Leibniz, Theology and the Mechanical Philosophy

Daniel Garber

Princeton University

The seventeenth century was a century of scientific progress, the century of Galileo and Descartes, Huygens, Leibniz and Newton. It was also a century in which religion, long important in European culture, continued to play an important role. It is not surprising that these two themes would intersect, as they did in many ways on many occasions.

The most famous such intersection is the one that took place between the Roman Catholic Church and Copernicanism in 1616, and then again in 1632. But the one that I want to discuss today is somewhat less well-known, though no less important.

One of the important scientific innovations of the seventeenth century was the rise of the mechanical philosophy. Recent scholarship has emphasized the complexity of the situation. But to put it crudely, the story goes something like this. The dominant view of natural philosophy was derived from an Aristotelian conception of nature. On that view, nature is divided into a number of elementary substances, earth, water, air, and fire. Each of these elements has its own special properties, defined by a distinct inner nature, its substantial form. So earth is cold and dry, and tends to fall toward the center of the earth, and fire is hot and dry, and tends to rise. The mechanical philosophy, on the other hand, held that all body is of the same underlying nature, and that all the properties of bodies could be explained in terms of the size, shape and motion of its constitutent parts, in just the way we explain the behavior of machines. Even though Aristotelian natural philosophy continued to be taught in the schools through most of the seventeenth century, the mechanical philosophy, advanced by figures like Descartes, Hobbes, Gassendi and Boyle came more and more to be the orthodoxy among many who worked on natural philosophy outside of the universities. (As I said, the story is really much more complicated than this, but this is a start.)

How does religion get into the picture? First there is the issue of the Eucharist and the doctrine of transubstantiation. The Aristotelian natural philosophy, revived in the thirteenth century, had become closely intertwined with Christian theology. In particular, it was used to explain the doctrine of transubstantiation and the real presence of Christ in the host. Not all sects accepted transubstantiation as part of their conception of the Eucharist, but among Roman Catholic theologians, it was believed that the mechanical philosophy could not account for the elements of their faith. (Again, the issue is complicated: Descartes, for example, thought that he had a perfectly satisfactory account of the Eucharist). More generally, conservative theologians of all stripes were very suspicious that the new view of the world advanced by the mechanical philosophers would lead directly to atheism and materialism. Gassendi the atomist was suspected of being a materialist, with good reason; Hobbes was certainly a materialist, and was suspected of being an atheist, with good reason. Descartes, a founding father of the mechanical philosophy claimed to be a dualist and a pious Catholic, but people had their doubts. Furthermore, several (though not all) prominent adherents of the mechanical philosophy, such as Descartes, Hobbes, and Spinoza had argued for the elimination of

final causes from physics, that is, the idea that nature could be understood in terms of God's plans and intentions. Indeed, that would seem to be quite in harmony with the core idea that things in the world could be explained in the way we explain the workings of a machine. But it would also seem to take God out of the world altogether. How, then, could one be both a mechanical philosopher and pious at the same time?

In my talk today I would like to examine how one mechanical philosopher, Leibniz, addressed this problem.

One of Leibniz's most important projects, from his earliest writings on, is the reconciliation of Christian theology with a mechanist view of nature. Beginning as early as the *Demonstrationes Catholicae* from the late 1660s, Leibniz tried to show how the mechanical philosophy then popular in progressive intellectual circles requires us to turn to God at crucial moments. However, there is an important development in this view. In his earliest writings, Leibniz brings God into the picture as the cause of such elements as shape, motion, and the coherence of bodies. But by the late 1670s, it is divine wisdom that is at issue, and not just God as an efficient cause. This emphasis on the need to supplement the mechanical philosophy with considerations relating to God's wisdom and final causes continues to the end of Leibniz's career.

Let us begin with an examination of some of Leibniz's earliest writings concerning the relation between the mechanical philosophy and theology.

As Leibniz told Remond in a well known letter from the end of his life, while he was educated in the scholastics, very early on he turned to the moderns, and was converted to the mechanical philosophy:

> *After having finished the trivial schools, I fell upon the moderns, and I recall walking in a grove on the outskirts of Leipzig called the Rosental, at the age of fifteen, and deliberating whether to preserve substantial forms or not. Mechanism finally prevailed….*[1]

It is debatable when exactly the young Leibniz make his momentous decision and adopted the mechanical philosophy, but there is no doubt that he did. By the late 1660s it appears prominently in his writings. Most notable is a long letter to his teacher, Jacob Thomasius from April 20/30 1669, reprinted in the preface to an edition of Marius Nizolius's *De veris principiis et vera ratione philosophandi libri IV* which Leibniz published the following year in Frankfurt. In that letter Leibniz advances a naïve version of the mechanical philosophy, together with an even more naïve argument that the new philosophy is perfectly consistent with Aristotelian natural philosophy.

Leibniz's infatuation with the mechanical philosophy will continue all of his life. But at the same time as he was beginning to express his adherence to the new mechanical philosophy, he was also deeply involved with questions of theology. In 1668, while at Mainz, Leibniz became associated with Baron von Boineburg, a converted Catholic. One of areas in which they shared a passionate interest was theology. It is in connection with

---

[1] G III 606; quoted from G.W. Leibniz, *Philosophical Papers and Letters*, trans. by L. Loemker, Dordrecht 1969, p. 655. (This translation is abbreviated as 'L' in what follows.)

Boineburg that Leibniz first concocted his *Demonstrationes Catholicae*, an unfinished project that was to have been a full-scale defense of the Christian faith.

It is not surprising that these two interests—mechanical physics and theology—would intersect with one another, given the tensions between the two throughout the century. From the beginning Leibniz was deeply interested in figuring out how to be both pious, and adhere to the new mechanical philosophy.

This question is addressed in a short essay Leibniz wrote in 1668 or 1669, the "Confessio naturae contra atheistas".[2] Part I of the essay is entitled "Quod ratio Phaenomenorum Corporalium reddi non possit, sine incorporeo Principio, id est DEO."[3] There Leibniz argues directly that not only is the mechanical philosophy consistent with theology, but that the mechanical philosophy *demands* that there is a God. The essay begins by noting that the mechanical philosophy might well be thought to lead us to atheism:

> *… Through the admirable improvement of mathematics and the approaches which chemistry and anatomy have opened into the nature of things, it has become apparent that mechanical explanations—reasons from the figure and motion of bodies, as it were—can be given for most of the things which the ancients referred only to the Creator or to some kind (I know not what) of incorporeal forms. The result was that truly capable men for the first time began to try to save or to explain natural phenomena, or those which appear in bodies, without assuming God or taking him into their reasoning. Then, after their attempt had met with some little success, though before they arrived at foundations and principles, they proclaimed, as if rejoicing prematurely at their security, that they could find neither God nor the immortality of the soul by natural reason, but that in these matters faith must rest either on civil laws or on historical records.*[4]

This, of course, is not satisfactory for Leibniz. In the rest of part I of the essay, Leibniz attempts to argue that when we go deeper into the mechanical philosophy, and attempt to arrive at the foundations and principles themselves, then we are forced to turn to God.

In brief, Leibniz proceeds as follows. He begins with a definition of body: …*a body is defined as that which exists in space*.[5] But, he notes, from the definition of body we cannot derive anything about the specific shape of a given body. And while it may follow from the definition of a body that it is mobile, we cannot infer from the definition that a given body is actually in motion, or that it has a specific motion. Leibniz then turns to the *consistentia* of bodies, by which he means their resistance to acquiring new motion, the coherence of their parts, and the fact that a hard body is reflected when it encounters another immovable body. Here he notes that these properties cannot be explained in terms of the shape, size or motion of bodies, or, presumably, in terms of the nature of

---

[2] This essay was given to Boineburg, who, in turn, gave it to Gottlieb (Theophilus) Spitzel, who published it anonymously in 1669. See E.J. Aiton, *Leibniz: A Biography*, Bristol and Boston 1985, pp. 26-27.

[3] A6.1.489.

[4] A6.1.489 (L 109-110).

[5] A6.1.490 (L 110)

body. How, then, can we explain these features of body? Leibniz's conclusion is that it is by appeal to God: *For through the ultimate analysis of bodies, it becomes clear that nature cannot dispense with the help of God*.[6] Or, as he puts it more fully:

> *But since we have demonstrated that bodies cannot have a determinate figure, quantity, or motion, without assuming an incorporeal being, it readily becomes apparent that this incorporeal being is one for all because of the harmony of things among themselves, especially since bodies are moved not individually by this incorporeal being but by each other. But no reason can be given why this incorporeal being chooses one magnitude, figure, and motion rather than another, unless he is intelligent and wise with regard to the beauty of things and powerful with regard to their obedience to his command. Therefore such an incorporeal being will be a mind ruling the whole world, that is, God.*[7]

In this concluding paragraph of part I of the "Confessio," there is a gesture toward God's reasons for chosing the specific shape and motion that he does for things in the world. However, the divine reasons are considered only in order to establish that the agent who creates bodies with shape, motion and *consistentia* is an intelligent agent, i.e. God as understood in the Christian tradition. But what is really at issue here is God as the *efficient* cause of shape, motion and *consistentia*: without an immaterial agent such as God, there is no other agent who could fix these elements of the physical world.

But it is interesting to note one aspect of the physical world where God doesn't enter at all: the laws of motion. Shortly after writing the "Confessio naturae," Leibniz is introduced to the problem of collision through a friend of Boineburg's, who alerts him to the controversy about the laws of impact then going on in the Transactions of the Royal Society. This, in turn, starts Leibniz in the path that leads to his first serious work in technical physics, the *Theoria motus abstracti* and the *Hypothesis physica nova* or *Theoria motus concreti*, both published in 1671. In these works, Leibniz frames some laws of motion and impact. These laws, heavily influenced by the vision of physics found in Hobbes's *De corpore*, are fully *a priori*, based on the definitions of the terms alone, not on God, and not on experience. In one of the preliminary studies for these works, Leibniz wrote:

> *… [E]xperiments must be eliminated from the science of the abstract reasons for motion, just as they should be eliminated from geometrical reasonings. For they are demonstrated not from fact and sense, but from the definitions of the terms.*[8]

But this will change radically as Leibniz's thought develops.

---

[6] A6.1.492 (L 112).

[7] *Ibid.* Cf. also the outline of the *Demonstrationes Catholicae* of the same period. There, in part I chapts.2 and 3 Leibniz includes demonstrations of the existence of God "ex principio: quod in corporibus nulla sit origo motus" and "ex principio: quod in corporibus nulla sit origo consistentiae." [A6.1.494].

[8] A6.2.160. See also "Demonstratio propositionum primarum" (Autumn 1671-early 1672 (?)) A6.2.479, where Leibniz groups geometry, arithmetic, and "phoronomica abstracta" as all being necessary and eternal.

In the late 1660s and early 1670s, Leibniz was definitely interested in reconciling the atheistic tendencies of the mechanical philosophy with piety. His strategy then was to argue that when we examine the foundations of the mechanical philosophy we will see that we have to introduce God as an efficient cause of various features of the world which are otherwise unintelligible. But a few years later, Leibniz seems to have expanded his vision quite substantially. Leibniz wrote the following in the late 1670s in the draft of a preface for a book on natural philosophy that he never seems to have started:

> *Here it will be well, however, to explain a little more distinctly how a middle way can be found, in my opinion, between the Scholastic and the mechanistic basis for philosophy; or better, in what sense there is truth on both sides. … The mechanists condemn the Scholastics … as ignorant of what is useful for living, while the Scholastics and the theologians who cultivate the Scholastic philosophy hate the mechanical philosophers as harmful to religion. … This is what I think. … Mathematical science provides magnitude, figure, situation, and their variations, but metaphysics provides existence, duration, action and passion, force of acting, and end of action, or the perception of the agent. Hence I believe that there is in every body a kind of sense and appetite, or a soul … But on the other hand, I think that when once we have demonstrated the general mechanical laws from the wisdom of God and the nature of the soul, then it is as improper to revert to the soul or to substantial forms everywhere in explaining the particular phenomena of nature as it is to refer everything to the absolute will of God.*[9]

This sentiment is repeated over and over again in the years that follow, as Leibniz begins to work out the details of this middle way between the schoolmen and the mechanical philosophers. Everything is explicable mechanically, but the mechanical philosophy itself must be grounded in something that goes beyond the resources that the mechanical philosopher allows himself. In part, what Leibniz has in mind is the necessity of introducing force, both active and passive, and thus the need for introducing something beyond the geometrical in bodies. But the mechanical philosophy—not to mention piety and religion—requires something else that had been eliminated from the mechanical philosophy: divine wisdom in the form of final causes. As he wrote in the *Tentamen Anagogicum* (1696 (?)):

> *This consideration gives us the middle term needed to satisfy both truth and piety…: all natural phenomena could be explained mechanically if we understood them well enough, but the principles of mechanics themselves cannot be explained geometrically, since they depend on more sublime principles which show the wisdom of the Author in the order and perfection of his work.*[10]

The "sublime principles" Leibniz has in mind here, which help to reconcile the mechanical philosophy with piety are the reasons for which God chooses the laws that he

9 A6.4.2009-10 (L 289).

10 G VII 272 (L 478).

imposes on mechanical nature. Leibniz wants to reform the mechanical philosophy, and bring it back to piety by emphasizing God's wisdom, and not just his power.

But here it gets complicated, and interesting. For Leibniz, God and his wisdom intersects with the mechanical philosophy in a number of complex ways. Leibniz is not always careful in setting out this theme in his thought. However, there seem to be a number of different ways in which divine wisdom enters his conception of the mechanical philosophy. First, God enters in connection with the grounding of the laws of motion. But Leibniz also argues for the importance of divine wisdom *within* the mechanist's world: while everything can be understood mechanistically, through efficient causes, Leibniz also argues that everything can be explained in terms of God's wisdom as well. Leibniz argues that parallel to the understanding of the world in terms of efficient causes, there is also an explanatory structure grounded in principles that must be understood in terms of final causes, God's plan. In this way the appeal to divine wisdom is useful in physics itself, and enables us to discover things that are too complex for us to discover if we limit ourselves to the study of efficient causes. Let us explore these issues one by one. Late in his life, Leibniz wrote the following words to Nicolas Remond:

> *My dynamics requires a work of its own … Your are right, sir, to judge that it is in large part the foundation of my system, since there one learns the difference between truths whose necessity is brute and geometric and those truths which have their source in fitness and final causes.*[11]

This conception of the laws of nature as grounded in the will of God is fundamental to Leibniz's mature thought. In texts too numerous to cite Leibniz shows how the laws of nature in this best of all possible worlds are grounded in such principles as the principle of the equality of cause and effect and the principle of continuity, principles which are chosen by God as part of his creation of this best of all possible worlds.

It is important to note here that the issue is *not* a simple question about whether the laws of nature are necessary or contingent. For Leibniz the problem of necessity is distinct from the problem of final causes: Leibniz at least entertains the position that God might have *chosen* the best of all possible worlds *necessarily*. If so, one might hold that what God chose, he chose necessarily, but that, nevertheless, there is a *reason* why things are the way they are and not another. The contrast that Leibniz is drawing in the passage quoted from the letter to Remond is between truths that are grounded in "fitness and final causes" and truths "whose necessity is brute and geometric," that is, truths that don't involve divine wisdom. The distinction is nicely drawn in a text from the *Théodicée*, published in 1710, shortly before the letter to Remond:

> *Now, the truths of reason are of two sorts. Some are those which one calls eternal truths, which are absolutely necessary in the sense that their contrary implies a contradiction: these are the truths whose necessity is that of logic, metaphysics, or geometry, and which one cannot deny without our being led to absurdity. There are others which one can call positive, since they are the laws which it has pleased God*

11 Leibniz to Remond, 22 June 1715: G III 645.

> *to give nature, or which depend on him. We learn them either through experience, that is a posteriori, or by reason, and* a priori, *that is by considerations of suitability which made them be chosen. This suitability also has its rules and reasons, but it is the free choice of God, and not a geometrical necessity which makes him prefer the suitable, and carries them toward existence. Thus one can say that physical necessity is grounded on moral necessity, that is, on the choice of the wise, worthy of his wisdom, and that both should be distinguished from geometrical necessity. This physical necessity is that which makes up the order of nature. It consists in the rules of motion, and in certain other general laws, which it pleased God to give to things in giving them being. It is thus true that it isn't without reason that God imposed these rules and laws, since he choses nothing capriciously or by chance, or from pure indifference. But the general reasons of good and order which he brought forth can be conquered in certain situatiosn by greater reasons of a superior order.*[12]

Leibniz's point is that the laws of nature are a result of divine wisdom, *physically* or *morally* necessary, though not *geometrically* necessary. Geometrical necessities, unlike physical or moral necessities, are absolutely necessary, and their contrary implies a contradiction.

Leibniz came to the view that the laws of nature are the result of divine choice at just about the same moment that he began to outline his mature system, both his mature metaphysics and his mature physics, that is, in his early and mid-30s. Interestingly, that was also the time when he first came upon the philosophical system of Spinoza.

Spinoza was one of the philosophers who was most explicit in his rejection of final causes and divine wisdom. In his *Ethics*, he wrote:

> [There is] *a widespread belief among men that all things in Nature are like themselves in acting with an end in view. Indeed, they hold it as certain that God himself directs everything to a fixed end; for they say that God has made everything for man's sake and has made man so that he should worship God....There is no need to spend time in going on to show that Nature has no fixed goal and that all final causes are but figments of the human imagination. For I think that this is now quite evident* [from discussions earlier in the Ethics]*...that all things in Nature proceed from an eternal necessity and with supreme perfection.*[13]

This view quite shocked Leibniz. It is just about this period in his career that he begins to emphasize the importance of divine wisdom in physics. My conjecture (which I won't defend here) is that Leibniz's brush with Spinozism awoke Leibniz to the importance of final causes in the physical world. In particular, I suspect that it was in reaction to Spinoza's denial of divine wisdom that Leibniz changed his view about the grounding of the laws of nature in the definition of their terms. This and the fact that he had been completely unsuccessful in actually making good on his promise to give an *a*

---

12 *Théodicée*, disc. prélim. §2, G VI 50. See also *Théodicée* § 349, G VI 321.

13 *Ethics*, part I, appendix, Spinoza 1925, vol. 2, pp. 78-80.

priori demonstration of the laws of motion. These two factors, the desire to marry faith and physics, and the failure of his program for giving an *a priori* demonstration of the laws came together at about this time, in the late 1670s, to yield a doctrine that he was to hold for the rest of his career, that the laws of motion are the result of divine choice. I admit that this isn't much of an argument for Leibniz's conclusion. But interestingly enough, though he repeats the claim time and again, he himself never gives an actual argument for why it is that the laws of motion must be grounded in divine wisdom.

It is interesting to note, though, that even if the laws of motion cannot be given a *geometrically a priori* proof, there is a sense in which, nevertheless, they are *a priori* for Leibniz. The appeal to divine wisdom puts the laws of nature in a rather interesting epistemological category. Even though they are metaphysically grounded in the free choice of God, insofar as we have some insight into how God chooses, we can know *a priori* the laws of nature that God chooses for this best of all possible worlds. In this way, it is possible to have genuine *a priori* knowledge of contingent truths.

Leibniz seems to have recognized the importance of this insight almost as soon as he realized the importance of divine wisdom and final causes for his natural philosophy. In the draft preface to the early book on natural philosophy he never wrote in the late 1670s, he writes:

> ***The most perfect method involves the discovery of the interior constitution of bodies a priori from a contemplation of God, the author of things. But this method is a difficult one and not to be undertaken by just anyone.***
> *Just as there is a twofold way of reasoning from experiments, one leading to the application, the other to the cause, so there is also a twofold way of discovering causes, the one a priori the other a posteriori, and each of these may be either certain or conjectural. The a priori way is certain if we can demonstrate from the known nature of God that structure of the world which is in agreement with the divine reasons, and from this structure, can finally arrive at the principles of sensible things. This method is of all the most excellent and hence does not seem to be entirely impossible. For our mind is endowed with the concept of perfection, and we know that God works in the most perfect way.*[14]

The question at hand here is the interior constitution of bodies, but there is no reason why this observation shouldn't apply equally well to knowledge of the laws of nature. A decade or so later Leibniz uses such reasoning to show why another of his basic principles, the principle of continuity, must be observed in nature. The issue is the argument that he advanced against Descartes' laws of impact that they result in egregius violations of that principle. In the essay, "Lettre de M. L. sur un principe general utile à l'explication des loix de la nature par la consideration de la sagesse divine…," which Leibniz published in the *Nouvelles de la république des lettres* in July 1687, he wrote:

> *The Rev. Father Malebranche admits in a way that there is some difficulty in them [i.e. the violations of continuity in Descartes' laws] but he continues to believe that since the laws of motion depend on the good pleasure of God, God could*

[14] A6.4.1998-9 (L 283).

> *therefore have established laws as irregular as these, but the good pleasure of God is ruled by his wisdom, and geometricians would be nearly as surprised to see irregularities of this kind occur in nature as to see a parabola to which the properties of a ellipse with an infinitely remote focus could not be applied.*
> 15

This observation is, of course, also found in the passage quoted from the *Théodicée* above, where Leibniz admits a class of truths of reason which he calls "positive," which are "the laws which it has pleased God to give nature, or which depend on him." We can know these positive laws through reason and *a priori*, Leibniz holds, "by considerations of suitability which made them be chosen."[16] In this way, the laws of nature for Leibniz are a kind of contingent *a priori*, truths that can be known without the aid of experience, even though they are not necessary.

We have seen one way in which final causes enter into Leibniz's mechanical philosophy. Leibniz argues that the laws of nature were (freely) chosen by God in accordance with his wisdom. In this way the laws of nature *must* be understood in terms of final causes, God's choice of the best. But there is another way in which Leibniz wants to reintroduce final causes into the world. Though he agrees with mechanists such as Hobbes, Descartes and even Spinoza that everything *can* be explained mechanically, he also wants to argue that everything can be explained through final causes as well. He often expresses this view through the metaphor of the two kingdoms. As he puts it in the *Specimen dynamicum* of 1695:

> *In general, we must hold that everything in the world can be explained in two ways: through the kingdom of power, that is, through efficient causes, and through the kingdom of wisdom, that is, through final causes, through God, governing bodies for his glory, like an architect, governing them as machines that follow the laws of size or mathematics, governing them, indeed, for the use of souls, and through God governing for his glory souls capable of wisdom, governing them as his fellow citizens, members with him of a certain society, governing them like a prince, indeed like a father, through laws of goodness or moral laws. These two kingdoms everywhere interpenetrate each other without confusing or disturbing their laws, so that the greatest obtains in the kingdom of power at the same time as the best in the kingdom of wisdom.*[17]

What exactly does Leibniz have in mind here?

One thing he has in mind is directly connected with some questions in optics that he worked on from the late 1670s. The passage just quoted from the *Specimen dynamicum* begins as follows:

> *Indeed, one can even bring final causes to bear from time to time with great profit in particular cases in physics (as I showed with the clearly remarkable example of*

---

15 G III 53-4 (L 352). Cf. A6.4.2038, and the "Tentamen Anagogicum," G VII 279 (L 484).

16 *Théodicée*, disc. prélim. §2, G VI 50.

17 GM VI 243 (AG 126).

> *an optical principle, which that most celebrated Molyneux greatly applauded in his Dioptrics), not only the better to admire the most beautiful works of the Supreme Author, but also in order that we might sometimes discover things by that method [via] that are either less evident or follow only hypothetically on the method of efficient causes. Perhaps philosophers have not yet sufficiently seen just how useful this is.*[18]

The reference here is to an essay Leibniz wrote some years earlier, "Unicum opticae, catoptricae et dioptricae principium," published in the *Acta eruditorum* in June 1682. There Leibniz proposed a new principle for understanding the behavior of light: *Light travels from the radiating point to the point illuminated by the easiest of all paths*.[19] Using this principle, Leibniz then went on to show how one could derive both the laws of reflection and refraction for light.

Leibniz immediately realized the philosophical significance of this technical discovery. Earlier in the century, Descartes had proposed to derive these laws from considerations of purely efficient causes. Using models of light conceived as streams of particles, Descartes appealed to the laws of motion to argue for laws that govern the behavior of light when it is reflected from an immobile surface, or when its speed changes as it passes from one medium into another.[20] What Leibniz has shown, he thinks, is that these same laws can be derived not only from efficient causes, but from divine wisdom and final causes as well. As he announced in his first public statement of the principle:

> *Therefore we have reduced all laws concerning [light] rays, justified through experience, to pure geometry and calculation, having made use of this singular proposition, obtained through a final cause, if you consider the matter correctly. […] And so those who reject final causes in physics with Descartes greatly err (not to say something more serious still), since besides providing admiration for divine wisdom, final causes also give us a must beautiful principle for finding the properties of those things whose inner nature is not yet known clearly by us….*[21]

As Leibniz was later to repeat, on the basis of this example from optics, considerations of final causes lead us not only to piety, but can even help us discover new laws in nature. As he wrote much later in the *De ipsa natura* of 1698:

---

[18] *Ibid.* See William Molyneux, *Dioptrica nova* (London, 1692), pp. 192ff.

[19] Leibniz 1682, p. 185. Later statements refer to it as the principle of the most determined path, "the path most determined in length of time." ["Tentamen anagogicum," G VII 278 (L 483)]. McDonough (forthcoming), p. 8 paraphrases the rule as follows: "Put simply, Leibniz's principle is tantamount to the claim that from among all the possible paths between a source and a sink, a ray of light will travel along the path which is unique with respect to ease; where "ease" is understood as the quantity obtained by multiplying the distance of the path by the resistance of the medium(s)." See McDonough (forthcoming) more generally for an account of the optical example and its historical context. See Duchesneau 1993, pp. 263-4 for an account of the change in Leibniz's terminology.

[20] Ref to D, *Dioptrics*.

[21] Leibniz 1682, p. 186.

> *For I believe that God came to decree those laws observed in nature through considerations of wisdom and reasons of order. And I think that it is apparent from this (something that I once noted, using an opportunity afforded by the laws of optics, something that was afterwards greatly applauded by the distinguished Molyneux in his Dioptrics) that final causes not only advance virtue and piety in ethics and natural theology, but also help us to find and lay bare hidden truths in physics itself.*[22]

But Leibniz, from the start, saw the particular example as leading to a metaphysical truth deeper still. In the context of a long and rambling document, entitled "Definitiones cogitationeqsue metaphysicae" by the Akademie editors and dated at 1678-1680/1, Leibniz precedes a brief account of his emerging proof of the law of refraction with the following very general statement:

> ***All the phenomena of nature can be explained solely by final causes, exactly as if there were no efficient cause; and all the phenomena of nature can be explained solely by efficient causes, as if there were no final cause****.*[23]

In this way, Leibniz seems to be advancing the very general thesis that not just in optics, but in *every* case, there are parallel modes of explanation: anything that can be explained in terms of efficient causes can also be explained in terms of final causes.

This view gets its fullest expression in the 1690s, in the *Specimen dynamicum* and especially in the essay, "Tentamen anagogicum," an extended exposition of the importance and utility of appealing to final causes in physics, with a full exposition of the optical work that originally led Leibniz to this view. There he writes:

> *The most beautiful thing about this view seems to me to be that the principle of perfection is not limited to the general but descends also to the particulars of things and of phenomena…. [T]he smallest parts of the universe are ruled in accordance with the order of greatest perfection; otherwise the whole would not be so ruled. It is for this reason that I usually say that there are, so to speak, two kingdoms even in corporeal nature, which interpenetrate without confusing or interfering with each other—the realm of power, according to which everything can be explained mechanically by efficient causes when we have sufficiently penetrated into its interior, and the realm of wisdom, according to which everything can be explained architectonically, so to speak, or by final causes when we understand its ways sufficiently*.[24]

In the principal expositions of this view of parallel modes of explanation, Leibniz puts great weight on the optical examples that go back to the late 1670s. There are others,

---

[22] "De ipsa natura," § 4. Cf. the preliminary draft of the "Système nouveau," G IV 472; "Reponse aux reflexions…" (1697), G IV 340; etc.

[23] A6.4.1403 (Arthur, 253).

[24] "Tentamen anagogicum," G VII 272-3 (L 478-9). On the role of architectonic principles in Leibniz's thought, see Duchesneau (1993), pp. 259-379.

though not many.[25] But even if the optical case is not the only one Leibniz has on which to base his thesis, it does seem to be a bold hypothesis that *all* phenemona in nature can be explained through either efficient or final causes: the idea of parallel explanitory structures everywhere in nature seems a kind of speculative program for a natural philosophy, grounded in a metaphysical vision rather than in detailed argument, empirical or otherwise.

We today are inclined to see science and religion at odds with one another. Nor was this an idea that was foreign to the seventeenth century. But for Leibniz, the two were intimately interwoven. For him, even the laws of motion and the path taken by a ray of light were testimony to the wisdom of the Author of nature.

[25] Jeffrey McDonough notes three classes of problems where Leibniz thinks that teleological principles are useful. The first involves maximization of an area or volume for a given perimeter or surface area. This can explain "the case of a liquid placed in another of a different kind, which forms itself into the most capacious shape, namely that of a sphere." A second class involves the shape of the catenary, the curve made by a cord or chain suspended at two points. This is "the case in common mechanics where the struggling of many heavy bodies with one another finally gives rise to a motion through which there results the greatest descent, taken as a whole." And finally, there is the problem of the brachistochrone, the curve of shortest descent between two given points. Leibniz notes here that "if in the case of the curve of shortest descent between two given points, we choose any two points on this curve at will, the part of the line intercepted between them is also necessarily the line of shortest descent with regard to them."