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THE SOCIETY FOR ANCIENT GREEK PHILOSOPHY
The Functionalism and Dynamism of Aristotle

It is the contention of this paper that Aristotle's thought is relevant and suggestive for two of the most important present-day philosophical movements, the concern with language, and the concern with natural processes and their analysis. For Aristotle is not adequately understood merely as that "syllogistic gentleman with a category for every emergency,"¹ whom the pseudo-Aristotelians, from Thomas Aquinas down,

¹ The phrase I owe, like so much else, to my teacher F. J. E. Woodbridge.

have made out of him. Aristotle can be viewed today as the outstanding functionalist in the Western tradition. In modern terms, he is a behaviorist, an operationalist, and a contextualist, with a thoroughgoing philosophy of process. St. Thomas is no doubt very, very important--he certainly has been and is a tremendous power. But Aristotle's philosophy is more than "important": it is true. It is not the whole truth, of course: it remains open and growing. We have learned a lot more, especially from our experience of cultural change and history: and we have much still to learn. But Aristotle's wisdom does seem to be the foundation of any possible truth. Aristotle did not say the last word on anything. But without what Aristotle did say, all words would be meaningless. And when what Aristotle said is forgotten, they usually are.

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For Aristotle, understanding and thinking are not only the product of logos, of language, terms, propositions and demonstrations, of what things can be said to be. Understanding is also a biological process, a natural activity practiced by men in a world that is intelligible, a characteristically human way of living in an environment that sustains it.

The fact that knowing or understanding can itself be analysed in these two quite different ways illustrates that double approach and aspect that appears throughout all Aristotle's investigations. His inquiries are carried on with two different sets of concepts. Things can be understood in the way they can be talked about, and they can also be understood as taking part in a dynamic process of change. They lend themselves to intelligible expression in terms of language, and they also have a career, a kind of life. Aristotle therefore developed and used a set of distinctions appropriate to talking, to discourse or logos, and also another set of distinctions appropriate to becoming, to living. The first or logical concepts and distinctions are well illustrated in the Organon in general, and in the Posterior Analytics in particular, which seeks to consider what science or true knowledge is, regarded from the point of view of the way language is used as an instrument to express it. The second set, the functional or biological concepts and distinctions, are illustrated in the De Anima, which Aristotle himself announces as an introduction "to the whole domain of truth, and more particularly, to the study of nature, psyché being as it were the arché of all living

things."² They are applied in the De Anima to living processes in

² De Anima 402a 4-8.

general, and also to knowing, considered not as the creation of language, but as itself a living process, as a natural activity in a knowable world.

The Posterior Analytics and the De Anima taken together thus furnish an excellent introduction to the double method and the double set of concepts of Aristotle. The various relations between these two sets of distinctions, and between them and the common world they have been developed to render intelligible, furnish the theme of the central core of that compilation of writings we know as Aristotle's Metaphysics, Books Zeta, Eta, and Theta, in which what Aristotle himself calls "first philosophy" appears as an inquiry into just these ultimate distinctions.

However, it is not quite accurate to speak of Aristotle as using a "double method." The relation between the two approaches in his inquiries is actually much more intimate than that would suggest. For his investigations normally follow the same pattern in any field. Starting always with what things can be said to be, and with the careful analysis of that saying---starting, that is, like an Oxford logician, with an analysis of the language in which things are talked about and stated--he always finds that this linguistic analysis, clarifying and essential as it is, sooner or later reaches a point where it raises questions that cannot be answered through the analysis of language alone, a point not yet reached by the Oxford analysts. He then asks, "Well, how did this thing come into being?" He is led to examine the further context of discourse, in which we must "see" that subject-matter, those things in their genesis and operation, co-operating with other things in the world of natural process, before we can arrive at an adequate statement of what they are. That is, the formal analysis with which Aristotle always begins his inquiries into any field, the formal analysis of the language in which we express what is there, drives him to a "physical" or functional analysis of what is there itself. Starting with what the logikos or talker, the dialektikos or dialectician, has said and continues to say about a subject-matter, he is led to what the physikos, the "natural philosopher" or investigator of natural processes, can find in the world. This contrast between the logikos and the physikos runs throughout Aristotle. In his view, the logikos can formulate the questions, but it is ultimately the physikos who must answer them.

1. What is Life?

The De Anima, Peri Psychēs, is about what the Greeks called psychē. At the outset Aristotle defines psychē as the archē of zōē, living things: as that which sets off and distinguishes "living" beings from those that are not living. The Greeks made their distinction between what they called ta empsycha, "animate" things, the things that possess psychē, and ta apsycha, "inanimate" things, the things without psychē. Animate things behave and act in a different way from

inanimate things: characteristically, the Greeks made their distinction in terms of two ways of behaving and functioning, whereas we moderns distinguish the "organic" from the "inorganic," in terms of two different kinds of structure. The difference between ta empsycha, the animate, and ta apsycha, the inanimate, is clearly that the former possess psychē or anima, the latter do not. The first possess "life," the second do not. What is this "life" or psychē? What is its nature and essence, and what are its properties? This is the question with which Aristotle starts out.

The De Anima is thus an introduction to the sciences which deal with living things, with special reference to human living. Its title, Peri Psychēs, should really be translated, On Living and Knowing. For Aristotle, starting in the first book, as always, with what earlier Greek thinkers had said about life or psychē, finds that the term had been used in the attempt to explain living and knowing. It had been taken as that archē which would not only distinguish the animate from the inanimate, but would also make living and knowing intelligible. For Aristotle is not inquiring merely into a term or a thing, least of all into what we may mean when we use the term "soul." He is inquiring into a subject-matter which that term as an archē sets off as the field for a distinctive inquiry or science, namely, the processes of living and knowing.

"Life" or psychē thus means for Aristotle the complex but determinate power which all living things, all empsycha, exhibit. It is the power possessed by living organisms of moving themselves, and of discriminating between other things, of "sensing" them, and, in man, of "knowing" them, so important a part of human living. As the archē of animals, of zōa, it is the determinate power in terms of which the various specific activities and behaviors of different kinds of living organisms are to be understood. This distinctive power possessed by living things, their "life" or psychē, is a cardinal instance of that kind of archē in terms of which the activities of all natural things, all physika, are to be understood: psychē is an instance of the "nature" or physis of natural things, which is their power of acting in definite and discoverable ways. For ta empsycha, animate things, belong to the large and more inclusive class of physika, natural things, and the "nature" or physis of living bodies to act in specific ways is their psychē, their "life," their tendency to act and function in a determinate manner. Thus every "life" is the "nature" of the living body whose life it is; but not every "nature" is a "life," only the "natures" of living bodies.

Hence for Aristotle psychē meant two things: 1) the power or archē of living, "life"; and 2) the power or archē of what he calls "discriminating", to kritikon: the power of selective response, which includes both sensing and knowing. Since traditionally psychē has been turned into Latin as anima, and into English as "soul," it is important to realize at the outset that Aristotle is not talking about the "soul," as centuries of Christian supernaturalism, to say nothing of Cartesian dualism, have led us to conceive it. That conception of a "soul" quite independent of any body, as he encountered it in the Pythagoreans, he

could not take seriously. He calls the notion "absurd":

Such theories attach the psychē or "soul" to, and inclose it in, body, without further determining why this happens and what is the condition of the body.... The supporters of such theories merely undertake to explain what kind of thing the psychē is. Of the body which is to receive it they have nothing more to say: just as if it were possible for any soul taken at random, according to the Pythagorean tales, to pass into any body. But each body seems to have its own distinctive form (eidos kai morphē). It is just like saying that carpentry can pass into flutes: for the art must employ its own instruments, and the psychē its own body.³

³ De Anima 407b 15-26. Eidos kai morphē is the technical phrase translated into Latin as forma, and into English as "form." It means, in this case--for all Aristotelian terms depend upon the case, and each legetai pollachōs--what makes the body what it is, a particular living body of a particular kind. Aristotle of course holds that psychē or "life" is the "form" of the living body.

Thus for Aristotle the psychē is not the archē of religion. He is not investigating the Christian anima or "soul," but rather "living," "sensing," and "knowing," taken as biological processes. He is asking, "Just what do we mean by 'life'?"

Now, if life or psychē is the power of living and knowing, then it is clearly not a thing, like the living organism or body, but rather an activity or function of the living organism. It is not an ousia or "substance" capable of existing independently by itself, but rather the "form" of the living organism. That is, life is not an additional "thing" besides the body, but the body's power to do what the living body does, its function (ergon), its operation (energeia), its end (entelecheia).⁴

⁴ These three terms are one of Aristotle's families of terms which mean the same thing in a scale of increasing emphasis. Ergon, the common term for "work" in Greek, is the term Aristotle uses for what we call "function." Energeia means literally the "putting to work" of a "power," or in Latin, its "operation." "Power" and its "operation," dynamis and energeia, are for Aristotle polar concepts, like the corresponding abstract Latin terms, the actualization of a potentiality. Entelecheia, "entelechy," is a term invented by Aristotle to denote the most complete functioning of a thing--in Latin, its "actuality."

The "life" of that living body is what makes it that kind of a body, and hence is that body's "form."

Aristotle uses two examples to make his meaning clear. If the living organism, instead of being, as it actually is, a complex organization of many organs, were instead a single natural organ, like the eye, then "vision," the power of seeing (opsis), would be its "life," or psychē. Or if it were an instrument made by art, say, an axe, then the power of cutting would be its "life" or psychē. Exactly the same is the relation of the living organism to its "life" or psychē. It is the relation of the instrument or organ to its function, its power of functioning--the relation of the flute to fluteplaying.

Hence Aristotle's first and formal definition of "life" or psychē runs: "Life is the first entelechy of a natural body possessing the power to live (dynamēi zōen echontos)."⁵ Life is the first

⁵ De Anima II, 412a 27, 28.

entelechy, as the power to live and know. The second entelechy is the operation of that power, "actual" living and knowing--as we still say. The difference between the first and the second entelechy is the difference between possessing a function, and exercising that function: it is the difference, says Aristotle, between possessing knowledge when asleep, and knowing when awake. "Life," psychē, is a function in both senses, but it is primarily the power to perform the function.

2. Aristotle's Functionalism.

Now an organic body can exist, for a while at least, without life or psychē: it can be dead. But life, psychē, obviously cannot exist without a living body. Life, as the archē of the living body, is that in terms of which the body's actions and behavior are to be understood. But life, psychē, is itself not understood in terms of the body and the body's structure. In general, for Aristotle an activity or function, though it always involves an instrument with a determinate structure, so that that kind of instrument is necessary to the performance of that function, and without that instrument the functioning cannot occur--there can be no fluteplaying without a flute--is not to be understood merely, or adequately, in terms of its necessary instrument alone. He puts it: "Activities and functions are logically prior to powers (and their instruments)."⁶ That is, we understand powers in terms of their

⁶ De Anima II, 415a 18-20.

operations. We understand the power of sight or vision in terms of the activity of seeing, and likewise the instrument by means of which vision operates, the eye. We understand the power of thinking, nous, in terms of the activity of thinking, and likewise the instrument by means of which thinking operates, the images or phantasmata. Aristotle is a thoroughgoing functionalist and operationalist.

Moreover, activities and functions are themselves understood in terms of that toward which they are directed, of that to which they can be said to be a "response," their "correlative objects" (ta antikeimena). Seeing is understood in terms of what is seen, the visible; nutrition (or metabolism) is understood in terms of what is assimilated as food; desiring is understood in terms of what is desired; thinking is understood in terms of what is thought. There is some object or objective in the environment, in the situation or context, to which the activity is a response, and toward which it is directed. The activity cannot be understood without reference to such an environment or context and to the objective to be found in it. Aristotle is a thoroughgoing contextualist or objective relativist. It is in terms of this objective or end in the context that we understand the activity; and it is in terms of the activity that we understand the power. Aristotle's Greek is able to indicate these relations through appropriate suffixes. Thus it is through its objective or end, "the desired" (to orekton), that we understand "desiring" (to oregesthai); and it is through desiring that we understand the power of desiring (to orektikon). Likewise, it is through what is sensed (to aisthēton) that we understand sensing (to aisthanesthai); and it is through sensing that we understand the power of sensing (to aesthētikon). It is through what is known (to noēton) that we understand knowing (to noein); and it is through knowing that we understand the power of knowing (to noētikon, or nous).

In general, for Aristotle the living organism is understood in terms of its "life" or psychē, its unified functioning in response to stimuli in its environment--how it acts and behaves in its context. In other words, for Aristotle life or psychē is the behavior of the organism as a whole in its environment. Aristotle is thus a thoroughgoing behaviorist. He is, of course, a functional and contextual behaviorist, not a mechanistic behaviorist. For him, life is the power of living and knowing, the power of selective response of the organism to the world. It is a natural function, like the breathing or the digestion that are aspects of life--"parts" of it, Aristotle puts it.

3. Aristotle's Dynamism.

The two highest functions involved in living, sensing and knowing, which Aristotle groups together as to kritikon, the power of selective or discriminating response, and treats as "passive powers," powers of being acted upon, by sensed objects (aisthēta) and by noused objects (noēta) respectively, he treats before dealing with life as an active power, as the "mover" of the organism (to kinoun), which he does not get to until the last five chapters of the De Anima. But these two passive powers must be seen in the context of the active power of desire (orexis), for they serve to modify and direct it: that is why they are grouped together as to kritikon, the power of discrimination and selecting.

In his general analysis of this active function, Aristotle distinguishes four factors in the process of motion in animals:

Motion implies three things: first, the mover (to kinoun); secondly, that by which it moves; and again thirdly, that which is moved (to

kinoumenon). The mover is itself twofold: first, that which is unmoved, and secondly, that which moves and is moved. The unmoved mover is the practical good; that which moves and is moved is the power of desiring (to orektikon). For the animal which is moved is moved in so far as it desires, and desire (orexis) is a kind of motion or operation (energeia). Finally, the thing moved (to kinoumenon) is the animal. The organ with which desire moves it, once reached, is a part of the body.

⁷ De Anima III, 433b 13-19.

What moves the living organism to action, therefore, the "mover" (to kinoun), is thus twofold, There is something in the situation, to orekton, the object of desire; and there is something in the organism itself, "desire" (orexis). The ultimate mover, the ultimate spring of action, is the desired, to orekton: some stimulus in the situation, some end of conduct, some practical good, which is not itself moved or affected by being desired, and is hence an "unmoved" mover. The immediate mover, the immediate spring of action, is desire itself, awakened by the stimulus of the desired. Desire then acts through some organ of the body; the organism as a whole responds and seeks the object of its desire. The instrument or efficient cause involved, the "by which," is the bodily organ by which the organism is moved.

Aristotle here speaks of life, psychē, and its "parts," like desire, as "moving" the organism, not mechanically--the various organs of the body, like the legs, do that--but in the sense in which any particular function can be said to "move" the body. Desiring something moves the organism to get it, just as seeing a snake makes us avoid it, or running enables us to escape. All these functions, like desire, or like their sum, life itself, Aristotle calls "moved movers," in contrast to the unmoved mover in any process, the object of desire. A function he considers as a motion or process that can initiate other motions.

The "unmoved mover" in any process is thus in one sense a factor in that process: it is the stimulus (though not a mechanical stimulus), the point toward which the process is directed. The process is defined and understood in terms of that particular unmoved mover. In another sense, however, the unmoved mover is outside the process, "external" to it: it is itself unmoved, not affected by the process (apathes).⁸

⁸ Compare Whitehead's very similar Aristotelian analysis of process. For him, the relation between an "eternal object" and an "actual occasion" is "internal-external." That is, an actual occasion, or process, is itself constituted by the eternal objects ingredient in it: in this sense, the two are internally related. But the eternal objects are not themselves affected by their ingression into the process: in this sense, they are externally related to it.

Thus for Aristotle's analysis, every individual process has its own unique unmoved mover. The name is a generic term for a factor to be found in every process. There are untold billions of unmoved movers in Aristotle's world. When he generalizes, he gives to them a mythical unification, as in Book Lambda of the Metaphysics. And this mythically unified Unmoved Mover possesses the same traits as the factor in every process: in one sense it is immanent in every process, in another it is transcendent, and external to all processes. But even in Book Lambda Aristotle at once goes on to speak in chapter 8 of 55 Unmoved Movers. Aristotle's is a pluralistic philosophy, not a monistic or monotheistic theology.

The action of all living organisms is thus a response to some stimulus. In those animals that do move as a whole, including men, their movement proceeds from an impulse or drive, what Aristotle calls a hormē; such a hormē or drive he sees implanted in everything that exists by nature. Every natural thing, every physikon, has its own distinctive drive or hormē, to act in its own proper and determinate way. This Aristotelian hormē is the counterpart in his conception of the world, his vision of the cosmos, of the "inertia" of masses in the Newtonian philosophy of nature.

In animals--in life lived on the sensitive level--this universal hormē appears as orexis, desire (in Latin, appetitus), the desire for or aversion to something in the environment, to orekton, the desired. In 17th century philosophizing, this Aristotelian "desire" takes the form of Hobbes's "endeavor toward or fromward"-- in many fundamental respects Hobbes remained a good Ockhamite Aristotelian. It appears as Spinoza's conatus, though with his rejection of natural teleology, it becomes a Stoic conatus sese conservandi, an endeavor to persist in its form of being, rather than, as in Aristotle, a drive to achieve its own characteristic form of being.

4. Human Action as Intelligent Response to the Object of Desire.

All human action therefore likewise proceeds from orexis, desire, and is likewise a response to the stimulus of some object of desire. But man, possessing the power of nous as well as the power of sense, is able to respond to the desired "intelligently." Being, because of his possession of this power of nous, "aware of the future," and not being, like other animals, limited to an immediate and present stimulus, man can respond to what will be: he can desire a future good. And nous, knowing the structure of things and events, can use that structure in its practical deliberation to achieve the object of desire (to orekton).

Man can thus act from desire, as he always must, even when he is acting from that "desire to know" which all men possess by nature; but he can act from desire modified by reflection and deliberation on the best way to attain the object of his desire. Man can act from an intelligent response to the object of his desire. Man can act from forethought, from the intelligent choice of means: he can act from proairesis, intelligence in the service of desire. This power of proairesis, so fundamental in Aristotle's analysis of human conduct, of, literally, "forechoice," the intelligent choice of means, when it has

grown into a settled habit, a hexis, and become a "second nature," becomes that intellectual excellence or "virtue" we call phronēsis, providentia, "prudence"--foresight and intelligence.

In the life of action, the practical life, in human praxis or conduct, such phronēsis, such prudence or practical intelligence, is the highest intellectual excellence or "virtue." Theoretical knowledge of the structure of things supplies the means for attaining the object of desire. Practical nous or intelligence applies this scientific knowledge of means in particular cases, in particular problems and situations. Theoretical nous, which considers what is always or for the most part, thus serves practical nous, which considers what is variable and contingent, and can be otherwise--what in our language is relative--that is, the particular and relative goods of particular human situations, the relative goods which are the object of desire in intelligent conduct. Thus the analysis at the conclusion of Book III of the De Anima states a thoroughgoing instrumentalism in terms of the ends and procedures of practical nous.

Having carried his analysis of "the mover" from the homē That moves all natural beings through the orexis or desire that moves all animals to the desire modified by practical intelligence that moves men, Aristotle considers the nature of the relation between desire and intelligence in human action. What is the cause of the motion of the human organism as a whole?

It is not the power of reasoning or what is called nous that is the mover. For the theoretical nous thinks nothing that is practical and says nothing about what is to be avoided or pursued, whereas motion always implies that we are avoiding or pursuing something. But even when it thinks somethings of the sort, it does not forthwith order avoidance or pursuit. Thus it often thinks of something alarming or pleasant without prompting to fear; the only effect is a beating of the heart or, when the thought is pleasant, some other bodily movement. Besides, even if nous issues the order and reasoning (dianoia) bids us avoid or pursue something, we are still not thereby moved. Rather, men act from appetite (epithymia), like the incontinent man (ho akrates).... Nor again is it desire alone which controls motion. The self-controlled, though they feel desire and appetite, do not do that which they have the desire to do, but obey nous.⁹

⁹ De Anima III, 432b 26 - 433a 8.

Are there then two different movers, orexis and nous? No, Aristotle concludes; there is one single mover, the power of desiring.

For it is the object of desire (to orekton) that moves, and through this reasoning moves, since the object of desire is the starting-point of reasoning.... Now nous does not seem to be a mover without desire. For deliberation (boulēsis) is desire; and when anyone is moved in accordance with reasoning (kata ton logismon), he is also being moved in accordance with deliberation. But desire may move one in opposition to reasoning,

for appetite is a kind of desire.... Hence it is always the object of desire that moves, but this may be either the good or the apparent good. Not all good, however, but practical good; practical good is what is relative and can vary. Now desires arise which are contrary to each other, and this occurs whenever reason and the appetites are opposed, which takes place in those beings which have a sense of time (chronou aisthēsis). For nous bids one resist because of the future (dia to mellon), while appetite has regard only for the immediate present. For the pleasure of the moment appears to be both pleasant and good without question, since one does not see the future. Therefore, while in kind the mover will be one, the power of desiring as desire, and ultimately the object of desire (this moves without itself being moved, through being thought of or imagined), in number there is a plurality of movers.¹⁰

¹⁰ De Anima III, 433a 18 - 433b 13.

To explain how reasoning can thus form a link between the object of desire and an actual act, Aristotle tries to connect up his formal analysis of reasoning with this functional analysis of "moving" through what he calls the "practical syllogism." In this, the major premise is universal, while the minor is particular.

For, while the former asserts that such and such a person ought to perform such and such an act, the latter asserts that this particular act is such an act, and that I am such a person. Now it is the latter opinion that at once moves me to action, not the universal. Or is it both, but is the first more at rest, while the other is not?¹¹

¹¹ De Anima III, 434a 16-21. Compare the fuller treatment of the practical syllogism in De Motu Animalium, 701a 7 - 701b 1. It is also introduced in explaining the action of the incontinent man in Nicomachean Ethics, Book VII: 1147a 24 - 1147b 6. In explaining the cause of incontinence "physically" (physikōs), Aristotle concludes, "Thus it comes about that when men fail in self-restraint, they are in a sense acting under the influence of a principle (logos) or opinion, but an opinion not in itself but only accidentally opposed to the right principle (for it is the appetite and not the opinion that is really opposed)."

5. Practical Intelligence as an Intellectual Excellence.

It is in the sixth book of the Ethics, where he is considering the excellences or "virtues" of practical intellect as hexeis, "habits" or acquired powers, that Aristotle analyses most carefully the relations between desire and nous in human conduct. There are three factors in the psychē which control human action and the attainment of truth: sense, nous, and desire. Sense is never the archē of human conduct, but only of purely animal responses to stimuli.

Pursuit and avoidance in desiring correspond to affirmation and denial in reasoning (dianois). Hence since moral excellence is a habit of mind with regard to forechoice (hexis proairetikē), and forechoice is desire accompanied by deliberation (orexis bouletikē), it follows from this that both the principle (logos) must be true and the desire right, if the forechoice is to be good, and that desire must pursue the same things that principle affirms. We are here speaking of practical reasoning and of the attainment of truth with regard to conduct.... Now the archē of human action (the efficient, not the final cause) is forechoice, and the archē of forechoice is desire and reasoning directed to some end. Hence forechoice never occurs without nous or reasoning, or without moral habits (for acting well and the opposite never occur without reasoning and character).

Thought by itself however never moves anything, but only thought directed to some end, and concerned with action.... Hence forechoice may be called either nous served by desire (orektikos nous), or desire served by reasoning (orexis dianoetikē), and just such an archē is man. ¹²

¹²Ethica Nicomach. VI, 1139a 19 - 1139b 7.

Proairēsis, "forechoice," is clearly the key term here. In an earlier discussion, Aristotle has defined it:

Perhaps we may define proairesis as voluntary action preceded by deliberation; since forechoice occurs with reason and reasoning. Indeed, previous deliberation seems to be implied in the very term proaireton, which denotes something chosen before other things....

As then the object of forechoice is something within our power, which after deliberation we desire, forechoice will be a deliberate desire of things in our power, for we first deliberate, then select, and finally fix our desire according to the result of our deliberation. ¹³

¹³Ethica Nicomach. III, 1112a 14-18; 1113a 9-13.

It is thus clear that Aristotle's "forechoice," proairēsis, is in his careful analysis the closest of all his terms to the American conception of "intelligence" as the intellectual power of dealing with the problems of practical life. When this power of intelligent choice has become a fixed habit, a hexis, it emerges as one of the five intellectual excellences, phronēsis, practical intelligence.

Practical intelligence is thus the highest intellectual excellence of every form of human conduct and action, both individual and political. Aristotle draws a distinction between "making things," which is art (technē) and "performing actions," which is conduct (praxis), based on the fact that the one aims to make an external product, while the other aims at the action itself. But in every other respect art and practical intelligence or phronēsis are alike: they are both kinds of what we Americans have come to call "know-how." They both deal with what is variable, contingent, and relative, and they both aim at a particular

outcome (in the artistic syllogism, just as in the practical, while the major premise is universal, the minor must be particular). In all these respects both phronēsis and technē differ from the third intellectual excellence, theoretical wisdom or sophia, which for Aristotle is a combination of epistēmē or demonstration from archai, and nous, which judges the archai themselves. Theoretical wisdom deals with what is always or for the most part, what cannot be otherwise, and what is universal.

We have now followed Aristotle's dynamism from his recognition of the basic drive or hormē to realize its own nature most completely, which he finds exhibited by every natural body, through the desire or orexis in which that drive is exhibited on the level of animal living, to its fullest development on the level of rational living in man, in the three forms of intelligence, theoretical in science and wisdom, practical, and artistic. Aristotle examines the relations between the three forms of intelligence, but he makes no attempt to rank them in order of value; his protest is at any one of them attempting to dominate the others. It is true that what is most distinctive about man is the desire to know which all men possess by nature. When one gets an imaginative grasp on the sweep of Aristotle's dynamism, and realizes the basic importance of desire in the whole panorama of living beings, the first sentence of the Metaphysics hits one in the face. And it is true that the Ethics ends by making clear Aristotle's own preference for the life of theoria, that sheer knowing in which man transcends the limits of human nature and becomes like the gods. From the standpoint of theoretical wisdom, practical intelligence orders the conditions of the life of knowing.

But from the standpoint of practical intelligence, which has to deal with the variable and relative goods ultimately of each situation, theoretical wisdom or science supplies the knowledge of what every form of being and every situation must take into account, that structure of things that is the same for all and cannot be otherwise. In its deliberation about ends and means practical intelligence must turn to science for what it has discovered about means. And practical intelligence can find in the conditions of its operation a humility that is in its own way as much an expression of a Platonic religious feeling as the participation of theoretical nous in the nous of the gods:

Wisdom must be a combination of nous and epistēmē; it must be a consummated knowledge of those things that are most exalted. For it is absurd to think that political or practical intelligence is the loftiest kind of knowledge, since man is not the best thing in the world. And as "wholesome" and "good" mean one thing for men and another for fishes, whereas "white" and "straight" mean the same thing always, so everybody would denote the same thing by "wise," but not by "intelligent"; for each kind of beings will describe as intelligent and will entrust itself to, one who can discern its own particular welfare; hence even some of the lower animals are said to be "intelligent," namely those which display a capacity for forethought as regards their own lives.

It is also clear that theoretical wisdom cannot be the same thing as political intelligence; for if we are to call knowledge of our

own interests wisdom, there will be a number of different kinds of wisdom, one for each species: there cannot be a single such wisdom, dealing with the good of all living things, any more than there is one art of medicine for all existing things. It may be argued that man is superior to the other animals, but this makes no difference: since there exist other things far more divine in their nature than man, for instance, to mention the most visible, the things of which the celestial system is composed. ¹⁴

¹⁴Ethica Nicomach. VI, 1141a 19 - 1141b 2.

6. The Problems of First Philosophy.

It is in his First Philosophy that Aristotle pursues the analysis further. First Philosophy, he holds, asks, what is it to be any kind of thing, any subject-matter whatsoever? What is it merely "to be"? What properties are involved in "being" anything, in any subject-matter that can be investigated, in "being as being"? This general question had been asked in Plato's Sophist, where it is presented as growing out of the problem of non-being raised by Parmenides and his followers. ¹⁵

¹⁵Sophist 243 C ff.

To this generalized question, Aristotle finds we can give two kinds of answer:

1). "To be" anything means "to be something that can be stated in discourse." It means, to be something of which we can ask the question, "What is it?" ti esti; and get the answer, "It is thus and so"--of which we can state "what it is," its ti esti. In this sense, anything that is, any ousia, is anything that can be talked about, any subject of discourse.

2). "To be" anything means "to be something that comes into being and passes away," something that is subject to change, that persists throughout a determinate change. In this sense, anything that is, any ousia, is anything that is what it is as the result of a process, a kinēsis. It is any outcome of a process.

These two kinds of answer to the question, What does it mean to be? reflect Aristotle's double interest, in talking, logos, and in natural processes, kinēseis. 1). What characteristics must be distinguished in things if they are to be talked about, if "what they are" is to be stated in rational discourse, in words--if they are to be intelligible? This question leads to a set of distinctions appropriate to a logic of discourse, in which a thing, an ousia or res, is what can be talked about in words, made the subject of propositions. Hence the precise question is, what is involved in being anything that can be made the logical subject of a proposition? 2). What characteristics must be distinguished in

things if we are to understand how they come into being and change, act and interact in the world of natural processes which experience reveals to us? This question leads to a set of distinctions appropriate to a logic of motion and change, of activities and processes, in which a thing or ousia is what can change and take its part in a process. What is involved in being something that can change?

It is significant that when Descartes asked, "What is Substance," he was asking for what persists unchanged throughout change, what it is in change that does not itself change. And in Locke and in Kant, in fact, throughout modern philosophy, "substance" has been taken as the unchanging, the permanent in change, whether Locke's "I know not what," or Kant's "permanent relations." But for Aristotle, who since he invented the term ousia which Cicero rendered into Latin as substantia,¹⁶

¹⁶Though not the Platonic term ousia rendered as essentia."

ought to know, ousia or substantia is defined precisely as what changes in change, what is at the end of any process different from what it was at the outset. And in the most important and fundamental kind of change of all, genesis kai phthora, "generation and corruption," a new ousia or substance is present at the end that was not there at all in the beginning, or a substance has disappeared completely. Thus it is clear, Aristotle's logic of motion and change is a logic of novelty that emerges in process.

And it is also significant that the first question is discussed in general terms, in terms of a logos, a discourse, isolated from any particular context. But Aristotle's formal analysis always arrives at the point where further questions cannot be answered in that isolation. Then, he always resorts to the second question: to a specific context in the generation of existent things, in some particular process of nature or art.

This procedure followed by Aristotle suggests that while discourse can be analysed in isolation, "formally," up to a certain point, and certain fundamental distinctions thus brought to light, these distinctions can never be understood, concretely, apart from some specific subject-matter. That is, the distinctions made in discourse are relative to a definite functional context; they are not understood when isolated from all contexts, when taken as just given, "absolutely," or haplōs. For example, what a thing can be said to be, its "form," and what is "essential to" and what "incidental to" being that kind of thing, cannot be determined in discourse alone. Such questions always take one to the context of some specific inquiry into some particular process of nature or of art. This methodological procedure can be stated generally: the ousia expressed in statement leads beyond statement to the ousia encountered in its natural operations. Starting with the things that are said, ta legomena, what things can be said to be, we are led to ta onta, to things themselves.

7. Ousia as the Outcome of a Process.

What is involved in ousia as something that changes, that is the outcome of a process? What is involved in the class-room table that was once part of a tree, and that will end in a bonfire? Change in the most general sense, becoming, metabolē, and process, "movement" or kinēsis, is a fundamental fact of our experienced world, the world, "we see." "Only a vegetable would try to deny it," Aristotle remarks rather scornfully of the Eleatics. How is this fact to be expressed, understood, and made intelligible? Things, ousiai, are always changing into something else. Materials are always taking on new forms. "This suches" are always becoming "other suches." Of things taken as undergoing such change, as subjects of processes, kinēseis, we can ask four different kinds of question, and get four different kinds of answer, four kinds of aitia. Aitia means literally the answer or response to a question: it meant in Greek what could be held "answerable" or "responsible" in a law court. Aristotle's four aitia are the four different factors "responsible" for a process, the four "necessary conditions" of any process, four dioti's or "reasons why," four "wherefores." Since Cicero translated them into Latin as the four causae, they have been known in the Western tradition as the "four causes:" the What, to ti esti; the From What, to ex hou; the By What, to hypo tinos; and the For What, to hou heneka.

These are four kinds of reason, four kinds of answer, four necessary conditions--necessary for understanding the process: if we are to find it intelligible we need to know all four. Only one of the four, the By What, the agent, the efficient cause, is a "cause" in the popular sense today--if "cause" have any clear meaning in our ordinary language. The unfortunate neglect of the other three has been due to the dominance of mechanical thinking since the days of Newton, complicated by the popular heritage of Hume and John Stuart Mill. It is worth noting, incidentally, that the empiricist notion of causation as constant succession, of "cause" as the invariable antecedent of its effect, is wholly lacking in Aristotle. Cause and effect are always for him simultaneous, hama.

All four are factors discoverable in any process. Every process or kinēsis is something being made out of some material by some agent or mechanism for some end. This is obvious in the processes that take place "by art," apo technēs, in human production. But in natural production, processes that take place "by nature," physei, or "in accordance with nature," kata physin, the situation seems different. And such processes are significantly different. In the first place, in them there is no intelligent maker or craftsman. Secondly, in them there is no "purpose," no consciously foreseen end. Aristotle's "For What," to hou heneka, is properly "end," telos, or "final cause"; it is both incorrect and very misleading to translate it as "purpose," which in English implies "foresight" and "intention." For Aristotle, human purposes do display foresight and intention, and they do form one subdivision of "final causes" or "ends." But whatever may have happened later in the religious adaptations of Aristotelian thought in the Middle Ages, when the operations of nature were identified with the Divine Providence, Aristotle himself finds such "purposes" and "intentions" only

in the processes by art, in human production. For him, there are no purposes in the world outside human actions and makings. Final causes, tele, are for him a much broader class than the sub-class of "purposes." That broad class includes not only human purposes, but also all natural ends and outcomes in the processes that take place by nature.

For although for Aristotle nature, apart from human arts, exhibits no discoverable purposes, it does exhibit natural ends or tele. Nature is the scene of productive enterprises, that are not to be understood as mere mixings and unmixings of elements. Events do not merely "happen," they have consequences, they achieve results, they exhibit a pattern of reaching outcomes that is repeated over and over again, that is "always or for the most part." Clouds form, rain falls, seeds sprout, plants grow, with a structure of natural teleology, a fixed order of successive stages of development. Nature is indisputably teleological: its processes are full of ends, tele, that are achieved, of conclusions that are reached over and over again. Only in human life are these ends and conclusions consciously intended, only in man are purposes found. For Aristotle, even God has no purpose or purposes, only men!

In a genuine sense, nature is a "life," and not a mere mixing and unmixing of elements, as was held by Empedocles, Democritus, and the atomists. In sharp contrast to Plato, Aristotle took these atomists very seriously, for they were real physikoi, genuine students of natural processes. He directs his main efforts to supplement their correct but incomplete analysis. For nature, to be sure, is a mixing and unmixing of elements. But it is a mixing and unmixing that reaches outcomes and ends; and natural processes are not adequately understood unless these outcomes and ends are also understood.

We ask, for example, "What is an egg?" Democritus can tell us, it is a chemical process. But it is clearly not a "mere" chemical process: it is a chemical process that grows into a chicken. We can go back, find the elements out of which the egg is made up, either Aristotle's elements or our own; we can find the material of the egg, its From What. We can find the hen and her reproductive system, the cock and his, we can find the agents that generated the egg, the efficient cause of the egg, the By What. Both material and agent are necessary and important. But we clearly do not understand what an egg really is, unless we recognize the egg as a possible chicken. So to the old question, which comes first, the chicken or the egg? Aristotle has a clear answer: the chicken comes first--in understanding eggs, the chicken that is to be.

Aristotle's viewpoint and approach are, as we often say, biological, rather than "merely" mechanical. They spring out of the experience of the biologist that Aristotle was. He takes biological examples, living processes, as revealing most fully and clearly what natural processes are like. He analyses the behavior of eggs, not of billiard balls. He seems to have spent much time with the chickens, while the 17th-century founders of modern dynamics seem to have spent their lives, like Pascal, at the billiard and gaming table.

But Aristotle expands his essentially biological approach into ageneralized functional conception and analysis for understanding any

natural process. He takes motion in place--the billiard ball behavior from which modern dynamics started--as a limiting instance of more complex "motions" or processes. In this respect, his procedure is not without analogy to that of our own physical theory, which has likewise passed beyond billiard balls and the motions of masses to the more complex processes of the field of radiation.

For Aristotle, the world is a great spectacle and panorama of processes, of things with powers, dynameis, putting those powers to work, energeia, "into operation," passing from the mere power to the working, the operation of that power, from potentiality to actuality. Everything in the world has the power to operate in a distinctive, characteristic way, the way of the kind of thing it is. And everything has also a drive, an impulse, a tendency--a hormē--to put its powers into operation, a hormē "implanted" in each thing to become the kind of thing it can become. The verb oregetai for this impulse or drive is often translated "strives": acorns "strive" to become oak trees, eggs "strive" to become chickens, heavy bodies "strive" to reach the center of the earth. Occasionally Aristotle even says, the stone "strives" to become a doorstep. With reservations as to the doorstep, this is true. Types do persist, and acorns never do become pine trees or elephants.

Hence, the world being this great complex of processes, each directed toward its own distinctive end, and each having a drive implanted to realize that end, to understand any process we need to find out its end, the results, the outcome it achieves. To understand man, for instance, we need to find not merely impulses, drives, reflexes, habits, but also what man can do, his powers and possibilities, his end: the good life, living well. And to understand the world as a whole, we need to find what it can do. For man, this means that we need to find how it can make living, moral action, and knowing possible.

What "makes" all these processes happen? What they do? their ends, their possibilities, their powers, their outcomes? the good each achieves? Not at all! If potentiality, the power to do something, were itself an efficient cause, says Aristotle, if it were an agent, a By What, then every thing that can happen would have already happened. For Aristotle, the only agent is motion, ultimately, the eternal motions of the heavens acting on the earth. Aristotle is himself a naturalist, not an idealist, though he was often so taken in the Middle Ages. For him, ends, final causes, outcomes are fundamental in understanding processes; but they never "do" anything. Ends do not act or operate, they are never efficient causes or agents. Only motion in place can "do" anything or "make" anything take place.

It is to be noted that for Aristotle the world is not a process of processes, it is not an "evolution." He is not thoroughgoing enough, he does not exhibit enough natural teleology in his conception of the world, to satisfy our own present-day evolutionary thinking. Far from being too much of a teleologist, to a post-Darwinian Aristotle does not seem to have been enough of a teleologist.

8. Aristotle's Functionalism Illustrated in Biological Theory.

Aristotle's interest is rooted in living things. On the one hand he extends his analysis to embrace all natural processes, the inanimate as well as the animate. On the other he pushes it to deal with man and all the works of human art. But the central range from which his analysis springs lies in the fields and subject-matters we should today call "biological." Since the 12th century at least, it has been traditional to approach Aristotle's thought through his logical and metaphysical writings. But in the corpus neither bulks very large in comparison with the pages devoted to biological inquiries. The biological treatises comprise some third of the entire corpus. Clearly Aristotle's interest in the direct study and analysis of living beings can hardly have been for him a matter of secondary importance.

However it may stand with the biographical question of whether a consuming interest in the generation and growth of living things colored Aristotle's thinking from the very beginning, two facts are clear. His functionalism is exhibited and illustrated most fully, just as it is stated most explicitly, in his biological writings. Moreover, the concepts and distinctions he worked out to deal with the functioning of living things, and extended to include human and social living as well, are most suggestive and illuminating in grasping the traits and structures of biological and human processes. Here Aristotle's scheme for rendering the world intelligible can be seen at its best and most successful. The arguments for understanding in terms of functional and teleological relations, set forth in generalized forms in Physica II, chapter 8, are here revealed in their concrete meaning; such instruments are indispensable for the biologist in gaining an intellectual grasp upon his subject-matter. Here is set forth and illustrated what Aristotle means specifically by "natural ends" as principles of intelligibility, and by the relations of "natural teleology" as essential conditions of any understanding of processes.

When Aristotle goes on from describing the various "parts" of which animals are made up, to investigate "through what causes (aitias) each animal is made up in this way," that is, when he attempts to state his biological theory, he is a thoroughgoing functionalist. He is interested in the behavior of the organism and of its component organs. He is not primarily the anatomist or the histologist delineating in detail the structure of the various organs or of the "uniform parts" or tissues. In any event, without a microscope that task was impossible for him. Structures and tissues are to be understood in terms of what they do, the operations they perform. He several times repeats: "Our knowledge (of such structures) must come from a study of their functions (ek ton ergon)." ¹⁷

¹⁷ De Partibus Animalium II, 655b 21.

For the natural philosopher who would understand living things and living processes, final causes are more important than either material or efficient causes. To be sure, Aristotle recognizes much spontaneous

variation and much that has no function in biological processes, both alike due to the necessary consequences of mechanical or efficient causes. We must investigate and observe what the organism actually does, and then understand how its various structures and tissues enable it to do so. One is tempted to say, we must understand how these organs were "developed" to do so. We should not be falsifying Aristotle's own aim if we said this in reference to the development and growth of the individual organism from an embryo; the processes of generation, growth, and maturation fascinated him. And though of course Aristotle did not hold to the evolutionary development of the different types of animal life--for him species had no "origin"--his own experimental functionalism is so close to the teleological and functional concepts of evolutionary thought that at this point it seems to a modern to cry for such supplementation, and without it to be incomplete. For the ultimate function of every organ and arrangement for Aristotle is the "survival value" which for evolutionary thinking is the necessary condition of the process of natural selection. ¹⁸

¹⁸Cf. De Anima III, 434a 22-25; 434a 30 - 434b 1; 16-18.

This emphasis on survival value also makes clear that Aristotle's conception of "natural ends" and "natural teleology" is very remote from the conception of "final causes" familiar in the religious tradition, and employed in the conventional "argument from design" for the existence of a Creator. The 18th-century instances of such "final causes" advanced by Bernardin de Saint-Pierre may be rather extreme, but they serve to bring out the differences between such a notion and Aristotle's natural teleology. Bernardin suggests that melons are produced with ridges marked on their rind to increase the ease of division at a family meal, and that fleas are dark in color to be more easily picked off the human skin. He failed to give due consideration to Africa, which has many fleas. Now, such a notion of "final causes" was not unknown to Aristotle: for he could read in the Timaeus how the created gods, the stars, to whom the Supreme Craftsman assigned the creation of man's body, acted always for the best, and were ever guided by "final causes" or "ends." Thus they made the liver in animals so that men might practice divination of the future and prophesy; they placed a thick thatch of hair on man's head to provide shade from the burning sun; and they gave man eyes in the front of his head, so that he might see whither he was going, and not in the back, where he could see only where he had come from. Plato--if he really wrote the Timaeus--was capable of being quite as silly as Bernardin de Saint-Pierre.

Since it was such notions of "final causes" and "teleology" that led the great scientific pioneers of the 17th century to reject final causes completely as principles of intelligibility, and since it has been the identification of all teleology with such views that has kept alive among scientists and indeed in popular thought the prejudice that any kind of appeal to ends is "unscientific," it is worth while to point out with some precision just where Aristotle's "natural teleology" differs from that kind of "design."

1) Since the various religious traditions not unnaturally identified "nature," the system of ends toward which natural processes are discovered to be directed, with the "will of God," as Plato's creation myth had already done, "final causes" were taken as the conscious purposes of the Deity, and as such were held to be ipso facto efficient causes, themselves acting to bring about their own realization. In sharp contrast, for Aristotle "final causes" and "natural ends" are in no sense whatever to be taken as "purposes": they involve no conscious intent, except in the one case where conscious intent is obviously involved, in human actions and art. And for Aristotle final causes or ends are never to be identified with efficient causes: never for him does what a process brings about itself bring about the process. For Aristotle a final cause is always a necessary condition of understanding, a principle of intelligibility; it is never a "whence of motion," an archē of action.

2) In the second place, "final causes," as they were developed during the predominance of the religious traditions, tended to become a way of showing how under the ministrations of God's providence everything in the universe conduces to the self-centered purposes of man. In sharp contrast, Aristotle's natural teleology is, in the technical sense, wholly "immanent." No kind of thing, no species, is subordinated to the purposes and interests of any other kind. In biological theory, the end served by the structure of any specific kind of living thing is the good--ultimately the "survival"--of that kind of thing. Hence Aristotle's concern is always to examine how the structure, the way of acting, the "nature," of any species conduces toward the preservation of that species, and enables it to survive, to exist, and to continue to function in its own distinctive way. This Aristotelian emphasis on the way in which kinds of living things are adapted to their environment brings Aristotle's thought very close to the functional explanations advanced by evolutionary thinkers: in both cases the emphasis is placed on the survival value of the arrangement in question.

It might be well to add, that such functional and teleological conceptions are just the notions that modern biologists, no matter how "mechanistic" their explanatory theory, actually have to employ in describing the subject-matter they are attempting to explain. Teleological relations, the relations between means and ends, or "functional structures," are an encountered fact. Like all facts, they have to be explained in terms of certain mechanisms that are involved.

9. The Significance of Aristotle's Natural Philosophy.

It is possible here only to raise questions for discussion about Aristotle's application of his functionalism to natural philosophy. For him, nature is a kind of "life" of things in process of change; and change is fundamentally not a mere "event," an observed temporal difference, but a process resulting in the generation of novelty. It is not a mere quantitative rearrangement of elements, as Empedocles and Democritus held, though they were quite right in insisting that such a rearrangement of elements is always involved in any change. In other words, Aristotle is convinced that any science of change or process must

explain the egg-chicken "motion," and not merely the behavior of billiard-balls.

From the limited point of view of early modern physics, 17th century and Newtonian mechanics, Aristotle's physics, and especially his astronomy, seemed perverse and barren. Aristotle was judged by those pioneers as far behind his contemporaries. His physics was qualitative, not mathematical; it was teleological and functional, not exclusively mechanical. The Pythagoreans and the Platonists had developed a mathematical physics and astronomy, which were judged in the 17th century to be "real science," a combination of atomism and mathematics. Historically, the Platonists in the middle Academy carried on a keen criticism of Aristotle's physical theories, and out of their activities there developed Alexandrian mathematical physics. In later antiquity Aristotle's physics enjoyed in fact little influence outside the Lyceum. It came to be enormously influential during the Middle Ages; and during the modern era since the 17th century this influence has been judged to have been very unfortunate. It has been assumed that when the moderns, first in the 13th century, and then again in the 16th, turned from Aristotle to Platonic and Pythagorean ideas, they immediately began to secure fruitful results.

In the 19th century the attitude toward Aristotle as a scientist began to change. As biology came to the fore, it was realized that Aristotle was the greatest biologist until the 18th century. Darwin made the enthusiastic remark, "Linnaeus and Cuvier have been my two gods; but they were mere schoolboys compared to old Aristotle." In biology, Aristotle's mistakes and failures came from his lack of detailed observation, his lack of a microscope, his trust in common opinion; all these could be easily remedied by time. But in physics and astronomy it was Aristotle's aim itself that was "unfruitful." His method was "wrong," his direction "barren"--judged, that is, by the modern aim of seeking practical techniques for the control of nature.

Hence while he was an object of execration to the early modern scientists who were concerned exclusively with mathematics and mechanics, Aristotle's greatness as a scientific observer and theorist began to be appreciated as biology felt the impact of Darwin and Wallace; for the central Aristotelian ideas of process and function are fundamental in biology. But during the whole 19th century it was still held that as a physicist Aristotle was a first-rate biologist.

Then, in the 20th century, the physicists themselves found their billiard-balls, the Newtonian mass-particles following the simple laws of molar masses, dissolving into complex functional systems of radiant energy. They discovered that the subject-matter of physics itself must be treated in functional and contextual terms, in terms of concepts appropriate to "the field." And what this means is that in his basic concepts, the physicist himself must think like the biologist.

Today, the concepts of Aristotelian physics, those notions involved in his analysis of process, have been driving those of Newton out of our theory. That our revolution in physical theory can be so

stated is mostly unrealized. But it is often explicitly recognized that the ideas of Aristotle's physics are far closer to our present-day physical theory than are the ideas of the 19th century. Thirty years ago it was still possible to regard Aristotle's physics as the least valuable part of his thought, and as of mere historical interest.¹⁹

¹⁹Even in 1952 Mr. D. J. Allan, in his excellent The Philosophy of Aristotle, could say: "His principles were well adapted to historical and biological inquiry, but extremely ill-suited to other departments of the study of nature," and could call his physics "a sterile system of physical science." (pp. 206-7).

But cf. Kurt Riezler, Physics and Reality: Lectures of Aristotle on Modern Physics (1940), especially chapter 5, "Concreteness."

Today, his analysis of the factors and concepts involved in process strikes us as one of the most valuable parts of his whole philosophy, one of his most illuminating and suggestive inquiries. Far from being obviously "wrong," it seems today far truer and sounder than the basic concepts of Newton. And it is fascinating to speculate how, had it been possible in the 17th century to reconstruct rather than abandon Aristotle, we might have been saved several centuries of gross confusion and error.

The exclusively mechanical emphasis during early modern science, from the age of Newton through the end of the 19th century, is now beginning to seem a kind of transitory interlude in scientific thought. The functional concepts of Aristotle were not necessary for the simple molar mechanics of the 17th and 18th centuries; they were discarded in large part because they were not manageable by the available mathematical techniques. With the advance of mathematical methods themselves, and above all with the carrying of scientific methods into the much more concrete, rich, and less abstract fields, like radiant energy, we have been forced to return to Aristotle's functional and contextual concepts—this time, of course, in exact, analytical and mathematical formulation.

Thus the temporary eclipse of Aristotle's physics is emerging as a kind of adolescent stage in the development of our own physical theory, a mere passing blindness. Today it is Aristotle who often seems strikingly modern, and Newton who appears as "of mere historical interest." Newton, despite his epoch-making contributions to "natural philosophy," that is, to the science of dynamics, seems in the notions and concepts of his more general "philosophy of nature" to have been confused, and in many of his ideas barren, even wrong in his aim. It is Aristotle who strikes the modern student as suggestive, enlightening, and sound.

Hence Aristotle's philosophy of nature, his analysis of the factors involved in process, and of the concepts of physical theory by which they can be rendered intelligible, as contrasted, of course, with his antiquated cosmology and astronomy, deserves the most careful study. And he is to be studied in the light of our own enterprise of revising and reconstructing the confused concepts we have inherited from Newton's

"philosophy of nature." Where we are often still groping, Aristotle is frequently clear, suggestive, and fruitful. This holds true of many of his analyses: his doctrine of natural teleology; his view of natural necessity as not simple and mechanical but hypothetical; his conception of the infinite as potential, not actual; his notion of a finite universe; his doctrine of natural place; his conception of time as not absolute, but rather a dimension, a system of measurement; his conception that place is a coordinate system, and hence relative; on countless problems, from the standpoint of our present theory, Aristotle was right, where the 19th century Newtonian physicists were wrong.

The Physics is really a philosophical introduction to the concepts of natural science. As such, it is directly relevant to the criticisms we have now been making for a generation of the concepts of our inherited Newtonian philosophy of nature. For Aristotle is a thoroughgoing functionalist, operationalist, and contextualist, criticising the views of those whom in our day we call the reductive mechanists. He is trying to reinstate, reconstruct, and defend the ancient Ionian conception of "nature," physis, and of natural career or process, against the critics who had discredited it, Parmenides and the Eleatics, whose criticism had culminated in the mechanistic views of Empedocles and the atomists. These critics had used Parmenides' test of thinkability to conclude that there is no "nature," no physis, no process in the world: there is no genuine coming into being, no genesis. For it is not thinkable that anything should come to be out of what is not. There is only a mixing and unmixing of elements which themselves do not change. There are no "powers" in things coming into "operation," but only a sheer succession of actual states and their rearrangements.

As against this view, Aristotle insists that the world displays real geneseis, real comings into being, with a fundamental unity and continuity, a basic temporal pattern or structure. Wherever we cut into these processes, we find them, in the words of Leibniz, the 17th-century Aristotelian, "heavy with the past and big with the future." We find that in a significant sense, every process is now what it will be. It has genuine temporal parts and relations which are essential to its being that process, and not merely incidental to it. The process cannot be adequately understood apart from this temporal character and pattern.

Now this, as Whitehead has made clear, is precisely our own criticism of the Newtonian philosophy of nature. It makes time an accident, we say; it does not take time seriously. It regards motion as a succession of instantaneous states, as just one state after another. This view, as Whitehead pointed out, culminates in the structureless world of Hume, in which "anything may be followed by anything."

To such a view, which he found maintained by the Megarians, Aristotle answers, No! Every process involves the operation of determinate powers. There is nothing that can become anything else whatsoever. A thing can become only what it has the specific power to become, only what it already is, in a sense, potentially. And a thing can be understood only as that kind of thing that has that kind of a specific power; while the process can be understood only as the operation, the actualization, the functioning of the powers of its subject or bearer. Aristotle

generalizes: even local motion, motion in place, phora, the "motion" of Galileo and Newton, is the operation of a power, a genuine process: it is a passing from one position to another. Such motion in place is not to be understood in the terms in which the structuralists try to understand it: the Eleatics, the Newtonians, in our day Bertrand Russell, as a "distance traversed," a succession of successive points occupied at successive instants of time. It is rather the "traversing of a distance." It is not a succession of determinations, but the determining of a succession, a continuous operation or process. This is the view in terms of which Aristotle deals with and "solves" Zeno's puzzles.

It is in *Metaphysics*, Theta, chapter 3, that Aristotle defends his conception of the operation of powers in the only way in which such an ultimate distinction can be defended, by a dialectical development of the consequences of denying it.

There are some, for example, like the Megarians, who say that a thing has a power only when it is functioning, and that when it is not functioning it has no power. For instance, they say that a man who is not building cannot build, but only the man who is building, and at the very moment when he is building; and similarly in the other cases. It is not hard to see the absurd consequences of this theory. Obviously a man will not be a builder if he never builds, because "to be a builder" is "to be capable of building"; and the same will be true of the other arts. Now if it is impossible to have such arts unless at some time the art is learned and acquired, it is also impossible to cease to have them unless at some time they are lost, either by forgetfulness or by some misfortune or by the passage of time; but they never can be lost by the destruction of the thing itself, since this remains always. Hence, when a man ceases to practice his art and is supposed no longer to have it, how can he have acquired the art anew when he subsequently readily knows how to build?

Likewise in the case of inanimate objects that are cold or hot or sweet or in any way sensible: they will not be anything at all when they are not being sensed; so that those who maintain this position will have to affirm the doctrine of Protagoras. Indeed, nothing will have the power of sensing unless it is actually sensing. If, then, one who has normal organs of vision, but is not using them, is blind even though he has eyes and is normal, then one will be blind many times a day, and deaf too.

Also, if what has been deprived of a power can do nothing, then whatever has not yet come into being cannot possibly come into being. Now of what cannot possibly come into being it can never be truly said that it is or that it will be, for not having the power means just that. Consequently these doctrines take away all possibility of change or coming into being. Accordingly, whoever is standing must always have been standing, and whoever is seated must remain seated, since if he is seated, he has no power of rising; for it would be impossible for anything to rise which has not the power to rise. Since, then, we cannot say these things, it is clear that power and operation

are different. But these doctrines make power and operation the same; hence it is no small thing they are trying to do away with.²⁰

²⁰Metaphysics Theta, 1046b 29 - 1047a 21.

The prosecution rests its case: Aristotle is a thoroughgoing functionalist.

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