OTHER THEORIES OF PHYSICAL REALITY

Modern writings on the structure of physical reality usually oppose the Aristotelian doctrine of hylomorphism to the rival theories of *atomism* and *dynamism*. Too often overlooked is the great complexity of the questions involved, not to mention the ambiguity that haunts such terms as "atomism," "dynamism," and "mechanism." Quite possibly, by such equivocal or promiscuous logic, even Aristotle can be proved to harbor the sheerest atomism or mechanism, and Descartes, a mechanist if ever there was one, pronounced the complete anti-atomist. Care and circumspection should thus be the watchword in dealing with notions so elastic.

The atomism that cut across the hylomorphism of Aristotle came mostly from Leucippus and his disciple Democritus, and Aristotle's critical examination of their doctrine is perhaps still the best springboard to this whole

debate on the structure of physical reality. These two philosophers had devised an atomistic interpretation of nature which for pure consistency and ingenuity it would be hard to better. The material world, they said, was ultimately composed of very minute particles, indivisible and devoid of qualitative content, differing only in shape and figure. The things we see in nature resulted from the particles coming together in varying amounts and combinations; and the changes we see in things were similarly explained as mere rearrangements of these same particles.

Aristotle begins his *De Generatione et Corruptione* with a close analysis of this doctrine, which he finds he must reject for one compelling reason, namely, that such a doctrine cannot account for the generation or coming-to-be of new substances. A new grouping of atoms is not a new substance. Reclustering does not basically change the things clustered. Yet there are basic or essential changes in nature. "There is," he declares, "absolute generation and corruption, not by association and dissociation [in the mechanistic sense], but by the complete change of this thing to that." [24] Of this Aristotle is sure. "This," he concludes, "may be taken as established, namely, the generation cannot be the mere association some assert it to be." [25]

Atomism, therefore, cannot be a total explanation of physical reality because of its failure to account for substantial generation, at least in the traditional sense of the complete passing away of one thing and the coincident emergence of an essentially new thing. Aristotle's argument in *De Generatione* assumes, of course, that these essential

[24] *De Generatione et Corruptione,* I, 2, 317 a 20-21.
[26] *Ibid.,* 317 a 30-31.

changes do occur, but once we grant this premise the atomism of Leucippus and Democritus falls and hylomorphism, now as then, must stand. Thus, Aristotle's whole case against the Atomists comes and goes with substantial change; but of this the living kingdom, to say no more, offers what appear to be incontrovertible instances. A living thing is a substantial individual, substantially distinct from every other thing; and coming to life or succumbing to death is a substantial change. If not, then nature does indeed belong to the Atomists of old. But for all their ingenuity the Atomists could not long secure the philosophical citadel, and through the ages their partisans have fared little or no better.

As intimated earlier, however, atomism does not mean the same thing to everybody. To some it is only another name for the quantitative analysis of the physical world. This, in general, is what it means to the scientist, whose work consists primarily in sifting and ordering the corporeal world on a quantitative basis, or on the basis of spatial continuity. If this is atomism, there need be no quarrel with it. From his point of view the scientist, as a matter of fact, may well be justified to think of bodily things as though composed of minute particles whose arrangements and movements can be mathematically analyzed. Thus understood the physical universe does indeed assume a mechanistic or atomistic appearance. This conception, moreover, has a solid foundation in reality and is, for that matter, clearly warranted by Aristotle's own doctrine of the primacy of local motion. All other movement in nature presupposes, as we shall see, local motion, a quantitative displacement. What must not be lost sight of, however, is that the quanti-

tative picture of the physical world is bought at an abstraction; hence it affords only a partial, and not a total view.

In sum, both the hylomorphic and the atomistic (i.e., quantitative) explanation have their place. But, speaking philosophically, Aristotle's analysis cuts deeper and gets closer to the heart of things.

+ CHAPTER 3

Quantity ani Quality m Mobile Being

+ MATTER and form, the primary principles of corporeal substances, are not sense perceptible. What we do perceive by sense are size and a variety of qualities. In fact, quantity and quality appear so inseparably one with their subject that some philosophers have denied the real distinction between substance and these accidents. So it is that Descartes thought extension was substance and substance extension. The same mechanistic bias led him to repudiate the objectivity of sensible qualities. In this, moreover, he was a true disciple of the ancient Atomists, even as others were to be of him.

Since philosophers have so often divided on the status of quantity and quality in corporeal substance, we must give at least a brief account of the Aristotelian and Scholastic stand on the question. First, however, we shall

speak of the nature and the kinds of quantity, a preliminary step to the just resolution of the point at issue.

i. *Nature and Kinds of Quantity*[1]

a) *Its nature.*—Quantity, at first thought, suggests a multitude of some kind, or the extension of an object. Implicit in this offhand notion are a number of other items, such as divisibility, measurability, and localization, to mention the more obvious. Which of these aspects denotes, most formally, the essence of quantity?

Aristotle leaves no doubt about his mind. Quantity, essentially, is what causes a thing (a whole) to be divisible into distinct, intrinsic parts, of which each itself can be a thing. In the medieval Latin of St. Thomas the definition reads this way:

quantum dicitur quod est divisibile in ea quae insunt.[2]

Like Aristotle St. Thomas adds that the parts of quantity can, upon separation, be things by themselves; they are, in the idiom of the logician, *integral* parts. In this they differ both from the elements in a mixture and from matter and form: from the former, because in a mixture the elements are only "virtually" present; from the latter, because matter and form, essential parts, cannot exist separately.

Some commentators of St. Thomas—John of St. Thomas is one—take a slightly different view, stressing the fact that

1 Cf. Aristotle, *Metaph.* A, 13; St. Thomas, *In* V *Metaph.,* lect. 15, nos. 977-978.

2 Freely translated: "Something is quantified when it is divisible into the things (parts) that exist in it" (In V *Metaph.,* lect. 15, no. 977).

quantity gives order and arrangement to the parts in relation to the whole. Thus quantity is what causes a substance to have parts that are exterior to each other according to a definite order. This conception makes explicit what is implicit in the other, namely, the position of the parts in respect to the whole of which they are divisible parts. Basically, then, the two definitions are the same. For, if quantity is the order of parts, one of its immediate and essential properties is *divisibility,* the idea in the foreground of Aristotle's definition. And since, again by definition, the parts are homogeneous, another property of quantity is *measurability.*

A further property or effect of quantity is *impenetrability,* which rules out compénétration, the simultaneous occupation of one place by two bodies. The commonly held opinion has it that nature alone cannot bring two bodies to occupy the same place at the same time.®

One of the special problems of quantity has to do with the mystery of the Eucharist. Under the appearances of bread and wine the body of Christ is truly present together with its proper quantity; yet this quantity does not appear to have actual extension. For this reason theologians have found two different orders in quantity: the internal order of parts and their order relative to surrounding bodies, which is their external or spatial extension. The former is *internal* quantity, the latter *external.* In the mystery of the Eucharist external quantity (or external extension) is

8 Some authors feel that certain miracles required compénétration; for example, the risen Savior's passing through the closed door of the Cenacle. But this point need not be gone into here.—[Tr.]

miraculously suspended, but internal quantity remains. Thus, the Eucharistic body of Christ has distinct, integral parts, but they want the externalization that would bring them into spatial relation with other bodies.[4]

b) *The kinds of quantity.*—Quantity is of two general kinds: the quantity of extension or dimensional magnitude, and the quantity of number. This distinction is familiar enough. It is also the ground on which the science of mathematics, almost from its inception, branched into its two basic disciplines, geometry and arithmetic. Aristotle, of course, recognized the duality in quantity and saw, besides, that the difference in point reverts to the difference between a continuum and noncontinuum. Dimensive quantity is continuous or *concrete,* the quantity of multitude discontinuous or *discrete.* This is the accepted locution; quantity is either concrete or discrete.

Concrete quantity.—A continuum, as defined by Aristotle, is a whole whose parts not only touch (this is mere contiguity) but are so merged as to be indistinguishable. In concrete quantity the parts are therefore not actually separate though separable, which is to say they are continuous. As St. Thomas remarks, magnitude or concrete quantity is that which can be divided into continuous parts: *quod est divisibile in partes continuas.* Thus, a line is

4 Scholastic authors generally speak of the *primary* and the *secondary* effect of quantity. The primary effect consists in the order of parts as to the whole; this effect can never be prevented, not even by a miracle. The secondary effect is multiple, including, among other things, the order of parts as to place, causing one quantity to have a certain position with respect to another; this effect can by a miracle be withheld from the essence of quantity.—Translator's note.

divisible into segments whose parts again overlap and are indistinguishable.

Moreover, the continuum that characterizes concrete quantity is either *simultaneous* or *successive.* Line, surface, and volume are instances of the simultaneous continuum; they belong to the predicament of quantity per se or essentially. The successive continuum, on the other hand, is seen in motion and time, which are quantified by something extrinsic to them, their subject. Since this subject is an extended body, quantity necessarily attaches to its motion, and hence to time, the measure of motion.® But more of time and motion later.

Discrete quantity.—This is number, the quantity that can be divided into noncontinuous parts: *quod est divisibile secundum potentiam in partes non continuas.* If, moreover, number is taken absolutely, without reference to things numbered, it is called "numbering" number: *numerus numerans.* Thus, I may think of "ten" in this abstract sense, but I may also mean by it a group of ten objects, say ten men, and then it is "numbered" number: *numerus numeratus.* Either way the ultimate and irreducible parts of number are its units, and the unit is also its measure.

2. Quantity Differs from Substance by a Real Distinction

Judging by the senses, we might easily mistake the quantitative extension of a thing for its substance. In appearance,

5 Not that motion is quantified by the quantity of its subject, but because the distance a thing travels is a quantity. And, as noted in the text and will be seen later, the quantification of time follows on that of motion.—[Tr.]

at least, the quantity and substance of an object are indistinguishable. This may be the reason why, as mentioned earlier, some philosophers like Descartes profess what amounts to a mere distinction of reason between these two modes of being. By this reckoning the substance of bodily things is really nothing more than their quantification or extension. Nevertheless, in the Aristotelian tradition as well as in Scholastic philosophy generally there is no room for anything less than a real distinction between corporeal substance and its quantity or extension.

The proof of this thesis as well as the refutation of Descartes' position belongs primarily to metaphysics and epistemology; hence our remarks should not be taken as the full answer. Among other things, however, it may be noted that the formal effects of these two modes of being are so different as to seem irreducible. By substance a thing has absolute or subsistent existence (esse *simpliciter),* and its unity, too, comes from substance. Quantity, on the other hand, orders the parts of substance and accounts for its divisibility. Functions so diverse can scarcely be the work of the same principle; two separate principles are clearly indicated, one really distinct from the other and the first presupposed by the second. Again, the quantity of a body may change without modification of its substance. Generally speaking, moreover, quantity belongs to the sensible order, whereas substance, in the strict meaning, is not accessible to sense but only to intellect

Notwithstanding this real distinction, quantity enjoys a proximity with substance that is unique. Quantity is, in fact, the first and immediate disposition of substance. For this reason it has, also, a priority among accidents, so that

other accidents presuppose quantity as their immediate subject but substance as their ultimate subject. This closer solidarity of substance and spatial dimensions bulks large in metaphysics as well, specifically in the individuation of corporeal substance. Here, too, dimensive quantity interposes and is a necessary principle, the determinant of matter. Matter, I mean, individuates, but matter that is *signate* or quantified.

Accordingly, in maintaining the distinction between quantity and substance we must not overlook the many ways in which quantity touches and impenetrates substance. Nor, in Aristotle's physics, must quantity be discounted in favor of quality. To be sure, Aristotle's physics is in large measure qualitative, at least by comparison with the quantitative physics of today. But to see only its qualitative texture is to get a grossly distorted view. Dimensive quantity, even in Aristotle's physics, is just as important as quality, nay more important; it, and not quality, is the primary, the radical disposition of the being of nature. Aristotle, in this particular, is far less removed from Descartes than is sometimes imagined.

3. *The Reality (Objectivity) of Sensible Qualities*

The notion of quality applies to spiritual as well as material things. Since, however, the work of defining and assigning this notion falls upon metaphysics, we shall be brief in that regard and attend more to the question of its reality or objectivity.

Quality, in general, is easier to experience than to define. As a matter of fact, the experience is so primary and universal that it can scarcely be reduced to anything simpler.

Yet quality has been given a manner of definition. "By 'quality/ " says Aristotle, "I mean that in virtue of which things are said to be such and such." 6 This is a very broad rendition of quality, broad enough to include substantial differences, by which things are essentially dissimilar. In its more usual, and proper, meaning quality denotes an accidental modification or specification of what is already substantially or essentially complete. This is the sense we now speak of it.

On this subject of quality there is apparently complete opposition between Aristotle's physics and those science-imbued systems of thought that are customarily lumped together under the label *mechanism,* a loose term at best. In any event the mechanists, for want of a better name, distinguish qualities into primary and secondary. The former include such aspects as extension, shape, and motion; the latter, such properties as color, taste, and smell. So far so good, except that in Aristotelian psychology the primary qualities of the mechanists are in fact secondary, and conversely.

More important is the mechanists' allegation that only primary qualities are objectively real, and their consequent disregard of secondary qualities in the explanation of the physical world. Thus, all interpretation of nature becomes mathematical—or so the mechanists persuade themselves. It bears mentioning, though, that even the extremest mechanism never achieved the complete suppression of nature's qualitative features. The atoms of Democritus still had shape; and the amorphous extension of Cartesian physics was not a universe or cosmos except by differentiat-

6 *Categories,* 8, 8 b 25.

ing motions. Therefore mechanism, despite its claim, does not spell the total liquidation of nature's qualitative aspects; rather, it underscores the age-old desire to conquer this more elusive order of things by sifting and reducing it to its simplest features.

Aristotle, it is clear, could not accept the mechanistic account of quality without considerable pruning or adjustment. In his view, qualities, even as perceived, are objectively real. Not only that, but quality is the immediate principle of all physical change in nature, since "alteration," which is movement according to quality, provides the immediate disposition to such change. In Aristotle's study of nature quality, accordingly, assumes a role and importance which it does not have in the mechanistic tradition.

Much could be said about this diversity of outlook; much, also, that would be beside the point. One thing to be borne in mind is that while Aristotle and the mechanists —perhaps we should say "scientists"—seek the same trophies, the secrets of nature, their search is from different levels. The scientists may prefer to study nature from the quantitative aspect, which lends itself to more exact measurement. This course is perfectly legitimate, though in his preoccupation with the quantitative side of things an investigator, wittingly or not, may minimize and oversimply the qualitative features. But the quantitative explanation of nature is never the whole story; it is a selective report. This, too, needs to be remembered.

Above all, it must not be supposed that the quantitative discovery of nature is a philosophy of nature, an expression of the total reality down to its ultimate principles. In the philosophical study of nature quality will hardly be less

important than quantity. As a matter of fact, even in science proper (in the modern sense) the recognition is growing that quality cannot be utterly neglected. The time is over when mechanism (with its imagined elimination of quality) could commend itself to scientists as an exhaustive explanation of the physical world. The significance of this change in attitude should be apparent. Today, a philosophy of nature in which (as in Aristotle's) quality has a primordial role cannot be counted out on the plea of inassociability with scientific outlook.

+ CHAPTER 4

Nature

+ BOOK II of the *Physics* may be divided into two sections. One (chapters 1 and 2) deals primarily with the meaning of nature. The other (chapters 3 to 9) is a study of causes.

Actually, in the first two chapters Aristotle is again occupied with the problem of principles, the burden of Book I. But the line of inquiry shifts. What he now examines is not exactly the principles of mobile being, but the principle of motion itself. This is called *nature,* and is opposed to *art.* Art is the principle of changes which result in fabricated or "artificial" things, whereas the products of nature are "natural" things. All in all it seems what Aristotle does in these two chapters is to determine more precisely the subject matter of natural science, which is to say, of the philosophy of nature.

To be noted, moreover, is that in studying the world of nature Aristotle is foremost a biologist. Many of the ideas he sets forth, the concept of nature in particular, bear the

stamp of his familiarity and preoccupation with the biological order of things. To forget this is to miss the real meaning of much of his natural philosophy.

i. *Definition of Nature*

In Aristotle's view the existence of natural beings, or natures, has not to be proved; it is self-evident. Animals and their parts, plants, the elements—these are all natural beings. In physics (in the Aristotelian sense) nature, like motion, is simply a postulate, a given, which Aristotle defines as follows: "Nature is a principle and cause of motion and rest in the thing in which it inheres primarily and as an attribute that is essential and not accidental." [1]

a) Nature, therefore, is first a *principle of motion.* In its original use "nature" presumably meant the motion itself, but in time it came to denote the principle of motion. As for saying it is also a principle of "rest," this is a necessary inclusion because in Aristotelian physics rest is the motionlessness of something that can be moved. Like motion it has, therefore, to be accounted for by a cause. So, to the ancients, the nature of an element is the reason why it inclines to a particular place. Earth, one of the elements, is heavy. Earth, or its nature, is the reason why a heavy body falls and why it comes to rest after reaching its natural place.

b) Nature, moreover, is said to be an *intrinsic principle.* This distinguishes it from art. A manufactured thing, a coat or bed, does not, as manufactured, have a proper activity proceeding from its art-instilled form. As Aristotle observes, if a wooden bed were planted and grew, it would

[1] *Phys.* II, i, 192 b 21-22.

not come up a bed, but wood. The proper principle of a work of art is in the mind of the artist. But his mind or conception is an extrinsic principle; is it not, in the present meaning, a physical or natural principle.

In one sense, no doubt, man-made things have their characteristic form; but this form does not possess an activity of its own. If man-made things manifest a natural leaning or tendency, this comes from the materials in them, which retain their original properties within the artificial form imposed on them by the artist. By contrast with the artist, nature is an intrinsic principle, which both originates and determines the specific character of the activities embodied in its works.

c) Nature, finally, is something that inheres essentially, and not accidentally as a supervening attribute. This eliminates what Aristotle calls *accidental causality.* Thus, a man who is a doctor might heal himself, and the principle of healing would be within him, but not as an essential attribute—one can be a man without being a doctor. That he was healed by his own art is, in the Aristotelian sense, accidental to him, and not a dispensation of his nature.

Usually when Aristotle refers to nature, he means the nature of an individual being. Sometimes, however, he speaks of it as a cosmic principle of life and movement: Nature with a capital letter, as is the fashion in some philosophical circles. But even with a capital, nature by Aristotle never has the build of a veritable world soul.

Another point of note is that nature is not the sole principle or cause of activity in a thing. There are also extrinsic causes, as is most evident in the inanimate world. Inanimate beings are known for being moved by another.

Not that living things cannot so be moved; but the fact is more obvious in the other.

2. *Both Matter and Form Are Nature, but More So Form*

A salient issue in the first chapter of Book II is whether nature is principally matter or form. The answer will help to decide—the burden of chapter 2—what the natural philosopher should study, form or matter, or both; and if both, which should command his inquiry.

Aristotle's predecessors had tended to identify nature with the material elements, water, air, fire, and the like. Aristotle grants some justification to this opinion. After all, the elements and, more generally, matter are integral parts of nature. Nevertheless, nature is more than matter; it is also, in fact mainly, form or the principle of perfection in a thing. What distinguishes one thing from another, and causes its activities, is primarily its form. The implication for the natural philosopher is clear. He must study matter, yes; but even more must he study form. Writes Aristotle: "Since nature has two meanings, form and matter, we must search nature in the same way as we would the essence of snub-nosedness. In other words, such things neither exist without matter nor can be considered from their material aspect alone." [2] Form, in short, is the primary consideration in the study of nature.

In taking this position Aristotle was announcing the basic trend and character of his whole physical philosophy. Doubtless, a being of nature is composed of both matter

[2] *Phys.* II, 2, 194 a 12-14.

and form, and Aristotle's analysis of its compositeness is second to none. But his finest and most satisfying answers are about its form or formal structure and consequently about end or final causality. I say "consequently," because form and end have coincident meanings and what is form in one respect is also end from another, as we shall see in the next chapter, on causes. All told, Aristotle's physics is centered on formal and final cause, and this, to be sure, sets it off from the mechanistic interpretation of nature, with the focus on matter and its quantitative structure.

3. *Nature, Art, and Violence*

Earlier in the chapter we contrasted nature with art. In Aristotelian thought nature also contrasts with *violence*. Like art violence refers to an activity whose source or principle is outside the affected subject, but the source may be natural or artificial. In either case, however, violence —and this is its distinctive feature—is directly contrary to the natural tendencies of the receiving body. Thus, by the ancient physics the upward motion of a heavy body is "violent." Such a body moves naturally down.

In the Scholastic tradition these three notions, nature, art, and violence, have acquired each a formulation that is standard and well worth reproducing here:

(i) *Natura est principium et causa motus et quietis in eo in quo est primo et per se et non secundum accidens.* (Nature is a principle and cause of motion and rest in the thing in which it inheres immediately and as an attribute that is essential and not accidental.)

(ii) *Artificiale est cujus principium est extra, in ratione*

externam materiam disponente. (That is artificial whose principle is outside, namely, in reason disposing external matter.)

(iii) *Violentum est cujus principium est extra, passo non conferente vim.* (A "violent" action is one whose principle is outside, without active contribution from the affected subject.)

+ CHAPTER 5

The Causes of Mobile Being

+ AFTER the first two chapters of Book II, in which, as we have said, Aristotle determines the subject—"formal object," as it were—of physical philosophy, he goes at once to the causes of mobile being. This is a logical step, since science (any science) in the Aristotelian sense consists, basically, in knowledge through causes. Hence, one of the first things to be done in the science of nature is to ascertain the causes of mobile being. Causes, moreover, are principles of demonstration in a science. Consequently, to treat of the causes of mobile being is also to clarify the method one should follow in the study of nature.

Aristotle addresses himself to the topic with great thoroughness. Introduced are a variety of chapters, dealing not only with cause in the familiar sense but also with more

cryptic expressions of nature, such as chance, fortune, necessity, and especially, teleology. On first acquaintance with these chapters it may not be instantly clear how one thing relates to another or to the discussion as a whole. One train of thought, however, is soon discernible and becomes increasingly apparent. In physics (in the Aristotelian sense) an explanation by final cause excels all others; especially does it surpass the deterministic kind of explanation for which Democritus was known. Aristotle, as we know, had found the out-and-out materialism of Democritus a very unfinished view of nature, revealing at most one aspect. Nature, he was sure, was far more resourceful than this Atomist had surmised. Indeed, for the study of nature Plato's theory of celestial forms or archetypes, though not without difficulties of its own, was by comparison far more illuminating.[1]

I. THE CAUSES AND THEIR MODES

Aristotle begins abruptly with a statement of the four typical causes.[2] But before reviewing his discussion of them we ought to know the meaning of cause itself, and its bearing in Aristotelian philosophy generally. This knowledge we shall first provide.

i. The Aristotelian Notion of Cause

Neither in Aristotle nor in St. Thomas does one find a complete, systematic account on cause. The nearest thing to it in Aristotle is the chapter of the *Physics* in which he

1 Cf. Text II B, "Tire Causes," p. 173.
2 Cf. *Phys.* II, 3, *init.*

tells the kinds of causes and their modes? Yet the idea of cause is everywhere made use of in their writings, in logic, physics, metaphysics, theodicy, theology. Hence, by comparing the numerous passages in which they speak of cause, what they meant by this notion still becomes reasonably clear.

Broadly speaking, the Aristotelian notion of cause contains two essential notes. A cause is a *principle of being,* and secondly, in the order of knowledge, a *principle of explanation.* Primarily, it is a principle of being, of concrete reality. Everything that is, save God, depends on something not only for its being but also for its becoming. This something, of whatever sort, is a cause. "Those things are named causes," says St. Thomas, "on which other things depend for their existence or becoming"[3]:

> *causae autem dicuntur ex quibus res dependent secundum esse suum vet fieri.*[4]

John of St. Thomas' definition strives for greater precision; it reads: *causa est principium alicujus per modum influxus seu derivationis, ex qua natum est aliquid consequi secundum dependentiam in esse.*[5]

A principle of being, cause is by that very fact a principle of understanding and explaining reality. It is, in fact, a

[3] *Phys.* II, 3, which is repeated, almost in the same words, in *Metaph.* A, 2.

[4] "Those things are called causes on which things depend either for existence or becoming" *(In I Phys.,* lect. 1, no. 10).

[5] "A cause is a principle by influx or derivation of such nature that a thing arises from it with dependence of being" (John of St. Thomas, *Cursus Philosophicus,* I Pars, q. 10, a. 1; ed. Reiser, II, 198).

necessary means of acquiring what Aristotle calls scientific knowledge; science, by his definition, is precisely knowledge through causes: *scientia est cognitio per causas.* On this fundamental rests his entire logic of demonstration, all his scientific methodology, down to the last iota. And when, in the chapters of the *Physics* we are now to consider, he introduces the notion of cause, this is the aspect put forward—cause as a principle of explanation.

2. *The Four Causes*

Aristotle's enumeration of causes is universally accepted in the Aristotelian and the Scholastic tradition, i) Material cause, 2) formal cause, 3) efficient cause, 4) final cause, these are the four causes.® The division is, in fact, based on the essential types of causality that can be discovered in reality: *diversas rationes causandi,* as St. Thomas expresses it. lire distinction of the four causes is therefore a distinction in kind or species.

How did Aristotle himself arrive at this list of causes? In chapter 3 he gives no indication, but later, in chapter 7, he notes that there are as many causes as there are specifically distinct "whys" of a thing.7 In that case, however, the validity of the "whys" requires some justification.

Actually, Aristotle's theory of four causes appears to be a distillation of several convergent lines of philosophical inquiry. Aristotle had studied, and reached certain conclusions about, the conditions pertaining to generation or to becoming.® He had also occupied himself with the principles

• Cf. *Phys.* II, 3, 194 b 24 ff.
7 *Ibid.,* 198 a 15.
• Cf. especially *De Generatione et Corruptione,* II, 9.

of artistic creation, as witness the well-known example of the statue. And he had similarly made an analysis of the general methods of scientific investigation and explanation. The net result was his doctrine of four causes, which was further and finally confirmed through the process of comparing it with the corresponding investigations and findings of his predecessors.[9] St. Thomas himself seems to suggest this train of development when he writes: "The Philosopher reduces all causes to the four modes which have been enumerated, saying that everything that is named cause falls under the aforesaid modes." [10]

a) *The intrinsic causes.*—We have already seen that Aristotle identifies the essential principles of mobile being as matter and form. In propounding the theory of causes he reverts to these principles, declaring them, in effect, the intrinsic causes. Principles or causes, they are the same matter and form. But to designate them as "causes" adds to their notion a relation to the thing caused. This relation may be implied in a principle, too, but it is made more precise and explicit in the term "cause." Consequently, the terms "material cause" and "formal cause" give additional meaning respectively to the mere notions "matter" and "form."

Aristotle defines *material cause* as "that out of which a thing comes to be and which remains in it." [11] The Scholastic transliteration is:

ex quo aliquid fit cum insit.

To illustrate his definition Aristotle cites bronze, the

[9] Particularly in *Metaph. A,* 3-10.
[10] *In* V *Metaph.,* lect. 3, no. 777.
[11] *Phys.* II, 3, 194 b 24.

material cause of the statue, and silver, the material cause of the bowl. Other examples are listed as occasion invites. Thus, letters of the alphabet are material causes of syllables; fire, earth, etc., of mixed bodies; parts, of the whole; premises, of the conclusion. Obviously, this type of causality presents itself in the most diversified areas of thought and reality, but always with the identical causal implication. In every case the thing or item in point is a cause on the ground of being a passive and immanent receptor of form, or, as the idiom has it, a cause in the manner of subject, "per modum subjecti."

Formal cause, on the other hand, Aristotle defines this way: "In another sense cause is the form or exemplar, that is, the definition of the essence and its genera." [12] The standard Scholastic formulation is:

id quo res determinatur ad certum essendi modum.[13]

Aristotle again illustrates. The parts of a definition, the ratio of 2 : i for an octave, and number generally, these are cited as instances of formal cause. Wherever the causality of form is at work, its effect is to actualize the poten tiality of matter, or whatever assumes the role of matter.

Not to be overlooked is that Aristotle uses two different terms for formal cause: *eidos* and *paradeigma.* These are not synonymous. The first, "eidos," corresponds to formal cause in the proper sense, to the form intrinsic to a thing. The other, "paradeigma," denotes a model or exemplar, and is therefore called "exemplary cause." This kind of

[12] *Ibid.,* 194 b 26.

[13] Literally: "That by which a thing is determined to a certain (i.e., a specific) mode of being."

cause is extrinsic, but like formal cause it may serve to define a thing. Hence it assimilates to formal causality, and one speaks of it as "extrinsic formal cause," a notion which, though not to be gone into here, is far from negligible in Scholastic discussion.

Furthermore, something we referred to in the chapter on principles of mobile being may well be repeated here. Both material and formal causality have analogical applications. Primarily, it is true, material causality relates to prime matter and formal causality to substantial form. But, on another level, the reciprocal causality of matter and form exists between subjects and the accidents by which subjects are further determined. In grammar, too, and in logic and mathematics (still other fields could be mentioned) the same relationship, transferred, shows itself.

So much, for the moment, for material and formal cause, the intrinsic causes of mobile being.

b) *The extrinsic causes.*—Generation, or becoming of any kind, requires more than intrinsic causes. There has plainly to be a mover to initiate the process of becoming. And even this is not all. Necessary also, if we look closer, will be found the causal influence of an intended goal, which is to say, the end. Agent and end are therefore the extrinsic causes of change and, consequently, of mobile being itself.

In Aristotle's definition, *efficient cause*—perhaps "moving cause" would be more exact—is "the primary source of a change or coming to rest. Thus, the author of a decision is cause, the father is cause of the child, and in general anything that does the making of what is made and the changing of what is changed." [14] In Scholastic terms,

[14] *Phys.* II, 3, 194 b 29-32.

causa efficiens est principium a quo primo profluit motus.[15]

Efficient cause is what the average person usually means by cause.[16] Philosophically, it is the primary principle, the headmost source, of any motion. Call it the point of departure, the *terminus a quo,* but remember it is more. Efficient cause is not passive; it exerts itself upon its subject, producing a real influx from agent to patient, the nature of which Thomistic commentators take much pains to clarify. As for the very existence of efficient causality, historically speaking Aristotle's assertion of it was partly in answer to Plato, who seems to have preferred to do without it and, in consequence, never managed to explain how forms make their way into matter.

Final cause, or end, is "that for the sake of which" an action takes place:

id cujus gratia aliquid fit.

In this way, says Aristotle, "health is the cause of walking. 'Why,' we ask 'does he walk?' 'For his health's sake.' And having said this, we think we have produced the cause." [17] If efficient cause is the most evident, final cause is often the most veiled and inscrutable. Not that its existence eludes the mind, but its precise working is most difficult to conceive.

15 "Efficient cause is the principle from which motion primarily springs," or more loosely, "from which motion receives its primary impetus."

16 The reason, presumably, is that of all causes it is in a way the most palpable. One can see that this man is swinging the bat, and that man is calling him out.—[Tr.]

17 *Phys.* II, 3, 194 b 32-35.

Aristotle notes that his predecessors scarcely suspected the existence of final cause.[18] This is understandable, since it poses a number of thorny problems. How, for example, can final cause exert itself when it does not yet exist? And what of beings devoid of all power to know, nescient beings; how can they move themselves to an end? But most of all, does final cause really exist? Aware of these difficulties Aristotle, toward the end of Book II, gives the notion of final causality a thorough hauling over, which, however, nets its doubters and deniers nothing. Final cause, he cannot but aver, exists in nature.[19] We shall have more to say on this later in the present chapter.

3. *The Modes of Causes*

Having established the division of causes, Aristotle follows it up with a division of their modes.[20] We mentioned earlier that the differentiation of causes into their kinds is based on the diverse meanings or notions of cause itself (*rationes causae*). The diversification of their modes, on the other hand, is grounded on the different relationships that may exist between cause and effect. Hence, the modes do not constitute new kinds of causes.

Aristotle lists as many as twelve modes of cause. However, this number is got by dividing six modes by act and potency. The twelve, that is, may be cut to six. But the six themselves are reducible to three pairs of opposite members; which, in effect, means that the modalities of causes

[18] Cf. *Metaph.* A, 7.

[19] Cf. *Phys.* II, 8.

[20] *Phys.* II, 3, 195 a 28 to end of chapter. In the parallel chapter of the *Metaphysics* (A, 2) he follows a similar course, explaining first the kinds of causes, then their modes.

are basically three in number. A word about each will help to make this clear.

The first kind lists the modes *per prius* and *per posterius.* These terms correspond to anteriority and posteriority in the same line of causality. They may refer to the real order, or to the logical order of concepts. A more universal concept is anterior to a less universal. From this point of view a doctor is a "per posterius" cause of health, and the man (that he is) is a "per prius" cause, the notion of man being more universal than that of doctor. In the real order "per prius" and "per posterius" refer respectively to remote and proximate causes of real being. Thus, to use an ancient example, the proximate *(per posterius)* cause of a man's coming to be is another man, but the remote *(per prius)* cause is the sun.[21]

A second kind of modes couples the notions "essential" and "accidental." These, in Scholastic idiom, are the *per se* and *per accidens* modes. They indicate an essential or accidental association between cause and effect. For example, every effect has its proper *(per se)* cause. But both with the effect and with the cause may be associated modalities of being which, themselves, may also be regarded respectively as effects and causes. Polycleitus, in this respect, is accidentally *(per accidens)* the cause of the statue, since it might well have been carved by another sculptor. The proper *(per se)* cause is the statue-maker as such, whoever it may be. We shall see, presently, that accidental cause is

21 That the sun should be thought a cause in human generation can offend only those who have yet to grasp the full measure of meaning in the Aristotelian concept of cause. The sun, most assuredly, is at least a remote—how remote doesn't matter—efficient cause of every proper *(per se)* natural effect.—Translator's note.

highly important in the Aristotelian scheme of things, notably in the explanation of exceptional, that is, chance happenings.

The third kind of modes opposes simple and composite causes, *simplex* versus *complexum*. Aristotle again uses the example of Polycleitus-sculptor, which, together, constitute a composite cause of the statue, but taken separately are simple causes of it. A more concrete case of composite causality would be two forces actually harnessed together, say two horses on the same wagon.[22]

4. *Aristotle's Causes: Network or Medley?*

At first glance Aristotle's assemblage of causes may seem to be a gathering of disconnected notions, with apparently no unifying thread. Closer scrutiny, however, will show that this is far from the case. Even though, as we have said, there is not to be found a full-scale treatise on cause either in Aristotle or St. Thomas, both of them—St. Thomas even more so than Aristotle—present coordinated developments on the subject, and these, without exaggeration, add up to a truly integrated philosophy of cause.

Consider, first, the fact of four causes. This means that every mobile being is the work of four different causes, each exercising its proper causality in its own area of operation. So, in the case of the statue, bronze is the material cause; the figure carved into it, the formal cause; the sculptor, the efficient cause; and the purpose in its being made, the final cause. Thus, the four causes operate conjointly to produce, each in its own way, one and the same effect.

This is not all. The causes depend on each other for the

12 Cf. Text II B, h) "The modes of causes," p. 180.

exercise of their proper causality; which is the meaning of the axiom that causes are causes to each other: *causae sunt ad invicem causae.* Material and formal cause on the one hand, and efficient and final cause on the other, are associated pairs. Matter is not a cause except in conjunction with a formal cause; and the agent, if not determined or impelled by an end, cannot impart motion to anything. Since, moreover, matter and form cannot be brought into composition without an efficient cause, and this, as we have said, is itself conditioned and called into action by the end, the four causes are plainly so ordered as to constitute a closely knit economy, with final cause always in the commanding role. Seeing, therefore, how clearly Aristotle discerns and defines not only the kinds of causes but also their manifold interdependence, one has every right to speak of his thought in point, not as a medley, but as a philosophy or system of causes, a body of doctrine in which all parts are present and properly accounted for.

In the following passage from the Commentary on the *Metaphysics* St. Thomas summarizes the interconnection of causes with fine precision:

"Assuming, as previously established, that there are four causes, we should note that two of them have a reciprocal relation, and so do the other two. Efficient cause and end are reciprocally related in that efficient cause is the principle of motion, and end [final cause] the term. Similarly matter and form: form bestows existence and matter receives it. Efficient cause is therefore cause of the end, and the end is cause of efficient cause. Efficient cause is cause of the end as to its existence, since by its activity efficient cause brings the end into being. The end, on the other hand, is cause of efficient cause, not

as to its existence, but as the reason [ratio] of its causality. For, efficient cause is cause so far as it acts, but it does not act except by reason of the end. Hence, efficient cause has its causality from the end. Form and matter, however, are causes of each other as to their existence: form of matter, in that form causes matter to be in act; but matter of form, in that it sustains form." 23

And in this other passage from the same Commentary St. Thomas declares the priority and pre-eminence of final cause:

"Although in some things the end is last with respect to existence, in the order of causality it is always first. Hence it is called the cause of causes, since it is cause of the causality of all causes. It is cause of the causality of efficient cause, as already said. Efficient cause, in turn, is cause of the causality of matter and form, for by its activity it causes matter to be receptive of form, and form to inhere in matter. Therefore the end is also cause of the causality of matter and form." 24

23 "Sciendum est autem, quod cum sint quatuor causae superius positae, earum duae sibi invicem correspondent, et aliae duae similiter. Nam .gfficiens et finis sibi correspondent invicem, quia efficiens est principium motus, finis autem terminus. Et similiter materia et forma: nam forma dat esse, materia autem recipit. Est igitur efficiens causa finis, finis autem causa efficientis. Efficiens est causa finis quantum ad esse quidem, quia movendo perducit efficiens ad hoc, quod sit finis. Finis autem est causa efficientis non quantum ad esse, sed quantum ad rationem causalitatis. Nam efficiens est causa inquantum agit: non autem agit nisi causa finis. Unde ex fine habet suam causalitatem efficiens. Forma autem et materia sibi invicem sunt causa quantum ad esse. Forma quidem materiae inquantum dat ei esse actu; materia vero formae inquantum sustentat ipsam" (In V *Metaph.,* lect. 2, no. 775).

24 "Licet finis sit ultimus in esse in quibusdam, in causalitate tamen est prior semper. Unde dicitur causa causarum, quia est causa causalitatis in omnibus causis. Est enim causa causalitatis efficientis,

As we shall see in the course of this chapter, and indeed of our study, Aristotle's whole procedure in natural philosophy, his every argument and demonstration, is governed by this hierarchical concept of causes, in which, once more, the primacy is always to final cause.[25][27]

II. CHANCE

The three chapters[26]—a little labored, it may seem—which Aristotle devotes to the study of chance are a logical sequence to the search for the kinds of causes. Some things, we commonly say, happen (that is, are caused) by chance. Are we to conclude that chance and fortune are separate kinds of causes, distinct from the ones we have just considered? This is the question Aristotle proceeds to answer, examining the views of others and then stating his own.

i. *Theories Criticized by Aristotle*[21]

Aristotle begins by observing that some deny the very existence of chance. Every event, they say, has its proper cause. If, for example, I should meet at the market a man whom I really wanted to see but whom I had not gone there to find, I may well credit the meeting to chance. But was it chance? No, says the opposition. There was a definite cause of the meeting, namely, the intention I had to go and buy

ut iam dictum est. Efficiens autem est causa causalitatis et materiae et formae. Nam facit per suum motum materiam esse susceptivam formae, et formam inesse materiae. Et per consequens etiam finis est causa causalitatis et materiae et formae" *(ibid.,* lect. 3, no. 782).

25 Cf. Text II B, d) "Reciprocity of causes," p. 177; e) "Priority among causes," p. 178.

28 Phys. II, 4-6.

27 Ibid., chap. 4.

in the market. Similarly in all cases attributed to chance or fortune it is possible, they maintain, to find a proper cause at work—an interpretation, it need hardly be said, that runs counter to the popular mind.

Others—the Atomists—ascribe the formation of the heavens, in fact of all the worlds, to chance.[28] Thus, what would seem to be the most regular occurrences in nature—the celestial movements—are due to chance. Yet in the area where we most often come upon exceptions to the regular course of events, in the generation or production of things around us, in the history of men and animals and plants, in this area these same people (the Atomists) deny all chance and say that everything happens from fixed causes. This, suggests Aristotle in rebuttal, is a strange statement to make, for one should have expected just the reverse.[29]

2. *Aristotle's Definition of Chance*

In Aristotle's view the first mark of chance is infrequency. What always happens, *semper,* or most of the time, *ut in pluribus,* is evidently the effect of causes acting in their proper nature or capacity. But what seldom happens, *ut in paucioribus,* and comes as an exception, this seems to escape the determining influence of these causes.

Infrequency, however, as Aristotle makes clear, is not

28 The Atomists, it seems, believed in a great multiplicity of worlds, stretched out in infinite space.—[Tr.]

29 That is, the denial of chance in the celestial realm, and the acknowledgment of it in the terrestrial world.—[Tr.]

Aristotle mentions yet another group, those who hold that chance is a cause; but, mysterious and divine, it balks human scrutiny (196 b 5).—[Tr.]

enough to indicate that chance is at work. The event must belong to the order of finality, something that could be an object of choice. But though the event could have been purposely sought, it was not sought. So, to come back to our example, when a creditor just happens to meet his debtor in the market place, it is a chance meeting. Neither, assumedly, went to meet the other, nor do they always meet there. But, and this is the point, the encounter could have been premeditated, or knowingly sought. The fact is it wasn't.

These three notes of chance—"exceptional," "intentional," but "not intended"—are readily discernible in this definition of Aristotle's, namely, "Fortune and chance are incidental *(per accidens)* causes in regard to things which admit of coming to pass neither absolutely nor for the most part, and which, moreover, can come to pass in view of an end." [80] St. Thomas transcribes Aristotle as follows:

> *Utrumque, scilicet fortuna et causa, est causa per accidens; et utrumque est in iis quae contingunt non simpliciter, id est semper, neque frequenter; et utrumque est in iis quae fiunt propter aliquid.*[31]

Though the definition applies both to fortune *(ruxq)* and chance *(avróp.arov),* Aristotle makes a distinction between them. Chance is the generic term, including all cases, but when chance bears on creatures who have freedom of

[10] *Phys.* II, 5, 197 a 33–35.

[81] "Each, namely chance and fortune, is a *per accidens* cause, and each is found in those things which happen not necessarily *(simpliciter),* i.e., not always, nor frequently; and each is in those things which come to be for the sake of something" *(In II Phys.,* lect. 9, no. 446).

choice, it is called fortune. If the unexpected is favorable, it is good fortune; if unfavorable, ill fortune. A lucky creditor is the object of good fortune, an unlucky one, of ill fortune. A nonliving thing, or even an animal—yes, a babe in arms—is not said to be similarly blest or plagued.

3. *Import of Aristotle's Theory*

What did Aristotle have in mind with his theory of chance? Obviously, he meant to oppose the idea of absolute determinism in nature, that the same causes invariably produce the same effects. Hence his insistence on what most men would never think to question, namely, that some facts and events are not only rare but exceptional. Yet these facts have a kind of cause, and Aristotle's further aim is to show that they pertain to the order of final causality. The conclusion that follows from this is that a philosophy, a meaningful explanation, of chance is possible but only if it is based on a philosophy of order or regularity. Indeterminism in nature presupposes a certain determinism. Were there no normals, there would be no abnormals. This, in a word, is the basic import of Aristotle's theory of chance.

Still, it may be asked whether chance, as defined above, is the only source of contingency in nature. A careful reading of all the pertinent passages would show that Aristotle's thought is more involved than might appear from isolated paragraphs. Chance, we should find, often denotes exceptional facts of any kind, including such as might not have been produced in view of an end.[32]

32 Aristotle, speaking of chance, says that "some things are for the sake of something, others not"—*quaedam,* in St. Thomas' phrasing,

Another point of interest is how the purpose-associated working of chance ties with the necessary action of matter, or, in the more usual phrase, with material necessity. Of this necessity, though not explicitly of this problem, we shall speak in a moment.

III. TELEOLOGY AND NECESSITY

In the last two chapters of Book **II**[33] Aristotle again comes to grips with the mechanist theories of his predecessors. This time it is their philosophy of cause that is called to account. The mechanists, by and large, believed that every cause-and-effect sequence resolves itself into a chain of necessary, blind determinations. "Since the hot is by nature such, and the cold by nature such, and similarly other things, therefore this kind of thing and this kind of change necessarily follow from them." [34] This, in substance, is their argument, which, if true, amounts to the suppression of final cause. "Why," to sample their case further, "should not nature act, not in view of an end or because it is better, but just as Zeus causes the rain, not to make

fiunt propter finem, quaedam vero non. This, observes St. Thomas, raises a difficulty, because every agent acts for an end, whether the agent acts from nature or from intellect. Aristotle's meaning, according to St. Thomas, is that some things are a pleasure or credit in themselves, and to this extent their own end. Or, an alternate suggestion, Aristotle may have had in mind certain things that are not the result of a deliberate end, as when a man unconsciously strokes his beard. This man does not act without an end; but the end is in the imagination (i.e., inner sense in general), and not in the intellect; it is therefore not a deliberate end. See *In II Phys.,* lect. 8, nos. 420-421.—Translator's note.

[83] Chaps. 8-9.

[84] *Phys.* II, 8, 198 b 12-14.

the corn grow, but of necessity? For, what evaporates into air must cool, and when cooled must become water and fall again. That the corn in consequence grows, is accidental. So also when, on the other hand, the corn is spoiled on the threshing floor, it was not for this that the rain fell —it was just incidental [to the rain]." [36]

Aristotle's answer to this position begins with a thoroughgoing defense of finality in nature. That done, he goes on to explain how finality nevertheless accords with a degree of necessity in causal sequences. Eliminated, however, is the absolute determinism which the mechanists attribute to the cause-and-effect relation in nature.

1. *Finality in Nature*

Aristotle's demonstration of finality in nature finds him at his resourceful best. Three arguments stand out. The first is drawn from the fact of chance. Some things are due to chance, they happen but rarely. On the other hand, what happens as a rule, or regularly, cannot be the result of chance, hence must occur in view of an end. If, in other words, there is chance, there is finality. The coexistence in nature of the seldom and the constant, of the regular and the irregular, is unexplainable unless there is both finality and chance.

Another argument is seen in art and nature following similar courses: art imitates nature. A doctor in his treatment follows nature's lead. If, then, as is manifestly true, finality is in art, it must also be in nature.

Thirdly, Aristotle finds finality in the way that animals and even plants adapt themselves to their needs and func-

[36] *Ibid.,* 198 b 17-23.

tions. Neither of these act by intelligence. The swallow building its nest, the spider spinning its web, the plant pushing its roots down into the nourishing soil, all these act by nature yet with obvious finality, or purpose of action.

These, in sum, are Aristotle's arguments.[36] To develop them in detail, or to compare and contrast them with modem modes of scientific thought would take us too far afield. But pry and prick as we will, we should not find them gravely vulnerable. The core of these arguments, if not the trim, endures. As a matter of fact, the existence of final cause can be established even more directly, by the metaphysical approach. Tire starting point in that case is efficient cause, and the argument turns on the prerequisites of this cause. As mentioned earlier, the prime precondition of efficient cause is final cause, for no agent acts without an end. St. Thomas presents this thought as follows: "An agent docs not move except with intention of an end. For, if an agent were not set on some definite effect, it would not do one thing instead of another. Hence, in order that it produce a determinate effect it must be fixed on some definite thing, which has the nature of an end." [37]

In fine, every single instance of efficient causality, which[80]

80 As the author indicates, the arguments in the text, though essentially complete, are barely sketched. Anyone who has never done so would find it most rewarding to read side by side Aristotle's own masterful presentation of his case, and St. Thomas' equally masterful and incisive commentary.—[Tr.]

87 "Agens autem non movet nisi ex intentione finis. Si enim agens non esset determinatum ad aliquem effectum, non magis ageret hoc quam illud; ad hoc ergo quod determinatum effectum producat, necesse est quod determinetur ad aliquid certum, quod habet rationem finis" *(Summa theol.,* Ia Hae, q. 1, a. 2).

is to say every act of any kind, necessarily implies finality, or final cause.

It may be objected that nature cannot act for an end because it lacks intelligence, hence cannot deliberate and decide. To this the answer is that there are two ways of moving toward an end. One, as St. Thomas explains, is the way of rational creatures, who know their end and move themselves toward it. The other is the way of irrational creatures, who are borne toward their end by the transcendent motion of a higher intelligence. The former act *(agunt)* in view of an end; the latter are moved *(aguntur)* toward their end. For, observes St. Thomas, "the entire irrational world is related to God as an instrument is to a principal agent." [38]

To sum up, nature is unquestionably endowed with finality. But this is not to say that one can always identify the specific end of each thing and each activity in nature.[39]

2. *Necessity in Nature*

The case for finality is now made. But does this mean that all necessity is eliminated from nature? And if not, what manner of necessity does nature admit?

38 "Tota irrationalis natura comparatur ad Deum sicut instrumentum ad agens principale" *(ibid.)*.

39 This, perhaps, bears heeding on both sides. Both the protagonists and antagonists of finality sometimes, I will not say create, but occasion the impression that to profess finality is to pretend a discovery of the immediate end of every part and particle in nature. And, on a slightly different note, in the refinement of nature and her processes, the sciences may well claim homage from philosophy. Indeed, in this domain of the house of knowledge the scientist can often play host to the philosopher, and a philosopher welcomes the gesture.—Translator's note.

Necessity, as Aristotle explains it, is twofold: absolute and hypothetical. *Absolute necessity* is one that depends on pre-existent causes: "quae dependet ex causis prioribus," to use St. Tlromas' wording. St. Thomas, moreover, notes that this necessity is found in three kinds of causality.[40] It is found in material causality, as may be seen in an animal, which is necessarily corruptible because it is composed of contraries. Again, absolute necessity occurs in formal causality. Thus, what flows from or reduces to the definition of a thing is absolutely necessary; a man, for example, is necessarily rational (this pertains to his definition), and the interior angles of a triangle equal two right angles (this flows from the definition of a triangle). Lastly, this kind of necessity exists in the realm of efficient causality, since the action of the agent entails the effect. So, in St. Thomas' example, the alternation of day with night is necessary on account of the sun's movement.

Hypothetical necessity, on the other hand, is tied to a condition, to something not yet effected: "necessitatem ab eo quod est posterius in esse" is St. Thomas' phrasing. It is the necessity exemplified in the statement: "This thing is necessary if that thing is to be made or done."

Aristotle takes exception with those who acknowledge only absolute necessity in nature. Not only, he declares, is there the necessity of finality, which is hypothetical or conditional, but this necessity is preponderant. The predominant reason why a house, to take his example, comes into being is not because certain materials are put together; rather, the materials are assembled and put together be-

40 *In II Phys.,* lect. 15, no. 522.

cause a house was decided on. The end (final cause) came first. Similarly, we should more correctly say, not that a saw cuts because it has iron teeth, but it was given iron teeth so it would cut. In all cases of this kind the prime source of necessity lies in final cause, which may or may not be put. Hence the necessity is hypothetical, conditional.

Ultimately, therefore, all necessity in nature rests on final cause. But, as mentioned a moment ago, necessity does reach into the other causes, too. To produce a certain kind of thing it will be necessary to use a certain kind of materials; or, this kind of agent must be had to perform this kind of work. The attainment of the end does, in some manner and measure, depend on matter and the other preexistent causes. This simply means—and we shall come back to the point in the next heading—that nature is a complex reality, that the whole explanation of its course and events must be sought in all the causes. The end, however, is the principal cause and condition. All others are subordinate and secondary. Whatever they contribute to a thing, they contribute by virtue of final cause; and, inversely, whatever a thing owes to them, it owes still more to final cause. This, in effect, is the burden of the following excerpt from St Thomas' Commentary:

Therefore, it is clear that that is said to be necessary in natural things which is like matter or the material motion, and the reason for this necessity is from the end, because by reason of the end it is necessary that there be such matter. Also, the philosopher of nature should give both causes, namely the material and the final, but more the final, because the end is the cause of the matter but the opposite is not true. It is not true

that the end is such because the matter is such, rather the matter is such because the end is such.[41]

For Aristotle, then, there is a kind of determinism in nature, but its inmost reason lies in finality, and hence in intelligence. It is a determinism that leaves room for accidental causality, and so for things of chance. All told, Aristotle's theory of finality and necessity makes for an explanatory apparatus that is remarkably flexible, encompassing nature in its several aspects.

IV. CONCLUSION: METHOD IN THE STUDY OF NATURE

Aristotle's study of causes in Book II of the *Physics* is mostly accomplished with chapter 7. Chapters 8 and 9, which we have examined, do not speak of further kinds of causes, the one being a defense of final cause, which had already been put forward, the other a delineation of necessity in nature.

Chapter 7, on which we have not yet remarked, inquires about the principles of demonstration in the philosophy of nature, the causes (whether all or some) the natural philosopher should seek and analyze. "Since the causes are four, the business of the natural philosopher," says Aristotle, "is to know about them all; and in answer to the

41 "Sic igitur manifestum est, quod in rebus naturalibus dicitur esse necessarium quod se habet per modum materiae vel materialis motus; et ratio huius necessitatis est ex fine; propter finem enim necessarium est esse materiam talem. Et Naturalis quidem assignare debet utramque causam, scilicet materialem et finalem; sed magis finalem, quia finis est causa materiae, sed non e contra. Non enim finis est talis quia materia est talis; sed potius materia est talis quia finis est talis" *(In* II *Phys.,* lect. 15, no. 533).

'why' in the science of nature, he will reply with all four: the matter, the form, the mover, the end."[42] Thus, in physics (in Aristotle's meaning) there are four kinds of explanation, according to the four kinds of causes.

Aristotle, however, does not leave it at that. Having made his point, he seems to temper it in the next sentence. Form, mover, and end, he goes on to say, often coincide, "for the essence or 'what' and the end are one, and the proximate source of motion is identical in species with them (for man engenders man), and so, in general, are all moved movers."[43] This is a striking passage; it seems to indicate that Aristotle was disposed to narrow the methods of explanation to two. Form and end, when realized, are one, and the form by which the agent acts in the process of generation is like the form the agent seeks to introduce in matter. Thus, if form and end are one, and the agent is sometimes of the same species as the form introduced in matter, all three may be considered as one, or under one aspect—two things equal to a third equal each other.[44] This analysis would leave us with two, and not four, truly

42 *Phys.* II, 7, 198 a 23-25.

43 *Ibid.,* 198 a 26–27.

44 St. Thomas explains when and in what sense form, end, and agent are identical. Form is identical with final cause if we mean the final cause of generation, not of the thing generated. Thus, the end of human generation is the human form, but the end of man is not his form. Similarly, the moving cause (agent) is identical in species with form and end when it is a univocal agent, one that makes something like itself in species, as man generates man. In this case the form of the agent, which is the principle of generation, is specifically the same as the form of the thing generated, and this in turn is the end (final cause) of the act of generating. But the agent is not specifically identical with the produced form when it is a non-

distinctive types of explanation in physical philosophy, one taking its evidence from the material elements of a thing (material cause), the other from its formal structure (form and its properties), which, in the ultimate reckoning, receives its determination from final cause.[45] The early Physicists had centered their attention on material cause; the object of their search had been the primordial substance or its basic elements. Aristotle is more with Plato, seeking in form and end the greater revelation. Foremost, however, is the end, whether in explanation or being, in thought or reality.

Yet it should not be assumed that the reduction of method to two types of explanation is absolute. Aristotle does not retract the assertion that the philosopher of nature should produce proofs from all the causes, and that each type of demonstration has its own character. The proof from efficient cause is frequently used, and this cannot be reduced to material cause, to the allocation or disposition of the elements. Nor, though for different reasons, can it be assimilated to the exemplary causality of form. But the efficient cause depends ultimately on the prime mover, which, be it noted, moves secondary movers by the "desire"

univocal, or equivocal, agent. So, concludes St. Thomas, "not every agent is the same in species as the form that is the end of generation; nor, on the other hand, is every end the form" *(In II Phys.,* lect. 11, no. 474; see also nos. 472-473).—Translator's note.

[48] It is in this context that Hamelin *(Système d'Aristote,* p. 274) says that all causes reduce to form and matter, since mover and end are one with form, and matter has the role of whatever is necessary in view of prior conditions, "le rôle . . . de tout ce qui est *vis a tergo."* But see the preceding note for St. Thomas' pertinent distinctions.

it evokes, hence by final causality. Thus, final cause always stands first, and the light it sheds surpasses every other.

This, then, is Aristotle's general theory of demonstration or explanation in natural philosophy. One last question suggests itself. What would a modern scientist make of it, or how do Aristotle's theory and method compare with modern conceptions? Final causes, no one doubts, have lost much of their former standing in the study of nature. A possible exception is biology, where, often by different name, they still seem to be recognized. But recognized or not, they are and remain the foremost causes of things. If, as intimated, they have fallen from scientific grace, the reason may well be that they are more difficult to discover than other causes, perhaps much more difficult than the ancients realized.

In addition one can maintain the validity, or even the superiority, of demonstration by final cause without assigning it priority in practice. Often one's purpose is met, or one's progress halted, before coming to final cause. Thus, it may at times be necessary to settle for more immediate demonstrations, whether by efficient cause (seeking the antecedents to a given effect), by material cause (theorizing the structure of the elements), or by formal cause (as in mathematical analysis). This granted, there are no basic incompatibilities between Aristotle and modern scientists. His ideas on what to look for in nature and what kinds of proof to produce will readily harmonize with their practice and procedures.

We end this chapter with a diagram. It depicts the chain of causality in nature as envisaged by Aristotle. Heading the chain is final causality, which results in the hypothetical

determinism of the other causes. Each of these produces a specific effect by its specific causality. Completing the chain is the chance effect of accidental causality. Thus, the diagram portrays the sum and substance of Aristotle's doctrine of causality:

Final causality (hypothetical)	determinism of antecedent causes	proper effect by proper causality chance effect by accidental causality [48]

[48] Cf. Text II B, g) "Reduction of causes," p. 179.

More detailed analysis of Aristotelian methodology in natural philosophy may be found in a recently published work of some note, namely Melvin A. Glutz's, C.P., *The Manner of Demonstrating in Natural Philosophy* (River Forest, Illinois: Dominican House of Studies, 1956); reviewed by, among others, William L. Baumgartner, Ph.D., *The New Scholasticism* XXXI, 4 (October, 1957), 559-561. Also consulted, especially for its successful attempt at relating the Aristotelian method of proof by all four causes to the special sciences of nature, should be William A. Wallace, O.P., "Some Demonstrations in the Science of Nature," *The Thomist Reader* (1957), 90-118.—Translator's note.

+ CHAPTER 6

Motion

+ PHYSICS, in the Aristotelian meaning, is the study of nature. Since nature, however, involves motion, a clear understanding of one without the other is not possible. But necessarily linked with motion are still other topics, which have therefore to be included in its study. They are:

—the *in-finite,* which is an intrinsic attribute of motion because motion is a continuum, and the infinite enters the definition of the continuum,

—*time,* the measure of motion,

—*place,* which, with Aristotle, is the measure or limit of the movable. With others, this measure is the *void.*

These, then, are the main topics Aristotle treats in Books III and IV of the *Physics:* motion, the infinite, place, the void, and time, in the order mentioned. We shall take them up in the same order, motion in this chapter, its concomitants in the next.[1]

1 Cf. Text III A, "General Divisions for the Study of Motion," p. 186.

i. Definition of Motion

a) In Book III Aristotle makes no reference to the Eleatic theory (i.e., the denial) of motion. Having once for all affirmed its existence in Book I, his only concern now is to explain its nature. Also, he makes short shrift of the opinion that motion is a separate reality, after the Platonic fashion. Motion, he insists, is something of the physical world; it is in things themselves, and has to be explained in the light of its sensible manifestations.

Nevertheless, for his definition of motion, which he advances with a minimum of preliminaries, Aristotle calls upon a cardinal distinction of the metaphysical (rather than the physical) order, the distinction of act and potency. He could hardly do otherwise, seeing that motion is a fundamental concept, above classification in any single predicament, for it is found in several. Hence, if it is to be defined at all, recourse must be had to transcendental notions. And this is what Aristotle does.

b) Granted the distinction of act and potency, what is in potency is not yet in motion: a thing that is not yet being warmed, is not in motion toward warmth. On the other hand, what has reached its term, what is in completed act, is not in motion either: a thing that is warm is no longer in motion toward warmth. Consequently, to be in motion is to be in an intermediate state, between the initial potency and the terminal act, hence partly in potency and partly in act. In a word, the warmth of a thing that is being warmed is in imperfect act, and this imperfect act is motion, but on condition that the thing remained headed toward further warming. Motion impounds, as it were, both ideas,

both act and potency at once. In Aristotle's celebrated definition it is "the entelechy (act) of what exists in potency, so far as it is in potency." [2] Or, in the Latin of the Schoolmen, it is:

actus existentis in potentia in quantum est in potentia.

This definition, which has often been abused but never improved, could be discussed at great length. For the present, note three points.

Actus (act) indicates that motion itself is a kind of fulfillment or realization; in the warming of a thing there is already a degree of actualization present.

Existentis in potentia (of what exists in potency) affirms that the act in question is not at a standstill, as though fully realized, but that the subject of the act remains in potency to still more actualization.

In quantum est in potentia (so far as it is in potency) means that the act identified with motion determines or actuates its subject, not in every respect, but in the respect by which it is in potency. So, for example, in the carving of a statue the process of carving is not the actualization of bronze as bronze, but of bronze so far as it is in potency to becoming a statue.

These points we find recapitulated, with characteristic skill, in St. Thomas, who writes:

Thus, imperfect act has the nature [ratio] of motion either way, that is, whether we take it as potency in respect to further act, or as act in respect to something yet more imperfect. Hence, it is neither the potency of what exists in potency nor the act of what exists in act, but the act of what exists in potency. So,

2 *Phys.* III, 1, 201 a 10.

saying it is "act" we designate its order to the anterior potency, and saying "of what exists in potency" we designate its order to the ulterior act.[3][4]

c) Motion, then, however we approach it, is imperfect act, a potentiality not yet perfectly actualized. It is, as remarked, a kind of intermediate state between complete potency and complete act. Aristotle takes special note of motion's intermediateness and incompleteness. "Motion," he says, "is indeed a kind of act, but incomplete, and the reason is that the thing in potency whose act it is, is incomplete." *

To be sure, Aristotle was not the first to mark the indeterminate character of motion, or to wrestle with it. Others had ruminated on it but never achieved a philosophically technical explanation. St. Thomas, on the other hand, though not the author of the definition of motion, shows in his analysis a penetration to rival his master's. If motion is *actus imperfectus,* it differs from things that are fully realized, fully in act, and St. Thomas has talented paragraphs on the manner of this difference.[5] If to the definition there nevertheless clings a veil of obscurity and of impenetrability, this is not because the definition is faulty

3 "Sic igitur actus imperfectus habet rationem motus *et* secundum quod comparatur ad ulteriorem actum ut potentia, *et* secundum quod comparatur ad aliquid imperfectius ut actus. Unde neque est potentia existentis in potentia, neque est actus existentis in actu, *sed est actus existentis in potentia;* ut per id quod dicitur *actus* designetur ordo eius ad anteriorem potentiam, et per id quod dicitur *in potentia existentis* designetur ordo eius ad ulteriorem actum" *(In III Phys.,* lect. 2, no. 561).

4 *Phys.* III, 2, 201 b 30-32.

5 Cf. In XI *Metaph.,* lect. 9.

but simply because motion itself is, as Aristotle intimates, a shadowy thing, hovering as it were between light and darkness, between act and potency.[8]

2. *Motion, Mover, Movable*[9]

Aristotle's definition of motion is general; it makes no mention of a particular kind, or of the conditions attending every motion. But experience shows that the change from potency to act which characterizes motion cannot be made without the activity of an agent or *mover* exerting itself on a *movable,* on something that is formally distinct from the mover. This brings up the relation of motion to mover and movable. Respectively linked to mover and movable are, moreover, *action* and *passion,* two predicaments of being which also, it is thought, express the fact of change, including the change that is motion. Hence, there is the further question whether these predicaments are distinct from motion.

Our answers, developed in the order given, will' be:

—that motion is the act of the movable;

—that mover and moved have one and the same act;

—that action and passion differ from motion, but only, as we shall see, by their respective relation to mover and movable.

a) *Motion is the act of the movable.*—We assume, what would seem an obvious fact, that motion involves a receiving subject, a "movable," and an application to the subject from an outside agent, from a "mover." What may not be self-evident is whether motion, which is joined both

8 Cf. Text III B, "Definition of Motion," p. 188.

9 Cf. *Phys.* III, 3.

to mover and movable, is the act of the mover or the movable.

According to Aristotle, when there is motion, what is moved is the passive or receiving subject, and not, properly speaking, the agent. This is also the impression we get from experience, and it is confirmed by the nature of motion itself. Motion, after all, is the act of what is in potency. But which of the two is in potency, the subject or the agent? Obviously the subject. It cannot be the agent, because in the exercise of its agency an agent is in act. If in its activity the agent, too, happens to be modified or moved, this is only by reaction of the receiving subject, whose reaction is accidental to the motion imparted by the agent.

Motion, consequently, is in the movable, that is, in the moved. Yet, as mentioned a moment ago, it is also connected with the agent, but as proceeding from it, as *ab hoc,* and not as founded in it or *in hoc.* Motion, in short, is the act of the movable. Or, in Scholastic idiom: *motus est actus mobilis.*

b) *Mover and moved have one and the same act.*— If motion is the act of the movable, what becomes of the agent or mover? Is there not act in the mover as well? These questions, it should be apparent, bear on the unity of motion. If the act of the movable and of the mover are two different acts, then every motion is in fact two motions. But this is inadmissible, since the course of motion has a manifest unity. What the agent produces when it moves the movable, and what the movable receives when moved, these are one and the same thing; hence there is only one motion, which, however, is the simultaneous act of mover

and movable alike. Motion, accordingly, is the act of the mover so far as it proceeds from the mover into the movable; but it is the act of the movable so far as it is in the movable from the mover.[8] Aristotle finds an illustration of this in teaching and learning. The teaching which the teacher imparts, and the pupil receives, are one and the same teaching.[9]

c) *Motion: action or passion, or both?*—To say that motion has unity safeguards the true meaning of motion; but, as already intimated, it also raises a serious difficulty in connection with the predicaments *action* and *passion.* According to predicamental teaching, the act of the agent is action, and the act of the patient *passion.* If we say that action, the act of the agent, and passion, the act of the patient, constitute two distinct motions, we counter our previous assertion of the unity of motion. On the other hand, if action and passion are the same motion, can we still maintain that they are two distinct predicaments of being?

In reply, action and passion are indeed the same motion, but from different points of view. Action is motion as proceeding from the agent, whereas passion is motion as resident in the passive or receiving subject. On which St. Thomas has this, as usual perceptive, gloss. "It is clear," he writes, after some careful deciphering, "that the motion of mover and moved is the same motion because motion as motion abstracts from both formalities [i.e., the formal-

8 "Motus secundum quod procedit a movente in mobile est actus moventis, secundum autem quod est in mobili a movente est actus mobilis" (In *III Phys.,* lect. 4, no. 599).

9 Cf. *Phys.* III, 3, 202 biff.

ities *ab hoc* and *in* hoc];[10] but action and passion nevertheless differ because in their respective signification they include these opposite formalities." [11]

The term "motion," therefore, as St. Thomas indicates, is more abstract and universal than the term "action" or "passion." Motion, taken absolutely, is not in a particular predicament; reductively, or in the last analysis, it is placed in whatever predicamental genus terminates it, either in quantity, quality, or place. But though motion may be considered in the abstract, it is not an abstraction but a concrete reality, and one of the conditions of its production is the causal activity of an agent. From the perspective of this activity motion presents itself with agent and patient, and we may, in consequence, refer it to the separate predicaments of action and passion.

3. *The Kinds of Motion*

In Book III Aristotle does not attempt a classification of motion by its kinds. This is done at the beginning of Book V.[12] As for the special distinction between generation and the movements of alteration and growth, this discussion is remitted to its more proper place, viz., Book I of *De Generatione et Corruptione.*

When, in Book V, Aristotle does unfold his division of motion into its kinds, he goes into considerable detail.

10 Cf. present chapter, heading a) : *Motion is the act of the movable.*

11 "Et sic patet quod, licet motus sit idem moventis et moti propter hoc quod abstrahit ab utraque ratione, tamen actio et passio differunt propter hoc quod has diversas rationes in sua significatione includunt" (In *III Phys.,* lect. 5, no. 614).

12 Chaps. **1-2.**

For our purpose, however, it will be enough to chart the essentials.

Aristotle, after some preliminaries, declares that everything which changes must do so in one of four ways, namely:

—from nonsubject to subject,

—from subject to nonsubject,

—from subject to subject, or, finally,

—from nonsubject to nonsubject.

"Subject," in this instance, as St. Thomas points out, does not mean that which underlies or supports form, but, as Aristotle himself notes, whatever is expressed affirmatively.

The last mentioned possibility, from nonsubject to nonsubject, is dismissed without further ado; it cannot be a species of change, as it lacks an opposition of terms, and every true change falls within contraries or contradictories. The transition from nonsubject to subject is primarily substantial generation; and the change from subject to nonsubject is primarily substantial corruption. Neither of these, as we shall further remark in a moment, is properly speaking motion. This leaves the passage from subject to subject, which is motion proper. But where, in the list of predicaments, is such change found? Wherever, says Aristotle, contraries (not to be confused with contradictories) occur: hence in quantity, quality, and place.

Aristotle comes to this conclusion, not by actually proving that motion exists in each of these three categories—this he deems evident—but rather by arguments which eliminate motion from the others. The arguments, in essential, are as follows:

a) First, motion properly speaking is not in the category

substance. The reason is that motion involves contrariety, and no mode of being is in strict definition the contrary of substance.[13] Besides, motion requires an actual subject that is common to its two terms, and this actual subject is wanting between the terms of a substantial generation or a substantial corruption.

b) Secondly, motion is not in the category *relation.* A relation is between two terms. A change in one can cause a change to the other, though the other may not have changed in itself. Tirus, a thing may be equal in size to another, but if the first becomes smaller or larger, the second is no longer its equal, though there has been no change in the second. A new relation is established without a change in one of the terms. But, and this is the point, such an occurrence is not possible in a predicament of being where motion or movement exists; a change in the same predicament necessarily means a change in the subject. So, for example, a new color cannot supplant an old one without the colored object being altered. Hence, motion or movement is not in the category of relation.

Moreover, the absence of motion in relation entails its absence in *position* [situs] and *possession [habitus],* both of which imply relation.

c) Thirdly, motion is not in the categories *action* and *passion.* Motion in these would be equivalent to motion of motion, the possibility of which Aristotle takes the better part of a chapter to disprove.[14]

13 St. Thomas goes to some length to show that Aristotle is right in denying motion of substance on the ground of noncontrariety in substance. See *In* V *Phys.,* lect. 3, nos. 1276-1284.

14 Cf. *Phys.* V, 2.

By the same reasoning, motion is not in the category *when [quando].* "When" fixes the time, but time, being the measure of motion, is founded in it, so that motion in time would again be motion of motion.

Consequently, the others having been eliminated, only three categories or predicaments remain in which motion, in the proper sense, occurs: quantity, quality, and place. To be borne in mind here is the distinction between motion or movement proper [motus] and change *[mutatio],* a more comprehensive notion. Thus, a substantial generation or corruption is change, but not, precisely, motion. This, in the light of the foregoing paragraphs, should now be clear. And if motion is only in three categories, there are strictly speaking only three species or distinct kinds of motion, namely:

—motion according to quantity, which means motion by *increase* and *decrease.* This, in Aristotelian conception, pertains only to living things, specifically to their increase or decrease in size;

—motion according to quality, the proper name for which is *alteration;* and

—motion according to place [ubi], which is *local motion.*

These motions, though distinct kinds, interpenetrate. They are an interacting network whose functioning commands the course of all nature. Tire control center is *local motion,* the most perfect of all, and the only kind that affects all bodies, not excepting celestial bodies. By inducing the arrangement of bodies within and varying their contacts without, this motion governs the whole complex of all other motions and changes. Placed in contact, bodies alter, which is the motion of *alteration;* are engendered

and destroyed, which is *generation* and *corruption;* and, if living bodies, gain or lose their natural quantity, which is motion by *increase* and *decrease.*

Having declared the kinds of motion, Aristotle continues, in the remainder of Book V and in Book VI, to explore the subject of motion from a great number of other aspects. Treated are, for example, the unity of motion, the contrariety of motion, its continuity, its first moment, its term, its rest. We shall not enter into these matters. Instead, we shall conclude this chapter with an account of the essential ideas in his theory of local motion. This, as we have said, commands the cosmic procession, and a few remarks on it now will stand us in good stead in the chapters to follow.[15]

4. *Local Motion*

a) *Its nature.*—Local motion is a fact of experience. Yet in the history of philosophy there have not been wanting those to question this experience. Despite the evidence of sense Achilles can never overtake the tortoise. This was Zeno's cry; but it harbored a fallacy, which lay in thinking that motion is composed of actually divided parts, though indivisible in themselves, when in fact motion is only potentially divisible. With this distinction no valid argument against local motion can be raised; logic and experience bear each other out.[18]

Experience also gives us the basis for the definition of local motion. When we see a thing passing from one

[18] Cf. Text III C, "The Kinds of Motion," p. 191.

[16] Aristotle's refutation of Zeno is given in *Phys.* VI, 9. See also St. Thomas' Commentary, *in ibid.,* lect. 11.

place to another, we say it has changed its place or *locus* (hence *local* motion). Local motion is therefore a change of place, or the transit from one place to another. More metaphysically, and in Scholastic phrase, it is the "act of the transitive as transitive,"

actus transeuntis ut transeuntis.

b) *The cause of local motion.*—Assuming for the present that whatever is moved is moved by another, then whatever moves locally is moved by another; the cause of its motion is extrinsic. Aristotle speaks of this motive causality being exercised in two ways, in the natural motion of bodies, and in the oblique motion of projectiles, things hurled or thrown.

Some bodies, being heavy, move naturally down; others, naturally light, move up. To explain this natural motion Aristotle invokes what he calls *natural place (locus naturalis),* to which its own nature inclines a thing. Accordingly, the motion of heavy bodies toward the center of the earth and the upward motion of light bodies away from the center are explained by these bodies seeking their natural place.

Natural place alone, however, cannot account for the oblique motion of projectiles. When a thing is uninterruptedly borne or pushed by a discernible agent, the cause of its translation is obvious. The ragpicker pushes his cart; he is a perceptible mover in unbroken contact with his cart. But far different is the motion of a thing which, after launched, seems to follow its path by itself, as for example a stone hurled in the air. Such motion was a real puzzle to the ancients, to whom the concept of energy and the law

of inertia were unknown. Aristotle firmly believed that even here there was a mover in constant contact with the object, namely the surrounding air, which, stirred by the impinging object, became in turn the mover of the object.

The motion of projectiles was to become a central point in the development of modern physical theories. Already in the sixth century the Aristotelian commentator John Philoponus abandoned the theory that a projectile's motion was by constant push from the surrounding air. What he proposed instead was an impetus or thrust from within the projectile itself. This suggestion was later borrowed and turned to account by a leading professor at the University of Paris, John Buridan (fourteenth century). The conclusions he drew from it were nothing short of revolutionary, scientifically speaking. If, as John Buridan declared, the movement of celestial bodies comes from an internal thrust, the circular motion of celestial spheres can be explained without recourse to intelligent movers. Thus, by one stroke celestial mechanics is assimilated to the mechanics of sublunary bodies and the unification, or at least the integration, of all physical sciences is on the point of being realized.[17]

What John Philoponus had scarcely more than surmised was in modern times to find scientific expression. Descartes with his quantification of motion and Leibnitz with his concept of energy made great strides in this direction. When, not long after, Newton propounded the law of universal gravitation, the scientific obsolescence of

17 For the historical study of the motion of projectiles see Pierre Duhcm, *Études sur Leonardi de Vinci,* 3 vols. (Paris: Hermann, 1906-1913).

Aristotle's explanation of local motion was complete.[18] But the vicissitudes of scientific thought are inexorable. With the advent of Einstein and the atomic age, Newtonian physics itself was marked for eclipse.

18 The "obsolescence" to which the author refers, and which certainly took place, may however have been more complete in fancy than in fact. Is Aristotle's *locus naturalis* really hopelessly outdated? Is there no discernible common denominator between "gravitation" and "tendency toward natural place"? Or, from another aspect, if the moon were "heavier" or "lighter," would it maintain its present course? See the perceptive remarks of Andrew G. Van Melsen, *The Philosophy of Nature,* and ed. (Pittsburgh: Duquesne University, 1954), pp. 172–174; also, James A. Weisheipl, O.P., "Space and Gravitation," *The New Scholasticism,* XXIX (April, 1955), 175-223; and, *idem,* "Aristotle on Natural Place," *ibid.,* XXX (April, 1956), 206-215, the bttcr an exchange between Father Weisheipl and Robert R. Barr, S.J.—Translator's note.

+ CHAPTER 7

The Concomitants of Motion

I. THE INFINITE[1]

+ MOTION, like magnitude and time, is a continuum and therefore implies the notion of the infinite. This notion was prominent in the speculations of the early Greek philosophers, both among the Physicists and the Pythagoreans and Platonists. Aristotle, in consequence, could not ignore it. In the *Physics* he devotes five chapters to it. Since these chapters are rather involved, we shall limit ourselves to sketching the contents.

i. Reasons in Support of the Infinite *

—The infinite seems to be essential to time.

—The division of magnitude is apparently endless, i.e., it can be pursued ad infinitum.

[1] Cf. *Phys.* Ill, 4-8.

[2] *Ibid.,* chap. 4.

—Generation and corruption are ceaseless, or so it seems; hence their source must be infinite.

—The very notion of limit presupposes the infinite. (Every limited body finds its limit in another, which is either limited or unlimited. If it is not unlimited, then it is terminated by another, etc.)

—Lastly, number appears to be infinite, even as magnitudes generally and the spaces that surround the world.

2. *The Infinite Does Not Exist in Act*[8]

First of all, if the infinite exists, where is it likely found? Or, what kind of thing is it? Aristotle begins with some remarks to the effect that the infinite, as the physicist speaks of it, cannot be separate from sensible things, in the manner of Plato's ideas or the Pythagorean numbers. Hence, if there is an infinite we must look for it in the world of bodily things.

Tire question, then, comes to this: Are there infinite bodies? Aristotle produces an array of arguments, both of the logical and the physical order, to show the impossibility of such bodies. One of these, the only one we shall rehearse, revolves on his theory of place. Every body has a place, but place is necessarily determined and finite. Up and down, for example, are determined and demarcated positions, and so are other regions of space. Since place is limited, the bodies it encompasses must also be limited.

Nor can there be an actually infinite number of bodies, since number is by definition numerable or measurable, whereas the infinite cannot be actually numbered.

[8] *Ibid.,* chap. 5.

3. The Infinite Does in Some Way Exist *

Granted that the infinite does not exist in act, does it exist at all? The answer is that it does, since three of the arguments mentioned above in support of it are well founded. The first one relates to time, which, on Aristotle's supposition of eternal motion, must have neither beginning nor end.[4] Secondly, number is infinite, that is, may be increased without end. Thirdly, and most important of all, magnitudes are divisible ad infinitum. Still, the actual, or actually realized, infinite is impossible. Yet, as we have just seen, the infinite does in some way exist. But since its existence cannot be actual, it will be potential only. In a word, there is an infinite, not actually but potentially.

But what does this mean? The potentiality of the infinite, like that of motion, is of a special kind. Ordinarily, a thing in potency can be actually realized. Socrates in potency in a block of marble can become a Socrates in act in the same marble. But the infinite can never make the transition to act. To say, therefore, that something is potentially infinite can only mean that a given process can be carried on in it ad infinitum or endlessly. Thus, magnitudes can always be further divided (infinity of division); numbers can always be added to (infinity of composition);

4 *Ibid.,* chaps. 6-7.

5 This argument, of course, which supposes the eternity of the world, is not accepted by the Christian philosopher, but is in line with Aristotle's view of the world. Hence St. Thomas' annotation that to posit a beginning and end for time is indeed inconsistent with the world being eternal: "quod reputatur inconveniens secundum ponentes aeternitatem mundi" *(In III Phys.,* lect. 10, no. 721). —Translator's note.

and time can always be increased or divided (infinity of composition and division). Consequently, the infinite, far from being a perfection, denotes incompleteness or imperfection, and one would be in grave error to conceive it here as something perfect or absolute.

There is, however, another kind of infinite, an infinite that is actual, and utter perfection. This is the infinity of Pure Act. If the one is extensive and quantitative, the other, in a manner of speaking, is intensive and qualitative. But the infinity of Pure Act is not our present business, and we mentioned it only to caution the unwary.

4. *The Infinitely Divisible, or the Continuum*

If something is infinitely divisible, it is also continuous or a continuum. Hence, we shall next speak of the continuum, even though Aristotle does not expressly treat of it in connection with his discussion of infinity, but defers it to Books V and VI.[6]

Tire continuum is opposed to the discontinuous, or the consecutive, as well as to mere contact. Contact approaches continuity but is still not it. These three terms—consecutive, contact, continuous—show, therefore, a certain progression, from the utter absence of continuity to its complete presence. They are defined as follows:

—things are *consecutive* if between them there is no intermediary of the same genus: for example, two adjacent numbers in a series of whole numbers;

—things, say two objects, are in *contact* when their extremities touch but remain individual extremities;

—things or parts are *continuous* when their extremities

[6] *Phys.* V, 3; VI, 1-2.

are one and the same, so as to be contained in each other: for example, the parts of a line prior to division of the line.

With these definitions in mind it is readily seen why the continuum cannot be composed of actual parts. If these parts are distinct, they have their real and distinct limits or extremities, in which case they may be in contact but are not continuous. If these parts are conceived as truly continuous, they are no longer absolutely distinct, hence no longer actual parts. Besides, in any continuum one can always multiply parts indefinitely; thus the continuum is endlessly or infinitely divisible. To put it squarely, the continuum is not composed of actual parts, but it is potentially divisible ad infinitum. So, the line is not composed of points, time is not composed of instants, and motion is not composed of rests. But—and this is the import of the potentially divisible—at all points of a line, or time, or motion, or any continuum, we may arbitrarily mark divisions and thereby assign parts.

This, then, is Aristotle's conception of the continuum, and it served him well in refuting Zeno's sophistical arguments against motion. These arguments had assumed that the continuum is actually composed of parts or, what is the same, composed of actual parts. Aristotle's idea of the continuum was, clearly now, quite different, and the difference provided him the tool to unmask and undo Zeno's reasoning.

II. PLACE, THE VOID, SPACE †

Aristotle's theory of place and his concept of the void are aspects of the same problem, namely, the spatial and

† Cf. *Phys.* IV, 1-9.

physical conditions of motion; they should be studied together. Modern scientists, for their part, have mostly abandoned the Aristotelian theories in hand, preferring, because of their mathematical leaning, to consider motion under the conditions of space rather than place. Nevertheless, the basic ideas and problems are much the same either way, and we shall therefore not only present Aristotle's notion of place and the void but also take a brief comparative look at the modern notion of space.

*i. The Problem of Place**

Everybody has some idea of "place" or what it means "to be in a place." Everything all around is localized, is "somewhere." The fact is particularly noticed when we see the *displacement* of something. Where there was water in a pitcher, there is now milk or wine or just plain air. The contents changed, the place remained. The existence of place is further underscored by *local motion,* which, both by definition and experience, is precisely a going from one place to another. And if we advert to the behavior of the elements, water, air, etc., we discover something else about place. These elements clearly display a *natural movement* in a certain direction, up or down or between. Place, every place, has therefore a power of attraction that is proper to it, and not all places wield the same specific attraction.

Such, in the main, are the observations by which Aristotle introduces his discussion on place, and having made them, he plunges at once into the not inconsiderable difficulties as to its nature. What, he asks, is place? It cannot

8 *Phys.* IV, 1-3.

be a body, for then there should be two bodies in the same place. Nor can it be part of the body it contains, since this body may be removed and the place left behind. And what happens when a body increases? or grows? Does its place grow, too? This, as we shall see, seems inadmissible, at least in Aristotle's view of the matter. In short, place presents a number of difficult questions. A most familiar thing, it has much to baffle search and scrutiny.

Aristotle discusses these difficulties along with related questions in the first three chapters of Book IV. Finally, in the beginning of chapter 4, he brings his preliminary inquiry to a close with an enumeration of the things that appear to be essential characteristics of place. These, in outline, are three. 1) Place is the first limit or surrounding of the body it localizes; this is a fact of ordinary experience. 2) Place is independent of the thing it contains, hence separable from the thing. 3) Place is physically determined; there is an "up" and a "down" to place, and these positions have their distinctive power of attraction. These are the assumptions from which Aristotle proceeds to evolve the definition of place.

2. *Definition of Place* [9]

In his effort to settle on a definition Aristotle considers four possibilities, of which the first three are found in error and so discarded.

Place, according to one suggestion, would be the *form,* not the substantial form but the exterior configuration of a body, its shape or "figure" (fourth species of quality). But this is impossible because a body and its shape

9 *Phys.* IV, 4.

are one piece and the shape disappears with the body.

Secondly, place might seem to be the *matter* of the contained body. The same reason as before militates against this because matter is neither separable from a body nor contains it; place, however, is separable from a body and contains it. Note again, however, that Aristotle is not speaking of prime matter, but of matter in the Platonic sense, that is, space considered as an undefined reality, a kind of receptacle for bodies which successively occupy it.

Thirdly, place is thought to be the *interval* between the extremities of container and contained, because the contained may change while the container remains the same. Thus place would be an entity independent of bodies, an empty space. Aristotle rejects this view because the interval docs not exist by itself but as an accident of bodies which successively fill the container.

Rejecting, as we have said, all three of the aforesaid opinions, Aristotle concludes that place is the *limit* (boundary) *of the containing body,* or in the Latin idiom, the "terminus corporis continentis." This boundary does indeed give the appearance of being a surrounding surface existing independently of a body. And well it might, for it is not a mere abstraction; it is something real, with properties that are real.

Place is immovable.—One important doubt concerning place remains to be satisfied. If place is the enveloping container of a body, does place change abode with a body, as when a vessel is carried away with its contents? Or,—and this comes to the same thing—suppose that the contents remain unmoved but the surrounding bodies are displaced. A notable instance of the latter is a stationary body sur-

rounded by flowing water, say a boat moored in a river. The river flows ceaselessly by. Shall we say that the place of the boat is constantly changing?

Aristotle will not have it so. Place, he insists, is immovable, as experience itself seems to indicate. As for the boat anchored in the river, its true place is the whole river, since as a whole the river is immovable or fixed. This is a significant assertion. Place, it turns out, is determined not so much by the immediate surrounding of a body as by its ultimate environment. Taking this position, Aristotle is undoubtedly tempering his previous remarks on the meaning of place. The immediate layer or container, it now becomes clear, is only a derivative or relative principle of localization. The radical principle of place, the one that positions and immobilizes the limits of the immediate container, this is the outermost layer or shell of the universe, which was thought to be immovable. And this outermost, motionless layer of the universe is the indispensable key to the traditional definition, namely, that place is "the immovable limit of the immediate container," or as the Latin has it,

terminus immobilis continentis primum.[10][11]

Obviously, the ultimate, motionless layer of the heavens is not the immediate container of all bodies, but in the view of the ancients it is, to repeat, the layer or shell in relation to which the limits of the immediate container are fixed and immovable, hence always the same.[11]

10 Cf. Text IV, "Definition of Place," p. 193.

11 Considering the abstruseness of the formulation, which merely reflects the abstruseness of place itself, it is perhaps understandable

3. *Function of Place in Aristotelian Cosmology*

What, more precisely, is this ultimate layer or primary container? The answer is provided in the cosmology, or rather the astronomy of the ancients, since this is clearly the background of Aristotle's theory of place. In the ancient theory the ultimate or, from another point of view, the first container is the sphere of the fixed stars, the last of the celestial spheres. From this the extreme positions of place, that is, up and down, were determined. Whatever was toward the circumference of this sphere was "up," and what was toward the center (the earth) was "down," while the intermediate places were reckoned from these extremes. Thus, each thing's natural place was defined in relation to the outermost sphere, and changes in things were explained, in part at least, as a seeking or finding of their natural place.

It should be apparent, therefore, that place has a central role in Aristotle's theory of the physical universe. The basic movement of the four elements is, as just indicated, a response to the attraction of their natural place. What is light tends naturally toward the higher places; what is heavy, toward the lower. Hence the importance of the theory of place. Remember that local motion is the cardinal motion, the one that commands all other changes and transformations in the sublunary world. But local motion itself is controlled by place, or the attraction of place,

that authors do not always see eye to eye on the meaning or the soundness of Aristotle's definition, particularly on his claim of immobility for place. Some remarks in point may be found in A. G. Van Mclsen's aforementioned work, *The Philosophy of Nature,* pp. 164-165.—Translator's note.

Consequently, place as envisaged by Aristotle is nothing less than the foundation of all cosmic movement, the masterwheel of celestial as well as terrestrial mechanics. Such is the role, the pivotal role, of place in Aristotle's scheme of the material universe.

This theory of place, however, still leaves Aristotle with a twofold problem. What of the last (or first) sphere? Is it also localized? And if not, how understand the motion of a body that is not in a place?

a) According to the ancients, with whom Aristotle is here in accord, the first heaven or sphere is not in any place, since there is nothing further to limit or contain it.

b) But then, what explanation is there for the uniform motion, or so it seems, of the heavens? This point caused Aristotle's commentators no end of perplexity. Averroes thought that the fixed position of the center, the earth, served somehow to place the celestial spheres. St. Thomas, preferring Themistius' solution, holds for localization of the parts in relation to one another. Thus, there can be motion in each of the parts, but not in the sphere taken as a whole, since this, by the ancients, is strictly speaking not in a place.

4. *Critical Reflections on the Theory of Place*

There is no doubt that Aristotle's theory of place is a masterful conception, worthy of the genius that produced it. An obvious question, however, is whether it can still claim the allegiance of science, or whether present-day scientific understanding of place is utterly alien to Aristotle's view. Hence a few words of comparative evaluation are in order.

Certain points in Aristotle's theory are, admittedly, out-

moded. For example, his principle of localization, the sphere of the fixed stars together with its immovable center, necessarily suffered the same fate as the astronomy of which it was an integral part. Also, his ideas on the natural movement of the elements would seem to be in need of considerable remaking, if indeed they can be salvaged at all. But does this mean that his whole theory of place has to be discarded? Tire answer depends on whether the essentials are retainable. Two points in particular have to be considered.

a) There is first his very concept of place. Aristotle defines place as a container. Modern science usually defines it as a point in a system of coordinates. Place, in this view, depends on whatever system of coordinates is devised to serve one's scientific purpose, and it is much more something imposed by the investigator than something given by nature.

Doubtless, this idea of place, which is more mathematical than Aristotle's, does lend itself better to the modern proclivity for measuring things on a mathematical scale; but it docs not necessarily invalidate Aristotle's container concept, which is more concrete and, for want of a better term, more natural, that is, more in line with what place appears to be in ordinary, prescientific experience. The man on the street may not know what a point in a system of coordinates is, but he does know that things are *in* a place, which is the meaning of place as a container. Furthermore, an interesting comparison could be made between the modern notion of fields of force or gravity and Aristotle's idea that place has powers of attraction. All in all, the theory of place as container or enveloping surface should

still have meaning even for the scientist. Revisions there must be to bring it up to date, but these will not destroy the basic concept.

b) The second point is more difficult to resolve. Along with the ancients Aristotle believed that there was in the universe an absolute system of localization. If this is true, at least some motions are absolute, and not just relative. The moderns in general dispute this idea. Motion, it is widely thought, is always relative to certain frames of reference arbitrarily chosen. It takes place within two terms, but the terms and hence the motion have meaning only in reference to other similarly arbitrary terms. The question is not whether some motion is relative, but whether any other is possible.

Who is right in this debate we are not prepared to say. A fair question, however, is whether absolute relativity—ironical locution!—of place and motion can be conceived by the mind (to utter a phrase is not necessarily to conceive it); or, same question, whether the fluctuations (relative changes) of place and motion in the universe do not imply a stable (absolute) principle of localization and measurement. At any event, and this is where we shall leave the matter, scientific thought itself has not achieved unanimity on this head. The debate goes on.[12]

12 What the author alludes to is, of course, the theory of relativity in modem physics, a subject he may be pardoned for not pursuing in an introductory study of St. Thomas' philosophy of nature. The student whose acquaintance with the question of relativity is sufficient to whet his appetite will also know, or know where to find, the general and specialized bibliographies, which, incidentally, grow by the day. One obvious reference is Einstein's own exposition in *Relativity, the Special and General Theory,* New York, 1947.—Translator's note.

5. Theory of the Void.[13]

As we mentioned at the beginning of our discussion on place, the theory of the void and the theory of place are related questions, aspects of the same basic problem. Some of the ancients thought that motion presupposes place; others believed that motion is possible only in a void, meaning a place in which there is nothing—an empty space. The Atomists in particular had recourse to the void to explain the motion of the atoms. Modern theories of force and motion (dynamics) speak in much the same vein.

Tire partisans of the void recognized two kinds. One was the void that existed independently of bodies; this was thought necessary for local motion. The other was the interstitial void, or the void of interstices, to account for condensation and rarefaction. After discussing the meaning of the void and the opinions of others,[14] Aristotle declares his own position, arguing first the nonexistence of the separate void,[15] then the nonexistence of the interstitial void.[16]

On the supposition of a void, he explains, motion is unintelligible. Why? Because in a void there is no distinction of up and down, hence no way of positioning a body and tracing its motion. Besides, what is there to prevent local motion even in the absence of gaps between bodies, as may be seen in the circular motion of a liquid? Here, it seems, Aristotle advances the theory of motion by circu-

[13] *Phys.* IV, 6-9.
[14] *Ibid.,* chaps. 6-7.
[15] *Ibid.,* chap. 8.
[16] *Ibid.,* chap. 9.

lar displacement, or vortex motion, a theory that Descartes was to develop and make famous. In fine, the void, says Aristotle, is inconceivable, and so far from being necessary for motion, it would render motion impossible.

The void, or vacuum, was destined however to have its career. Aristotelians continued, understandably, to oppose it, taking as axiomatic that "nature abhors a vacuum." But with the beginning of modern science the notion of a vacuum came again into its own, the consequence in large measure of the experiments of Torricelli (1608-1647), an early Italian physicist popularly regarded as the first man to create a vacuum. In France the question ignited a celebrated controversy that pitted against each other such notables as Pascal (1623-1662), defender of the vacuum, and Descartes (1596-1640), championing in this instance the Aristotelians, upholders of the plenum.

We have no intention of handing down a verdict on this controversy. But we will say that both sides had everything to gain by distinguishing between the relative vacuum which the physicist may achieve in his laboratory, and the theoretically absolute or metaphysical vacuum whose defense, or denunciation, turns on philosophical suppositions. And the distinction that should then have been made, should still be made whenever there is question of the void or vacuum.

6. *Space*

In modern scientific thought the problem of place has been mostly translated into the closely allied problem of space. Consequently, motion, as said before, is no longer conceived as a change of place or container but as a re-

lational variation in a system of coordinates projected in space. Hence, a modern scientist prefers to speak of bodies being in space rather than in place. Yet these two perspectives are not wholly divergent; and while Aristotle does not set forth a theory of space, it is possible to find points of comparison between his idea of place and the modern notion of space. So, what is space from an Aristotelian standpoint?

To the imagination, space is very nearly like an enormous void, a vast *continuum* in which all bodies are located. But this is not a very scientific description. A more precise characterization of space is to say that it is comprised of dimensions, or an *order of dimensions,* necessarily conceived as continuous. From this it is a natural step to determine and delimit space by pivotal points within an assumed system of coordinates, thus giving explicit and, usually, mathematical expression to the implicit dimensions of space.

But this is an empirical, or utilitarian, concept of space. It leaves unanswered the philosophical problem as to its objective reality. The questions that the philosopher asks are these: Is space, as appears to the unsophisticated view, an objective reality, independent of perception? Or is it only a subjective condition of perception? Or, third possibility, is it something between, partly subjective and partly objective? To pose these questions is to suggest the three major philosophical theories of space, which are:

a) Space is an absolute (i.e., wholly objective) reality. This notion is expressed in

—the void of the ancient Atomists,

—the extended substance of Descartes, and

—the geometric substance of Newton.

b) Space is a *construct of the mind.* Prime specimens of this theory are

—Leibnitz' order of coexistences, and

—Kant's a priori form of sensibility.

c) Space is an *abstraction grounded in reality.*[17]

Of these answers, the last is by all odds the correct one; it is also the one that best accords with the general character of Aristotelian philosophy. Space, by this account, denotes the real order of dimensions in or between bodies, but this is all it denotes. Everything else, every other property of bodies, is omitted from the concept of space. Primarily a logical and mathematical entity, it is nevertheless based on a concrete reality, namely, dimensive quantity or the extension of bodies, and this is a real accident, one of the ten predicaments. Thus, the reality of space, such as it is, rests on the reality of concrete extension, of which it expresses the dimensional or measurable aspect, prescinded from all actual or specified limits. Considered from the standpoint of indeterminateness, space exists only in the mind but corresponds to, because derived from, an objective reality, the reality of concrete extension.

Space, in consequence, is a more abstract concept than place. A logical entity with a foundation in things, space is so to speak one remove from reality, whereas place is itself a reality, a real accident of things. If, from one point of view, space is abstract, limitless extension, place, the limit of what contains, is comprised of concrete, limited (and limiting) dimensions; and furthermore, in Aristotelian thought, it possesses a real, a physical power of attraction.

17 In Scholastic phrase: *ens rationis cum fundamento in re.*

Space, on the other hand, indicates something prior to all considerations of force and energy (dynamics). It is therefore not only more abstract but also emptier of denotation, denoting much less than place; and one of the reasons why the sciences prefer to think of bodies in space rather than in place is just this greater simplicity or lack of denotation.[18]

III. TIME [19]

Time is one of those things of which everybody has some idea but few can tell the exact nature. Aristotle begins his discussion with a consideration of the difficulties that time presents.[20] Next, he works out the definition,[21] which is followed by two chapters on certain other aspects, such as the meaning of "to be in time," [22] and the nature of the instant or "now." [23] Finally, he returns to some questions regarding the universality, the reality, and the unity of time.[24] Of all these developments we shall canvass only the more important conclusions arrived at by Aristotle.

18 For a more complete discussion of philosophical theories of space the student may profitably consult R. P. Phillips, *Modem Thomistic Philosophy,* I, chapter 6, "Place and Space," pp. 78-96. Also helpful, especially for a comparative study of space in philosophy and modern science, is V. E. Smith, *Philosophical Physics,* chapter 10, "Place: The Measure of Motion," *in toto.*—[Tr.]

19 Cf. *Phys.* IV, 10-14.

20 *Phys.* IV, 10.

21 *Ibid.,* chap. 11.

22 *Ibid.,* chap. 12.

23 *Ibid.,* chap. 13.

24 *Ibid.,* chap. 14.

i. The Nature of Time

Speaking of the nature of time, Aristotle notes first of all that time and motion appear to be inextricable. And so indeed they are. In fact, some of his predecessors went so far as to identify them. Time, they thought, was the motion of the universe, more particularly, of the heavens or the "enveloping sphere." Aristotle refutes this theory by pointing out that time is everywhere, and not just in the heavens or the outermost sphere.

Besides, motion can be fast or slow, but not time—"fast" is what moves in a short time, "slow" what moves in a long time; hence to say that time is fast or slow would be to define it by itself.

But though time is not motion, it is nevertheless unseverable from motion. Take away all change or motion, and time disappears. That is why the awareness of time dies with the awareness of change, as happens in sound sleep. No motion, no time, so much is true. But motion is time, no. Hence, though not identical with it, time is yet somehow affiliated with motion. What is this affiliation? What, in other words, is time?

Aristotle's answer is progressive. Time, he says, is continuous; it attends motion, and motion implies extension, which is continuous. This, then, is one thing that defines time; it is continuous. Secondly, in magnitudes there is a before and after, namely, of position; hence, corresponding to these there must be a before and after in motion and, consequently, in time, since time and motion go hand in hand. As a matter of fact we become aware of time when we perceive a relation of before and after in motion. But

note, thirdly, what we do when we perceive the before and after. We distinguish phases of the motion, marking off, mentally, one part from another. That is, we perceive the motion as measurable or numerable, and number it. To differentiate within a quantity or magnitude is equivalent to numbering. In general, therefore, we may say that motion plus numbering equals time, a thought which St. Thomas sets forth as follows: "Since succession is found in all motion, and one part follows another, in numbering the before and after of motion we apprehend time, which is nothing else than the number of before and after in motion." [25]

What St. Thomas says here is but a transcription of Aristotle's definition that time is "the number of motion in respect of before and after." [26] Time is number because, as said a moment ago, it distinguishes the parts of motion, and to distinguish parts is to number them. But—also an earlier mention—number is twofold. It may be what is counted, and what is counted with. What is counted is concrete number, *numerus numeratus.* What is counted with is abstract or mathematical number, *numerus numerans.* Time is what is counted, the parts of motion, hence concrete or numbered number.[27]

[25] "Cum enim in quolibet motu sit successio, et una pars post alteram, ex hoc quod numeramus prius et posterius in motu, apprehendimus tempus, quod nihil aliud est quam numerus prioris et posterioris in motu" *(Summa theol.,* Ia, q. 10, a. 1).

[26] *Phys.* IV, 11, 219 b 1.

[27] Cf. Text V, "Definition of Time," p. 200.

2. *The Reality of Time*

To know the definition of time is one thing, to know what sort of reality it is may be quite another. So evanescent is time that the question may well be asked with Aristotle whether it has any objective existence at all.[28] Can a thing be real if its parts do not really exist? Yet time appears to be made of parts that do not exist. It has past and future; but the past is no more, the future not yet. True, there is also the present moment, but this alone, whatever its actuality, does not constitute time. Add to this that time, it seems, can hardly exist without a mind to piece the parts together. Time is the number of motion. But without something that can count there should be no number. Yet only an intellect can count. It seems, then, that without a soul (in the sense of intellect) there could not be number, hence no time.

Aristotle allows that time in its full meaning cannot exist apart from mind.[29] The mind distinguishes the before's and after's of motion and by weaving them into a duration makes possible the perception of time. Nevertheless, time is not a sheer subjectivity. The mental work of discriminating before and after and relating them to each other has an objective foundation, being grounded in the motion of which before and after are parts. Granted that motion is an imperfect reality, in the sense explained earlier, it is nevertheless a reality. Thus, speaking of the objective and subjective elements of time, St. Thomas writes: "That part of time which is as it were its material element, namely,

28 Cf. *Phys.* IV, 10, 217 b 30 ff.
29 Cf. *ibid.,* 14, 223 a 25.

the before and after, is founded in motion; but the formal element[80] is completed in the soul's activity of numbering. And that is why the Philosopher says that without a soul there would be no time." [81]

Accordingly, the Aristotelian school takes a middle position in regard to the reality of time. It avoids both the extreme of those who, with Bergson in the forefront, would have us believe that temporal duration is the very heart and substance of reality, and the extreme of those who, in the manner of Kant, would reduce it to a transcendent category of the mind, to an utter subjectivity. In the Aristotelian view it takes both mind and reality to produce time. The mind perceives and, perceiving, lends completion to time; but the foundation is outside the mind, in the reality *motion.*

3. *The Unity of Time and Its Standard of Measure*

a) So far we have spoken of time in its general meaning. We have considered it more or less in the abstract, characterizing it as a concomitant and, in the mind, a measure of motion. Omitted from discussion have been concrete instances or systems of time. Also still unanswered is the important question whether time is one or many. Motion, of which time is a concomitant, is not all one. There are many motions all around, and many kinds, and one motion

[80] I.c., the numbering.

[81] "Illud quod est de tempore quasi materiale fundatur in motu, scilicet prius et posterius; quod autem est formale completur in operatione animae numerantis, propter quod dicit Philosophus quod si non esset anima non esset tempus" (In I *Sent.,* dist. 19, q. 2, a.

may be simultaneous with another. Does it follow that there are many times, one for each motion, and that several times may coexist?

Common experience testifies that time is basically one and the same everywhere, and this is also Aristotle's answer. There is but one time, which is the measure of all motions, whatever their kind and however their occurrence, whether in sequence or simultaneous, just as the selfsame number may be used to compute a variety of things, whatever their differences.

But if time is one, should there not also be a single motion on which all time ultimately rests and which, in consequence, serves as the standard of measure for all cosmic motion? If so, what is this unique motion? Aristotelian astronomy has a ready answer, one appropriated, virtually intact, from the appearances of sense. It is the motion of the first or outermost heaven. Because of its regularity and constancy, this motion thoroughly lends itself to being the foundation of a prime and universal measure or time.

In Aristotle's theory the unity of time hinges, therefore, on the motion of the first heaven and, in consequence, on his general scheme of cosmic motion. According to this scheme the universe is a unitary system of motion, dominated and regulated by the uniform, circular motion of the first heaven. To this motion all other motions are subordinated. In such a system it is indeed possible to discern a first or ultimate motion, even as it is possible to assign a first or ultimate principle of place; and given this system one can also fix an ultimate and universal time by which all motions are measured.

b) Such is the theory. But the same question suggests itself as in the theory of place. How much of it, if anything, is now practicable or scientifically sound? Present-day practice, it is true, still clings to the idea that time is fundamentally one and that it unfolds uniformly. Also, the standard of time continues to be set by the motion of celestial bodies. However, modern scientific thought finds it far more difficult than Aristotle, indeed seems to think it impossible, to identify a concrete motion that is primary to and the measure of all others; and in the absence of this, can there still be a unique, universal time that would be the measure of all motions? To ask this question is again to bring up the whole problem of relativity in modern physics. And again the issue cannot be resolved here.

This much, however, may be said. In the matter of time, as in the theory of place, the Aristotelian position presents, no doubt, certain aspects that will not stand up in the light of contemporary scientific thought. But other aspects have proved more durable. The idea that cosmic motion is a unitary system, or that a regulating principle of time is necessary—these, if not others, are far from gone."

c) Finally, a few words on the practical problem of measuring time. Since time is a successive continuity, it is not directly measurable, but is measured by the distance traveled by local motion. In local motion, which serves to

82 For further philosophical orientation to the question of time in the relativist setting resort may be had to V. E. Smith, *Philosophical Physics,* chapter **n,** "Time: The Measure of motion"; also, a more mathematically-centered inspection, to A. G. Van Melsen, *The Philosophy of Nature,* pp. 181-194.—[Tr.]

measure other motions, there is a correspondence between the time that elapses and the space traveled; hence, in practice, time is measured by measuring the distance of motion. If, moreover, one assumes with Aristotle and, for that matter, with the moderns that the measuring motion is uniform, it is a simple step from the calculation of distances to the calculation of the corresponding times.

As for measuring the duration of qualitative motions (local motion is quantitative), this offers no special difficulty. The characteristic moments of the qualitative change in question are noted and compared with the coincident moments in the motion used as the standard of measure. Any change that permits of such coincidences being established can be measured in time.

4. *Some Related Notions: Eternity, Aevum, Duration*

a) *Eternity.*—Though Aristotle made no separate study of the notion of eternity, it nevertheless occupies a very important place in his philosophy and, as a matter of fact, in the speculations of the ancient philosophers generally. In a primary sense eternity appears to be the prerogative of higher or supernatural beings. Thus, in the present book of the *Physics*[33] Aristotle remarks that eternal things, things which are always, are not in time, since their existence is not affected by time and cannot be measured by it. In Book A of the *Metaphysics,* in which he sets forth his natural theology, eternity is attributed to the prime mover, to pure act, which is separate, eternal, and living.[34] But in

[33] IV, 12, 221 b 3.
[34] *Metaph.* A, 6.

another sense Aristotle also attributes eternity to motion.[80] There has always been motion, he believes, and always will be. Thus the world itself is eternal.

The Christian medievals could not, of course, lend themselves to the affirmation of the world being eternal; it was, or seemed to be, in open contradiction to the dogma of creation. In fact, this thesis of Aristotle's, perhaps more than any other, was responsible for the opposition to his philosophy among some medieval masters, who, understandably, arose to declaim in the name of the faith against a too slavish acceptance of Aristotelianism. It explains, for example, St. Bonaventure's sharp criticism, though, well to remember, his immediate target was the extreme Aristotelians of his own day. These, apparently, saw nothing incongruous in their version of Aristotle not mixing with Christian teaching.

Aristotle, however, as everyone knows, had also defenders, led by St. Thomas himself. Like all Christian teachers, they acknowledged the fact of creation in time, *in tempore;* but they also admitted the theoretical possibility of creation from all eternity, *ab aeterno.* Thus Aristotle, as they saw it, was not propounding a contradiction in terms; and if he did not know Genesis, for that he could hardly be blamed. As for the meaning of eternity in its most proper sense, St. Thomas' explicit enunciation of it occurs in the *Summa* in connection with his study of the divine attributes.[38] This is where one should expect it, for from the Christian view eternity is primarily just that—an attribute of God, and of no other. What, then, is eternity?

[80] *Phys.* VIII, 1–2.

[80] *Summa theol.,* Ia, q. 10.

If time is the measure of motion, of something possessed by degree and succession, eternity is precisely the opposite, a mode of possession not by degree or succession, but of all at once or everything together. It is the way in which a being that is utterly changeless possesses its life. The classical definition of eternity stems from Boethius (4807-524?), in whose rendering it is "the perfect and totally simultaneous possession of a life that has no limits":

interminabilis vitae tota simul et perfecta possessio.

Some clarifications may be in order. The words "interminabilis vita" (life without limits) mean that eternity has neither beginning nor end. The absence of limits is, however, secondary and accidental to eternity, even though one is sometimes led to think that it is the essential. As a matter of fact, it is quite possible to conceive of a world, or of motion, that has no beginning and no end. But all this implies is duration without determined limits, which is not the same thing as eternity proper. Eternity, in its complete meaning, presupposes utter immobility and changelessness, or, in the succinctness of Boethius, the totally simultaneous possession of one's entire life. When so understood, eternity is only in God, who alone is the substantially Eternal; of Him alone is it true to say that eternity is an essential attribute, that essence and life are one.

To be sure, the word "eternity" can be used, as already indicated, in a derivative or comparative sense, as when we speak of the eternity of the world, meaning a world without limit at either end, or, in another sense, without determinable limit. This is what the cosmologist or natural philosopher means when he raises the problem of the eternity of

the world. The solution, however, lies not with him but rather with the metaphysician. St. Thomas' answer has been mentioned. For him, a world of perpetual (or, in the sense just referred to, of eternal) duration is in the realm of possibility, hence not a contradiction in terms. But faith, and faith alone, he says, teaches us that the present world had a beginning, a beginning in time, since even an eternal world must have a beginning in the sense of cause.

b) *Aevum.*—Only God, we have said, possesses life with perfect and totally simultaneous possession; only God is truly eternal. But there are intermediate substances between God and man, substances whose resistance to change and destruction is far above anything in the world of our experience; in fact, their nature is incorruptible, though susceptible of annihilation by the First Cause, but by no other. In the cosmology of the ancients the intelligences which were thought to move the celestial spheres, as well as the spheres themselves, were such substances. In the Christian universe angels are of this kind, though angels are not thought to inhabit the spheres. Substances of this class possess their being in more perfect manner than corporeal things have theirs, since the latter are by nature corruptible.

Yet even the separate substances, as they are called, are subject to change in their accidental determinations. In the spheres of the ancients there is local motion, and the utter spirits of the Christian world think and will by thoughts and volitions that are successive. Hence, their condition is one of substantial permanence with accidental impermanence. For this mode of being Christian thought has a special name, the *aevum,* a sort of intermediate state be-

tween eternity and time. The accidental modifications of these substances are measured, to be sure, by a manner of time, since they occur by succession; but the time, at least of the utter spirits or angels, is discontinuous rather than, like ours, continuous.[37]

c) *Duration.*—If *aevum* describes a condition unfamiliar to mortals, "duration" comes much closer to home. "For the duration," to take an instance, needs no explanation to anyone; popular thought and expression abound with the idea. On another level and in our own day Bergson (1859–1941), a philosopher of renown, popularized a philosophy principled by the concept of *duration,* with, however, a meaning all his own. This is our present interest, namely, the philosophical tenor of duration and, more particularly, whether Bergson's idea of it can be fitted into Aristotelian thought.

In general, duration has a more concrete, a more stable and substantial connotation than time. What it refers to primarily is the actual existence of a thing but from a special point of view, existence in its sustained reality against the flux of accidental variations. Duration is abiding reality as compared with the succession of change, whereas time, for its part, is the measure of the succession. This, at any rate, is what duration means in the Aristotelian and Thomistic tradition.

In Bergson's philosophy the meaning is far different.

37 On the meaning of *aevum,* and how it differs from both time and eternity, see *Summa theol.,* Ia. q. 10, aa. 4-6. Some helpful remarks on the notion of "discrete time" may also be found in Sister M. Jocelyn, O.P., "Discrete Time and Illumination," *Laval Théologique et Philosophique,* II (2, 1946), 49-57.—[Tr.]

Duration, according to him, is indeed the basic reality, but a reality without stability and permanence. Everything is in constant change. There is no stable subject that could be the seat of accidental change yet remain basically unchanged. If nevertheless Bergson stresses the idea of duration, he means by it not so much an abiding reality as ceaseless "creative" activity that puts duration itself in constant innovation to its very root and foundation—if indeed one may speak of root and foundation in a philosophy where nothing is even relatively permanent. In fact, wherever Bergson writes "duration," Aristotle or St. Thomas could generally rewrite "change" with no appreciable loss of meaning. Bergson's duration is not duration in the traditional sense; it is the flux of Heraclitus all over again. Furthermore, the real meaning, says Bergson, of the changes we observe lies in their qualitative succession only, and not at all in their quantitative or local motion.

Bergsonian duration, accordingly, is poles apart from Thomistic duration. Bergson denies all permanence to things, whereas in Thomistic philosophy duration is founded on the comparative permanence of substances and would have no meaning without it. Nor is Bergson's duration the same as time. Time presupposes the continuum in reality; its foundation is therefore in the order of quantity and not, like the duration of Bergson, in the order of quality. On this matter, then, one will look in vain for exact agreement between the two philosophies.

+ CHAPTER 8

Proof of the Prune Mover

f ARISTOTLE ends the *Physics* with a formidable book devoted to proving the existence of a first principle of motion. This, it may be noted, is not the only place in his writings where he applies himself to the task. Three times, in fact, we find him bending his efforts to it, twice in the *Physics* (VII, i, and VIII, virtually *in toto),* and once in the *Metaphysics* (A, 6). The contents of *Physics* VII, however, are really an abbreviated version of Book VIII, and all indications point to Book VII not having been in the original redaction. But the other two occurrences, *Physics* VIII and *Metaphysics* A, 6, do not simply repeat each other. They are distinct presentations of the demonstration at hand, and a comparison of them raises two questions of major importance.

i) One is whether the prime mover of Book VIII is to be identified with the first substance, with pure act, the burden and conclusion of the argument in the *Metaphysics?* Granted that the demonstrations themselves are basically

alike, the end-products, the things demonstrated, look different. In the *Physics* we come at last upon a physical prime mover, unextended and immaterial no doubt, but having no other function, it seems, than to move the first sphere of the heavens. Is this God? Or is it only a transcendent physical mover? In the *Metaphysics,* on the other hand, the supreme principle arrived at has all the attributes of a first and unique being; it is pure act, thought of thought, etc.

The question, as we have said, is whether these two principles, the prime mover of the *Physics* and the pure act of the *Metaphysics,* are identical. The answer is undoubtedly yes, but with a proviso. In the *Physics* the prime mover, formally speaking (that is, on the evidence of the demonstration), is merely shown to be the first physical principle of motion in the universe; whereas in the *Metaphysics* the prime mover is brought forth with all the properties of the primary, absolute being.

2) The second question, or problem, is more difficult to decide. The prime mover of the *Physics* acts in the manner of an efficient cause, but the prime mover of the *Metaphysics* is said to put the spheres in motion by being the primary object of desire, hence as final cause. These two points of view are not necessarily opposed; in the Christian universe, as a matter of fact, the one complements the other. But Aristotle's philosophy wants a complete explanation of the relationship between God and the world, and this lack poses the problem how to reconcile the prime mover as efficient cause with the prime mover as final cause. The solution, however, is beyond the scope of this volume.

We turn at once, therefore, to the demonstration in the

Physics. Since the succession of arguments that make up this demonstration is rather extensive, and the reasoning close and involved, we shall not make a point-by-point examination of it. Indeed, such a course would likely defeat the purposes of an introductory study. Suffice it, then, to produce the basic structure of the demonstration and, in conclusion, to indicate the recasting it undergoes in the hands of St. Thomas.

1. *Plan and Exact Purpose of Book VIII*

In Book VIII Aristotle's purpose is not only to demonstrate the prime mover. He also sets out to determine the distribution of all essential movers and movables according to their respective motion and rest. This adds to the complication of the book. For, in addition to a prime movable, a *primum mobile,* which is eternally moved, he must also show that there are movables which are only sometimes moved and therefore sometimes at rest. This general theme is effectively expounded at the beginning of chapter 3 and at the conclusion of chapter 9.

From this perspective, then, the proof falls into three distinctive parts:

1) Preliminary demonstration: the eternity of motion (chaps. 1-2).

2) Principal argument: layout of the world on the basis of movers and movables (chaps. 3-9).

3) Corollaries: properties of the prime mover (chap. 10).

2. The Eternity of Motion

For the eternity of motion Aristotle adduces two principal arguments:

a) A movable being is either eternal or generated. If generated, the generation, which is a change of one thing to another, presupposes anterior motion, and so on ad infinitum. If, on the other hand, we say that the movable is eternally pre-existent, then rest is prior to motion, an impossibility because rest is the privation of motion, hence presupposes it. Thus we must conclude that movables are generated, and this indefinitely or eternally without a beginning in the process, since one generation presupposes anterior motion, and this motion yet another, and so on in ceaseless regression.[1] By similar reasoning Aristotle excludes the existence of an ultimate term in the process of change and becoming.

b) Besides, argues Aristotle, the eternity of motion follows from the eternity of time. If, like him, we accept as a demonstrated fact that time is eternal, it does indeed follow that motion too is eternal, since time, the number of motion, does not exist without motion.

[1] This proof, once again, as St. Thomas carefully notes, does not hold on the supposition of a beginning by creation. St. Thomas' penetrating commentary on Aristotle's doctrine of eternal motion is something every student should experience for himself. See especially *In VIII Phys.,* lect. 2.—Translator's note.

3. *Allocation of Motion and Rest and Demonstration of the Prime Mover*

a) *Presentation of the problem.*[2]—Various suppositions can be advanced concerning the state of rest and motion:

—either everything is always at rest,

—or everything is always moved,

—or some things are moved, others at rest.

Assuming the last supposition correct, we find that it in turn allows of three different possibilities:

(i) either that things moved are always moved, and things at rest are always at rest,

(ii) or that everything is alternately moved and at rest,

(iii) or that some things are eternally motionless, others eternally moved, and still others admit of both states, i.e., are sometimes at rest and sometimes in motion.

Possibilities (i) and (ii) must be rejected, as experience shows that: 1) not everything is at rest, 2) not everything is always in motion, 3) there are things which are sometimes moved and sometimes at rest.

Remains to be proved, therefore, that possibility (iii) is the right one.

b) *Whatever is moved, is moved by another.*[3]—Surprisingly enough, Aristotle does not here try to prove this principle in a priori fashion; he does it inductively, considering in how many ways a thing's motion may be brought about.

2 *Phys.* VIII, 3.

3 *Ibid.,* chap. 4.

Leaving out of account accidental motion,[4] there are, he observes, three ways for a thing to be moved:

—to be moved by nature and at the same time by itself,

—to be moved by nature without being moved by itself, and

—to be moved contrarily to nature, hence most clearly by another.

This list is exhaustive. In the first case the distinction of mover from moved is less obvious than in the other two, yet in all of them, as Aristotle explains at some length, what moves and what is moved are different. So, exploring the possible ways of being moved, Aristotle finds that all the facts in the matter come to one conclusion: whatever is moved, is moved by another.[5]

c) *Necessity of a prime mover; this mover is immovable, eternal, one."*

Necessity of a prime mover.—Aristotle supplies a variety of arguments in proof of a prime mover, but all of them come to this: If everything moved is necessarily moved by something else, there has to be a first mover that is not moved by another. It is impossible, so runs the thread of all the arguments, that a series of movers which themselves are moved by another should be infinite, as it must be without a first or prime mover. For, if everything moved is moved by another, then this other is unmoved, or it is moved by still another, and so on indefinitely. But the series cannot be infinite, because in an infinite series there

[4] For the meaning of "accidental" motion see St. Thomas, *In VIII Phys.,* lect. 7, no. 2144.

[5] Phys. VIII, 4, 256 a 4.

[6] *Ibid.,* chaps. 5-6.

is no first, hence no second, no third, etc., and all motion ceases. So, the series must stop somewhere—*àvàyK-q ar^vai,* says Aristotle, and never did two words leave more impress on the course of philosophical history.

Accordingly, the whole proof of the prime mover rests on the impossibility of an actually infinite series. Note well, however, that the series of movers is thought to be in essential subordination to one another. The argument does not hold for a series that is only accidentally connected. St. Thomas, at any rate, seems to think that such a series could be infinite.[7]

Immovable.—The prime mover is not moved by another. Either, then, it is immovable and utterly unmoved, or it is moved by itself. If moved by itself, it must be composed of one part which acts as unmoved mover and another part which is moved. Hence, whichever the case, there exists a first unmoved mover.

Eternal.—The prime mover is eternal. Aristotle deduces this from the premise, which he regards as certain, that motion is eternal. The Christian, in passing, could not of course argue from this ground.[8]

One.—There is only one prime mover rather than many. One prime mover, says Aristotle, is enough to account for the facts of motion. A plurality of prime movers would also

7 For example, in *Summa theol.,* la, q. 46, a. 2, ad 7. See also the remarks of R. Garrigou-Lagrange, O.P., *God: His Existence and His Nature,* trans, by Dom Bede Rose (St. Louis & London: B. Herder Book Co., 1949), L 77-81. [Tr.]

Aristotle, it will be recalled, has a parallel demonstration of the prime mover in *Phys.* VII, 1.

8 St. Thomas bases God's eternity on His immutability; see *Summa theol.,* la, q. 10, a. 2.—[Tr.]

explain them, but wherever two or more explanations are possible preference should go to the simpler. The simpler in this case is the unicity of the prime mover. Other considerations, continues Aristotle, point to the same conclusion, as the fact that motion, if presumed eternal, must be continuous, hence one. But it will only be one if the mover and movable involved in it are each of them one.[9]

d) *Necessity of a first movable,* **primum mobile.**[10]— Some things, as remarked earlier, are sometimes in motion and sometimes at rest. Also now established is the existence of a prime mover, immovable, eternal, one. On these two premises Aristotle reasons the existence of a first movable that is perpetually in motion.

The prime mover, according to the argument, always imparts one and the same motion, and always in the same manner, since its relation to the movable never varies. Hence the prime mover cannot be the immediate source of variation in change and motion, such as we see in the constant succession of generation and corruption. But a perpetually moved mover can perform this function. By its own eternal motion this moved mover accounts for the eternity of the process of generation and corruption, and by its different positions it explains the alternating cycles —the point at issue—we observe in generation and corruption. At the same time this moved mover is uniformly moved by the first mover.

Briefly, Aristotle's scheme of cosmic motion requires both an eternal, immovable prime mover and an eternal prime

[9] For St. Thomas' proof of God's unicity see *Summa theol.,* Ia, q. 11, a. 3.—[Tr.]

[10] Phys. VIII, 6, 259 b 32 ff.

movable, uniformly moved by the prime mover. But by the motion it in turn imparts the prime movable is the immediate cause of the rotations in nature's course, where motion alternates with rest, and generation with corruption.

e) *The kind of motion caused by the prime mover.*[11]— We have seen how Aristotle conceives the arrangement of essential movers and movables in the universe. But we have not yet explained what kind of motion it must be that the prime mover imparts to the prime movable. Aristotle resolves this point in three steps.

First, he declares the primacy of local motion. Growth, he observes, presupposes alteration: food has to be altered before it can be assimilated. But alteration depends on the active and passive elements being brought in contact, and this involves local motion, which is therefore primary.[12]

Secondly, not all local motion is the same. It may be circular or rectilinear, or a combination of the two. Only circular motion can be infinite, one, and continuous. Rectilinear motion cannot be infinite, because this would imply infinite magnitude, an impossibility; it cannot be continuous, because it necessarily involves renewal in the opposite direction. Aristotle's discussion of these propositions is not only detailed but also highly complex.[13]

Thirdly, Aristotle contends that circular motion is the primary local motion, hence primary to all motion. Circular translations, he argues, are simpler and more perfect than rectilinear displacements. Continuous and uniform,

[11] *Phys.* VIII, 7-9.
[12] *Ibid.,* chap. 7.
[13] *Ibid.,* chap. 8.

circular motion is pre-eminently suited to being the measure of all other motions.[14]

Which, in reality, is this circular, uniform, and eternal motion of which Aristotle speaks? As readily surmised, it is the motion of the first heaven or first sphere, and this sphere in consequence becomes the first movable. Thus, what emerges as a deductive or logical necessity is also found a fabric of reality. If, that is, the primacy of circular motion is argued deductively, the final deduction ends where, true to Aristotle, it originally began—in experience.

4. *The Prime Mover Is Without Magnitude* [15]*

That the prime mover is devoid of all magnitude is reasoned as follows. Its magnitude would be finite or infinite. But wc know from the preceding chapter that a magnitude cannot be actually infinite. As for a finite magnitude or mover, it could not impart an infinite motion: this would be a contradiction. Consequently, if the motion imparted by the prime mover is eternal, which means infinite, the prime mover must be without magnitude, hence indivisible and without parts.

Such is Aristotle's conclusion, the importance of which is seen at once. The prime mover, it follows, is not in the order of quantified beings, therefore is not, it would seem, a material reality. But to call it immaterial is merely to put it negatively. What it is positively speaking the *Physics* does not tell. For the answer we must go to the theological portions of the *Metaphysics.*[19] There we are informed that

[14] *Ibid.,* chap. 9.
[16] *Ibid.,* chap. 10.
[19] *Metaph.* A, 6-7 in particular.

only pure act, posited as the ultimate principle of the universe, meets all the requirements of an absolutely prime and primary being.[17]

5. *Conclusion: Reflections on Aristotle's Demonstration and Comparison -with the "Prima Via" of St. Thomas*

a) First, a few comments on the *method* or *procedure* employed by Aristotle. This, as one cannot but notice, bears a strongly a priori stamp. There is, to be sure, constant reference to the given, to the vouchings of sense, so that the image of the universe that finally unfolds does conform with experience. But if Aristotle is anxious to square his design of cosmic movers and movables with experience, the impression persists that he is even more solicitous about something else. What he wants to prove above all, or so it seems, is that this is the system of motion which the universe, to be perfect, *must* have.

If this impression be correct, to what extent can his argumentation be considered valid? Some parts, no doubt, hang by an improbable thread, as when, to say no more, he argues the case for circular motion. Other parts would just as certainly have to be trimmed out. But there is no simple rule for pruning his dialectic. His demonstration of the prime mover is not, to change the metaphor, of a piece but textured, comprising, as we have seen, many separate arguments. Each of these arguments must be judged on its own merits, but only after the detailed analysis that does not come within our purview.

17 Cf. Text VI, "The Prime Mover Is Without Magnitude," p. 206.

Yet, however the verdict should turn out on this or that particular aspect of the demonstration, underlying it all are two philosophical principles which seem unimpeachable. These principles are "that whatever is moved, is moved by another," and "it is impossible for a series of moved movers to be infinite." If these be true—and no one has successfully challenged them—Aristotle's demonstration is fundamentally sound and invulnerable, as St. Thomas, for one, was quick to perceive.

b) This brings us to the second point, Aristotle and the *prima via.* St. Thomas takes up Aristotle's proof of the prime mover on several occasions, sometimes merely expounding it, as in the commentaries,[18] other times adapting it to his purpose, as in the two Summas.[19] With St. Thomas the demonstration had, of course, to undergo an important modification, since the fact of creation in time ruled out Aristotle's initial supposition of motion being eternal. This, however, does not undermine the demonstration; in fact, says St. Thomas, the causality of the prime mover is made the more evident by the world having a beginning.[20] Just the same, Aristotle's proof comes out considerably revamped.

Especially worthy of note, for example, is the way St. Tliomas, in the *Summa theologiae,* untangles the argument of the *Physics* from the whole machinery of Aristotle's physical universe. As for the two basic principles mentioned earlier, on which Aristotle's proof rests, these could not but be retained. St. Thomas, however, does not validate them in the manner of Aristotle in the *Physics;*

[18] *In VIII Phys.; In XII Metaph.,* lect. 5.

[19] *Contra Gentiles,* I, 13; *Summa theol.,* la, q. 2, a. 3.

[20] *Contra Gentiles,* I, 13, "Praedictos autem processus. . .

instead, his whole defense of them is embodied in a pair of more fundamental propositions, namely, "that a being cannot be reduced from potency to act except by something that is in act" and "where there is no first term, there can be no ultimate or intermediate term." 21 Thus, while it is true that in the hands of St. Thomas Aristotle's proof remains metaphysically the same, nevertheless there is performed by St. Tliomas a process of enucleation that brings the core of the argument more plainly to light.

To illustrate, may we cite the text of the *prima via,* a text in which, it may be added, the long history of natural philosophy achieves, as it were, its crown and pinnacle. For this reason it not only makes a fitting conclusion to the present discussion but also qualifies to be cited in full:

That God exists can be proved in five ways. The first and more evident way is the one taken from motion. It is certain and evident to the senses that some things in this world are in motion. Now, whatever is in motion, is moved by another; for nothing moves except so far as it is in potency to the thing toward which it is moving. On the other hand, whatever imparts motion does it so far as in act; for to move something is none other than to bring it from potency to act, and nothing can be reduced from potency to act except by something in act. Thus, what is actually hot, say fire, causes wood, which was potentially hot, to be actually hot, and thereby moves and alters it.

It is not possible, however, that the same thing should be simultaneously in act and potency in the same respect, but only in different respects. For example, what is actually hot cannot at the same time be potentially hot, but it is at the same time potentially cold. Impossible, therefore, that in the same re-

21 "De potentia autem non potest aliquid reduci in actum nisi per aliquod ens in actu. - - - Si non fuerit primum . . . non erit ultimum nec medium" (Sumnw *theol.,* Ia, q. 2, a. 3).

spect and in the same manner a thing should be both mover and moved, in other words, move itself. Hence, whatever moves [i.e., is in motion] is necessarily moved [i.e., put in motion] by another. And if the thing by which it is moved, is itself in motion, then this also must be moved by another, and this again by still another. But this regression cannot continue to infinity, because then there should be no first mover, and consequently no other mover, the reason being that second movers move only through being moved by the first mover, as for example a walking-stick moves only through being moved by the hand. Consequently, it is necessary to come to a first mover that is moved by no other, and this all understand to be God.[22]

[22] "Dicendum quod Dcum esse quinque viis probari potest. Prima autem et manifestior via est, quae sumitur ex parte motus. Certum est enim et sensu constat aliqua moveri in hoc mundo. Omne autem quod movetur, ab alio movetur. Nihil enim movetur, nisi secundum quod est in potentia ad illud ad quod movetur; movet autem aliquid secundum quod est actu. Movere enim nihil aliud est quam educere aliquid de potentia in actum; de potentia autem non potest aliquid reduci in actum, nisi per aliquod ens in actu; sicut calidum in actu, ut ignis, facit lignum, quod est calidum in potentia, esse actu calidum, et per hoc movet et alterat ipsum.

"Non autem est possibile ut idem sit simul in actu et potentia secundum idem, sed solum secundum diversa; quod enim est calidum in actu, non potest simul esse calidum in potentia, sed est simul frigidum in potentia. Impossibile est ergo quod secundum idem et eodem modo aliquid sit movens et motum, vel quod moveat seipsum. Omne ergo quod movetur, oportet ab alio moveri. Si ergo id a quo movetur, moveatur, oportet et ipsum ab alio moveri, et illud ab alio. Hic autem non est procedere in infinitum, quia sic non esset aliquod primum movens; et per consequens nec aliquod aliud movens, quia moventia secunda non movent nisi per hoc quod sunt mota a primo movente, sicut baculus non movet nisi per hoc quod est motus a manu. Ergo necesse est devenire ad aliquod primum movens, quod a nullo movetur, et hoc omnes intelligunt Deum" (Summa *theol.*, Ia, q. 2, a. 3).

+ CHAPTER 9

The Aristotelian Astronomy

+ ARISTOTLE'S study of mobile being is not all in the *Physics,* which is only a general treatise on motion and its principles. The particular kinds of motion and the special problems relating to them are the burden of separate works following the *Physics,* notably of *De Caelo, De Generatione et Corruptione,* and the *Meteorológica.* These works are of interest mainly to the specialist or, perhaps, the antiquarian. There is in them constant reference to scientific conceptions current in Aristotle's time but long since obsolete. This not only adds to the reader's task but also limits the advantage to be gained from them. Nevertheless, the dedicated scholar will study them.

Yet even the general student should have some acquaintance, if not with all the topics of these special treatises, at least with one—I mean Aristotle's astronomy.

The influence of this astronomy, while perhaps not so complete as sometimes thought, was still very great, abiding moreover close on to two thousand years. In this last chapter before our concluding appraisal we shall, accordingly, trace the basic design of Aristotle's astronomical universe and then indicate the modern innovations that were to render it a thing of the past.[1]

i. *Aristotle s Astronomical System*

a) *Basic postulates.*—All the astronomers of antiquity agreed that their hypotheses had not only to be scientifically (or mathematically) correct and as simple as possible, but also capable of explaining the "look" of celestial motions. In the expression which Simplicius attributes to Plato, any acceptable astronomical theory had "to save the appearances"—*ad^eiv rà (¡>aivóp.eva.* This, to the astronomers, was the basic test, and all their efforts were aimed at meeting it by resolving the apparent travelings of the celestial bodies into the simplest motions possible.

But if all of them pursued this aim, not all claimed the same degree of objective reality for their theories. On this basis they classify into two groups. One group, the mathematicians, cared little whether their theories of celestial mechanics were actually embodied in nature. The other, the physicists, were convinced that the theories devised by them were factual arrangements, and not just mathematical inventions. Believing that their system or systems copied reality, they had therefore the greater burden; unlike the

[1] Though now a little dated, the standard work on this subject is still Pierre Duhem's *Le système du monde,* 5 vols. (Paris: Hermann, 1913–1917); see especially Vol. I (1913).

mathematicians, they had also to show how nature operates the system, how one part of the heavens moves another, and the whole moves together. Aristotle, a physicist, certainly numbers in the second group, those who believed that their theories were actual fact and not just mathematical, though serviceable, figment.

Pursuing this goal of tallying theory with reality, the physicists set to work. Underlying their efforts were two very important assumptions, briefly stated as follows:

—the heavenly bodies, being perfect, are moved with perfect motion, which, to recall, is circular and uniform;

—the earth, in the shape of a sphere, is at rest at the center of the world or universe, the latter being visualized as an immense shell of finite dimensions.

On the foundation of these two premises, and with considerable borrowing from the Platonists Eudoxus and Callippus, Aristotle built his astronomical system, a system of concentric spheres.

b) *The astronomy of concentric spheres.*—According to Aristotle, the universe is to be conceived as an interlocking system of concentric spheres, with the earth as their common center. Their radius, however, varies, increasing with each successive sphere. The stars, having no motion themselves, are carried by the spheres, and are moved with their motion. The outermost sphere makes a uniform rotation on its axis once in twenty-four hours, and attached to it are the so-called fixed stars.

The seven planets then known—Saturn, Jupiter, Mars, Venus, Mercury, the sun, and moon—were carried by intermediate spheres. But since the movement of one sphere could not describe the irregularities observable in the orbits

of the planets, each planetary trajectory was accounted for by a combination of several circular motions. Thus, each planet had its individual system of spheres—five, says Aristotle—so arranged that the poles of one were joined at the right places to the next immediate sphere. Since, moreover, Aristotle meant his system to be successful in fact as well as in theory, he was faced with further complicating his mechanics of the heavenly bodies. Not to go into detail, suffice it to say that he had to introduce compensating spheres which canceled out certain movements within each planetary subsystem.[2]

All told, then, he gets fifty-five spheres, though at times he places the number at forty-nine. For Aristotle, to repeat, the spheres were real; they existed in the heavens, or rather they were the heavens, and consisted of an incorruptible transparent element, ether, the so-called fifth element altogether different from the four terrestrial elements. The first heaven, that is to say the outermost sphere of the universe, was moved by the prime mover, the other spheres by movers distinct from the prime mover. But the relation of these second movers to one another and to the prime mover is not made very clear. Apparently, the movers of the lower spheres were to be understood as souls that desired and, by desiring, imitated as far as possible the eternal life of the prime mover. This much, then, for Aristotle's celestial mechanics.

c) *Composition and movements of the sublunary world.* —In Aristotle's view, as we have learned, the world we in-

2 The function of compensating spheres is conveniently described in W. D. Ross, *Aristotle,* 3rd rev. ed. (London: Methuen & Co. Ltd., 1937), p. 97.—[Tr.]

habit is made of four elementary bodies: water, air, earth, and fire, a classification that was accepted for centuries after him. These elements have a tendency to move up or down, following the attraction of their natural place. The motion of the elements puts them in contact with one another, thus making possible the alterations corresponding to their basic contrarieties. Subsequent to alterations, assuming the proper moment, are substantial generations and corruptions. But commanding the alternating rhythm of all these transformations is the movement of the sun, which, following the ecliptic, is successively nearer and farther away and thereby exercises a varying influence on the earth and all that is in it. So it is that in Aristotle's account the whole sublunary world, the life and activity of each of the beings that compose it, appear in the final reckoning to be regulated by the movement of the heavenly bodies, of the sun in particular.

Such is Aristotle's conception of the world and all that moves in it, a system relatively simple and remarkably coherent. Yet in this system are combined an astronomy, a physics, and even, to use the modern word, a chemistry, the chemistry of the elementary bodies and also of their transformations. But its most striking feature is the contrast between the constancy of the heavens and the instability of sublunar bodies, between the basic immutability of the one and the essential perishableness of the other. Celestial bodies, incorruptible and ingenerable, receive only uniform, circular motion, whereas terrestrial bodies are open to every manner of change and decay. Modern scientists were to find it otherwise. Theirs, it was soon apparent, would be a universe without this radical difference between

the globe of man and the expanse out yonder. The same system of motion would govern the whole, and the same general kind of properties, activities, and defectibilities inhabit the whole.

2. *Sequel to Aristotle's Astronomy*

a) *Drawbacks to the system.*—Despite its undeniable ingenuity, the astronomical system devised by Eudoxus and his disciple Aristotle did not wholly succeed in saving the appearances. There were, it was soon realized, certain variations in the movement and appearance of celestial bodies that it could not account for. Specifically, the apparent variation in the diameter of the planets seemed to indicate a variation in their distance from the earth. Also, closer observation revealed certain regressions in the planetary orbits, and these regressive motions could scarcely be accommodated to the original theory. Subsequent astronomers coped with these problems.

b) *Ptolemy and the astronomy of epicycles and eccentric rotations.*—Foremost among the astronomers that followed the classical Greeks were Hipparchus (second century b.c.) and Ptolemy (second century a.d.), author of the famous *Almagest,* long to remain the standard reference on the subject of astronomy. They concluded, as did other astronomers of the time, that some of the Eudoxian postulates had to be given up, but not the fundamental of uniform, circular motions. These motions were therefore retained, but the earth was no longer considered the precise center of their rotations. Instead, a system of epicycles and eccentrics was devised, in substance as follows:

—the celestial bodies were thought to be carried each

by a small circle whose center was fixed on the circumference of another moving circle, called the deferent: this was the system of *epicycles.*

—the celestial bodies continued to rotate around the earth, but the earth was no longer placed at their geometric center: this was the system of *eccentrics* or eccentric rotations.

These improvements made it possible to give a more satisfactory account of the irregularities in the planetary movements. They also ensured the continued acceptance of an astronomy based on uniform, circular motions, an acceptance that lasted into modern times. For the record, though, it should be mentioned that at the beginning of the medieval cultural renaissance allegiance wavers for a spell between Aristotle's version and Ptolemy's. St. Thomas bears witness to this state of mind; he knew both theories but sided with neither. From the end of the thirteenth century, however, the hesitancy gives way; Aristotle's system gradually yields to the mechanically superior *Almagest.*

3. *Copernicus and Modern Astronomy*

One of the principal differences between ancient and modern astronomy results from the substitution of heliocentricism for geocentricism. No longer is the earth the astronomical center around which the universe moves. Instead, the earth and all the planets revolve around the sun. Heliocentricism was not, however, a uniquely modern discovery. It had already been proposed among the Greeks by Aristarchus (third century B.c.);and even earlier Philolaus, a contemporary of Socrates, had thought of the earth as rotating, not indeed around the sun, but still around a

central fire. Yet, there is no denying that until the Renaissance the theory which places the earth at rest at the center of the universe was almost universally upheld. How this centuried theory was finally supplanted is a study in itself.

Perhaps the most complete presentation of this great scientific revolution is found in Pierre Duhem's monumental *Le système du monde.*[3] According to Duhem the beginnings of the new astronomy are already discernible in the fourteenth century, among the Nominalists at the University of Paris. There, to mention the more notable, Albert of Saxony, John Buridan, and Nicholas Oresme laid the foundations of a system of mechanics altogether different from Aristotle's. Especially significant was their repudiation of the ancient theory of projectile-propulsion by surrounding air. For, instead of explaining, as heretofore, the motion of celestial and earthly bodies by different mechanical principles, it permitted them to account for both types of motion by a single system; which is to say they were able to combine into one what in the old theory had been two distinct systems of motion, celestial and terrestrial mechanics. Nicholas Oresme, moreover, clearly propounded the theory of the earth's diurnal movement.

Once begun, the new science moved ceaselessly on, its next phase looming up in the Italian Renaissance, thanks above all to names like Girolamo Cardano (Jerome Cardan: 1501-1576) and (as who doesn't know?) Leonardo da Vinci (1452-1519). Still another phase dawns with Copernicus, first of that eminent line of astronomical scientists culminating in Issac Newton, founder himself of the system that was to rule virtually unaltered and unchal-

[8] For publisher and publication dates see note 1, p. 148.

lenged to the present time. That the physics of relativity has had to revise even Newton does not in the least detract from the grandeur of his achievement.

Truly, the development of modern astronomy is a renowned chapter in the history of science. Herewith, barely sketched, are the high lights and foremost representatives.

Copernicus (1472-1545).—His *De revolutionibus orbium caelestium* (On the Revolutions of the Celestial Bodies) was published in the year of his death. In a preface marked by fine discretion he states that his astronomical theories should not be taken for more than they are, namely, a mathematical description. The earth, he says, rotates on its axis, and it also revolves around the sun, as do the other planets. But Copernicus still holds to uniform, circular motion, a circumstance that prevented his eliminating the system of eccentrics and epicycles.

Tycho Brahe (1546-1601).—Brahe proposed a theory that incorporated some aspects of heliocentrism while retaining some features of the traditional astronomy. Thus, the earth is still at the center of the world, and the sun moves round the earth, but the other planets move round the sun. His real contribution, as a matter of fact, lay not so much in the discovery of new theories as in the wealth of his observations, which by their precision paved the way for future progress.

Kepler (1571-1630).—His principal discovery was the elliptical movement of the planet Mars. On the basis of this fact and after much computation he set down his three famous planetary laws: 1) A planet travels in an elliptical orbit, with the sun in one of its foci. 2) Its rate of travel is such that the "radius vector," the line joining it to

the sun, covers equal areas in equal times. 3) Tire squares of the periods of planetary revolutions are in the same ratio as the cubes of their mean distances from the sun (the mean distance of a planet from the sun is half the major axis of its elliptical orbit).

Galileo (1564-1642).—His fame includes numerous works on the motion of bodies. He was also one of the first, if not the first, to construct a telescope, an invention that enabled him to discover Jupiter's satellites. In his *Dialogo dei due massime sistemi del mondo* (Dialogue on the Two Great World Systems) [4] he came to the defense of the Corpernican theory. In consequence of this—side issues in which he was not altogether blameless were also involved—he fell afoul of the Holy Office, incurring its condemnation in 1633.

Isaac Newton (1642-1727).—Newton's monument is his *Philosophiae naturalis principia mathematica* (Mathematical Principles of Natural Philosophy). Through the discovery of the law of universal gravitation Newton succeeded in organizing the new conceptions of the universe into a coherent system. The result was the *Principia,* which, interestingly, he still deems a study in "natural philosophy."

[4] This work has recently appeared in two separate, English translations: "Dialogue Concerning the Two Chief World Systems —Ptolemaic and Copernican," trans, by Stillman Drake, foreward by Albert Einstein (University of California Press, 1953); "Dialogue on the Great World Systems," in the Salusbury trans., revised, annotated, and with introduction by Giorgio de Santillana (University of Chicago Press, 1953). For a comparative review of these versions see J. T. Clarke, S.J., "Galileo Galilei in Recent Double Exposure," *The New Scholasticism,* XXVIII (July, 1954), 320-334. -[Tr.]

+ CHAPTER 10

Concluding Appraisal

+ NEWTON'S work marks the turning point in the career of Aristotle's universe. Thenceforth, Aristotle's conception of the cosmos could no longer be regarded as a total explanation. To be sure, Newton himself was in many ways to be surpassed, for science marches on. But, as intimated before, the enormous progress since his day should not blind us to the greatness of his achievement, even from the strictly scientific point of view.

As for Aristotle, though his sway has come and gone—I am speaking of the natural sciences and astronomy—history must nevertheless regard him as one of the great scientific geniuses of mankind. His original contributions, especially in the natural sciences, cannot be denied. In fact, one has to wait almost till the eighteenth century before meeting with new advances in this field—a tribute to his abundant genius, to his thoroughness and penetration. Considering what he had to work with, the structure of his scientific thought was neither more nor less arbitrary

than was, for their time, that of Descartes or Newton.

Some authors, while acknowledging Aristotle's influence, take a less benign view of it. This very influence, they contend, was responsible for the long scientific sterility that allegedly set in after Aristotle. Like most sweeping criticisms, this is open to challenge in more ways than one. For example, Euclid, Archimedes, Ptolemy, Pappus, Diophantus, these, to which others could be added, form an imposing array of scientific pioneers, and all of them belong to the immediate centuries after Aristotle. With such names to distinguish it, was this an epoch of scientific sterility?

Concerning the relative decline of science in the early Middle Ages, to blame this on Aristotle or, for that matter, on the incdicvals does little justice to history. If one remembers the repeated onslaughts of the Barbarian invader, it would seem far more realistic, as well as more appropriate, to esteem than to disesteem the medieval scientific legacy. And when from the fifteenth through the sixteenth century science again reached a development that compared favorably with its growth among the Greeks, the Aristotelian formulas and axioms repeated by the Schoolmen in the lecture halls do not appear to have stifled the spirit of original inquiry. On the contrary, this was again a time of real geniuses, a time of such productivity that in less than a century a whole new order of scientific thought had established itself.

To come to a more particular point. Aristotle's physics or philosophy of science (in the modern sense) is often opposed to the philosophy of the Pythagorean school, meaning a philosophy built on number or quantity. Aris-

totle's physics, it is said, stresses the qualitative side of nature to the exclusion of its quantitative aspects, the implication being that only a quantitative reduction of nature brings results. Here again a more discriminating appraisal would put the matter in a different light. Aristotle affirms the primacy of quantity over the other accidents; it is first in the order of accidents, the immediate disposition of substance. He also maintains the primacy of local (quantitative) motion. Definitely, then, and by his own showing, Aristotle is far from underrating the quantitative aspect of phenomenal nature. His system of physical motion could not, it is true, survive. Nevertheless, it was a practical, and not just a theoretical, explanation of celestial and terrestrial motions; for his day, and long after, it was on the whole adequate.

What Aristotle did and could not envisage was the enormous possibilities that lay in the mathematical exploration of the corporeal world; the tools for this manner of attack, so prominent in modern scientific inquiry, had not yet been forged. Yet, what mathematics there was he knew about; for as a member of the Academy he took part in its discussions on number. So removed from reality they generally were, however, that a man of Aristotle's scientific bent must often have left disappointed. Aristotle's interest was anchored to reality; probing it qualitatively, not to say quantitatively, he was far more the true scientist than were the armchair number-philosophers of the Academy.

But whatever the merits of his scientific accomplishment, Aristotle's most lasting success in the domain of nature is his *philosophy* of nature, the probings and findings underneath the surface, the unveilings round the core

of physical reality. His conception of the principles of mobile being, his theory of causes, his ideas on change, on finality, on determinism, his analysis of motion and its primary concomitants of space (or place) and time, these matters still command the attention of the serious philosophical investigator of nature, because seen in their true light they have lost none of their substantive correctness.

A few simple facts of universal experience sustain this philosophical edifice. There are change, and becoming, and multiplicity in the physical world. There are concrete individuals which come and go, are born and die. Things of nature, they have quantity and quality. These facts of experience, which bear not mistrust, are the piers and pillars controlling the whole structure. Science, no doubt, will continue to find new theories for itself, and remake or discard old ones. But one cannot imagine that science will ever find us a universe from which the aforesaid essentials are missing. Improvements, certainly, can be made at many points in Aristotle's thought, improvements and additions. But this is face lifting. In foundation, in essential cast, the philosophy of nature that Aristotle gave to the world is and bids fair to remain intact.

TEXTS

+ ALL, or nearly all, of St. Thomas' natural philosophy is in the commentaries on Aristotle: on the *Physics, De Caelo, De Generatione et Corruptione,* and the *Meteorológica.* To these one must go for a complete study. But the foundations and the keystones are in the Commentary on the *Physics,* as they are in the *Physics* itself. Inasmuch as our inquiry has dealt mainly with the foundations, the texts that follow are, with one exception, from this Commentary. The exception is Text II, which reproduces in full St. Thomas' opusculum *De Principiis Naturae* (On the Principles of Nature), written during his first years of teaching, in Paris (ca. 1254). This minor treatise, far from minor in importance, is a model presentation of the basic notions of Aristotle's cosmology. The same ideas could be illustrated with excerpts from the Commentary, but in the opusculum they are brought together and neatly arranged in one synoptic view. For this reason we have preferred and produced it *in toto.* The piece, more-

over, has the stamp of authenticity from all the best textual scholars, and despite its occasional prolixity, it ranks as a classic in its kind.[1]

I. DEFINITION AND DIVISIONS OF NATURAL PHILOSOPHY

(In I *Phys.,* lect. i, nos. 1-7. Collate with *supra,* "Formal Object and the Division of Natural Philosophy," p. 9.)

1. Because the *Physics,* which we here intend to explain, is the first book of the science of nature, in the beginning of this treatise we should state the matter and the subject of this science.

2. Now, every science, it should be noted, is in the intellect, and a thing becomes intelligible in act to the extent that it is abstracted from matter. Consequently, so far as things are diversely related to matter they pertain to diverse sciences. Further, since every science results from demonstration and the middle term in demonstration is the definition, it necessarily follows that the sciences are diversified by the various ways of defining things.

[1] The English rendition of De *Principiis Naturae,* based on Pauson's critical edition (Fribourg-Louvain, 1950), is quoted, with minor variations, from R. A. Kocourek's version in his An *Introduction to the Philosophy of Nature* (St. Paul: North Central Publishing Co., 1951). Similarly quoted in Dr. Kocourek's version, *ibid.,* is Text I, from Book I of the Commentary on the *Physics.* Dr. Kocourck has generously granted the use of his excellent translations. The texts produced from other parts of the Commentary are in my own rendition. Finally, paragraph numbers of the Commentary are according to A. M. Pirotta, O.P., In *Octo Libros De Physico Auditu sive Physicorum Aristotelis Commentaria,* editio novissima (Naples: M. D'Auria, 1953).—[Tr.]

3. It should be understood, accordingly, that certain things there are whose existence depends on matter, nor can they be defined without matter. But other things there are which, although they cannot exist without sensible matter, can be defined without sensible matter. Tírese things differ from one another as *curved* and *snub. Snub* exists in sensible matter and sensible matter must be included in its definition because snub is a curved nose. All natural things are of this kind, for example, man, stone, etc. On the other hand, even though *curved* cannot exist except in sensible matter, we do not include sensible matter in its definition. All mathematical things, as numbers, magnitudes, and figures, are of this kind. Still other things there are which do not depend on matter either for existence or in definition, and this because they never exist in matter, as God and the other separate substances, or because they are not universally in matter, as substance, potency and act, and being itself. These latter, accordingly, are treated in metaphysics. Mathematics, on the other hand, treats those things which depend on sensible matter for existence, but which are defined without matter. But the philosophy of nature, which is called *Physics,* treats those things which depend on matter, not only for existence but also in definition.

4. And because everything that has matter is mobile, it follows that *mobile being* is the subject of the philosophy of nature. For, the philosophy of nature is about natural things; but those things are natural whose principle is nature, and nature is the principle of motion and rest in that in which it is. Consequently, the science of nature is about those things which have in themselves a principle of motion.

5. Furthermore, what follows from something universally should be treated first and separately; otherwise we must repeat it over and over, every time we discuss the parts of that subject matter. For this reason it was necessary, in the science of na-

ture, to have at the beginning a book that treats the things which pertain to mobile being in general; just as first philosophy [metaphysics], in which we determine the things that are common to being as being, is placed before all sciences. This treatise is the book of the *Physics,* which is also called *On Physics,* or On *Natural Learning [De Naturali Auditu],* because it was imparted to the listeners in the manner of a doctrine. Its subject is *mobile being* simply.

6. I do not say *mobile body,* because in this book we prove that every mobile being is a body, and no science proves its own subject. This is the reason why in the beginning of the treatise On *the Heavens,* which follows this one, we begin immediately by explaining the notion of *body.*

•*j.* This present treatise is followed by the other books on the science of nature, in which we treat the kinds of mobile things. For example, in the treatise On *the Heavens* we consider the mobile thing according to local motion, which is the first species of motion. In the treatise On *Generation and Corruption* we speak of the motion toward form and of the first mobile things, the elements, as to their common transmutations; their special transmutations are treated in the book *Meteorology.* Inanimate, mixed mobile things are considered in the treatise On *Minerals,* and animate things in the treatise On *the Soul* and in the books that follow it.

II. THE PRINCIPLES OF NATURE

(De *Principiis Naturae)*

Tire principles and the causes of the being of nature are explored in the first two books of the *Physics;* indeed, this is their principal object of inquiry. Prior to his commentary on these two books St. Thomas had covered the same ground, though not in the same way, in one of his

smaller treatises. This, as has been mentioned, was his *De Principiis Naturae,* addressed to Brother Sylvester—*ad fratrem Sylvestrum,* whose identity is, however, unknown. Like *De Ente et Essentia,* which stems from the same period, *De Principiis* proceeds *doctrinaliter:* rather than a methodical inquiry, it is an orderly setting forth, chiefly in straight definitions, of a doctrine, that is, of a body of truth already established. For this reason, as well as for its clear and simple style, it is invaluable for the beginner, and that is why we have preferred it to equivalent paragraphs from the Commentary. As an aid to the reader, moreover, we have inserted a number of subheadings, the main ones being:

A. The Principles,
B. The Causes,
C. The Analogy of Matter and Form.

A. *The Principles*

(Collate with *supra,* "The Principles of Mobile Being, p. 17.)

a) *Matter, form, generation.*—1. Some things can be, although they are not, and some things now are. Those which can be but are not, are said to be in potency. Those which are, are said to be in act. But existence is twofold: one is essential existence or the substantial existence of a thing; for example, *man exists,* and this is existence *simpliciter* [absolutely, completely, simply]. Tire other is accidental existence; for example, *man is white,* and this is existence *secundum quid* [relatively, in some respect or manner].

2. Moreover, regarding both kinds of existence there is something in potency. Something is in potency to be man, as sperm

or the ovum; and something is in potency to be white, as man. Both what is in potency to substantial existence and what is in potency to accidental existence can be called matter; for example, sperm is the matter of man, and man of whiteness.

3. But there is this difference between them, that what is in potency to substantial existence is called the matter *from which* [i.e., of which the substance is composed], but what is in potency to accidental existence is called the matter *in which* [the accident is received]. Strictly speaking, however, *matter* [i.e., prime matter] is the name for what is in potency to substantial existence, whereas what is in potency to accidental existence is called the *subject.* Thus, we say that accidents are in a subject, but we do not say that the substantial form is in a subject.

4. Matter, accordingly, differs from subject, because the subject is not what has existence by reason of something added to it, but it has complete existence of itself *[per* se]; just as man does not have existence through whiteness. But matter has existence by reason of what is added to it, since of itself it has incomplete existence. So it is that absolutely speaking the form gives existence to matter; but the accident does not give existence to the subject, rather the subject gives existence to the accident, though sometimes one is used for the other, namely, matter for subject, and conversely.

5. Now, just as everything that is in potency can be called matter, so everything from which a thing has existence, whether substantial or accidental, can be called form; a man, for example, who is white in potency becomes actually white through whiteness, and sperm, which is man in potency, becomes actually man through the soul. Because form produces existence in act, we say that form is act. Whatever causes substantial existence in act is called substantial form, and whatever causes accidental existence in act is called accidental form.

6. Furthermore, since generation is movement toward form,

corresponding to twofold form is twofold generation. Generation *simpliciter* [pure and simple] corresponds to substantial form, and generation *secundum quid* [relatively speaking] to accidental form. When a substantial form is introduced, we say that something comes into being *simpliciter,* as, for example, man comes into being or man is generated. But when an accidental form is introduced, we do not say that something comes into being *simpliciter,* but in this or that respect. Tirus, when a man becomes white, it is not said absolutely that a man comes into being or is generated, but that he comes into being or is generated as white.

7. Opposed to this twofold generation is a twofold corruption, namely, *simpliciter* and *secundum quid.* Generation and corruption *simpliciter* are only in the genus of substance, but generation and corruption *secundum quid* are in all the other genera. Since, moreover, generation is a change from nonexistence to existence, corruption must be contrariwise, from existence to nonexistence. Yet, generation does not arise from just any nonbeing, but from the nonbeing that is being in potency, as a statue from bronze, which is a statue in potency and not in act.

b) *The three principles of generation.*—8. But that there may be generation three things are required: *being in potency,* which is matter; *nonexistence in act,* which is privation; and *that through which a thing comes to be in act,* which is form. When, for example, a statue is made from bronze, the bronze, which is in potency to the form of the statue, is the *matter;* its shapeless or undisposed condition is the *privation;* and the shape by reason of which it is said to be a statue is the *form.* But it is not a substantial form, because before the imposition of this shape the bronze already has existence in act and its existence does not depend on the shape. It is, rather, an accidental form, because all artificial forms are accidental. Art, in other words, op-

erates only on what is already constituted in existence by nature.

9. There are, accordingly, three principles of nature: matter, form, and privation. Of these, form is that on account of which generation takes place; the other two are found on the part of that from which there is generation. Matter and form are therefore the same in subject but differ in definition, just as the bronze and what is shapeless are the same before the imposition of the form; yet the reason for calling it bronze is not the same as the reason for calling it shapeless. Privation, in consequence, is not said to be a *per se* principle but a *per accidens* principle, seeing that it is coincident with matter. So, for example, we say it is *per accidens* that a doctor builds, since he does not do this from the fact that he is a doctor but from the fact that he is a builder, which happens to coincide in the same subject with being a doctor.

10. There are, however, two kinds of accidents: the necessary, which is not separable from the thing, as risibility in man; and the nonncccssary, which can be separated, as white from man. Consequently, even though privation is a *per accidens* principle, it docs not follow that privation is not necessary for generation, since matter is never devoid of all privation. For, while it is under one form it has the privation of another, and conversely; thus, in air there is the privation of fire, and in fire the privation of air.

11. Further to be noted is that although generation is from nonexistence, we do not say that negation is the principle but privation is, because negation does not determine a subject. *Nonseeing,* for example, can be said even of nonbeings, as we might say that a dragon [fabled monster] does not see, and we say the same of beings that are not fitted by nature to have sight, as stones. But privation is said only of a determined subject, in which, namely, a certain condition *[habitus]* is by nature apt to come about; for instance, blindness is said only of

things that are by nature apt to see. Moreover, generation does not arise from nonbeing *simpliciter,* but from the nonbeing that is in some subject, and not in just any subject, but in a determined subject—fire, let's say, does not arise from just any nonfire but from such nonfire as is apt to acquire the form of fire. And for this reason we say that privation is the principle, and not negation.

12. Privation, however, differs from the other principles in that the others are principles both of existence and of becoming. That a statue may be produced there must be bronze and, furthermore, there must be the shape of a statue. And when the statue exists, these two must exist. Privation, on the other hand, is only a principle of becoming and not of existing. For, while a statue is in process it must not yet be a statue; if it were, it could not come to be, because whatever comes to be, is not, except in successive realities, as time and motion. From the moment that the statue exists there is no longer the privation of statue, since affirmation and negation cannot be simultaneous, and neither can privation and possession *[habitus].* Also, privation, as explained above, is a *per accidens* principle, but the other two are *per se* principles.

13. From what has been said it is also plain that matter differs from form and from privation by definition *[secundum rationem].* Matter is that in which the form and privation are understood, just as in bronze the form and the absence of form *[infiguratum]* may be understood. Thus, matter sometimes designates privation, and sometimes not. When bronze becomes the matter of the statue it does not imply privation, because in speaking of bronze in this way I do not understand it as undisposed or shapeless. But flour, on the other hand, considered as matter with respect to bread, implies in itself the privation of the form of bread, because when I say *Hour* the nondisposition or nonordination opposed to the form of bread is signified.

Now, in generation the matter or the subject remains, but the privation does not, nor does the composite of matter and privation. Consequently, that matter which does not imply privation is permanent, but that which implies privation is transient.

14. Observe, moreover, that some matter has composition with form, such as bronze. This, though the matter with respect to the statue, is itself composed of matter and form. Consequently, bronze is not called prime matter, since it possesses form. That matter, however, which is understood without any form and privation but is the subject to form and privation is called prime matter because no other matter is prior to it. This, in Greek, is *vXrj.* And since every definition and all knowledge come through form, prime matter cannot be defined or known in itself but only through the composite; hence it may be said that that is prime matter which is related to all forms and privations as bronze is to the statue and the shapeless. And this matter is called first *simpliciter.* But a thing may also be called prime matter with respect to some genus, as water with respect to aqueous solutions. This, however, is not first *simpliciter,* because it is composed of matter and form, and hence has prior matter.

15. Note, besides, that prime matter and also form are neither generated nor corrupted, since every generation is from one thing to another. That from which generation arises is matter, and that toward which it tends and terminates is form. If, then, matter and form were generated, there would be matter of matter and form of form, ad infinitum. Hence generation, properly speaking, is only of the composite.

16. Further to be noted is that prime matter is said to be numerically one in all things. But to be numerically one can be meant in two ways: namely, that which has a determined, numerically one form, as Socrates—prime matter is not said to be numerically one in this way, since in itself it has no form.

But something is also said to be numerically one because it is without the dispositions that would cause it to differ numerically—prime matter is said to be numerically one in this way, because it is understood without all dispositions that could cause it to differ numerically.

17. In addition, prime matter, though in its definition [in *sua ratione]* it has no form or privation—as, for example, there is neither "shape" or "shapeless" in the definition of bronze—, nevertheless prime matter, I say, is never completely without form and privation. For it is now under one form, and now under another. But it can never exist by itself *[per se].* Since in its definition it does not contain any form, it cannot exist in act: existence in act is only from the form. It exists but in potency. Therefore, whatever exists in act cannot be called prime matter.

B. *The Causes*

(Collate with *supra,* "The Causes of Mobile Being," p. 59.)

a) *Agent and end.*—18. It is clear, from what has been said, that there are three principles of nature: matter, form, and privation. But these do not suffice for generation. What is in potency cannot reduce itself to act. The bronze in potency to being a statue cannot cause itself to be a statue; it needs an agent so that the form of the statue can pass from potency to act. Form also cannot educe itself from potency to act. I am speaking of the form of the thing generated, which we say is the term of generation. Form, in other words, exists only when the thing has been made; but what does the making is present in the becoming itself, or while the thing is being made. Besides matter and form there must therefore be some principle that acts, and this is called the efficient, or the moving, or the agent cause, or that from which is the principle of motion. And since, as Aristotle remarks in Book II of the

Metaphysics (a, 2, 994 b 15), whatever acts does so only by intending something, there must necessarily be a fourth thing, namely, what is intended by the agent; and this is called the end.

19. But although every agent, whether natural or voluntary, intends an end, it does not follow that every agent knows the end or deliberates about the end. To know the end is necessary in those agents whose actions are not determined, but who can act for opposite ends; such are voluntary agents. These, in consequence, must know the end by which they determine their actions. But in natural agents actions are determined; hence it is not necessary [for them] to choose the means to the end. Avicenna cites the example of the harpist, who does not have to deliberate about every pluck of the strings, since the strokes are already determined for him; otherwise there would be a delay between each stroke, and this would not be harmonious. Yet the fact of deliberation is seen in a voluntary agent rather than in a natural agent. Hence, by reasoning *a maiori* it is apparent that if a voluntary agent, in whom deliberation is more often the case, sometimes does not deliberate, neither does the natural agent. Accordingly, a natural agent can intend the end without deliberation; to intend this is but to have a natural inclination to something.

b) *Principles and causes.*—20. From the aforesaid it is plain that there are four causes: material, efficient, formal, and final. But although *principle* and *cause* are convertible terms, as is said in Book V of the *Metaphysics* (A, 1, 1013 a 16), still in the *Physics* Aristotle asserts four causes and three principles (Phys. I, 6, 18g b 16; 7, 191 a 14-23), the reason being that in this place he means by cause both what is extrinsic and what is intrinsic. Matter and form are said to be intrinsic to a thing because they are parts constituting the thing. Efficient and final cause are said to be extrinsic, for they are outside the thing. By principles, on the other hand, he means only the intrinsic causes. As for priva-

tion, this is not listed among the causes, for it is a principle *per accidens,* as has been said.

21. When we say that there are four causes, we mean the *per se* causes, to which all *per accidens* causes are reduced, since everything that is *per accidens* is reduced to what is *per se.*

22. Moreover, even though Aristotle in Book I of the *Physics* [cf. *supra]* refers to intrinsic causes as *principles,* nevertheless *principle* properly speaking is applied to extrinsic causes, as noted in the *Metaphysics* (A, 4, 1070 b 22-30), and *element* to the causes that are parts of a thing, namely, to the intrinsic causes, but *cause* is said of both. For all that, however, one is sometimes used for the other. Indeed, every cause can be called a principle and every principle a cause.

23. Still, *cause,* it appears, adds something to *principle* as ordinarily understood, that is, so far as what is a principle [or that from which anything proceeds in any way whatsoever] can be called principle whether the existence of the subsequent results from it or not. So, for example, the craftsman is called the principle of the knife because the existence of the knife comes from his operation. And when something is changed from white to black, white is said to be the principle of that change; and, universally, everything from which motion begins is called a principle. Whiteness, however, is not that from which the existence of the subsequent results, namely, blackness. Cause, on the other hand, is predicated only of that principle from which the existence of the subsequent results. Hence we say a cause is that from whose existence another results. That principle, therefore, which is the starting point of motion cannot be called a cause proper *[per se],* though it is called a principle. For the same reason privation is placed among the principles and not among the causes, inasmuch as privation is that from which generation begins. But it can also be called a *per accidens* cause, so far as it is coincident with matter, as was said earlier.

c) *Element.*—24. *Element,* strictly speaking, applies only to those causes of which a thing is composed, which are properly material causes—not, however, any material cause, but that one of which a thing is primarily composed. Thus, we do not say that the members of the body are the elements of man, because the members in turn are composed of other things. But we do say that earth and water are the elements, because these are not composed of other bodies, but natural bodies are primarily composed of them.

25. Accordingly, Aristotle in Book V of the *Metaphysics* (A, 3, 1014 a 26) states that "element is that of which a thing is primarily composed, and is in that thing, and is not divisible according to form." The explanation of the first phrase, "that of which a thing is primarily composed," is evident from what was said above. The second phrase, "and is in that thing," is inserted to differentiate clement from that matter which is entirely corrupted by generation. Bread, for example, is the matter of blood, but blood is not generated save by the corruption of bread; hence bread does not remain in blood. Bread, therefore, cannot be called an element of blood. Elements must remain in some way, since they are not entirely corrupted, as is said in the book *De Generatione et Corruptione* (I, 10, 327 b 22-31). The third phrase, "and is not divisible according to form," is added to differentiate element from things which have parts that differ in form, i.e., in species, such as the hand, whose parts are flesh and bone, which differ according to species. An element is not divided into parts that differ according to species; it is like water, whose every part is water. For an element to exist, it need not be indivisible in quantity; suffice that it be indivisible in form. And even if it is in no way divided, it is called an element, as letters are the elements of words. Thus, from what has been said it is plain that *principle* in some way applies to more than does *cause,* and *cause* to more than does *element.* And this is

what the Commentator [Averroes] says in Book V of the *Metaphysics* (cap. 3, comm. 4).

d) *Reciprocity of causes.*—26. Having now seen that there are four genera of causes, we should note that it is not impossible for the same thing to have several causes, for example a statue, whose cause is both the bronze and the craftsman, the craftsman as efficient cause, bronze as material cause. Nor is it impossible that the same thing be the cause of contrary things; thus the captain is the cause both of the ship's safety and of its sinking, of the latter by his absence, of the former by his presence.

27. Observe also that the same thing can be cause and what is caused even with respect to the same object, but from different points of view; walking, for instance, is sometimes the cause of health, as an efficient cause, yet health is the cause of the walking, as end. Walking, in other words, is sometimes done for reasons of health. Similarly, the body is the matter of the soul, but the soul the form of the body.

28. The efficient cause is termed a cause with respect to the end, since the end does not become actual except by operation of the agent. Conversely, the end is called the cause of the efficient cause, since the efficient cause does not operate except by intention of the end. Accordingly, the efficient cause is the cause of that which is the end, such as walking to be healthy. But the efficient cause does not cause the end to be the end; hence it is not the cause of the causality of the end, that is, it does not cause the end to be the final cause. A doctor, say, causes health to actually exist, but he does not cause health to be the end.

29. The end, for its part, is not the cause of that which is the efficient cause, but it is the cause of the efficient cause being operative in action; health, as an example, does not cause the doctor to be a doctor—I am speaking of the health that

comes about through the doctor's agency—but it causes the doctor to take his action. The end, accordingly, is the cause of the causality of the efficient cause, since it causes the efficient cause to be in action *[facit efficiens esse efficiens].* Similarly, the end causes the matter to be the matter and the form to be the form, since matter receives form only for the sake of the end, and form perfects matter only through the end. The end, in consequence, is called the cause of causes, since it is the cause of the causality in all causes.

30. Matter, also, is said to be the cause of form, so far as form exists only in matter. Form likewise is the cause of matter, so far as matter has existence in act only through form. Matter and form, in fact, are defined by relation to each other *[dicuntur relative ad* invicem], as noted in Book II of the *Physics* (2, 194 a 12; 194 b 9). They are also defined by relation to the composite, as the part to the whole and the simple to the composed.

e) *Priority among causes.*—31. Since, moreover, every cause as cause is naturally prior to what it causes, we should note that there arc two ways of being prior, as Aristotle remarks [cf. *De Generatione Animalium,* B, 6, 742 a 21]. Because of this diversity we can call something prior *and* posterior with respect to the same thing, both the cause and the thing caused. One thing is said to be prior to another in generation and time, and again in substance and completeness. Since, then, the operation of nature proceeds from the imperfect to the perfect and from the incomplete to the complete, the imperfect is prior to the perfect, that is, in generation and time, but the perfect is prior to the imperfect from the standpoint of substance. So, for example, it may be said that the man precedes the boy according to substance and completeness, but the boy comes before the man according to generation and time. But even though in generable things the imperfect is prior to the perfect and potency to act—considering that in one and the same thing the imperfect is prior

to the perfect and potency to act—nevertheless, absolutely speaking act and the perfect must be prior, because what reduces potency to act is in act and what perfects the imperfect is the perfect.

32. Matter is prior to form in respect of generation and time, since that to which something comes is prior to that which comes to it. But form is prior to matter in respect of substance and completeness, since matter has completed existence only through form. In a similar way the efficient cause is prior to the end from the standpoint of generation and time, since the motion to the end comes from the efficient cause. But from the standpoint of substance and completeness the end is prior to the efficient cause *qua* efficient cause, since the action of the efficient cause is not completed except through the end. Consequently, the material and the efficient cause, these two are prior in the order of generation, but the form and the end are prior in the order of perfection.

f) *The two types of necessity.*—33. There are two types of necessity: absolute and conditional. Absolute necessity is that which proceeds from the causes prior in the order of generation, which are material and efficient cause. For example, the necessity of death comes from the matter and from the disposition of the composing contraries. This necessity is called *absolute* because it does not admit of impediment. It is also called the necessity of matter. On the other hand, conditional necessity proceeds from causes posterior in generation, namely, from the form and the end. Thus conception, we say, is necessary if a man is to be generated. This necessity is called *conditional,* because for this woman to conceive is not absolutely necessary, but only conditionally, that is, if a man is to be generated. This is called the necessity of the end.

g) *Reduction of causes.*—34. Three of the causes, moreover, can coincide in one thing, namely, the form, the end, and the

efficient cause, as is plain in the generation of fire. Fire begets fire; hence fire is the efficient cause so far as it generates. Also, fire is the formal cause so far as it gives actual existence to what was previously in potency. Moreover, fire is the end, that is, so far as the operations of the agent terminate in it and it is intended by the agent.

35. Tire end, however, is of two kinds: the end of generation and the end of the thing generated, as is evident in the generation [production] of a knife. The form of the knife is the end of the generation; but cutting, which is the operation of the knife, is the end of the thing generated, that is, of the knife. Sometimes, moreover, the end of generation is coincident with the two aforesaid causes [i.e., efficient and formal], namely, when generation takes place from what is similar in species, as when man generates man, and the olive an olive. But the same cannot be said of the end of the thing generated.

36. Observe, also, that the end coincides with the form according to numerical identity, since the form of the thing generated and the end of the generation are numerically identical. But with the efficient cause the end does not coincide by numerical identity, though by specific identity, since it is impossible that the maker and the thing made should be the same numerically, but they can be the same specifically. Thus, when man begets man, the man begetting and the man begotten differ numerically but are the same specifically. As for matter, it does not coincide with the other causes. The reason is that matter, by the fact that it is being in potency, has the nature of the imperfect, whereas the other causes, by the fact that they are in act, have the nature of the perfect. The perfect and the imperfect do not coincide into one.

h) *The modes of causes.—yj.* The causes, as we have seen, are four: efficient, formal, material, and final. Each of these causes, however, can be spoken of in many ways. We call one

thing a prior cause and another a posterior cause. Art and the doctor, for example, are the cause of health, but art is a prior cause and the doctor a posterior cause. The same goes for formal cause and the other causes. And note that we must always bring the question back to the first cause. If, for instance, it be asked, "Why is this man healed?" the answer ought to be, "Because the doctor has healed him." But to the further question, "How is it that the doctor healed him?" the answer must be, "Because of the art of healing which the doctor has."

38. Also to be noted is that the proximate cause is the same as the posterior cause, and the remote the same as the prior. Hence these two divisions of causes, namely, prior and posterior, remote and proximate, signify the same thing. Mark, however, that what is more universal is always called the remote cause, and what is more particular the proximate cause. Thus we say that the proximate form of man is his definition, to wit, "rational animal"; but "animal" is more remote, and "substance" even remoter. All superiors are forms of the inferiors [as in the "tree of Porphyry"]. Similarly, the proximate matter of a statue is "bronze," but the remote matter is "metal," and tire still more remote is "body."

39. Furthermore, some causes are *per se* and some *per accidens.* A *per se* cause is a cause of a thing as such *[inquantum huiusmodi],* in the way the builder is the cause of the house and the wood is the matter of the bench. A *per accidens* cause is one that happens to be joined with a *per se* cause, as when we say a grammarian builds. The grammarian is the cause of the building *per accidens,* that is, not precisely as grammarian, but because the builder happens to be a grammarian. And so it is with the other causes.

40. Again, some causes are simple, others composite. A cause is simple when that alone is said to be the cause which is a *per se* cause, or that alone which is a *per accidens* cause, as were

we to say that the builder is the cause of the house, and also were we to say that the doctor is the cause of the house. A cause is composite when both are said to be the cause, as when it is said that the "builder-doctor" is the cause of the house.

41. It can also be said that a cause is simple when, as Avicenna explains it *{Sufficientia,* I, 12), something is a cause without the addition of another, as bronze is the cause of the statue without the addition of other matter—a statue, in other words, is made of bronze. In the same way a doctor is said to cause health, and fire to heat. On the other hand, a cause is composed when many things must come together for there to be a cause. So, for instance, the cause of the ship's motion is not one man but many, and the cause of a house is not one stone but many stones.

42. In addition, some causes are in act, others are in potency. A cause in act is one that is actually causing a thing, as the builder while he is building, or the bronze when a statue is being made of it. A cause in potency is one which, though not actually causing a thing, nevertheless can cause it, as a builder when he is not building, and bronze while it is not yet a statue.

43. Concerning causes in act, moreover, it is necessary that the cause and the thing caused exist at the same time, so that if there is the one there is also the other. If there is a builder in act, he has to be building; and if there is building in act, there has to be a builder in act But this is not necessary of causes that arc only in potency.

44. Take notice, also, that a universal cause relates to a universal thing caused [effect], and a singular cause to the singular thing caused. Thus a builder, we say, is the cause of a house, but this builder is the cause of this house.

C. The Analogy of Matter and Form

45. Regarding the intrinsic principles, namely matter and form, attention is called to the agreement and difference among things that result from principles as well as to the agreement and difference among principles.

a) *The kinds of identity and diversity.*—Accordingly some things, we find, are numerically the same, as are Socrates and this man, meaning the Socrates that is pointed out. Others are numerically different but specifically the same, like Socrates and Plato, who differ numerically yet are the same by their human species. Still others differ specifically but are generically the same, as man and the ass are of the same genus *animal.* Others, again, are generically diverse and only analogically the same, as substance and quantity, which have no common genus and are but analogically the same; that is, they are the same only so far as they are beings. *Being,* however, is not a genus, since it is not predicated univocally but analogically.

b) *The different modes of predication.*—46. To understand this last remark, we must explain that one thing can be predicated of a number of others in three different ways: univocally, equivocally, and analogically. A thing is predicated *univocally* if predicated according to the same name and the same nature, i.e., definition. In this way "animal" is predicated of man and the ass, since each is called animal and each is a sensible, animate substance, which is the definition of animal. On the other hand, a thing is predicated *equivocally* when it is attributed to several by the same name but with a wholly different meaning *[secundum diversam rationem].* In this way "dog" is said of a thing that barks and of a constellation in the heavens; these two agree in name but not in definition, nor in signification, seeing that what is signified by the name is precisely the definition, as stated in Book IV of the *Metaphysics* (r, 7, 1012

a 23). Lastly, a thing is said to be predicated *analogically* when it is predicated of several whose natures and definitions *[rationes et definitiones]* differ yet are referred to one same thing, as "healthy" is said of the animal body, of urine, and of the remedy; but its signification is not wholly the same in all three. "Healthy" is said of urine as of a sign of health, of the body as of the subject of health, and of the remedy as of the cause. Yet all these meanings [rationes] refer to one end, health.

47. Sometimes things that are alike by analogy, that is, by proportion, comparison, or association, are referred to one end, as was evident in the aforesaid example of health. Sometimes, also, they are referred to one agent, as "medical" is said of the person who practices the art [of medicine], and of the person who practices without the art, like the midwife, and even of the instruments; but it is said of all in reference to the one agent that is medicine. Other times such things are referred to one subject, as "being" is said of substance, of quantity and quality and the other predicaments. Yet it is not for wholly the same reason that substance is being, and quantity, and the others; rather, all are called being inasmuch as they are attributed to substance, which is the subject of the others.

48. Being, it follows, is said priorly of substance and posteriorly of the other predicaments. Hence, being is not a genus of substance and quantity, since no genus is predicated of its species on the basis of priority and posteriority. Being, as a matter of fact, is predicated analogically, and that is why we say that substance and quantity differ in genus but are the same by analogy.

49. *Application to matter and form.*—In accordance with the aforesaid, the form and matter of things that are numerically the same are themselves numerically the same, as are the form and matter of Tullius and Cicero. The form and matter of things that are the same in species but differ in number are not

the same numerically but only specifically, as the matter and form of Socrates and Plato. Similarly, when things are the same in genus, their principles [matter and form] are generically identical, as the soul and the body of an ass and a horse differ in species but are the same in genus. So also when things are alike by analogy or proportion, their principles are but analogically or proportionately the same. Thus, matter and form and privation, or potency and act, are the principles of substance and of the other genera of being. Nevertheless, the matter of substance and quantity, as also the form and privation, differ generically and have but proportional likeness; in other words, in the order of matter *[in ratione materiae]* what the matter of substance is to substance, the matter of quantity is to quantity, etc., but just as substance is the cause of all other [modes of being], so the principles of substance are the principles of all other [principles of being].

III. MOTION

The last six books of the *Physics* are devoted to the study of motion, which, in Aristotle's thought, constitutes the characteristic difference of the being of nature, *ens mobile.* The following paragraphs from St. Thomas' Commentary set out the arrangement and the groundwork of this study. Three major headings are indicated: the divisions of the tract on motion (A), the definition of motion (B), and the kinds of motion (C). To be noted, moreover, is that in the present context St. Thomas' word for motion or movement (motus) is not, as in common parlance, restricted to local or spatial displacement; it includes every kind of change in corporeal being, whether in the order of quality or of quantity. (Collate with *supra,* "Motion," p. 87.)

A. General Divisions for the Study of Motion

(In III Phys., lect. i, nos. 538–546)

538. Having determined the principles of natural things, and the principles of natural philosophy, Aristotle takes up the question concerning the *subject* of this science, which is mobile being as such. The inquiry as a whole is in two parts, in the first of which he considers motion in itself (Book Iliff.), in the second, motion in relation to movers and movables (Books VII-VIII). Tire first part, in turn, is in two sections, which deal respectively with motion itself and its concomitants (Books III-IV) and with its divisions (Books V-VI). . . .

539. On the necessity of studying motion he reasons as follows. Nature is a principle of motion and change [motus *et mutationis],* as is evident from the definition given in Book II (192 b 20)—as for the difference between motion and change, this will be explained in Book V (225 b 34). Hence, to be ignorant of motion is obviously to be ignorant of nature, seeing that the definition of the latter includes motion. Since, then, we intend to propound the science of nature, it is clearly necessary to explain what motion is.

540. Next, after motion itself, Aristotle discusses certain concomitants of motion, and this for two reasons, of which the first is as follows (nos. 540-545). When one studies a thing, one should also study the things that succeed from it: subject and accidents pertain to the same science.

541. Now, the infinite is an intrinsic consequent of motion. Tire proof is this. Motion is a continuum, as will be seen in Book VI (231 b 18), and the definition of the continuum includes the infinite—"in the primary sense" adds Aristotle, because the infinite that derives from the addition of number

comes from the infinite whose principle is in the division of the continuum. That the infinite is included in the definition of the continuum he attests by remarking that "often" those who define the continuum use the term *infinite* in their definition, as when they say that the continuum is what is divisible ad infinitum. The reason why he says "often" is that there is another definition of the continuum, occurring in the *Predicaments* (5a 1), namely, the continuum is that whose parts unite in one common term.

542. There is, however, a difference in these two definitions. The continuum is a kind of whole and has therefore to be defined by its parts. But parts are related to the whole in two ways: by way of composition, so far as the whole is formed of parts, and by way of resolution, so far as it is divisible into parts. The definition of the continuum given above is from the point of view of composition, whereas the one in the *Predicaments* is from the point of view of resolution. In any case, it is clear that the infinite is an intrinsic consequent of motion.

543. But there are also things that are consequent to motion in an extrinsic manner, serving as its extrinsic measures, like place, the void, and time. Time is the measure of motion itself. The measure of the movable, on the other hand, is place according to the truth of the matter, though in the opinion of some it is the void. And so, because of these extrinsic concomitants, he says that motion cannot exist without place, or the void, or time.

544. Not all motion, it is true, is local, but this has no bearing on the aforesaid. The fact is that nothing can move that is not in some place. Every sensible body, I mean, is in a place, and there can be no motion except of such a body. Besides, local motion is primary to all movements. Take it away, and the others cease, as will appear later in Book VIII (chap. 7).

545. Thus, it is evident that the four things mentioned above are all involved in motion; hence, for the reason stated the study of them pertains to the natural philosopher.

546. Aristotle gives another reason why their study falls [to natural philosophy]. The aforesaid attributes are common to all natural things, and all natural things must be included for investigation in the science of nature. But the preliminary step should be the consideration of each of the things mentioned above, since the study of what is particular to anything should come after the study of what is common, as was said in the beginning (184 a 24). Among these common attributes of natural things, however, the first to be investigated is motion because the others flow from it, as previously said.

B. *Definition of Motion*

(In ***III Phys.,*** lect. 2, nos. 557-562; 572-573)

557. Some have defined motion as "the noninstantaneous transition from potency to act." So doing, they erred by putting into the definition of motion certain notions that are sequent to it. "Transition" is a particular kind of motion, and as for the word "instantaneous," its definition implies the notion of time, since the instantaneous is what occurs in an indivisible of time.

558. Consequently, it is absolutely impossible to define motion otherwise than Aristotle here does, if the definition is to be in terms that are prior to motion and more known. Every genus of being, as we have said (no. 548), is divided by potency and act. But potency and act are among the prime differences of being; as such, they are by nature prior to motion, and they are, accordingly, the notions that Aristotle uses to define motion.

559. Some things, it should be pointed out, are in act only,

others in potency only, and others still in an intermediate state between pure potency and perfect act. What is in pure potency is not yet in motion, and what is in perfect act is no longer in motion, but has already been moved. Hence, the moved is a thing in an intermediate state between pure potency and act, a thing partly in potency and partly in act, as may be seen in the motion that is alteration. When water, for example, is only potentially warm it is not yet in motion, and when it has become warm the movement toward warmth has run its course. When, however, it is already sharing somewhat of warmth but imperfectly, only then is it in motion toward warmth. So, then, what is getting warm shares gradually more and more in warmth.

560. Accordingly, this imperfect act of warmth existing in a thing that can get warm is motion, not just because it is in act, however, but on the ground that, already existing in act, it is ordered to further act. If the ordination to further act were eliminated, the anterior act, however imperfect, would not be motion but the term of motion, as happens when a thing is only half warmed. Ordination to further act pertains, however, to a thing that is in potency to it [i.e., further act]. If, on the other hand, the imperfect act be considered merely in its ordination to further act, that is, so far only as it has the formality [ratio] of potency, then again it does not have the formality of motion but the formality of principle of motion. For instance, the tepid as well as the cold can begin to get warm.

561. Imperfect act, in consequence, has the nature [ratio] of motion either way, that is, whether taken as potency in respect to further act, or as act in respect to something yet more imperfect. Hence, it is neither the potency of what exists in potency nor the act of what exists in act, but the act of what exists in potency. So, saying it is "act" we designate its order to the anterior potency, and saying "of what exists in potency" we designate its order to the ulterior act.

562. Thus, Aristotle has given a most appropriate definition of motion in saying that "motion is the entelechy, that is the act, of what exists in potency as such."

572. Here Aristotle explains the meaning of the phrase "as such," first by an example, then (573) by a reasoning in proof. To add the words "as such" was necessary, he says, because what is in potency is also something in act. But though one and the same existent subject is both in potency and in act, to be in potency and to be in act are not the same in formality *[secundum rationem].* Bronze, for example, is in potency with respect to a statue, and it is bronze in act; but the formality by which bronze is bronze is not the same as the formality by which it is in potency to a statue. Motion, accordingly, is not the act of bronze as bronze, but of bronze as in potency to a statue. If it were otherwise, then bronze would always be in motion, as long as it is bronze—which is obviously false. Hence the addition of the words "as such" was altogether apropos.

573. Next, Aristotle makes the same point by an argument based on the theory of contraries. The identical subject can be in potency to contraries. Blood, or the bodily fluid, is one and the same subject, in potency to both health and sickness. But to be in potency to health is clearly not the same as to be in potency to sickness—I mean this in relation to their objects. If, let us say, to be able to work and to be able to get well were the same, then to work and to get well would also be the same. As a matter of fact, however, to be able to work and to be able to get well differ in formality *[secundum rationem],* but the subject thereof is one and the same. Clearly, then, for a subject to be a certain being does not come under the same formality as for that subject to be in potency to something else. If it did, potency to contraries would all be one in formality. For the like reason color and the visible, I might add, are not one in for-

mality. So, then, it was necessary to specify that motion is the act of the possible "as such" *[in quantum est possibilis],* lest it be thought the act of what is in potency so far as the "what" is a certain subject.

C. The Kinds of Motion

(In V *Phys.,* lect. 3, nos. 1271-1275, 1287, 1293; lect. 4, nos. 1314-1315)

1271. Since motion is from subject to subject and subjects are in some genus of the predicaments, Aristotle concludes from what has gone before that the species of motion are differentiated according to the genera of predicaments; for motion, as has been said (no. 1244), receives its denomination and specification from its term. The predicaments are divided into ten genera of things, to wit, substance, quality, etc., as is seen in the book *Predicaments* (4, 1 b 25 ff.) and in the *Metaphysics* (A, 7). Since motion is found in three of them, there are three species of motion: the motion in the genus *quantity,* that in the genus *quality,* and that in the genus *place,* which is called local motion.

1272. How motion is realized in these genera and how motion pertains to the predicaments of action and passion was explained in Book III (3, 202 b 19). Hence, suffice here to say briefly that a motion is in the same genus of being as its term. Not that a motion whose term, for example, is quality, is itself a species of quality, but through reduction. Accordingly, just as potency is reduced to the genus of act for the reason that every genus is divided by potency and act, so motion, which is imperfect act, must be reduced to the genus of perfect act. But when motion is considered "in this" as coming "from another," or as proceeding "from this" to "another," then it pertains to the predicaments of action and passion.

1273. Aristotle now goes on to show first, that motion cannot be in any other genera besides the three mentioned, and secondly how it exists in those three. Concerning the first point he establishes three things: a) that motion is not in the genus of substance, b) that it is not in the genus of relation, and c) that it is not in the genus of action or passion.

1274. Aristotle makes no mention herewith of three predicaments: "when," "position," "possession" *[quando, situs, habere],* "When" indicates existence in time, but time is the measure of motion. Hence, for the same reason that motion is not in action and passion, which pertain to motion, it is also not in time. "Position" expresses a certain order of parts, and order is relation. "Possession" also implies a certain relation between a body and what is near or next to it. However, motion is not in relation, so it cannot be in "position" and "possession" either.

a) 1275. That motion is not in the genus of substance Aristotle proves thus. Every motion, as has been said (nos. 1257-1258), takes place between contraries. But nothing is the contrary of substance. Hence there is no motion by substance.

b) 1287. Next, Aristotle shows that motion is not in the genus of relation. In every genus where motion properly speaking takes place, nothing new pertaining to this genus can be found in a thing unless the thing itself has undergone some modification. A new color, say, is not taken on by a colored body without the latter being altered. But it does happen that a thing, though not itself modified, is truly said to be in a new relation to another when this other undergoes some modification. Hence motion is not, *per se,* in the genus of relation, but only *per accidens,* that is, so far as a new relation follows upon some change. So it is that upon a quantitative change follows

equality or inequality, and upon a qualitative change similarity or dissimilarity.

c) 1293. Thirdly, Aristotle proves that motion is not in the genus of action or passion. Action and passion do not differ from motion as to subject, but they add a formality *[aliquam rationem]* to motion, as stated in Book III (202 b 19). Hence, saying that motion is in action and in being-acted-on *[in agere et pati]* is saying that motion is in motion. [But this, Aristotle shows, is impossible for six reasons, which St. Thomas sets forth in the succeeding nos. 1295-1312 of the Commentary.]

Leet. 4, 1314. Aristotle has now told why motion is neither in substance, nor in relation, nor in action and passion. From this he infers the genera in which it is found. . . . The conclusion, accordingly, is that motion is only in these three genera, namely, quantity, quality, and place, the reason being that in each of these genera there is contrariety, which motion requires.

1315. But the reason for excluding the three genera "when," "position," "possession," and the way in which contrariety exists in the three genera where motion exists, all this has been explained. [For the manner of contrariety in the genera of motion, that is, "quality," "quantity," and "place," see In V *Phys.,* lect. 3, nos. 1285-1286, which do not appear above.]

IV. DEFINITION OF PLACE

(In IV *Phys.,* lect. 6, nos. 875-882, 885, 891-901)

Space and time afford the universal setting for physical motion. Quite naturally, then, philosopher and scientist alike generally incorporate the study of motion into this framework. Aristotle himself, in the *Physics,* was perfectly

aware of the part that space and time contribute to motion. For him, in fact, place (if not space) and time are the extrinsic measures of motion.

The paragraphs here cited represent but the core of Aristotle's step-by-step elucidation of the nature of place, an elucidation to which St. Thomas lends valuable commentary. Aristotle, in this discussion, expresses insights which, enfranchised to no particular era of science, have stood through every scientific advancement; their validity is unimpaired. But interspersed with these basic notions are others, the property of a scientific outlook that is admittedly obsolete. This heterogeneous texture of the argument should be borne in mind as one reads the following excerpts; for without the separation of the essential from the dispensable in Aristotle's theory of place, any attempt to integrate it with modern conceptions of the physical universe must prove ill-fated. (Collate with *supra,* "The Problem of Place," p. 108.)

875. From what has now been said (nos. 858-873), what place is begins to be evident. According to the commonly held opinions place is one of these four things: a) either the matter, b) the form, c) a space comprised within the limits of the containing body, d) or, if within these limits there be no space having dimensions other than the magnitude of the body within the containing body, then it is necessary to adopt a fourth answer, namely, that place is constituted by the boundaries [inner surface] of the containing body.

876. Aristotle eliminates three members of the aforesaid list. . . .

a) *Place is not the form (configuration of the contained body)*

877. Concerning this opinion he establishes two things. First he explains why the form might seem to be place. Form contains, and this appears to be the characteristic of place. Indeed, the boundaries of the containing body and those of the contained are together [sunt *simul],* since the container and the contained touch throughout. Thus it is that the boundary of the container, which is place, does not appear to be distinct from the boundary of the contained body, and place, in consequence, seems not to differ from the form.

878. Next he shows that the form is not place. Even though place and form agree in each being a boundary, they are not boundaries of the same thing. Form is the boundary of the body of which it is the form, but place is not the boundary of the body of which it is the place, but the boundary of the containing body. So, the boundaries of container and contained are not the same thing, despite their being together.

b) *Place is not an intermediate space*

879. Here Aristotle deals with the opinion that place is space. First, again, he shows why space would seem to be place; and secondly, why it is not. Frequently, he says [in reference to the first point] the body contained by place and distinct from it is changed from one place to another and bodies successively occupy the same place, yet all the while the container remains unmoved, after the manner that water empties from a vessel. This observation leads to the impression that place is an intermediate space within the boundaries of the containing body, as though, in addition to the body that is transported from one place to another, something else were there. If [runs the argument] nothing else were there besides that body, we should

have to conclude, either that place is none other than the placed thing, or that what is intermediate to the boundaries of the container cannot be place.

880. But [continues the argument] just as place is necessarily something other than the contained body, so, apparently, it must be something other than the containing body, because place remains unmoved, whereas it may happen that the containing body and everything in it is removed. Yet, other than the containing and the contained body the only thing there could conceivably be is dimensions of space that are not in a body. Considering, therefore, that place is immovable, space would seem to be place.

881. Aristotle then shows that space is not place, and this for two reasons. First, it is not true that within the extremities of the containing body there is anything else than the containing body that is removable from place to place. Within the extremities of the containing body there is simply a body, which can be any body whatever, so long as it is mobile and by nature apt to be in contact with the containing body.

882. Indeed, if in addition to the dimensions of the contained body there could be an intermediate containing space that always remained in the same place, we should be faced with an impossible situation, namely, an infinity of places existing simultaneously. . . . [This impossibility is elaborated in nos. 883-884.]

885. Aristotle's second reason against space being place is as follows. If the dimensions of the space within the extremities of the containing body are place, it follows that place can change position. For, it is evident that if a body, say a jar, is removed, removed by that very fact is also the space comprised within the limits of the jar, since this space is only where the jar is. But whatever is removed to a place is penetrated, according to theii position, by the dimensions of the space to which it is removed.

The result is that other dimensions intrude the dimensions of the space in the jar, and thus of one place there will be another place, and many places will be coincident *[erunt simul].*

c) *Place is not the matter [the receiving subject)*

891. Aristotle passes now to the opinion that place is the matter. First he explains why the matter is said to be place; secondly, that it is not place. Matter, he says, appears to be place if one considers how bodies succeed each other in the same place, place being like a subject that remains locally unmoved. For the moment, also, no account is taken of the fact that place is separable, but only that the change occurs in a single continuous subject. Suppose that a continuous body undergoes alteration while remaining locally unmoved. It may become alternately white and black, soft and hard; yet all the while it is numerically one and the same body. Because of this change of forms relative to the subject we say that matter is something that remains one or the selfsame though the form has changed. And since place gives a similar impression, it appears to be a comparable reality; it abides and is successively occupied by different bodies. However, we do not describe the two cases in the same way. To designate matter or the subject we say, for example, that "what is now water, was previously air," but to signify the unity of place we say rather that "where now there is water, there was previously air."

892. Next, he explains why matter is not place. As earlier noted (no. 823), matter is not separate from the thing of which it is the matter; neither does it contain the thing. Both circumstances, however, are true of place. Hence, place is not the matter.

d) *Place is the limit (boundary) of the containing body*

893. Having eliminated three opinions, Aristotle concludes in favor of the fourth. Since place, he says, is none of the three entities considered so far, neither the form, nor the matter, nor a space distinct from the dimensions of the thing in place, it must be the last of the things mentioned above, "the limit of the containing body." And lest anyone should think that the contained or what is in place is an intermediate space, he adds that the contained body is what by nature is apt to be moved according to local motion.

e) *Place is immovable*

894. Aristotle then proceeds to investigate the characteristic difference of place, which is immovableness. In the inquiry he makes two points, showing first that a faulty understanding of this difference has given rise to an error concerning place, and secondly how the immovableness of place is to be interpreted. He begins, accordingly, by saying that what place is seems to be a great and difficult thing to comprehend. Creating this impression is the fact that some think place is the matter or the form, an opinion deserving of the highest consideration, as mentioned earlier (no. 822). Another reason is that the change of what is moved locally takes place in something at rest and having the nature of a container. Nothing but space, however, seems to be containing and immovable; hence there is apparently no other course but to regard place as an intermediate space distinct from magnitudes that are locally moved.

895. Adding no little credence to this opinion is that air appears to be incorporeal. Where there is air, there is apparently no body but an empty space. Thus it seems that place is not

only the limits of the vessel but something between them, in the manner of a void.

896. Aristotle now explains how the immovableness of place is to be understood and, in consequence, the preceding opinion ruled out. A vessel and a place differ, he says, in that a vessel is transportable, but not place. Hence, just as a vessel can be called a "transportable place," so place can be called an "immovable vessel." When, accordingly, a thing is carried in a body which itself is moved, a boat in a river for example, the thing utilizes this body as a vessel rather than as a place. Place, in fact, "wants to be immovable," meaning that by aptitude and nature it is immovable. Consequently, it is truer to say that the place of the boat is the whole river because as a whole it is immovable. The whole river, then, considered as immovable, is the place in general.

897. As for place proper, this is part of the general place; therefore, the proper place of a boat in a river has to be defined by its relation to the whole river considered as immovable. So it is that we should describe the place of the boat in flowing water not by the water that glides on, but by the bearing or the position this flowing water has to the whole river, and this bearing or position remains the same for the water that follows. Materially considered, therefore, the water keeps flowing by; but considered as having the character *[rationem] of* place, that is, as having this particular bearing or position to the whole river, from this standpoint it does not change.

898. This explanation, moreover, tells us how we should understand that place is constituted by the limits of natural mobile bodies. Here, similarly, we must take place in relation to the whole spherical body of the heavens. Because the center and poles are immovable, this body has fixture and immovableness.

899. This portion of air, accordingly, which was the con-

tainer, may change and move on, as also this portion of water considered as this water. But considered as having the character of place, namely, position and bearing in relation to the whole sphere of the heavens, the water remains the same throughout. So it is also that fire is said to remain the same as to form, though from the standpoint of matter it changes by reason of the alternate addition and consumption of wood.

900. The aforesaid explanation also disposes of a possible objection against our saying that place is the limit of what contains. What contains is understood to be mobile; hence the limit of the container will be mobile, and furthermore, a thing at rest will have divers places. But this deduction is not valid. The limit of the container was place, not according as it is the surface of this particular mobile body, but according to the bearing or position it has in the whole immovable. Thus it is evident that the principle of place for all containers depends entirely on the prime container and localizer, which is the heaven *[tota ratio loci in omnibus continentibus est ex primo continente et locante, scilicet caelo].*

f) *Conclusion: definition of place*

901. From the foregoing considerations Aristotle concludes the definition of place, namely, that place is "the immovable limit of the prime container." He specifies "prime," to indicate place proper, and exclude place common.

V. DEFINITION OF TIME

(In IV *Phys.,* lect. 17, nos. 1099-1113)

Time is the measure of motion in respect of before and after: *tempus est mensura motus secundum prius et posterius.* This definition of Aristotle's is classic, but far from self-evident. For this reason St. Thomas' explanatory les-

son, save for the omission of the first paragraph, is reproduced in full. St. Thomas, as usual, unravels the meaning with the dexterity of the master he is. (Collate with ***supra,*** "Time," p. izo.)

a) *Time is "something of motion"*

1099. First, Aristotle examines this part of the definition, namely, that time is "something of motion." Since, he says, we are investigating what time is, we must begin by identifying the element of motion that answers to time *[quid motus sit tempus].* That time is something pertaining to motion is evidenced by the fact that we perceive motion and time together. True, we sometimes perceive the passage of time even if we sense no particular sensible motion, as when in the dark we have no visible perception of motion in an external body. If under these circumstances we experienced in ourselves no bodily alteration produced by an external agent, we should indeed perceive no motion of the sensible order. But if under these same circumstances a movement arises in the soul, a succession of thoughts or images, instantly it appears to us that there is time. Thus, whatever the motion, perceiving it we become aware of time; and conversely, in the awareness of time we have also the perception of motion. Since, then, time is not motion itself, as proved earlier (nos. 1092-1094), it must yet be something pertaining to motion.

1100. There may, however, be some doubt in reference to what is here said about the perception of time and motion. If time arises from sensible motion exterior to the soul, then, in consequence, whoever does not have a sensation of that motion will not have the sensation of time; yet the contrary has just been affirmed. If, on the other hand, time results from a movement in the soul, then, in consequence, things will not be related to time except through the agency of the soul, and

so time will not be a reality of nature but an "intention" of the soul [i.e., a mere logical entity or being of reason], comparable to the "intentions" *genus* and *species.* And if, finally, time arises universally from every motion, then there will be as many times as there are motions. But this is impossible, because two times cannot exist simultaneously, as was said earlier (nos. 1081-1083, 1090).

1101. To resolve these difficulties we have only to remember that there is one primary motion, which is the cause of every other motion. Consequently, all things whose being is subject to change derive this condition from that primary motion, which is the motion of the prime movable. Furthermore, whoever perceives a motion of any kind, whether it be in sensible things or in the soul, has the perception of a changeable being, and in consequence the perception of the primary motion from which time results. Whoever, then, perceives a motion of any kind perceives time, notwithstanding that time follows only from the one primary motion by which all other motions are caused and measured. And thus there is only one time.

b) *"in respect of before and after"*

1102. Next, Aristotle considers the second part of the definition of time. Granted that time is something of motion, namely, something that follows from it, we must then investigate in what respect time follows from motion, that is, "in respect of before and after." To this end Aristotle establishes three things, showing: 1) how before and after occur in motion, 2) how before and after compare with motion itself, and 3) that time follows on motion by respect to motion's before and after. Concerning the first point he declares two things: that continuity in time results from motion and magnitude; and so does before and after.

1103. 1) First, then, he states that whatever is moved is

moved from something to something. But among all mol ions local motion is primary, and this is from one place to anol her, according to a certain magnitude [i.e., of distance]. Time, how ever, follows from the primary motion; consequently, in investi gating the nature of time we must consider motion according to place.

1104. Now, motion according to place is motion according to the magnitude from one thing to another. But every magnitude is continuous; hence the motion must follow the magnitude in continuity. If, in other words, magnitude is continuous, motion according to magnitude must be continuous too. But then time also is continuous; for the amount of primary motion there is, that much time appears to pass. Not that time is measured according to the quantity of any motion whatever, seeing that the slow moves a little distance in much time, and the fast is just the opposite. Time, in short, follows the quantity of the primary motion only.

1105. Aristotle then shows that the same order of things applies to before and after. Before and after, he says, are first of all in place or magnitude, the reason being that magnitude is a quantity having position, and before and after are of the nature of position *[de ratione positionis].* Hence, by the very fact of position place has before and after. And since before and after are in magnitude, they must also be in motion, proportionately to the things "that are there," that is, in magnitude and place. Consequently, before and after are also in time, because motion and time are such that the one [i.e., the latter] always follows according to the other *[semper alterum eorum sequitur ad alterum].*

1106. 2) Next, Aristotle explains how before and after compare with motion. The before and after "of these things," he says, that is of time and motion, are identical in subject with motion *[quantum ad id quod est, motus* est]. But according to

definition *[secundum rationem]* they differ from and are not motion. Motion, by definition, is the act of what exists in potency, whereas before and after in motion result from the order of parts in magnitude. Thus, before and after are identical in subject with motion, but differ from it in definition.

1107. Since, then, it has already been shown that time follows on motion (nos. 1099-1101), what remains to be established is whether time follows on motion as such, or as having before and after.

1108. 3) Aristotle now shows that time follows motion by reason of motion's before and after. As remarked earlier, we perceive time and motion simultaneously, and from this experience we learn that time follows on motion. Time, however, will follow motion in accordance with that thing in motion whose knowledge results in the recognition of time. But we recognize time when we distinguish motion by before and after; and we say that time elapses when we take cognizance of the before and after in motion. Thus it must be that time follows on motion according to motion's before and after.

c) *The "number of motion"*

1109. Aristotle then determines what property of motion is time. Time, he concludes, is the "number of motion." He proves this by the same middle term, namely, by the knowledge of time and motion. It is clear that then we declare there is time when we apprehend distinct moments *[aliud et aliud]* in motion and mark an intermediate between them. When, in other words, we think of the opposite extremes of a mean and the mind pronounces them to be two nows *[duo nunc],* one before and one after, as if to count the before and after in motion, this we then say is time.

1110. Time, as a matter of fact, seems to be determined by the now itself. This we assume, at least for the while; it will

become more evident in the sequel (no. 1122). When, accoid ingly, we perceive a single now without discerning a befoir and after in motion, or when we discern a before and all ‹l in motion but take the same now as the end of what is befoic and the beginning of what is after, in these circumstances il docs not appear that there is time, because there is no motion cither. But when we mark before and after and number them, then we say there is time, and this because time is none other than "the number of motion according to before and after." For, as has been said (nos. 1096, 1109), we perceive time when we number the before and after in motion. Clearly, then, time is not motion, but follows from motion according as it is numbered. Therefore time is the number of motion.

1111. If to this definition it be objected that before and after are determined by time and so the definition is circular, the answer is that before and after are put in the definition of time according as they are caused in motion by magnitude, and not as they are measured by time. As Aristotle explained earlier (cf. no. 1105), before and after are in magnitude before they are in motion, and in motion before in time. Thus he forestalled this very objection.

d) *Supplementary clarifications*

1112. Finally, Aristotle illustrates the aforesaid definition in two ways. His first illustration is by a sign. That by which we judge a thing to be more and less is, he says, its number. But we judge motion to be more and less by time, hence time is its number.

1113. Secondly, he illustrates the assertion that time is number with a distinction relative to number. Number, he says, can be taken in two senses. It may mean what is actually counted, or what is countable, as when we say “ten men” or “ten horses.” This is called *numbered* number, because it is number applied

to the things that are counted. In another sense number means the number *with which we count,* that is, number itself taken absolutely, such as "two," "three," "four," etc. Time is not the number with which we count; if it were, then the number of any thing at all would be time. Time is rather numbered number, because the actual number of before and after in motion, and even the things that are counted according to before and after, are called time. Consequently, even though number is discrete quantity, time nevertheless, because of the thing numbered, is continuous quantity, just as ten measures of cloth are a continuum, albeit the number ten is a discrete quantity.

VI. THE PRIME MOVER IS WITHOUT MAGNITUDE

(In VIII *Phys.,* lect. 23, nos. 2546-2550)

The following selection represents the crown and pinnacle not only of Aristotle's demonstration of the prime mover but of his entire philosophy of nature. The demonstration itself occupies almost all of Book VIII. The achievement is marked throughout by the closest and the most stringent reasoning as it moves step by step to its culmination: the existence of a first immovable mover. What the exact nature of this mover is metaphysics rather than natural philosophy must, as far as possible, tell. But already in the *Physics* Aristotle goes so far as to declare that it is without magnitude, which is to say it does not belong to the world of matter. May one, at this juncture, go still further and say it is God? St. Thomas, as will appear, takes this final step. (Collate with *supra,* "The Prime Mover Is Without Magnitude," p. 142.)

2546. From what has now been demonstrated, Aristotle draws the conclusion that had been the principal object of his search. It is impossible, he says, for the first immovable mover to have magnitude, whether as being itself a body, or as being a force [virtus] residing in a body. If it had magnitude, this would be finite or infinite. However, in Book III (chap. 5), in discussing the common properties of nature, it was proved that no magnitude can be infinite. If, then, this mover has magnitude, it must have finite magnitude.

2547. But it does not have finite magnitude either. This is proved by the fact that finite magnitude cannot have infinite power. [Yet the first immovable mover must have infinite power; hence it cannot have finite magnitude.] [1]

2548. That the first immovable mover must have infinite power Aristotle proves from what was demonstrated earlier, namely, that it is impossible for a thing to be moved for infinite time by a finite power. Yet the prime mover causes perpetual and continuous motion, which exists as one selfsame motion through infinite time; otherwise this motion would not be continuous. Therefore the prime mover has infinite power; and consequently it has neither finite nor infinite magnitude.

2549. Thus it is apparent that the prime mover is indivisible and has no parts, just as a point also is indivisible; and having no magnitude at all, it exists in some manner outside the realm of magnitude *[quasi extra genus magnitudinis existens].*

2550. And so Aristotle terminates his general study of nature in the First Principle of all nature, which is God, blessed above all forever. Amen.

[1] The bracketed sentence is in the Leonine, but not in Pirotta.—[Tr.]

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