

Aristotelian natural philosophy: body, cause, nature

It is difficult now to imagine an intellectual landscape so thoroughly dominated by one figure as was that of the Schools by Aristotle. Except on certain well-known questions, the presumption was that Aristotle, suitably interpreted, was right. Nevertheless Aristotelianism was no frozen monolith (Schmitt 1988). During the four centuries of its predominance, it continued to change, and admitted on all but fundamental points or those on which ecclesiastical authorities had pronounced, a great latitude—within, as in all such frameworks, the limits of *its* thinkable.

In what follows I present some basic features of Aristotelian natural philosophy around 1600. I do so with Descartes in mind, and from his perspective. I therefore emphasize the views of Jesuit authors. In the first section of this chapter, I outline the institutional setting and discursive forms in which Aristotelian natural philosophy was presented, examining in particular the role of authority and experience. The rest of the chapter takes up three topics: substance, especially corporeal substance or body; natural change and the efficient and final causes; art and nature. The aim is to provide a sense of the philosophical framework within which Descartes was educated and to which he continued to respond. Knowing that framework helps to forestall misunderstandings; it gives us a Descartes who, interpreted not from the future but from his past, will not be a mere spokesman for some present-day position.

1. Institutions, forms, authorities

In the first book of the *Principles*, Descartes describes the *præjudicia* or preconceived opinions we acquire early in life when the mind is in thrall to the body. Those opinions turn out quite often to coincide with the opinions of the Schools. That Descartes thinks of Aristotelianism as foisted upon a mind still in tutelage is no surprise. It was, in the intellectual setting of the early seventeenth century, above all something *taught*. From the 1250s on, Aristotle's works were the basis of the baccalaureate curriculum. In three years, students would hear lectures on logic, metaphysics, natural philosophy, and ethics, lectures which took the form of commentary on Aristotle's text, divided into small portions called *lectiones* or *textus*. Paraphrases and philological elucidations were accompanied by *questiones* or "questions" suggested by the text. To each of the works that figured regularly in teaching there was attached a series of standard *questiones* in disputational form (Marenbon 1987).

In the second half of the seventeenth century, the format of commentary and questions began to give way to that of the *cursus* or textbook (Stone 2005), in which the subject-matter was treated

not in the order imposed on commentary by the text, but systematically, as in Suárez's *Disputationes metaphysicæ* (1597) or the *Cursus philosophicus* of Roderigo Arriaga (1632). The textbook made possible a pedagogically convenient arrangement of the material; because it was no longer bound to the text, new topics could be more easily introduced. The *Cursus* (1632–1635) of John of St. Thomas, for example, includes a question on the “new star” observed by Tycho Brahe. The *Physica* (1669–1671) of Honoré Fabri, a Jesuit who corresponded with Mersenne and Leibniz, departs even more from tradition, engaging in controversy with Descartes and other new philosophers.

That commentary should have been central to the teaching of natural philosophy for so long reflected the economy of knowledge in the medieval period. In matters of faith, God was the highest authority, whose judgments are given to us in the Bible, and the fathers of the Church, especially Augustine, were the highest human authorities. The realms of human knowledge were divided among several authorities, subordinate to faith, but otherwise presumed true: Aristotle in philosophy, Galen in medicine, Thomas in theology. An authority, once established, could be displaced only with effort. Nevertheless in some fields they were: in anatomy, for example, Vesalius rapidly took the place of Galen after 1570.

The new philosophers of Descartes' generation often portrayed their predecessors' attitude to authorities as one of unquestioning agreement. It is more illuminating to consider it in terms of trust and burden of proof. An authority has the presumption in their favor, and the burden lies more or less heavily on those who disagree to refute the claims of authority. God's authority alone is absolute. Human authority is limited not only by faith but by experience: Aristotle's opinion that the world is eternal was rejected first of all because it contradicts Genesis; philosophers endeavored *also* to show that it is inconsistent with experience.

Many events conspired in the sixteenth century to cast human, and even divine, authority into doubt. The familiar list includes the discoveries of the New World, the theories of Copernicus, schisms within the Christian Church and the wars that resulted from them, political turmoil and economic distress. Philosophical skepticism, revived from the ancients, was invoked to debunk the claims of authority. Descartes, unlike true skeptics in his period, held that human understanding, assisted by method and freed from the bonds of prejudice, can effectively replace authority in the pursuit of knowledge. He carefully shielded religious and political authority from doubt; but in natural philosophy and metaphysics he held that human understanding alone has authority. A letter to Beeckman in 1630 records his view that what I have reasoned my way to I have learned as if by my own power only (AT 1:160). If others have told me those things, that was at most only

an occasion for my thinking about them. In such an economy of knowledge there is no place for authority.

Reliance on authority did not preclude appeal to experience. *Experimentum* (or *experientia*), which in Descartes' time was used indifferently for what we now distinguish as experiment and observation, denoted first of all an empirical truth vouched for by common experience (Dear 1988). On such matters each of us, or the "common sense" of all, is an authority: fire burns, plants grow from seeds, animals reproduce their own kind. An *experimentum* can also be an empirical truth vouched for by a trustworthy author. Pliny's *Natural history* supplies many unusual observations concerning plants and animals. The human body dissected is not part of everyday life. But Vesalius's *De humani corporis fabrica*, given his authority, yields reliable claims about its anatomy.

Of the *experimenta* mentioned in textbooks, very few are first-hand reports. They seldom describe the manipulation of objects so as to yield new phenomena—"experiments" in our sense. That, more than any supposed incapacity or refusal to read the book of nature, distinguishes the role of experience in Aristotelian natural philosophy. The construction of devices by which to produce or reproduce natural phenomena (Galileo's use of balls rolling down inclined planes, Boyle's air-pump), the generation of new phenomena with the express aim of testing hypotheses, the recording of results in first-person dated accounts—all this, though not entirely absent from Aristotelian science, was incidental to the achievement of its aims.

Experimenta supply probable reasons in argument. They are often brought forward in conjunction with *a priori* arguments to the same conclusion. Suárez, for example, adduces both *experimenta* and *a priori* reasons to show that the powers of a natural body must be united in a form. Arguments on the existence of the void (Schmitt 1967) included *a priori* reasons (Aristotle's argument, for example, that the motions of bodies in a void, which offers no resistance to them, would be incommensurable with motion in any medium) and *experimenta* (the air in a sealed vessel forces its way out violently when the vessel is heated) (Schmitt 1967).

Descartes' use of *experimenta* remains in many ways close to that of the Schools. Like them, he combines *a priori* arguments with *experimenta*. The empirical basis, moreover, for the analogies he so often appeals to is common experience; and the phenomena he attempts to explain are for the most part drawn either from everyday experience or from other authors. The table of angles of incidence and refraction in the *Dioptrique* comes from Witelo; the anatomy of the *Traité de l'homme* from the treatises of Caspar Bauhin and others (Bitbol-Hespériès 1990). It is not in the production of new phenomena that the novelty of Descartes' natural philosophy is to be found, but in his

conception of corporeal substance and the ideal of mechanistic causal explanation.

2. Body as substance

Body is first of all substance. An individual body is a “complete” substance composed of two “incomplete” substances, matter and form. The term *incomplete* registers the fact that neither matter nor form can exist naturally except when joined with the other in an individual body. The term *substance* was, following Aristotle, defined in two ways: logically, as an ultimate subject of predication, and ontologically, as an individual capable of subsisting apart from any other individual.

Substance defined in the first way is contrasted with *accident*—with things that ordinarily only exist “in” another, as heat exists only in hot things. The relation of accidents to the things they exist in was called *inherence*.

Substance defined in the second way is contrasted with any entity that, even by God’s absolute power, cannot exist apart from all others. Substance in this sense is contrasted with *mode*. The relation of modes to substances I will call “ontological dependence”.

Figure, for example, is a mode (Suárez 1597/1859, 25:615). It cannot exist apart, even miraculously, from the figured thing; the definition of figure essentially presupposes the existence of the quantity of which it is the figure. The definition of the human soul, on the other hand, though it will make reference to the body as that to which the soul is naturally joined and through which it exercises some of its powers, does not presuppose the existence of the body; one of the standard arguments for its immateriality is that some of its powers can operate without an organ, and thus that the human soul, as the seat of those powers, can exist apart from any material substrate.

In his polemics against the Schools, Descartes has two *bêtes noires*: “real qualities”, as he calls them, and substantial forms. The rejection of real qualities amounts to an identification of inherence with ontological dependence; the rejection of forms is part of his program in physics of restricting the properties of bodies to figure, size, and motion.

The first bête noire: real qualities

By “real qualities” Descartes means qualities which, like the sensible qualities of the Host after transubstantiation, were supposed to subsist even though the substance in which they had inhered was annihilated and replaced by the body of Christ. In the Thomist account of transubstantiation, the sensible qualities of the host were said to inhere in its quantity which, once

the matter of the host is annihilated, itself inheres in nothing. Quantity, then, could not be a mere mode of substance; it must be a *res*, a thing, capable, as substances are supposed to be, of existing apart from any other thing. Essential to being an accident is not *actual* inherence but only *potential* inherence; accidents have this, substances do not (Fonseca 1615/1964, 3:199).

The term ‘real’ in this context (Latin *realis*, from *res*, ‘thing’) is likely to mislead readers now. Whether Descartes thought that sensible qualities like color and heat are real in current senses of that word is a delicate question; but when he denies that they are “real” qualities, he is not denying that they have some sort of existence independent of our conception of them, he is denying that they are *res*—that they can exist apart from their ordinary subjects of inherence. Having identified inherence with the ontological dependence of modes on substances, Descartes concludes that the doctrine of real qualities says of them that they are and are not substances, which is plainly contradictory. Not surprisingly, he refers to the doctrine with disdain.

For Suárez a *res* or thing is “that which of and in itself is something in such a way as not to require being always intrinsically and essentially affixed to another”; nor can it be united with another except “by a medium in some way distinct by nature from it” (Suárez 1597/1965, 25:257). Not only bodies but also their sensible qualities are *res* in this sense. Inherence, as the relation of a sensible quality to a subject, is thus distinct from the ontological dependence of modes on substances.

Res are contrasted with modes, whose nature requires that they be “affixed to another”. A mode includes in its definition, its “essential reason”, an intrinsic dependence on something else: in considering the definition of ‘figure’, say, we can see that ‘figure without quantity’ is contradictory, and that not even God can conserve the figure of a thing without its quantity. If we consider the definition of color, on the other hand, we should find—since colors for Suárez are *res*, and capable of existing without their ordinary subject—that it does not include an intrinsic dependence on something else actually existing. Color, unlike figure, does not intrinsically depend on quantity, even if, in the ordinary course of nature, it occurs only in quantified substances.

In the *Principles* Descartes, like Suárez, divides things into substances and the modes that are ontologically depend on them. But he has no use for any distinction between inherence and ontological dependence. Corporeal substances are either identical or really distinct; the only other relation he admits is that of mode to substance. Since the essence of body is extension (which here we can take to denote what the Aristotelian term ‘quantity’ denotes), everything that pertains to body must be a mode of extension. In particular, colors and other sensible qualities, if they exist at all in bodies, must be modes of extension.

One motive for ridding the world of real qualities, and thus for eliminating inherence, was that if colors are not just modes, the program of restricting the explanatory apparatus in natural philosophy to the modes of extension will fail. Descartes was bound therefore to deny that sensible qualities are *res* (Menn 1995:194). He does not, on the other hand, show that they cannot be modes of extension, taking for granted, I think, that his usual list—figure, size, and motion—would be treated as exhaustive.

The second bête noire: substantial form

The object of natural philosophy is body, more precisely (since metaphysics also treats body as substance) body as changeable—*ens mobile* (Toletus 1615/1985, 4:4). That there is change in the world and that the senses yield true beliefs about change the Aristotelians never doubted. The fact is certain: what remains is to provide a scheme for describing change and to determine its causes. Physics proper, in addition to defining matter, form, and change, sets out the four sorts of cause and proves that there is a first cause of all change, a *primum mobile*. The more specialized parts of natural philosophy consider particular kinds of body and the causes and effects peculiar to them.

Body, or corporeal substance, Aristotle says, is a composite of matter and form. The basic argument for the distinction, a version of which can be found already in Plato's *Timæus*, is this: even in the most radical changes—the death of an animal, the transmutation by heat of water into air—some component of the thing changed must of course be different, but some component must be the same. Otherwise we could not say *this* thing has changed; we would have to say that one thing had been replaced by another. What persists through change is the *matter* of the thing (with respect to that change); what differs is *form*.

By itself the argument yields little. It does not show that in each thing there is *one* matter that persists through all its changes; and because a thing can typically undergo many sorts of change, the argument would seem to show that it must have many forms. Nevertheless the Aristotelians held that in every natural thing there is one form that deserves to be called *the* form of that thing: its “substantial” form. In a living thing, for example, the soul is the substantial form, accompanied by many “accidental” forms—the quantity and qualities of body and soul. There is also in every natural thing a first or “prime” matter that persists even when the thing is destroyed or corrupted to the point of becoming, as an animal does in death, another kind of thing.

Corporeal substance is, first of all, a composite of substantial form and prime matter. In the form certain *powers* inhere, most importantly the active powers characteristic of the species to which the substance belongs. Cats have the active powers of locomotion and appetite and the

passive powers of seeing, hearing, and so forth. Those powers, in order to operate, require certain *dispositions* in the body—particular temperaments or mixtures of the elements, particular shapes, and so forth. The eye, for example, is round and contains a crystalline humor suited to the reception of color.

The role of substantial form in this scheme is twofold. It is the seat of the powers of a body, the source from which they all spring; and because the basis upon which bodies are classified into kinds is primarily the powers and dispositions associated with each body, that classification is based upon the form by which those powers and dispositions are determined. For that reason, form, considered as a cause, is said to give “specific being” to substance.

Descartes holds that form is an idle wheel in the machinery of physics. Aristotelian authors, however, knowing that some philosophers had denied the existence of form, took care to offer not only conceptual but empirical arguments for postulating, in addition to the qualities revealed to us by the senses, a form in which those qualities were united and by which they are brought into existence.

I will mention one such argument. On the basis of various *experientia*, Aristotelian authors hold that a distinction must be made between *accidental* change, in which a thing changes but remains of the same kind, and *substantial* change, the result of which is a new kind of thing. A standard example is the heating of water. In moderation, it merely alters the “intensity” of a certain quality. But *in extremis* it turns water into what they considered to be a distinct kind of thing—the element “air”. This second sort of change is all-or-nothing, irreversible, and accompanied by a wholesale alteration of the accidents of the water. What was heavy becomes light, what was cold becomes hot, and so forth. The phenomenal distinction thus made between two sorts of change is best explained, the Aristotelians believed, by postulating a distinction between the “accidental” qualities of the thing and its substantial form, so that substantial change is the replacement, not merely of one accident by another, but of one substantial form by another, together with all the changes implied by that (Suárez 1597/1965, 25:501–502).

In Cartesian physics there is, fundamentally, no way to distinguish substantial from accidental change. Material stuffs consist of corpuscles whose shapes are continuously deformable into one another. In principle lead could be made into gold by mere local motion. Boyle, who unlike Descartes attempts to refute the empirical arguments for form, argues that the phenomenal distinction is one of degree only. To preserve the commonsense view that there are different kinds of stuff he supposes that the corpuscles of a homogeneous stuff like iron or water share the same shape or “texture”, assuming implicitly that texture has the requisite stability (Boyle 1991).

Had the role of form in physical explanation alone been at issue, Descartes could have contented himself with substituting for the obscure Aristotelian notion his own clear and distinct notion of figure. But the Aristotelian holds that substantial form is itself substance, and really distinct from matter (Fonseca 1615, 2:82). If we consider only what form is according to its essential definition—as “that which gives specific being to matter”—and we take the definition to require not actual, but only potential “giving of specific being”, then it is not contradictory to suppose a form could exist without its matter. God, who can bring about whatever is not contradictory, could bring this about; the separated human soul is evidently just such a case.

Form neither inheres in matter nor does it ontologically depend on matter. Its relation to matter is the *sui generis* relation of union. Except in the human case, Descartes has no need of this relation, no more than he has for a relation of inherence distinct from ontological dependence.

Superfluous too are the quasi-substances form and matter, along with “real qualities”. Each of these includes in its essential reason a relation, which need only be potential, to something else from which it is really distinct—of form to the matter that gives it particular existence, of matter to the form that specifies it, of qualities to their subjects of inherence. In Descartes’ world, on the other hand, only things whose essential reasons are wholly independent are really distinct. The essence of body contains nothing that pertains to mind, and that of mind nothing that pertains to body (imagination and sensation, which ordinarily require bodily organs, are not part of its essence strictly speaking). Whatever is not wholly independent of a thing must be wholly dependent on it, and cannot exist without it, not even by God’s absolute power. There is no middle ground.

Matter and quantity

Bodies are composite of form and matter. Requiring union with matter to exist naturally is the defining character of material form. Spiritual forms, though they can interact with matter, never join with it to form a complete substance. In the late sixteenth century and the early seventeenth there was notable uncertainty concerning the essence of matter, an uncertainty that the best efforts of the Aristotelians, and of Descartes too, failed to dispel.

One point of agreement was that bodies ordinarily occupy space. In an Aristotelian context, occupying space is proper to things having *quantity*. The understanding of matter thus begins with the definition of quantity. Among the Aristotelians there was serious disagreement. Each of the major schools had its own view, and even among the Jesuits there were differences—the Coimbran commentary agrees with Thomas that the essence of matter is *pura potentia*, Fonseca

and Suárez do not. The positions I describe are those of Fonseca and Suárez.

Quantity is divided first into discrete and continuous. Continuous quantity is again divided into intensive and extensive. Intensive quantity is a property of qualities like heat, impetus, and courage that admit of degrees. Lengthy questions were devoted to the waxing (*intensio*) and waning (*remissio*) of qualities. Descartes ignores the issue. In his physics, local motion alone admits of degrees, and those degrees are measured by comparing the distances—distance or length being an extensive quantity—travelled by bodies in equal times.

Extensive quantity has three distinguishing features: it is the measure, as Aristotle says, of substance; it admits of division into integral parts, each of which is capable of existing separately; and it confers on matter the capacity not only to be present at, but to occupy distinct spatial places. Each of these features had been put forward as the essence of quantity. Fonseca and Suárez (who cites Fonseca) argue for the third. Following Scotus, Fonseca holds that the definition or “formal reason” of quantity is to be *per se* extended (qualities like color are extended too, but only *per accidens*, as the accidents of quantified substances) (Fonseca 1615, 2:639). Suárez holds the formal reason of quantity is not actual but potential extension, not the actual occupation of space but an aptitude or habitude toward doing so (Suárez 1597/1965, 26:547). Actual extension, then, is the “formal effect” of quantity, not quantity itself. From that effect the other features, measurability and divisibility, of quantity follow.

Descartes holds that there is nothing more to matter than extension, from which it follows that a material substance and its quantity are not really, or even modally, distinct. His position is, in almost so many words, that of Ockham, who argued that there is no real distinction between substance and quantity. From substantiality alone the three distinguishing features of quantity already follow, and since a real distinction must not be introduced without a compelling reason to do so, there is no reason to hold that substance and quantity are distinct except in our conception (Suárez 1597/1965, 26:533).

It is worth dwelling for a moment on the Jesuits’ replies to this argument. The first is that in the Eucharist, the substance of the bread and wine is annihilated, and replaced with the body and blood of Christ; the quantity, nevertheless, and the sensible qualities of the bread and wine must remain, since after all they appear to the senses just as before. Quantity, therefore, can exist without substance. But if substance could not exist without quantity, it would be a mode of quantity, which is evidently false. Substance and quantity are therefore really distinct (Suárez 1597/1965, 26:534). Descartes encountered the same argument from Arnauld in the Fourth *Objections*. His difficulties in responding to it—then and later—were among the grounds on which

Cartesian natural philosophy was condemned after his death (Armogathe 1977).

Suárez, acknowledging that the first reply to the Ockhamist argument rests on accepting the “mystery” of the Eucharist, holds also that the capacity of bodies to keep others from occupying their place—impenetrability, in short—is not the effect of substance alone. From the essence of substance (which is, as we have seen, the possibility of existing separately), or from that of matter, impenetrability does not follow. Ockham’s razor cannot be applied; quantity must be distinct from substance and from matter.

If quantity is distinct from matter, it cannot be part of its essence. What then is the essence of matter? The Thomists held that because not only quantity but all the other accidents of substance exist in substance by way of form, matter, considered by itself, has no other essence than that of potentially receiving form and all that comes with form: it is *pura potentia*, “pure potency”. God is *actus purus*, pure act: everything that God can be, he is. Matter is, in this respect, as distant from God as anything that is not nothing can be. God has all perfections, matter has none, not even that of existence.

Descartes’ name for that which lacks all perfection is *nothing* (AT 7:54). Indeed it is not easy to understand how an entity having no existence of its own could be joined with form to generate something new—a complete substance. Even the Coimbrans, who agree with Thomas, hold that matter has an existence of its own, even when it is not joined with form. Its existence is imperfect and incomplete, so much so that in the ordinary course of nature matter cannot exist without form. That matter has an essence which is not just *pura potentia* is indicated by the fact that, although it is receptive to every form (and in that limited sense *pura potentia*), it receives forms only in a certain order. The forms of the elements are received first, then those of mixtures like blood and flesh, and finally higher forms like those of plants and animals. Suárez, noting that the receptiveness of matter to quantity is a natural precondition to its union with form, holds that being receptive to quantity is proper to matter. The *potentia* of matter is biased, so to speak, and therefore not *pura*.

In this setting, Descartes’ position—that the essence of body is extension—has two distinguishing features. The first is that body in general, is already a substance in its own right, whose “form” is extension. Extension, like form, confers substancehood on whatever has it, and generically distinguishes material from spiritual substances; in these respects, and because all the properties of bodies are supposed to follow from extension, it resembles substantial form. But only up to a point: in Descartes’ physics, there are no individual or specific substantial forms. The differences between natural kinds are all of the sort that an Aristotelian would call accidental.

Unlike form, moreover, extension cannot be separated from its “matter” even by God.

The second noteworthy feature is what might be called Descartes’ super-nominalism. At the outset of his career, in his collaboration with Isaac Beeckman, Descartes already committed himself to a physics in which bodies are conceived to have only “mechanical” properties, namely, the modes of extension. In the *Rules*, we see him arguing already that extension and body cannot be clearly distinguished (AT 10:444–445). In *The World*, a few years later, the matter of his hypothetical universe is supposed to consist only in extension (AT 11:33). Descartes there begins to make ontology conform to method. But only after renewing his acquaintance with the School philosophers in the late 1630s did he formulate, in terms most likely taken from Suárez, the ontology of created things as one of substance, attribute, and mode; only then did he identify space, quantity, and matter. Like Ockham, Descartes holds that a body and its quantity are distinct only in our conception. But unlike Ockham he takes quantity—that is, extension—to constitute the nature of body, and infers that every accident of body is a mode of extension.

2. Change and causes

In Cartesian physics all change is local motion, and all causation is efficient causation. God and the human mind, the only active powers in Descartes’ world, intervene in nature but lie outside the purview of its laws, and so also outside natural philosophy. Because they do, consideration of ends must likewise be excluded from natural philosophy: agency, ends, and cognition cannot be separated. Descartes was in this respect more radical in his departure from the Schools than most of his contemporaries and successors. Some of them, notably Leibniz and the Cambridge Platonists, tried to reinstate notions of agency and end. To understand what was at stake, it is essential to keep in mind the fundamentals of Aristotelian theories of agency and the role of ends in nature. Our intuitions, being Cartesian, are likely to mislead us when we turn to the seventeenth century: the framework we take for granted was then still in flux.

Aristotelian natural philosophy is saturated with purposiveness. Natural change, properly understood, is directed change. Blind efficient causes and mere motion from place to place are marginal, limiting cases. A world like Descartes’ was not unthinkable: the Aristotelians had, after all, the examples of Democritus and Epicurus to consider. But to conceive of natural change in their manner, or in Descartes’, would in their view have precluded knowing the natures of things and the true causes of change.

Actual and potential

Fundamental to the Aristotelian conception of natural change is the distinction between *actus*

and *potentia* (“act” and “potency”). A thing is said to be *in potentia* such-and-such if, given a suitable agent and an environment free of hindrances, it will, in the ordinary course of nature, become such-and-such. Being *in potentia* such-and-such entails being possibly such-and-such, but it usually has the richer sense of *tending* to become such-and-such, by virtue of some real feature. The seed is *in potentia* a mature organism, not merely by virtue of its being logically possible for it to be one, but by virtue of some real feature that the seed now has.

It makes sense, therefore, to regard a thing which is *in potentia* such-and-such but which has not become such-and-such as imperfect, as having been hindered in its development. People normally acquire the sense of vision; a person who lacks vision is not just a “not-seer”, as a stone might be said to be; a human “not-seer” is *blind*—deprived of vision, hence lacking what a human being, by its nature, should have.

Ontologically, *actus* is just existence. The *actus* of my power to speak is an existing utterance. But *actus* is not existence *simpliciter*. It is existence conceived as a fulfillment or perfection that follows, under normal circumstances, from the nature of the thing whose *actus* it is. *Actus*, moreover, is a relational, not an absolute designation. An *actus* may itself be a *potentia*. Among the *actus* of my soul is the power of memory, which is itself a *potentia* whose *actus* is the recording and recollection of perceptions.

Natural change, or *motus*, is “the *actus* of a being *in potentia* insofar as it is *in potentia*” (Coimbra 1594/1984, 1:350). Descartes cites this as a piece of Scholastic nonsense (AT 11:39), but Aristotle’s commentators, though they disagreed about its interpretation, had no trouble making sense of it. I think it is best understood as a schema by which to pick out, in a thing that is changing, just what the change consists in. Heating is the *actus* (an actually existing quality of heat) of the thing heated (which is *in potentia* hot or at least hotter) insofar as it is *in potentia* (not yet as hot as it is going to be, or as it is naturally capable of becoming). Aristotle’s definition directs us to consider in any natural change the condition of the thing changed by virtue of which it initially admits of being changed in that way, together with the *terminus* or natural stopping point of that change. Change, at least in the central cases, is always directed.

Natural change is inseparable from agency. More precisely: “These five are to be considered in every action: the agent, the patient, the form which is brought about, the *fluxus* of the form, and the various respects or relations consequent upon them” (Toletus 1615–1616/1985, 4:86rb). The form is the terminus of the change, the “flux” is the *motus* itself. Some Aristotelians held that the flux is a stage of the form itself designated as a member of a succession of forms, others that it was somehow distinct; we can set that dispute aside. The agent is the efficient cause of the form,

which is received in the patient, as heat is received in earth from the sun; but even though the form is said to be “received”, nothing passes from the agent to the patient. The form that results from the change is newly generated in the patient—“educated”, as the common view put it, from the *potentia* of the patient’s matter.

From the asymmetry of agent and patient it was thought to follow that the agent is not changed in acting, except incidentally by reciprocal action or by way of improving the capacity of the patient to serve as its instrument. I become a better craftsman by building better tools, but strictly speaking only the tools are perfected, not me. It follows also that action, passion, and *motus* are not really distinct. ‘Action’ denotes the *motus* insofar as it is related (causally) to the agent, ‘passion’ denotes the *motus* insofar as it is, or results in, a form in the patient. Thus Descartes, when he says that action and passion differ only in reason, was merely repeating a commonplace (AT 3:428, 11:328). The *motus*, it should be noted, is unambiguously an accident of the patient; Descartes, in identifying action and passion, probably did not intend that we should think of the passions of the soul as joint modes of mind and body.

Cartesian physics has little use for the agent-patient scheme. Its basic event is the collision of two bodies, an event in which there is no asymmetry by which to distinguish agent from patient. In Cartesian psychology, on the other hand, voluntary action presents us with an evident asymmetry between mind and body: mind is the agent, will its active power. But Descartes also applies, not so aptly, the scheme of agent and patient to sensation. In the sixth *Meditation*, the passivity of sensation is necessary to the proof of the existence of body, which is, it would seem, the *agent* of sensation. The difficulty is that bodies have no active powers. If the scheme was seriously meant to be applied to sensation, God, it would seem, would be the agent. But one might also take Descartes to be altering, as he did in other instances, the sense of a term borrowed from the Schools: here, perhaps, ‘patient’ means no more than ‘thing affected’, and ‘agent’ no more than ‘causal antecedent’.

Causes in general and the efficient cause

The matter-form account of substance is combined with the agent-patient scheme of change in the Aristotelian system of the four causes. The *material* cause of a thing is its matter, and the *formal* cause its form. The agent or quality of the agent that brings it about that the matter has that form is the *efficient* cause, and the end for which the agent acts is the *final* cause. The reason under which matter, form, agent, and end are rightly called causes is, Suárez argues, that each in its own manner “gives being” to its effect. Suárez uses the phrase *influre esse*, “to inflow being”; the model

here is God, who in creation imparts, out of the fullness of his own being, existence to all created things. The “influx” here is not a *transfer* of being but rather a kind of *assimilation* of creature to God with respect to perfection, the most fundamental of which is existence itself. So too in ordinary causal relations nothing is transferred from the cause to the effect. The sun does not lose its heat by heating the earth; it elicits from the substance of earth the quality of heat which hitherto has been in it only potentially.

The material and formal causes we have seen already. As for the efficient cause, it is worth noting first that Descartes agrees with the Aristotelians on what might be called its formal aspects. Efficient causes necessitate their effects; they precede them in time; there is no action at a distance; “nothing comes from nothing”, and so the more perfect cannot be brought into existence by the less perfect. The application of the principle in its general form presupposes an order of degrees of perfection (or, in Descartes’ formulation, “reality”). Accidents, since they are dependent beings, are less perfect than substances and cannot cause them; material forms cannot cause spiritual forms.

Descartes’ innovation was to initiate a parting of the ways between (efficient) causation and (active) power. Descartes has no qualms about saying that one body *causes* another to move. But he denies that any body has the *power* to move another. The question here raised was treated in the Schools under the heading of the “efficacy of second causes”. God is the first cause, and evidently an active power: are there any others? Already in Islamic Aristotelianism it had been argued that God is the only active power. Created things are merely “occasional” causes of change, where an occasional cause satisfies the formal conditions on efficient causes, but which is supposed not to *initiate* the changes it brings about. Occasionalism was a constant temptation for philosophers who held that the world is created and sustained by an omnipotent deity. Almost everyone agreed that God *can* perform the office of any creature; but then it is not easy to see why active power should be attributed to anything else: why should the world not depend on God in this respect as it does for its existence?

Aristotelian authors argued at length for the efficacy of second causes—the human will first of all, but also natural agents. One alternative—that second causes are efficacious and entirely independent in their operation from God—was ruled out from the start. The favored alternative was to hold that God *concur*s in the acts of creatures—that he co-operates with them in the production of their effects, but in such a way as not to deprive them of their own efficacy. Descartes’ position was clear with respect to the human will: it is an active power, genuinely efficacious. With respect to bodies, his position was ambiguous and remains a matter of dispute. It

is worth noting, however, that (the case of the will aside) the considerations urged on behalf of the efficacy of second causes by the Aristotelians would have had little force for Descartes. He could, moreover, count on the Aristotelians' agreeing that *if* body is nothing other than extension, then indeed bodies can have no active powers. Extension, as Descartes well knew, is in the Aristotelian world utterly inert.

Ends and final causes

In the Aristotelian world, ends are everywhere. In the Cartesian, there are ends only where there are minds. That difference is not so radical as it might seem. Unlike Aristotle himself, Aristotelians in a theistic setting tended to restrict ends as causes to those which are cognized by a rational agent. Irrational agents—inanimates and non-human animals—have ends only derivatively, as means to divine ends.

For the Aristotelian the question is not whether nature acts according to ends (if we take those ends to be God's). Rather it is how ends can be understood as causes. Part of the answer is easy: an end “gives being” to a thing by virtue of being its completion or perfection—the actualization of its nature. Actuality is existence: the perfected thing has more being or more reality than the imperfect thing.

The causality of ends was understood by invoking, first of all, the familiar scheme of intentional action: the thought of the end moves the will to act toward that end. But it might be said—and some Medieval philosophers did say—that then the end comes out as a special sort of efficient cause. Suárez and the Coimbrans, who were familiar with that argument, argued that nevertheless the causality of ends is distinct from that of efficient causes. The end acts on the will not simply as something cognized; it acts under the “formal reason of goodness”. My thought that eating apple in front of me promotes health is part of the efficient-causal explanation of my eating it; but being thought of, though necessary to the will's being moved, is only incidental to understanding how it is that eating the apple becomes an *end* toward which I act. The healthiness of eating the apple—eating considered under the “formal reason” of perfecting the body—must be invoked.

3. Art and nature

Descartes' natural philosophy, and especially his physiology, makes abundant use of analogies between human artifacts and natural things. Living things are just configurations of extended matter; they differ from human machines only in complexity. From the structure of human machines we can thus infer, on the basis of similarity in operation, the structure of living things. In Aristotelian physics, on the other hand, the utility of art in generating knowledge by analogy

about the powers of natural things is strictly limited. Art, even though it is said to imitate nature, cannot serve as a model, because human production is by comparison with divine creation secondary, superficial, and subordinate.

1. *Secondary*. That art imitates nature, and is thus secondary to it, is obvious in the case of the arts of depiction. Other arts—carpentry, tailoring, cobblery—, though they do not imitate pre-existing natural effects, imitate those that “ought to have pre-existed” and strive to fashion them as nature would have (Toletus 1615-1616, *Phys.* 2c2q6; 4:54v). The claws, fur, fins that nature gave to animals nature gives us by endowing us with an intellect capable of conceiving the forms of all those tools. Human art can thus attain to a more direct imitation of the divine mode of production than is realized by natural agents.

Nevertheless art could not exist without the creative act of God and the generative acts of nature. God realizes in matter the exemplars or divine ideas of the forms of things. The active powers of nature execute the divine plan, generating substances composed of prime matter and substantial form, supported and embellished by suitable qualities. Art operates only on the finished substances of nature. Unlike God, it cannot create from nothing; unlike nature, it cannot reduce an existing substance to prime matter and give it a new substantial form.

2. *Superficial*. The forms of art are not the substantial forms of things, but their figures, their outward shapes. Figures follow forms. They are the attendants of form, the indices of substance. Human art cannot bestow on matter new substantial forms. To imitate the effects of natural substances on vision it can only employ the signs of form, that is, the shapes of things. This holds not only for the arts of depiction but also to some degree for the other arts: the rudder of a ship may look like a tail, but it is only by courtesy an organic part of the ship. Art remains at the surface.

Arriaga holds that the forms of art consist merely in the locations [*ubicationes*] of pre-existing substances. All we change is the *ubi*, the “where”, of various bits of stuff. The forms of artifacts are simply displacements of their materials (Arriaga 1632:319; see Des Chene 1996:245). In those arts which, like baking and cooking, do not merely move things around, the human contribution amounts only to the application of natural powers to suitable patients, as fire to dough. Nature, not art, produces whatever new forms are thereby generated; art merely provides the occasion.

3. *Subordinate*. Nature’s powers are subordinate to God; human industry is subordinate both to nature and to God. God, the Coimbrans write, brings forth [things] from nothing; nature from the potential being; art from perfected being; God by creating, nature by generating, art by compounding or composing (Coimbra 1594/1984, 1:214).

Natural forms are “active [*actuosæ*] and as if alive”. But the forms of art are “as if inert [*stolidæ*] and dead, having no effective force [*effectricem vim*]”. They are nothing more than reshapings of things. But shape pertains to quantity, and quantity “of itself is idle [*ignava*] and inert; it is given by nature [to things] as if it were another matter, to sustain their accidents”. Figure inherits from quantity its passivity. Art, in short, has no effects as such; and if the nature of a thing is, as Aristotle says, its principle of rest and motion, then artifacts have no natures.

The contrast could hardly be greater. Art deals only in the surfaces of complete substances, its forms are mere shapes, it is inert—more so than even the inanimate substances of nature. Nature, on the other hand, works from within and needs only prime matter for its material; the creatures of nature not only have active powers but are capable of conferring those powers on others.

Yet there seem to be instances in which art exceeds the limits thus set for it. The Coimbrans consider three cases: automata, magical figures and characters, and alchemy, to which they devote a special question (on the relations of art and nature in alchemy, see Newman 2004). The statues of Dædalus, the dove of Archytas, the animated stools of Apollonius of Tyana all seem to have possessed powers not unlike those of living things. Likewise the images and amulets produced by astrologers and natural magicians seem to exceed in their effects the powers of natural agents. And if alchemists can indeed generate gold from base metal, as they say, art will have managed not merely to relocate bits of stuff but to impose a new substantial form on prime matter.

But all this is either fakery or can be ascribed to natural causes. “Neither art nor artificial form by its own power is capable of the work of nature” (Coimbra 1594/1984, 1:218). If witches and magicians sometimes seem to endow figures and characters with active powers, the actions they bring about are, if not illusory, due to “the industry of demons who at the sign [given by the witch] hasten by tacit or express agreement to play with the minds of men”. The instruments of witchcraft are just visible manifestations of the witch’s intentions. In other cases ordinary natural causes are at work, and the appearance of activity in an artifact is owed to the concealment of those causes. So it is with automata, whose actions are brought about by “little machines hidden within”, which act in perfectly natural ways.

Concerning alchemy, the Coimbrans’ conclusion is a bit of a surprise: “Even if it is extremely difficult to produce true gold by chemical recipes, still it does not seem that one can judge it entirely impossible”. If gold has hitherto been made only under the earth, that is merely because only there have the requisite matter and the requisite agents been brought together. But the natural processes that produce it can occur, anywhere, even in the alchemist’s den.

Having thus approached what we would call a modern view of the matter, the Coimbrans

immediately retrace their steps. They remind the reader that in fact no one has demonstrated the art of making gold. In every case the product was either not true gold or, if genuine, was surreptitiously introduced during the process. Alchemists therefore deserve their bad name. And if the day comes when gold is made by art, it will be by way of applying natural agents to suitable materials. Art itself will remain an inert bystander. Alchemy, like natural magic, tests the limits of art but cannot exceed them.

Human art, even if it manages to produce substances, remains subordinate to nature. In Descartes' natural philosophy, the subordination of art to nature is not altogether rejected. But the difference between human and divine art no longer turns on the all-or-nothing presence or absence of generative powers. It is instead the difference between the finite and the indefinitely large, a difference in number and intricacy of parts. Human art is only accidentally, not essentially, subordinate to nature. The barrier between art and nature is thus displaced. Art is, one might say, that which is actually made in accordance with our desires; nature is that which is not, or which is only potentially so.

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DENNIS DES CHENE