



ORDER: GOD'S, MAN'S AND NATURE'S

Natural Laws and Divine Agency in the Later Seventeenth Century

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Prologue

It is a commonplace that one of the primary tasks of natural science is to discover the laws of nature. Those who don't think that nature has laws will of course disagree; but of those who do, most will be in accord with Armstrong when he writes that natural science, having discovered the kinds and properties of things, should "state the laws" which those things "obey" (Armstrong *What is a law* 3).

No Scholastic philosopher, on the other hand, would have included the discovery of the laws of nature among the aims of natural philosophy. Regularities there may be in an Aristotelian world, but the focus of inquiry is elsewhere—on natural kinds, powers, qualities, temperaments.

There must have been a change of view at some point. The obvious period in which to look for that change is the period in which the notion of law came to the fore in natural philosophy: the seventeenth century. That notion has been with us ever since. Scientists are quite happy to talk about all sorts of laws, from the basic laws of conservation to "phenomenological" and statistical laws.

Philosophers, on the other hand, have found them puzzling. The character attributed to laws seems to be in need of explanation, and yet no convincing explanation is at hand; indeed, as I have mentioned, some philosophers think that natural science has no laws, or at least that it doesn't need to appeal to them to accomplish its ends.

My suggestion will be that the configuration of features characteristic of laws arose in the early modern period as a response, in a theistic setting, first to what were considered the deficiencies of earlier accounts of causation and then, as the program of the new natural philosophy developed, to problems raised within that philosophy itself.

Character of laws

Laws are universal. At minimum a law must say of *all* things of a kind that some predicate holds of them. There may be unstated *ceteris paribus* conditions, but in principle all such conditions could be stated explicitly so as to yield a law without any implicit conditions. Laws thus may be contrasted with generalizations in Aristotelian natural science: those hold “always or for the most part”, and no unconditional universal generalization need be in the background to legitimate them.

Laws are modally distinct from “mere generalizations”. The precise modality in question is a bone of contention. One point in favor of there being a distinction between laws and mere generalizations is that laws hold counterfactually. Descartes’ rules of collision, for example, are stated not in the indicative, but in the subjunctive: *Were* two bodies of equal volume travelling with equal speed in opposite directions to collide, each *would* return in the direction from which it came, with the same speed (PP 2§46).

One question, then, is how laws came to be regarded as capable of “supporting counterfactuals”; or, more generally, how it came to be that natural science concerns itself not only with what *is* the case, but with what *would be* the case.

Laws form a system. The philosophers I will examine think of the laws of nature as forming a whole which is subject first of all to a requirement of consistency, and then (more importantly) to requirements of simplicity, richness of consequence, and so forth. They form a *complete* system, moreover: in nature there is no place for miracles—or rather what appear to us to be miracles are themselves part of what Malebranche and Leibniz call the “order” of nature.

There were in Scholastic philosophy principles according to which nature “does nothing in vain”; and Ockham’s razor was occasionally brandished; but in my view the application of simplicity and other global constraints (as we would say) to the laws of nature taken together is a seventeenth-century innovation.

Laws function as premises. They play the role of axioms in synthetic demonstrations of generalizations like the law of refraction (Descartes) or the law of falling bodies (Galileo). The *principles* of natural philosophy (as Descartes and his contemporaries understood that term) include more than just laws: they include the structure of space and time and a description of the primitive features of the things (in Descartes’ case, the extended substances) to which the laws apply. But in explanation, the ideal is to have demonstrated the (generalized) phenomena from the laws together with suppositions about microstructure.

How did this configuration come about? It’s worth noting—and I will return to this point—that the rise of the concept of law coincides with great difficulties concerning causation, especially once Descartes has cast out—if only temporarily—active

powers from natural philosophy. Philosophers' grip on the notion of "necessary connection" begins to weaken; and once God no longer can serve as its ground, Hume has a relatively easy time doing away with it. But as luck would have it, the concept of law supplies an appealing substitute—the causal relation can be construed in terms of the instantiation of laws. Hermann Weyl sums up the outcome nicely: "The abandonment of the metaphysical quest for the cause in favor of the scientific quest for the law is preached by all great scientists" (*Philosophy of mathematics and natural science* 189).

Roadmap

- (1) Brief look back at Aristotelian concepts of natural change, power, cause and effect.
- (2) Descartes and the introduction of the notion of law. Derivation of the laws of nature, its implications for the questions above, especially that of the modality of laws.
- (3) Malebranche: divine decrees, the primacy of order, and the denial of necessary connection (from which Malebranche derives his occasionalism).
- (4) Leibniz's theodicy and the system of natural laws.

I. Aristotelian concepts

At the base of Aristotelian natural philosophy is a *general model of natural change*. In brief, it includes the following general claims:

- (i) *Motus* or natural change is the actualization of a *potentia* in the thing that changes.
- (ii) In any natural change there is an agent and a patient. This is a genuine physical distinction, and not just a matter of convenience.
- (iii) An agent acts by virtue of possessing a specific active power to bring about change in its patients; powers are defined in terms of their operations and objects.

The dependence of effect upon cause requires that there be something in the nature of the cause by which it causes the effect; otherwise we have mere *per accidens* (incidental) causation. My sensation of white depends upon a thing whose nature includes or entails whiteness; only incidentally does it depend upon the teacher of Plato, who happens to be such a thing.

The causal relation is therefore *intentional*: in exhibiting the cause of a particular effect we must be able to point to something in the nature of the cause from which the effect would follow. A thing affects the sense of sight by virtue of a *potentia visiva* (so Suárez in the end decides), which is to say a power *directed toward* the visual organ, specially fitted (in ways to be determined) to affect it.

Intentions and causes

That causality is intentional for an Aristotelian is most easily seen in discussions of the distinction between causality *per se* and *per accidens*. In causality *per accidens* the conjunction of the effect with the cause is accidental: “the white thing heats”, “the musician builds”. “Fire heats”, on the other hand, is no *per accidens*, because (Suárez says) “fire radically and by its own virtue includes the proper reason of heating”—that is, fire is by its nature hot.

A chance effect, that is, an effect brought about by the fortuitous concurrence of several causes, has only *per accidens* causes (provided that the concurrence of causes does not itself have a “certain and definite cause”). Suárez holds that in such cases the effect is “outside the intention of the agent”. The stone, when it falls on Peter’s head, *intends* only the center of the earth—its ultimate resting place—; striking Peter is “outside” that intention, that is, not implied by the definition of the heaviness which initiates the fall.

Where is this talk of intentions coming from? Go back to the concept of natural change. Natural change is paradigmatically directed: the actualization of a *potentia* has in most cases a *terminus a quo*, a starting point, and (more importantly) a *terminus ad quem*, a point of completion or perfection. The *terminus ad quem* of a power is part of its definition. Every power, exercised or not, has an object toward which it is directed—its *intentio*. This holds not only for agents capable of representing the objects of their actions but for all agents, even those in which there is nothing comparable to an idea or species of the object intended.

In the paradigmatic cases of natural change, then, the “connection” between an agent and the change it effects in a patient consists in a natural relation between the agent and the *terminus ad quem* of the change, a relation referred to as “intending”.

II. Descartes

Descartes’ natural philosophy was set up, in part, in opposition to that of the schools. The notion of *law of nature* arises in that polemical context. In Descartes’ scheme, natural change is subject to, or “governed by”, a small set of *laws*. I will briefly describe the setup within which Descartes derives the laws.

Laws of nature

(i) God is the ultimate cause of every thing, with the possible exception of himself. Change is real, and therefore has God as its ultimate cause.

(ii) It is necessary for any created thing that at each moment of its existence it must be *conserved* by God. Conservation is the continuation of the act of creation, and is not distinct from it.

(iii) Natural change in a Cartesian world is always reducible to local motion, change of place. Explanation in principle consists in positing a mechanism and demonstrating from the laws that the mechanism, impinged on in certain ways by bodies, will move in certain ways.

(iv) Motion, though it is not a substance but only a mode of substance, is nevertheless a *thing* (as Descartes understands that term) and is conserved not only in being but in its quantity (this would count as its “state” in the application of the first law of nature: see below).

(iv) God created the material world with a certain quantity of motion overall; this he thereafter conserves.

Descartes presupposes the conservation of the total “quantity”, that is, the Volume, of matter. Quantity of motion in an individual body is by definition the product of its Volume and Speed; so if the Volume of matter in the world is constant, the conservation of the quantity of motion entails that as the matter of the world is divided, Speed will be allotted to the parts of matter so that the total remains constant. Descartes concerns himself only with *local* interactions of bodies; it is to those that the law of the conservation of the total quantity of motion is applied.)

(v) The conservation of the overall quantity of motion in the world is a consequence of immutability of the operation of the divine will.

In the derivation of his three laws of nature, Descartes again invokes the immutability of the operation of the divine will to prove the first and third; in his argument for the second law (according to which the tendency of a body in motion is to move in a straight line unless impeded) he also invokes the *simplicity* of rectilinear motion.

Determination, agency, immutability, ends

In Cartesian physics one should distinguish between the agent of change and the determination of that agent’s acts by the circumstances in which it acts. God, in my interpretation, is the sole agent in natural change (when it is not caused by minds). The determination of his acts, however, is owing to bodies, their locations, and their states of motion and rest. Since our interest in explanation is usually not in the mere existence of motion in the world, but in the determinate modes of motion present in this or that body, the focus is not on the agent—God—but on the determination of his acts.

God’s intention is always simply that the total quantity of motion in the world be conserved. Of the constancy of the quantity he is the *per se* cause; but of the particular determinations of motion in bodies by which the total quantity of motion is

conserved, God is only a *per accidens* cause; the *per se* cause of the determination of motion (e.g. that two bodies of equal volume and equal speed colliding head-on will reverse their motions) is the bodies themselves and their modes.

The reading I'm offering here is close to that of Descartes' occasionalist successors, Pierre Sylvain Régis and Nicolas Malebranche. Régis writes that we can continue to say that one body moves another, but only "on condition that when we say that a body moves another, we mean nothing else than that God makes use of the encounter and the impenetrability of that body to move another which was at rest" (*Cours* 1:313). The key point is that *determination*—*what* happens, or the particular outcome of an interaction—has been separated from *agency*—*that* something happens, or the general reason for there being interactions at all.

[[Here is Régis:] Since second causes act more immediately to produce movement or rest than does the first cause, and since it seems that from the fact that God moves bodies diversely according to the diverse qualities of those he makes use of to move them, it follows that customarily we attribute all the effects that depend on movement and rest to second causes, and say, for example, that a soul moves or stops a body, and that a body moves or stops another body.

We will therefore retain this way of speaking, but on condition that when we say that a body moves another, we mean nothing else than that God makes use of the encounter and the impenetrability of that body to move another which was at rest.]

We see here the germ of Weyl's distinction between the "metaphysical quest for the cause" (namely, God the agent) and the "scientific quest for the laws" that determine how, in each instance, God shall act.

The modality of laws

Descartes derives the laws of nature from (i) the immutability of the divine will and (ii) features of the objects upon which that will operates. The *form* of a law specifies the conditions that determine the operation of the will in the cases to which it applies; those conditions may vary but the law itself, as an expression of what Malebranche will later call a *general volition* of God, cannot vary; if it did, God's will would not be immutable.

It is clear that for Descartes the laws hold subjunctively; we can infer from them not only what *does* happen in actual instances but rather what *would* happen in instances that do not exist and perhaps cannot exist. In fact the laws of nature (with the possible exception of the second) hold only under the strongly counterfactual supposition that the bodies to which they apply are not being acted upon by others; but the Cartesian world has no voids, and so every body is in constant contact with others. Descartes *needs* his laws to hold subjunctively if they are to hold at all. That they do hold subjunctively follows, I take it, from the conceivability of a situation in

which a body's motion is not resisted at all by any other body, not because it moves in a void but because they remove themselves from its path; this, combined with the *inconceivability* of any alteration in the laws by which God orders his operations, yields the manner in which God's action would be determined in the instance conceived.

Summary

The decisive steps so far:

(i) The denial of active powers in matter, and with them, "natures" in the Aristotelian sense. Along with natures goes the distinction—in natural philosophy—between causation *per se* and *per accidens*. Natures are to be replaced by mechanisms; these can be as simple as the needle shape of water or as complicated as the machines we call animals.

(i') Order in nature, which will become more important as we move on, is in the Aristotelian system derived from the presence in matter of forms whose powers are oriented to ends. This is most evident in living things, but it applies to all natural agents and also to the community constituted by them—the *cosmos*, considered as a harmonious whole.

In Cartesian physics, we see the beginnings of a developmental or historical approach to the explanation of order. Descartes' historical cosmology and his theory of the earth are, however imperfect, examples of the production of complex structures according to the laws of nature, laws which themselves are quite indifferent to the presence or absence of order. Similarly in the *Description of the human body* Descartes attempts to show how from the seed of an animal the natural motions ("natural", that is, from a Cartesian standpoint) of the animal spirits and other fluids in the surrounding matter will eventually sculpt it into the shape of a human body, merely by "blind" local motion. There is no need for Aristotelian *intentions*, not even in those cases where the Aristotelian thought they were indispensable.

(ii) The derivation of the laws from divine attributes. Descartes differs from both his predecessors and from many of his successors in refusing any role in natural philosophy for divine goodness. But he has made the decisive move to introduce principles whose demonstration is based on the attributes of God.

In Descartes' case this is the "formal" attribute of immutability ("invariance under temporal translation", we might say) together with, in the case of the second law, the simplicity of the divine operations. Nature had, of course, been doing "nothing in vain" for a long time; in Cartesian physics, what had been attributed to nature is attributed instead to God.

III. Malebranche

On occasionalism

Some remarks

(i) Suárez (to whom Malebranche refers in the “Éclaircissement” on second causes) recognizes four views on the efficacy on second causes:

1. That God is the unique efficient cause.
2. That corporeal creatures are not efficient causes, but spiritual creatures are.
3. That corporeal creatures can be the efficient causes of accidents but not of substances; and spiritual creatures of both substances inferior to them (e.g. bodies) and of accidents.
4. That “created agents truly and properly bring about those effects that are connatural and proportionate to them” (*Disp.* 18§1¶5, 25:594). This was the orthodox view among Aristotelian authors.

(ii) The view I am attributing to Descartes is the second. It is a point of controversy among the interpreters of Descartes, but here I will just assume it. The key point is not so much the rejection of agency altogether from natural agents as it is the rejection of the Aristotelian apparatus of active *powers* that *intend* their objects.

(iii) Malebranche argues that God is the unique efficient cause. In outline his argument is this:

1. The idea of body as extension precludes attributing efficacy to bodies.
2. Therefore only spirits can move bodies. But “when one examines the idea one has of all finite spirits, ones sees no connection [*liaison*] between their will and the movement of any body whatever; on the contrary one sees that there is no such connection and cannot be” (*Recherche* 6pt2c3, Pléiade 1:646).
3. What remains is infinite spirit—God. “When one thinks of the idea of God [...], one recognizes that there is a connection between his will and the movement of all bodies, such that it is impossible to conceive that he should will that a body be moved and yet this body not be moved” (646); Malebranche later characterizes this connection as necessary (649).

How is it necessary?

(i) Consider one definition of omnipotence: God wills that *p* entails *p* (or, formally, “the inference from ‘God wills that *p*’ to ‘*p*’ is valid for all non-contradictory *p*). God’s volitions are “necessarily efficacious”.

(ii) God, because he has always a completely clear and distinct idea of the objects of his volitions, can form “full” intentions that comprise in all possible detail the intended object.

In short, what God wills cannot but occur (agency) and it is completely determined by his understanding.

From this I retain two points. Causality is, first of all, *intentional*, just as it was in Aristotelianism. Malebranche doesn't so much reject the Aristotelian position as work out its consequences in a Cartesian world.

Moreover, the relation of cause to effect is supposed to be one of necessity. Any defeasibility of the connection between the existence of the cause and that of the effect entails that the cause is only what Malebranche calls a "natural" cause—something that determines the particular effect of a genuine (*véritable*) cause.

On ends and order

Malebranche, unlike Descartes, cannot abide the thought that in the natural world there is no hint of God's goodness, or at least none that the natural philosopher may legitimately inquire into.

In the Cartesian world, moral and physical order are quite distinct. Physical order is just the outcome of the interactions of bodies; it can be explained without any appeal to divine intentions or to divine goodness. In the sixth *Meditation* we see that God's intentions in instituting constant conjunctions between certain states of the body and certain states of the mind can be known to us: the relations of mind and body are instituted so as to promote the well-being of the union. That in this case we can know the end to which God operates is owing in particular to our understanding of the passions and their role in promoting our welfare; moreover, the relations in question are relations not of bodies to bodies but of *the* body to a mind; they lie outside natural philosophy.

For Malebranche, on the other hand, the natural and the moral order cannot be separated. God, in creating the world, had to "combine physics with morals, in such a manner that the consequences of these laws were the best that can be" (*Entr. méta. relig.* 13art3; 2:925). Where in Descartes the derivation of the laws involves only the formal property of the immutability of the divine will, in Malebranche that derivation will appeal to divine wisdom—but to what I will call the "formal conditions of wisdom".

Priority of wisdom over will

The will of God is, according to Malebranche, subordinated to his wisdom. The moral order, which supplies the ends of creation, has priority over the physical order, which provides the means. One example:

if man [...] had not sinned [...], then since order would not permit him to be punished, the natural laws of the communication | of movements would not have been capable of rendering him unhappy.

The law of order is "essential to God", and so the arbitrary law of the communication of movements "must necessarily be submitted to it" (*TNG* 1pt1art20; 2:29–30). So much so that Adam, before he sinned, "could in certain circumstances suspend the

natural law of the communication of movements”—this so as to suppress the movements of the animal spirits that might otherwise have given rise to passions that in turn might have led him to sin (*Recherche*, _Écl. 8, 1:850). From the standpoint of physics alone, Adam could perform miracles. but with respect to order Adam’s feat was no miracle; it was the fulfillment of God’s wisdom.

Preponderance of the formal conditions of wisdom

God’s wisdom precedes his will; the laws of nature are subordinate to order. But what does that wisdom consist in, and how does it determine the laws? I will argue for the preponderance of what I call “formal conditions of wisdom” in God’s design. Those conditions turn out to coincide nicely with the conditions now thought to be required of good scientific theories (*TNG* 1pt1art12–18).

The wisdom of God encompasses all possible designs and all means of executing them. The design and means God chooses will be those which bear “most strongly the character of the divine attributes”. Those attributes, which I am calling the formal conditions of wisdom, are simplicity, generality, uniformity (art12add), and proportionality of means to ends (art13). I call them “formal” because, taken in themselves, they yield no specific ends, no particular goods to be attained in creation. They resemble the condition of immutability, which requires that *whatever* God wills he wills *eternally*.

There is a tradeoff between means and ends. Given an end, God chooses the simplest means. It may be that in choosing the simplest means God does less than he could were he to “perform miracles at all moments”. In such cases, Malebranche says, “the wisdom of God resists his volitions”.

As evidence of the wisdom of God, Malebranche adduces the “fecundity” of the laws, their invariability, their limited number. God has the foresight both to insure that the laws need not be altered to accomplish his ends and to use the most general laws consistent with doing so (rather than having to include special laws to repair the defects of more general laws).

[One *direct* application of the formal conditions to a physical situation (first version of the 16th *Écl.*, 1:1120ff): Suppose that God wills that the body A should collide with the body B. God knows that “A can collide with B along an infinite number of curved lines and also along a unique straight line”. Supposing that the only purpose God has in moving B is to collide with A, then “A must be transported toward B by the shortest path, that is, by a straight line”. Transporting A along a curve would require more “action”; but “action in God is will; therefore more will in God is required to move A in a circle than directly”. But God’s will, supposing that his only aim is to have A collide with B, is not sufficient to move A along a curved line. “Thus there is a contradiction [in supposing] that God does not act by the simplest ways”, given the ends attributed to him in acting.]

The requirements of simplicity and uniformity thus give priority to general over particular volitions. The laws of nature will be general in form. But what of their modality?

Nothing in what I've said so far concerning the formal conditions of wisdom bears on the question of what would occur were such-and-such a situation, which does not in fact obtain, were to obtain. This billiard ball changed its motion to such-and-such a direction, according to the laws of nature, when it was struck *thus* by another. But what if it hadn't been struck? We are no longer talking about the actual world; it is not clear whether in the world we imagine we should take the laws to hold or not, since they too seem to be up for grabs if we depart from actuality.

Perhaps the best way to think of the counterfactual case is to consider how those laws are stated. We saw that in Descartes the laws are subjunctive from the start. To distinguish even general volitions within what Régis refers to as the "simple, eternal, and immutable volition [with which God acts], a volition that includes indivisibly and by a single act all that is and will be" (*Méta.* liv1pt1c9, 1:92–93), we must consider God's will as if it were applied only to objects in the very situation to which that general volition applies: for example, in thinking of Descartes' first law, we consider a single body as if it alone were the object of God's will. We see that *were* that the case then God *would* will of that body as it is in itself that it and its state should be conserved. This alone is consistent with the formal conditions on wisdom.

In *Le Monde* Descartes writes that "those who can sufficiently examine the consequences of those truths [concerning 'number, weight, and measure', the knowledge of which is 'natural to our souls'] and of our rules [i.e. of motion] will know effects by their causes; and [...] will have *a priori* demonstrations of everything that can be produced in the new World" (*Monde* c7; AT 11:47). That is in part because the laws follow from the immutability of the divine will and the simplicity of God's means—from, in other words, formal and not substantive conditions.

Malebranche (and as we'll see, Leibniz) takes the laws of nature to depend on the formal conditions of wisdom; so that even though no non-actual (but possible) world can satisfy *all* the conditions under which the divine will operates as well as this world, it remains the case that with respect to the formal conditions, all worlds are on a par, since those conditions cannot vary. We are free to suppose, indeed we must suppose, that in every possible world whatever follows from the formal conditions of wisdom will hold.

Our access to the formal conditions of wisdom yields a principle of selection among hypotheses; it assures us, moreover, that the imposition on our theories of constraints like that of simplicity is no mere convenience but a guide to truth.

IV. Leibniz

I turn now to Leibniz. In agreement with Malebranche and contrary to Descartes and Régis, Leibniz holds that the divine understanding pre-exists the act of creation. In particular, for each possible world, whatever lawlike relations hold among the individuals of that world will already be present in God's conception of that world. As Leibniz puts it, an "order of nature" exists "eminently" in God, who has only to will that a world should exist for its order to be realized:

When one attributes to God [...] the understanding of reasoning about and consequences of creatures, in such a way that all their demonstrations and all their syllogisms are known to him, and are found eminently in him; then one sees that there is, in the propositions or truths that he knows, an order of nature without any order or interval of time (*Théodicée* §389).

The laws of nature in particular, though not "geometrically necessary", are not arbitrary in relation to the divine nature. They are "born from the principle of perfection and order; they are an effect of the choice and of the wisdom of God" (§349).

To act out of wisdom, to act reasonably, is to act according to principles or rules. In the *Théodicée*, Leibniz quotes Jacques Bernard who, in a review of William King's *De origine mali* (*Nouv. de la République de lettres*, mai-juin 1703), asks:

From whence does it come that God has prescribed laws to himself? What could he not do without general laws, according to his whole power and goodness? (§358)

Leibniz replies that

God could not but establish laws and follow rules, because laws and rules make order and beauty; and because acting without rules would be acting without reason (§359).

In explicit agreement with Malebranche, Leibniz holds that God does all according to order. Even miracles, though they may exceed the natural powers of individuals, are still encompassed within the design that God judged best. But Leibniz takes this, he says, a "little further" than Malebranche.

First of all, God never acts according to "primitive particular volitions", but only according to volitions which are either themselves general or else consequent upon general volitions.

He cannot determine himself concerning Adam or Peter or Judas or any individual, without there being a reason for the determination and that reason leads necessarily to some general statement. The wise man acts always by *principles*; he acts always by *rules* and never by exceptions (§337).

Apparent exceptions to the rules—for example, those that arise from a conflict of rules, will have been generated by the rules, and will be settled by rules, that is, by rules of precedence among rules or the like. Leibniz writes here of the "force" of rules: the weaker will give way to the stronger, according to a general rule

about rules. [There are no “original” exceptions, that is, none that do not arise in this way.]

The formal conditions on wisdom, therefore, *must* be observed by God who cannot act other than wisely. To take pity on Judas, for example, and by a primitive particular volition prevent his betrayal of Christ would have been *unreasonable*; God would have done ill by not doing the best, which is always determined by rule.

Even more than with Malebranche, and in keeping with Régis’s treatment of the divine will, for Leibniz the only adequate object of God’s intention is the entire world. It may well be that Nature in the small should appear quite indifferent—to *us* here on Earth, for instance, which is after all a minuscule portion of the universe. It might seem, then, as if in practice, physics could be as divorced from teleology for Leibniz as it is in principle for Descartes. Nevertheless, as we know, Leibniz insists on the applicability of teleological principles in physics. But those principles, like the principle of least time used in proving the law of refraction, remain formal.

I should note that for Leibniz estimates of the goodness of worlds are not *exhausted* by formal conditions. Spirits, for example, are better than bodies. They don’t occupy space (which means that their number can be infinite, even in a finite world), they can understand God’s purposes and appreciate his goodness, they can praise him. As far as I can see, none of these reasons can be regarded as merely formal. Nevertheless, it is clear that for Leibniz it is most consistent with wisdom that an agent should obey only formal principles, and even in the case of spirits he argues that a world that includes spirits, because they do not impede one another, can be richer than a world that includes only bodies. The formal principle of richness, *applied* to the case of bodies and spirits, yields a preference for spirits.

Conclusion

Descartes’ theology precludes any appeal to the formal conditions of wisdom. God, unlike the human being, acts with absolute indifference. That indeed constitutes divine freedom, whereas for us freedom consists in acting according to reason (*Resp.* 6). The only attribute of God to which the philosopher may appeal in deriving the laws of this world is the immutability of the divine will. I have taken immutability to mean constancy over time; one could equally well take it to mean constancy over bodies, so that the laws of nature, whatever they might be, would hold both for all times and for all bodies.

It is striking in this respect that when, at the end of the *Principles*, Descartes treats the question of choice among hypotheses (he has in mind primarily hypotheses concerning mechanisms), the analogy he uses to define the certainty that attaches to such choices is that of deciphering a message in code. Success in decipherment is

measured in part, no doubt, by the formal requirement of dealing with as much of the message as possible; but otherwise the criterion is the decidedly non-formal one of making sense: if by a simple substitution code we can “compose some Latin words” from the letters of the message, we consider ourselves to have succeeded in deciphering it (*PP* 4§205).

The appeal to the formal conditions on divine volition goes hand in hand, as we’ve seen, with God’s being a rational agent. In Leibniz’s view the God of Descartes is not a rational agent; Descartes’ God and his acts must be incomprehensible to us. Leibniz grants, as everyone does, that God’s understanding and foresight infinitely exceed ours. Yet the formal conditions of wisdom, applying as they do to all rational agents, apply to God as well as to us (insofar as we are rational). It is for that reason that we, applying to God’s work the formal conditions of wisdom that we take to be applicable to our own rational decisions, can reasonably expect that the results will yield the true laws of nature. Thus is justified the appeal to conditions like simplicity and fecundity.

It is no longer part of science to regard nature as the result of the acts of a rational agent. Simplicity and the other theoretical virtues no longer have the backing provided by theism. That is one problem: if they are guides to truth, how so? It cannot be that nature was created in accordance with the formal conditions of wisdom, conditions mirrored by human reason.

A second problem is suggested by the very success of the long-term scientific program inspired by the new natural philosophy of the seventeenth century. It does seem that to a degree we have succeeded in discovering the truth by judging in accordance with the formal conditions of wisdom. That is to say, nature to a degree *appears* as if it were the production or creation of a rational agent, or at any rate it cooperates to some degree with that supposition. The problem here is the unreasonable effectiveness, not of mathematics, but of reason itself in science.

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