

Gottfried Wilhelm Leibniz (1646-1716)

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Biography

Leibniz was one of the central figures of seventeenth-century philosophy, indeed, one of the central intellectual figures of his age. Born and educated in Germany, he travelled to Paris in 1672 and quickly entered into its lively intellectual and scientific life, acquainting himself with the most advanced ideas then in circulation. It was there that he invented the infinitesimal calculus, and laid the foundations for the philosophical and scientific programmes that were to occupy him for the rest of his life. He returned to Germany in 1676, entering the service of the House of Hanover where, except for brief absences, he remained until his death. There, along with his court duties, he had time for a wide variety of intellectual activities that eventually gained him an international reputation.

Leibniz's philosophy, particularly his metaphysics, can appear otherworldly and complex. But there are a few simple themes and basic commitments that run through his thought. At root is his philosophical optimism, the commitment that this is the best of all possible worlds, freely created by a rational God who always chooses the best for a good reason. This best of all possible worlds, Leibniz held, is 'the one which is at the same time the simplest in hypotheses and the richest in phenomena' (Discourse on Metaphysics §6). For this reason, the world must be governed by a variety of general principles to which Leibniz appealed in his philosophy: there must be a sufficient reason for everything in the world; there are no jumps in nature; there must be exactly the same power in the full cause as there is in the complete effect, among many others. While such principles do not deductively determine the rest of Leibniz's philosophy, they do play a major role in shaping it; they constitute a kind of lens through which he viewed the major philosophical issues of his age.

One such issue concerns the ultimate make-up of the world. Like many of his contemporaries, Leibniz adopted a mechanistic view, according to which everything in the physical world is explicable in terms of the size, shape and motion of the tiny bodies that make up the grosser bodies of experience. But he rejected the idea that this could be the ultimate explanation for things. Behind the mechanistic world of inanimate bodies in motion, Leibniz saw a world of living things and souls – active, genuinely individual, genuinely different from one another, the true atoms of nature, the true reality – which he eventually called monads. At the deepest level, Leibniz's world was made up of an infinity of mind-like entities, each with its own perceptions that change from moment to moment according to an internal programme by way of the faculty of appetite, all in harmony with one another so that they all reflect the same world. While the world of physics is mechanistic, it is merely phenomenal, the confused appearance of a deeper reality. A consequence of this was Leibniz's famous doctrine of pre-established harmony. In contrast to Descartes, for whom mind and body interact, and in contrast to the occasionalists, for whom God is the true cause who brings about motion in the body on the occasion of a volition and a sensation in the mind on the occasion of a stimulation of the appropriate nerves in the

body, for Leibniz God created the mind (a single monad) and the body (itself a collection of monads) in perfect harmony with one another so that their mental and physical states would always correspond in the appropriate way.

A second set of metaphysical issues of central concern to Leibniz involves the interlocking questions of necessity, contingency and freedom. In response to contemporaries such as Hobbes and Spinoza, Leibniz tried to find room for contingency and freedom in his world. He argued that even though God is, in a sense, constrained to choose the best, he does so freely. Consequently, the world he created, the best of all possible worlds, exists contingently, and at least some features of it are contingent, those whose contraries are not in themselves impossible. So for example, $2 + 3 = 5$, true in every possible world, is necessary, while 'Adam sins', whose contrary is not impossible, is contingent. But over and above contingency and divine freedom, Leibniz also wanted to make room for human freedom. According to Leibniz, when God created Adam as a part of this best of all possible worlds, he knew that Adam would sin; it is part of the concept of Adam that he sins, part of his internal 'programme' that he will eat the apple, and part of the internal 'programmes' of the monads that make up his body that he will actually eat the apple. But, Leibniz argued, what God builds in is that Adam *freely* chose to sin. God builds into the world the reasons that incline Adam's will without necessitating it, correctly predicting what Adam will do, and building the rest of the world around the consequences of Adam's free actions.

Important as they are, these two concerns constitute only a small portion of Leibniz's thought, even within the domain of philosophy. In psychology, he introduced a distinction between conscious and unconscious perceptions and tried to understand the way in which unconscious perceptions ('petites perceptions') in part determine conscious perceptions ('apperceptions'). In epistemology, he is important for his sophisticated version of the innatist hypothesis, and for appreciating the role that a mathematical theory of probability can play in understanding the world. In logic, Leibniz advanced programmes for a new formal logic more powerful than Aristotle's, and for a universal language. In ethics and political thought, he contributed to the seventeenth-century natural law tradition. In natural philosophy, he emphasized the importance of the notion of force and advanced the broadly Cartesian programme of a physics grounded in conservation laws. Outside philosophy he is well known for his work on the calculus. Though he co-discovered it with Newton, it is his notation that is still used, and his version probably had the greater influence in his day. But he was a major contributor to many other fields, including geology, natural history, linguistics and European history. Though he left no real school of followers, he deeply influenced philosophy after his death, particularly in eighteenth-century Germany.

1. Life

Gottfried Wilhelm Leibniz was born in Leipzig on 1 July 1646. He later recalled how his father, who died when he was only six years old, had instilled in him a love of learning. Leibniz started school when he was seven, but more important than his formal education in those years was his reading. He taught himself Latin at an early age in order to be able to read Livy and Calvisius, and because of that was admitted into his late father's extensive library, where he read widely. At

fifteen Leibniz entered University, first the University of Leipzig (1661–66), and then the University of Altdorf (1666–67), graduating with degrees in law and in philosophy. The education he received there was conservative, a mixture of traditional Aristotelian school philosophy and Renaissance humanism. Though invited to join the faculty at Altdorf, he chose instead to enter the service of the Elector of Mainz, where he stayed until he was sent to Paris in the spring of 1672 on diplomatic business.

While he had done significant work in a number of areas before going to Paris, including law, theology, mathematics and physics, the trip was crucial to Leibniz's intellectual development. In the later part of the seventeenth century, learned Europe was in the midst of a great intellectual revolution; the older Aristotelian philosophy of the schools was being challenged by a new mechanist philosophy which rejected the form, matter and qualities of the Aristotelian world, replacing them with a world in which everything was to be explained in terms of size, shape and motion. In this new world there was a special emphasis on mathematics, which was increasingly applied to problems in physics in a way quite foreign to the Aristotelian philosophy.

Though he had taken an interest in the moderns while in Germany (Hobbes was particularly influential on his early thought), it was only after he reached Paris that Leibniz was able to enter the mainstream of European intellectual life. There he came to know the important mathematician and physicist Christiaan Huygens, who introduced him to new ideas which Leibniz absorbed quickly. In those years, Leibniz laid the foundations of his calculus, his later physics and his philosophy. While there were no publications at the time, many unpublished notes survive, important for understanding the emergence of his mature thought.

Leibniz returned to Germany in December 1676, passing through Holland, where he discussed philosophy with the reclusive Spinoza. It was then that he first entered the service of the House of Hanover. He served under Duke Johann Friedrich until his death in 1679, under Duke Ernst August from 1680 to 1698, and then, finally, under the Elector Georg Ludwig, who ascended the throne of Great Britain as King George I in 1714. Except for his travels, he remained at Hanover for the rest of his life. There Leibniz undertook a very wide variety of tasks. He served as a mining engineer (unsuccessfully supervising the draining of the silver mines in the Harz Mountains), as head librarian of a large collection of books, as a general advisor and a diplomat, and was particularly interested in finding ways for the Catholics and the Protestants to reunite. Leibniz was also given the responsibility for writing a history of the House of Hanover. While he collected and published many previously unknown historical documents and published a number of other historical writings, this project barely got off the ground. All that he seems to have completed was a geological history of the region of Lower Saxony, the *Protogaea*. While it proved to be an important work in the history of geology when it was finally published in 1749, it seems not to have pleased Leibniz's employers who had hoped for a history of somewhat more recent times.

Through the rest of his life, Leibniz continued to explore the philosophical, scientific and mathematical questions that interested him from his earliest years. The 1680s and 1690s saw some of his most important writings. In these years, he published his new infinitesimal calculus and a variety of papers outlining his new approach to physics, particularly his new science of

dynamics, the science of force and its laws. The *Brevis demonstratio* of 1686 presents for the first time a refutation of Descartes' conservation law, and hints at the foundations of a more adequate physics. The details are developed in his unpublished *Dynamica* (1690), some material from which is published in the *Specimen dynamicum* in 1695, as well as in the numerous answers to attempted refutations of his argument from tenacious Cartesians. In philosophy, Leibniz published his *Meditationes de cognitione, veritate et ideis* (Meditations on knowledge, truth and ideas) in 1684, and in 1686 composed the *Discours de métaphysique* (Discourse on metaphysics), eventually published in 1846; the main arguments from the latter are discussed in a series of letters with the Catholic theologian Antoine Arnauld, letters Leibniz contemplated publishing in later years. These same themes are found, somewhat transformed, in two important publications in the 1690s, the *Système nouveau de la nature et de la communication des substances* (New system of the nature and the communication of substances) (1695b) and the *De ipsa natura* (On nature itself) (1698). In the first decades of the next century, Leibniz continued to be very active. Important in these years were the *Nouveaux essais* (New essays) (1704), a close examination of Locke's *Essay Concerning Human Understanding*, abandoned at Locke's death and unpublished until 1765. But he did publish his *Théodicée* (Theodicy) (1710), a compendium of philosophical and theological ideas involving further development of themes that go far back in his thought. His final philosophical works were short summaries, intended only as brief guides to his work, the *Monadologie* (Monadology) and the *Principes de la nature et de la grâce* (Principles of nature and grace), both of which probably date from 1714.

Throughout these years Leibniz kept up a vast correspondence, including exchanges with Huygens, Johann Bernoulli, Burchardus de Volder and Bartholomaeus Des Bosses, among many others. One exchange is particularly important. Leibniz had been at war with his English counterpart, Sir Isaac Newton, for many years; their rivalry went back to at least the early 1690s, and probably to their first contact in the mid-1670s. The affair was ugly, with accusations of plagiarism regarding the calculus from both sides, and bitter disagreements over the foundations of physics. The rivalry finally resulted, in 1715–16, in a correspondence between Leibniz and Samuel Clarke, the latter standing in for Newton himself (see Clarke, S. §3). The exchange was published by Clarke in 1717.

When his employer Georg Ludwig went to London in 1714 to take the throne of Great Britain, Leibniz did not follow. He was out of favour for his failure to make progress on the history of the House of Hanover, as well as for his generally old-fashioned manner. Furthermore, it is likely that Georg feared that the dispute with Newton and the British intellectual establishment would cause difficulties. Whatever the reason, Leibniz remained in Hanover, where he died on 14 November 1716. Though celebrated in his life and considered a universal genius for the breadth of his interests and activities, in death he was virtually ignored, buried with little ceremony in a grave that was to remain unmarked for many years.

2. The programme

Leibniz never wrote a single work, book or article, that constitutes a canonical exposition of his thought, preferring the short article or letter where he presents his thought from one or another point of view, often in response to the thought of another (Descartes was a favourite target), or in

response to questions from a correspondent. Indeed, Leibniz's complex thought seems to resist the kind of comprehensive treatment found in works like Descartes' *Meditations* or Spinoza's *Ethics*. Furthermore, it is only to be expected that Leibniz's beliefs changed over his long career, and from one presentation of his philosophy to another.

Despite its complexity, there are some themes and characteristics that run throughout Leibniz's thought, at least in the mature period that starts after his return from Paris in the late 1670s, the period on which this entry concentrates. (While there was not a radical break from the early years to the later, there is certainly a marked development.) Basic to his thought was his philosophical optimism: this is the best of all possible worlds, freely created by a rational God, who always chooses the best for a good reason, without any arbitrariness. It is because of our limited understanding that we cannot determine a priori all the general or particular features of this world. This conception of God and his creation shaped Leibniz's philosophy: the world is ultimately both rational and in every way perfect. Furthermore, though Leibniz's philosophical intelligence ranged widely, certain problems were particularly important to him. In an untitled note from the late 1680s he wrote: 'there are two labyrinths of the human mind, one concerning the composition of the continuum, and the other concerning the nature of freedom, and they arise from the same source, infinity' (Leibniz 1989: 95). The labyrinth of the composition of the continuum concerns the ultimate make-up of the world; the labyrinth of freedom concerns how freedom and contingency are possible in the world. The solution to both involves understanding the literally infinite complexity found in the world God created. Leibniz had an opinion about virtually every philosophical and scientific issue of his day, but these two issues consistently drew his attention.

3. God: creation and theodicy

Like many of his contemporaries, Leibniz thought that the existence of God could be proved, and he was particularly attracted by the so-called Ontological Argument, invented by Anselm and revised by Descartes (see God, arguments for the existence of §§2–3). According to the Ontological Argument, as given by Descartes and paraphrased by Leibniz in *Meditations on knowledge, truth and ideas* ([1684a] 1989: 25), 'whatever follows from the idea or definition of anything can be predicated of that thing. Since the most perfect being includes all perfections, among which is existence, existence follows from the idea of God... Therefore existence can be predicated of God'. Leibniz's contribution to the argument is the observation that, as it stands, the argument is not valid: 'from this argument we can conclude only that, if God is possible, then it follows that he exists'. For the argument to work, we must establish the self-consistency of the definition of God. But the consistency of the definition of God follows directly from the fact that God 'is without limits, without negation, and consequently without contradiction' (*Monadology* §45). In addition to this version of the ontological argument, Leibniz also used a cosmological argument for the existence of God, arguing from the existence of contingent things in the world, things whose reason lies outside of themselves, to the existence of a necessary being (*De rerum originatione radicali* (On the ultimate origination of things) (1697); *Monadology* §45). Finally, Leibniz argued from the existence of eternal truths: 'Without [God] there would be nothing real

in possibles, and not only would nothing exist, but also nothing would be possible' (Monadology §43).

In the opening sections of the Discourse on Metaphysics (1686b: §6), Leibniz argued that 'God has chosen the most perfect world, that is, the one which is at the same time the simplest in hypotheses and the richest in phenomena', a formula that recurs often in his writings. While this is the main account of creation, in other texts, particularly the essay On the ultimate origination of things, he argued that 'there is a certain urge for existence or (so to speak) a straining toward existence in possible things or in possibility or essence itself; in a word, essence in and of itself strives for existence' Leibniz [1697] 1989: 150). Leibniz continued: 'From this it is obvious that of the infinite combinations of possibilities and possible series, the one that exists is the one through which the most essence or possibility is brought into existence'. Such an account of creation has the apparent implication that God is not necessary for it, and that creation results from a quasi-mechanistic weighing of possibilities with respect to one another. But Leibniz emphasized that God is the ground of all possibles, and that it is God who ultimately actualizes the possibles that 'win' the 'contest'. The 'striving possibles' account of creation would seem to be a metaphorical way of expressing Leibniz's usual account in terms of God's choice of the best of all possible worlds.

Leibniz's account of creation had a number of important implications. First, against Descartes and Spinoza, it entailed that there is a standard of goodness and perfection that exists independently of God; God creates the world because it is good, a world which is good not just because it is the creation of God (Discourse §2). Furthermore, unlike Malebranche, Leibniz held that the world could not have been created better than it is (Discourse §§3–4). Leibniz's doctrine of creation can also be read as a direct attack against a conception of God argued by Spinoza. Central to Spinoza's enterprise in the Ethics is an attack on the view that God is like us, that he has aims and goals, that he chooses things for a reason, and that he is bound by standards of goodness that exist independently of his will. This anthropomorphic view of God, Spinoza argued, is an illusion, a projection of our own nature onto nature at large (see Spinoza, B. de §4). Against Spinoza, Leibniz presented his own God, who deliberately chooses to create this world for a particular reason, because it is the best of all possible worlds, a reason intelligible to us. It is on this basis that Leibniz argued against both Descartes and Spinoza for the importance of final causes in nature.

Leibniz's account of creation also addressed the problem of understanding divine justice, in particular, how sin, evil and suffering are possible in a world created by God – the 'theodicy' problem, to use the word coined by Leibniz. His answer was complex, filling many pages in Theodicy, the only philosophical book he published in his lifetime. Briefly, his argument was that evil is a necessary and unavoidable consequence of God's having chosen to create the best of all possible worlds. However bad we might think things are in our world, they would be worse in any other.

Leibniz's account of creation was closely connected with a number of his key principles, most prominently the Principle of Sufficient Reason. As he wrote later in the Monadology (§53), 'since there is an infinity of possible universes in God's ideas, and since only one of them can

exist, there must be a sufficient reason for God's choice, a reason which determines Him towards one thing rather than another'. The Principle of Sufficient Reason entails that the universe is in principle rational and intelligible: God must always act for a reason, and as a consequence, there must be a reason for everything. But the account of creation was also connected with a number of other principles in Leibniz's philosophy (discussed below). In this way one can say that the doctrine of creation underlies all of Leibniz's philosophy. Had we God's intellect, we would be able to derive all of the features of this world directly from its being the best of all possible worlds. As it is, our understanding of God's creation will enable us to fix certain general truths about this world, and set certain bounds on our hypotheses about the way things are.

Leibniz's interest in philosophical theology was not just the interest of a philosopher. He believed that his understanding of truths about God and nature would greatly assist the undertaking of uniting the Catholic and Protestant Churches under the umbrella of the true philosophy.

4. Metaphysics: substance, monad and the problem of the continuum

Leibniz is famous for his claim that he solved the problem of the composition of the continuum. In so far as the continuum (length, area, volume) is divisible, it would seem to be made up out of parts. But what parts could make it up? If the parts are extended (like atoms), then they too are divisible, and we require an account of their composition as well. On the other hand, if the parts are non-extended (like points), then it is difficult to see how they could make up an extended magnitude. Leibniz's solution was this: the mathematical continuum should not be thought of as being *composed* of parts at all; while it has parts, those parts are the result of the division of the whole, and thus are posterior to it. On the other hand, Leibniz claimed, while real physical extensions have parts, there are no physical continua. Physical extended things are at root discrete multitudes whose constituents are substances ('Remarques sur les Objections de M. Foucher' (Remarks on the objections of M. Foucher) (1696); (Leibniz to de Volder, 19 January 1706). This raises one of the central problems for Leibniz's philosophy: what are these substances that constitute the metaphysically ultimate constituents of the world?

While there are many paths into his views on substance, Leibniz's critique of Descartes' notion of corporeal substance is a convenient starting place. Descartes held that the essence of body is extension. What this meant is that bodies are geometrical objects made concrete, entities that have no properties that are not grounded in extension. Colour, taste, sound and so on are not themselves in bodies, but are only sensations in minds caused by our interaction with extended substances. While Leibniz as a mechanist agreed with this last claim, he rejected the Cartesian conception of body on which it is based (see Descartes, R. §§8, 11).

Leibniz offered a number of arguments against the Cartesian conception of bodily substance: (1) The notion of extension presupposes some quality that is extended, like whiteness in milk or resistance to new motion in every body, and so is not the kind of thing that by itself could constitute the essence of anything (Leibniz to de Volder, 30 June 1704; 'Note on Cartesian natural philosophy', 1702). (2) In so far as extended things are divisible, they are aggregates made up out of parts. But the reality of the aggregate presupposes some genuine individuals of

which the aggregate is composed; no such individuals can be found in Cartesian bodies (Leibniz to Arnauld, 30 April 1687; *Monadology* §§1–3). (3) If the world is full and there are no vacua, and if the world is filled with Cartesian extended substance, then there can be no change in the world. For any supposed change would consist in one portion of body replacing another, identical in every way ('On nature itself'). (4) If body were just extension, then it would be perfectly inert, and would have to be moved by God. If so, then God's creation would be imperfect for lacking creatures which cannot themselves carry out any of God's commands. Indeed, such a world would reduce to Spinoza's world in which finite things are just modes of God ('On nature itself'). Because of arguments like these, Leibniz wanted to take the Cartesian mechanist analysis of body back one step further, and resolve even extension into something more basic still, a world of substances that are genuinely individual, genuinely active, and which contain properties that distinguish individual substances from one another.

While there are a number of important discussions of the nature of substance in Leibniz's writings, two are especially noteworthy: the one he gave in the *Discourse on Metaphysics* at the start of his mature period, and the one he gave at the very end of his life in the *Monadology*. (There is a third important conception of substance that arises in the dynamical writings, discussed below in connection with his physics.)

Leibniz begins Section 8 of the *Discourse on Metaphysics* by noting that 'it is evident that all true predication has some basis in the nature of things, and that, when a proposition is not an identity, that is, when the predicate is not explicitly contained in the subject, it must be contained in it virtually'. (This principle, which probably derived from Leibniz's logical studies a few years earlier, was closely connected with the Principle of Sufficient Reason in Leibniz's mind; the containment of the concept of the predicate in the concept of the subject constitutes the 'sufficient reason' for the truth of a proposition. This connection with his logic has caused some commentators to see Leibniz's metaphysics as fundamentally logical in its inspiration.) And so, Leibniz claims, 'the subject term must always contain the predicate term, so that one who understands perfectly the notion of the subject would also know that the predicate belongs to it'. He concludes that 'the nature of an individual substance or of a complete being is to have a notion so complete that it is sufficient to contain and to allow us to deduce from it all the predicates of the subject to which this notion is to be attributed'. Since he held that there must be something in the substance itself in virtue of which this complete notion holds of it, he also concludes that at any given time, a substance must contain marks and traces of everything that is true of it, past, present and future – though only God could see them all. (It is not clear whether this committed Leibniz to holding that all properties of a given individual are essential to that individual, making him a kind of 'superessentialist', or whether he takes the weaker position that they are merely internal to the individual, making him a 'superintrinsicist'. Opinions differ among the commentators.)

In the *Monadology* Leibniz offers a somewhat different characterization of substance. Using the term 'monad' that he adopted to express the notion of an individual substance in the late 1690s, he expounds: 'The monad... is nothing but a simple substance that enters into composites – simple, that is, without parts. And there must be simple substances, since there are composites;

for the composite is nothing more than a collection, or aggregate, of simples. But where there are no parts, neither extension, nor shape, nor divisibility is possible. These monads are the true atoms of nature and, in brief, the elements of things' (Monadology §§1–3). So understood, the Leibnizian world is grounded in non-extended simple substances, whose principal property is non-divisibility and thus, Leibniz inferred, non-extension.

From these basic characterizations of the individual or simple substance (what Leibniz called a 'monad' after the mid-1690s), he inferred a number of important properties. The individual substance or monad is a genuine unity that cannot be split, something explicit in the Monadology account, less so on the earlier account in the Discourse. Consequently, it can begin only by divine creation, and can end only with divine annihilation; it is naturally ungenerable and incorruptible. On both accounts, individual substances or monads are the sources of all their activity, and cannot be altered or changed by the direct action of others; it is in this sense that Leibniz said that 'monads have no windows through which something can enter or leave' (Monadology §7). In the Discourse he derives this from the fact that a substance contains within itself all of the grounds of all its properties; there is no need – and no room – for any external causality. In the Monadology it is derived directly from the fact that monads are non-extended. The apparent action of one substance on another must be analysed in terms of the relations between the internal states of the one and the internal states of the other (as discussed below). Finally, because of the relations that hold between one substance and another, Leibniz argued that each individual substance or monad reflects the entire world of which it is a part, a thesis closely connected with the hypothesis of pre-established harmony (also discussed below). Though all the individual substances reflect the same one world, they each reflect it from a different point of view, adding the perfection of variety to God's creation (Discourse §§9, 15; Monadology §§4–7). This conception of harmony can be traced back to the Paris period and, perhaps, to Leibniz's earliest writings on physics.

On Leibniz's view, substances are distinguished from one another by their momentary perceptions, and by the appetitions, the internal source of a substance's activity that lead from one perceptual state to another. In so far as a substance has such appetitions, 'the present is pregnant with the future' (Monadology §22). Since there can be no external influences, each monad is created by God with a kind of internal programme, as it were, which determines all of the states that it will take and the order in which it will take them. Although the Cartesian soul is an important model for the individual substance (Leibniz to de Volder, c.1699), there are significant differences. While the momentary states are called perceptions, not all such perceptions are conscious. (Conscious perceptions are said to be 'apperceptions' in Leibniz's terminology, though because nature makes no leaps in this best of all possible worlds, there must be a continuous gradation between the unconscious and the conscious.) In scholastic thought, appetite is the general faculty that leads to change in a substance, of which will (or rational appetite) is a special case in rational souls. For Leibniz, too, not all appetite is rational. For these reasons, he distinguished carefully between rational souls, like ours, and monads with lesser degrees of consciousness and rationality – what he sometimes calls 'bare monads' (Monadology §§8–24).

5. Metaphysics: monad, body and corporeal substance

Much of Leibniz's attention was focused on the level of the individual substance or monad, the atom of nature and the building-block of his world, that which in some sense underlies the world of bodies. But in addition to the simple substances, Leibniz often also recognized complex substances, corporeal substances, particularly in the 1680s and 1690s. Corporeal substances are understood on analogy with the human being, a soul (itself an individual substance) united with an organic body. Leibniz often used Aristotelian language to characterize the corporeal substance, calling the soul its form, and the organic body its matter (see Aristotle §§8, 11). The organic body of a corporeal substance is itself made up of corporeal substances, each of which is a soul united to another, smaller organic body, in a sequence of tinier and tinier organisms that goes to infinity, a manifestation of the infinite variety in this best of all possible worlds that God created. Leibniz distinguished corporeal substances from corporeal aggregates, aggregates of animate corporeal substances whose unity is only mental, imposed by the mind, which perceives a group of substances together. While these corporeal substances are ultimately made up of non-extended individual substances, Leibniz's position (at least before 1704) seems to have been that these corporeal substances, as substances, are the genuine individuals whose reality grounds the aggregates that constitute inanimate bodies.

As discussed below, the soul of a corporeal substance is united to its body by virtue of pre-established harmony. However, by 1704, in response to criticism from René-Joseph de Tournemine, Leibniz came to think that this link does not produce genuine unity, and the notion of a corporeal substance becomes problematic for him. While he continued to assert that the physical world is made up of an infinite hierarchy of organisms, after this date he was not so sure that these organisms constitute genuine substances. (Nevertheless, Leibniz always thought that every monad has a body, and cannot exist without one, even if the monad together with its body does not constitute a genuine substance. Even in death the monad has a body, just a body radically smaller than the one it had had in 'life'.) The problem of constructing complex substances from monads led Leibniz in his correspondence with Des Bosses to explore the idea of a *vinculum substantiale*, or a substantial bond. While it is not clear that he ever really endorsed this idea, he does seem to have taken the problem of corporeal substance seriously in that dialogue.

However the issue of corporeal substance is treated, body had a kind of subordinate status for Leibniz. While corporeal substances may be genuine substances, genuinely individual and genuinely active, and thus genuinely real, they are still grounded in non-extended individual substances or monads. And inanimate bodies are inevitably phenomenal, whether the appearance resulting from a multitude of organic corporeal substances, or simply the appearance presented by an infinite multitude of non-extended substances. In this way, one can see Leibniz's philosophy as an inspiration for the distinction between the noumenal and the phenomenal worlds in Kant's philosophy. But in contrast to Kant, who claimed that we cannot know the noumenal world of the thing-in-itself, Leibniz is quite confident that he knows exactly how things are in themselves: they are monads (see Kant, I. §3).

6. Metaphysics: mind, body and harmony

A basic feature of Leibniz's metaphysics was his doctrine that everything reflects the entire world in which it exists. This harmony among things derives from God at creation, who adjusts the perceptions of individual substances or monads to one another in creating a world more perfect by virtue of its variety. And so, despite the fact that individual substances cannot communicate directly with one another, and thus have no real metaphysical causal relations with one another, yet there is an extended sense in which what happens in one substance can be considered the cause of what happens in another. Leibniz wrote: 'The action of one finite substance on another consists only in the increase of the degree of expression together with the diminution of the expression of the other, insofar as God requires them to accommodate themselves to one another' (Discourse §15; compare *Monadology* §52). God, in creating a given substance to perform a particular action at a given time, creates all other substances in such a way as to reflect that action at that time. This is what might be called *physical* causality, as distinct from *metaphysical* causality which Leibniz denied among finite things.

While every monad or substance is related in some way to every other, there is a special relationship between the mind and the body of a living thing, such as the human being: 'Although each created monad represents the whole universe, it more distinctly represents the body which is particularly affected by it, and whose entelechy it constitutes. And just as this body expresses the whole universe through the interconnection of all matter in the plenum (that is, space without empty place), the soul also represents the whole universe by representing this body, which belongs to it in a particular way' (*Monadology* §62; compare Discourse §33). In this way, the mind is connected with the world by virtue of the special connection it has with the body; on Leibniz's understanding of causality, mind and body can be the 'physical' causes of changes in one another.

So Leibniz solved to his satisfaction one of the central problems in seventeenth-century metaphysics: the interaction between mind and body. Because of the special harmony between mind and body, just when my body is in the state it would be in if it were pricked by a pin, my mind is programmed to have a sensation of pain. And just when my mind is in the state of willing my arm to raise, my body is in the physical state that would result in the raising of my arm, again not because of any direct causal connection (Leibniz to Arnauld, 28 November/8 December 1686 and 30 April 1687). For that reason, Leibniz wrote: 'According to this system, bodies act as if there were no souls (though this is impossible); and souls act as if there were no bodies; and both act as if each influenced the other' (*Monadology* §81). This is what he originally called the hypothesis of concomitance, but called the hypothesis of pre-established harmony when he published it for the first time in the *New system* (1695b).

The view is summarized in an analogy he often used. The mind and the body can be compared to two clocks that keep perfect agreement. One hypothesis to explain their agreement is that of natural influence, the hypothesis that there is some physical connection between the one clock and the other. This corresponds to Descartes' view of mind-body interaction, where there is real causal influence. The second hypothesis is that someone watches over the two clocks and, by tinkering with them, always keeps them in agreement. This corresponds to the occasionalism of many of Descartes' followers, in which mind-body causality is mediated by God who causes

sensations in the mind on the occasion of an appropriate bodily state, and actions in the body on the occasion of the appropriate volition in the mind (see Occasionalism). Finally there is the hypothesis that the clocks are so well made that they will always remain in perfect agreement with one another. This corresponds to the hypothesis of pre-established harmony, which Leibniz thought to be the most defensible (Leibniz to Basnage de Beauval 3/13 January 1696).

Leibniz offered a number of arguments directly against occasionalism. He argued, for example, that there must be genuine activity in things themselves because a world of genuinely active things is more perfect than a world of things manipulated by God; indeed, Leibniz claimed, a world of inert things is just the Spinozistic world in which God is the only substance of which other things are modes ('On nature itself'). He also argued that occasionalism posits perpetual miracles, in so far as God is called in to do that which goes beyond the power of things to do by their own nature (Leibniz to Arnauld, 30 April 1687). As noted below, the conception of the physical world that informs Leibniz's dynamics is itself a direct challenge to occasionalism. Nevertheless, Leibniz did share at least one important doctrine with occasionalism: that finite substances have no real causal relations with one another. This doctrine may strike a modern reader as eccentric, but it would have been rather less so for a seventeenth-century reader.

Leibniz often presented the hypothesis of pre-established harmony as a solution to the problem of mind-body interaction. But, at the same time, it allowed Leibniz to reconcile the mechanistic conception of the world with a conception grounded in final causes. He wrote: 'The soul follows its own laws and the body also follows its own; and they agree in virtue of the harmony pre-established between all substances....Souls act according to the laws of final causes, through appetitions, ends, and means. Bodies act according to the laws of efficient causes or of motions. And these two kingdoms, that of efficient causes and that of final causes, are in harmony with each other' (Monadology §§78–9). In more concrete terms, behaviour (raising one's hand, for example) can be explained either in terms of a volition and the harmony God established between mind and body, or purely in terms of the laws of motion, as applied to the physical body. By pre-established harmony, these two explanations will always agree. In this way Leibniz managed to reconcile the dualism of Descartes with the stricter mechanism of Hobbes; everything in the body can be explained in purely mechanistic terms, while, at the same time, Leibniz could also hold that human beings (and other living organisms) have souls which are the causes of much of their behaviour.

In addition to explaining the interaction between mind and body, when first introduced, Leibniz held that pre-established harmony also explains the union of mind and body, that which makes a single substance out of a mind and the collection of individual substances that constitutes its body (Discourse §33). In this way, pre-established harmony provided a central support for Leibniz's account of corporeal substance. Unfortunately, however, it proved inadequate to the task. In May 1703, René-Joseph de Tournemine pointed out that whatever resemblance one might suppose between two clocks, however justly their relations might be considered perfect, one can never say that the clocks are united just because the movements correspond with perfect symmetry. While it does not challenge pre-established harmony as an account of mind-body interaction, the argument is as simple as it is devastating against the somewhat different claim

that pre-established harmony accounts for mind–body unity. In consequence, Leibniz came to question the place of complex corporeal substance in his philosophy, as discussed above (see Malebranche, N. §3; Occasionalism).

7. Metaphysics: necessity, contingency and freedom

Central to Leibniz's philosophy were a variety of problems concerning necessity, contingency and freedom, problems which arise in a variety of ways from a variety of sources. Spinoza stood behind many of Leibniz's worries. According to Spinoza, everything in the world is necessary and nothing is contingent, so that things could not be other than they are. Indeed, everything that is genuinely possible is actual and if something does not actually exist, it is because it could not. Everything follows from the divine nature, not by choice but by blind necessity.

Furthermore, Spinoza argued, everything in the world is determined and what we take to be human freedom is just an illusion. We think that we are free because we are ignorant of the causes outside us that determine us to do what we do.

Other problems came from Leibniz's own views. Some came from Leibniz's principle in accordance with which 'when a proposition is not an identity, that is, when the predicate is not explicitly contained in the subject, it must be contained in it virtually' (Discourse §8). If every predicate true of an individual was part of its very concept, how could it fail to be necessary? A closely related problem followed from Leibniz's claim that every individual substance contains everything that can happen to it, past, present and future, which seems to entail that everything was determined from the beginning, and there is no room for the freedom of a creature. Here the problem concerns not necessity and contingency, but determinism and human freedom. Even if it were contingent that a certain creature has a certain built-in history, given that history, there does not appear to be room for freedom.

Leibniz offered a number of approaches to this problem in his writings. His basic response to the Spinozistic attacks on contingency is the claim that God *freely* chose the best of all possible worlds. He wrote in the early 1680s in an essay entitled *De libertate* (On freedom) 'God produces the best not by necessity but because he wills it' Leibniz [1680–2] 1989: 20). Yet, since God is perfect, it would seem that his nature necessarily determines his will to choose the best.

This led Leibniz directly to another account of contingency. In that same document, he continued by noting that 'things remain possible, even if God does not choose them'. That is, even if God *necessarily* created the best of all possible worlds (a concession Leibniz does not always make), unactualized possibles are still, in and of themselves, possible. The recognition of such unactualized possibles is what brought him back from the precipice of necessitarianism, so Leibniz wrote in another essay from the late 1680s (Leibniz 1989: 21). Elsewhere, he characterized those possibles that God chooses to create as necessary, but only *ex hypothesi*, on the hypothesis that God chose to create them. Though necessary in this limited sense, they are contingent in so far as their contraries are not self-contradictory (Discourse §13).

From time to time Leibniz used the kindred notion of compossibility. Two individuals are said to be compossible when they can be actualized at the same time, and are said not to be compossible when they cannot. In this way one can say that a possible world is a maximal set of compossible

individuals. The notions of compossibility and impossibility are not, however, logical notions, taken narrowly. Two individuals may fail to fit in the same possible world because they are logically in contradiction with one another (in a sense that must be specified), or because they fail to harmonize with one another.

Leibniz sometimes also suggested that it is contingent that this particular world is the best of all possible worlds. So, even if God necessarily created the best of all possible worlds, it is still contingent that he creates *this* world. These arguments address the worries that derive from Spinoza's view that God necessarily gave rise to this world (see Spinoza, B. de §4). But, as noted above, there are other more Leibnizian worries to address as well. If in any true proposition the concept of the predicate must be contained in the concept of the subject, how can any truth fail to be necessary? Leibniz gave one kind of answer in the Discourse on Metaphysics (§13) where he simply asserts that there are two kinds of conceptual containment. While all predicates are contained in the concept of the subject, some are contained necessarily, and some contingently. But in some documents, probably from the late 1680s, he attempted a different solution. He noted first that in some cases we can demonstrate that the predicate is contained in the subject in a finite number of steps. However, in other cases this cannot be done. 'In contingent truths, even though the predicate is in the subject, this can never be demonstrated, nor can a proposition ever be reduced to an equality or to an identity, but the resolution proceeds to infinity' (Leibniz 1989: 96). To demonstrate a contingent truth, one must show that a given individual with a given property is one among an infinity of individuals in a possible world that is the best among an infinity of other possible worlds, something that cannot be shown in a finite number of steps.

Beyond the question of necessity is the issue of human freedom. Take an individual substance, which contains everything that has happened, is happening and will happen to it. Even if one can establish that the sequence of 'happenings' it contains is contingent, yet by virtue of containing all these happenings, it would seem not to be free to do anything other than what it does. Contingency is thus compatible with strict determinism, which is incompatible with human freedom.

Leibniz's solution was that while God may build certain actions into a given individual, he can build them in as *free* actions: 'God sees for all time that there will be a certain Judas whose notion or idea...contains this free and future action' (Discourse §30). God does make us with free will, and the ability to choose one thing over another. So, when he chooses to create a given individual with a given life- history, he will include the conditions that will lead that individual to choose one thing over another. But the actual choice is ours, and it is free, Leibniz argued. In this way, 'God inclines our soul without necessitating it' (Discourse §30). Furthermore, while we can choose other than the way we do, God in his omniscience can predict what we will actually choose, and build its consequences into our future programme. This divine foreknowledge does not change the character of the events themselves: 'God foresees things as they are and does not change their nature.... Thus they are assured but they are not necessary' (Dialogue effectif sur la liberté de l'homme et sur l'origine du mal (An actual dialogue on human freedom and on the

origin of evil) [1695c] 1989: 112). Thus Leibniz had no worse problems on this score than does anyone who believes in divine omniscience.

Leibniz's doctrine did raise a knotty problem about the identity conditions for individuals, however. If all properties of a given individual are programmed in from the beginning, then though some may be contingent, and though some may be free, still, they define the individual as the particular individual that it is; were they different, then we would be dealing with another individual altogether, it would seem. From time to time Leibniz acknowledged that we might want to talk about what might have happened if Judas (*our* Judas, the Judas in *this* possible world) had not renounced Christ (Leibniz–Arnauld Correspondence, May 1686, (Leibniz 1875–90 vol. 2: 41–2); the specific example at issue there is not Judas, as in the Discourse, but Adam). But often Leibniz seemed quite willing to embrace a different view: 'But someone...will say, why is it that this man will assuredly commit this sin? The reply is easy: otherwise he would not be this man' (Discourse §30). In this way, given that every substance mirrors the entire world in which it finds itself, Leibniz often committed himself to the thesis that a person can belong to only *one* possible world.

8. Epistemology: ideas and sensation

Despite the fact that Leibniz is usually categorized as a continental rationalist, his main interest was not epistemological. At the same time, he did contribute to the discussions of his day on questions relating to ideas and knowledge.

In the New Essays (II.1.1), Leibniz defines an idea as follows: 'an idea is an immediate inner object [which] expresses the nature or qualities of things'. He emphasizes that we can think that we have an idea when we do not really have one. So, for example, there can be no idea of a fastest motion because the notion is incoherent. But, he notes, 'At first glance we might seem to have the idea of a fastest motion, for we certainly understand what we say; but yet we certainly have no idea of impossible things'. Mistaking our comprehension of the phrase 'fastest motion' for having a genuine idea can lead us into contradiction in this case. But in other cases, for example in mathematics, where we often use symbols without fixing ideas to them, we often must work symbolically because of the complexity of working directly with ideas themselves. In this sense one can have thought and even reasoning when we do not have ideas in the proper sense. This observation is connected with a distinction Leibniz drew between real and nominal definitions. A nominal definition is a definition in which one can doubt whether or not the notion defined is genuinely possible; a real definition is one in which the possibility of the notion defined has been established. One can thus say that it is only of real definitions that one can be sure that they correspond to a genuine idea (Meditations [1684a] 1989: 25–6; Discourse §24).

Leibniz was a supporter of innate ideas in a number of senses. First of all, he argued that there are certain particular ideas that are innate to the mind, and do not or cannot come through the senses: 'The ideas of *being*, *possible*, and *same* are so thoroughly innate that they enter into all our thoughts and reasoning, and I regard them as essential to our minds' (New Essays I.3.3). He made a similar claim for other notions, such as infinity (New Essays II.17.3). In this connection he used his celebrated marble analogy in the preface to the New Essays. Ideas and truths are in

the mind, he argued, just as the shape of Hercules might already be in the veins of a block of marble, making that shape more likely to emerge when the sculptor begins to hammer on it, even though considerable effort may be required to expose the shape: 'This is how ideas and truths are innate in us – as inclinations, dispositions, tendencies, or natural potentialities'.

Leibniz's metaphysics, however, committed him to a stronger position still, that *every* idea is innate, strictly speaking, since nothing can enter a mind from the outside. He wrote: 'The mind always expresses all its future thoughts and already thinks confusedly about everything it will ever think about distinctly. And nothing can be taught to us whose idea we do not already have in our mind' (Discourse §26). But even though all ideas are strictly innate, Leibniz could distinguish between the ideas of sensation that in a certain sense come to us from outside, and the ideas that do not and cannot do so. As with the explication of physical causality in the context of a view in which there can be no real metaphysical causality between finite things, Leibniz could say that 'we receive knowledge from the outside by way of the senses, because some external things contain or express more particularly the reasons that determine our soul to certain thoughts' (Discourse §27).

Sensations are distinguished from other notions not only by their causal origin (in Leibniz's somewhat extended sense), but also by the fact that they are confused, in contrast to the distinct notions one uses, say, in mathematics. A notion is distinct when one has 'marks and tests sufficient to distinguish a thing from all other similar' things; distinct notions include number, magnitude, shape and so on. A notion is confused 'when I cannot enumerate one by one marks sufficient for differentiating a thing from others, even though the thing does indeed have such marks and requisites into which its notion can be resolved'. In this sense 'colours, smells, tastes, and other particular objects of the senses' are confused (Meditations [1684a] 1989: 24). Indeed, they are the confused perception of the geometrical properties of bodies that, on the mechanist programme, ground the perception of sensible qualities. 'When we perceive colours or smells, we certainly have no perception other than that of shapes and of motions, though so very numerous and so very small that our mind cannot distinctly consider each individual one in this, its present state, and thus does not notice that its perception is composed of perceptions of minute shapes and motions alone' (Meditations [1684a] 1989: 27). Elsewhere Leibniz used the analogy of a wave to understand this phenomenon. When we hear the roar of the ocean, we are actually hearing just a large number of individual waves, lapping on the shore. But since we cannot distinguish the sounds each individual wave makes, we hear it as an undifferentiated roar. This is just the way the confused perception of the corpuscular microstructure of bodies results in our sensation of colour, taste and so on (New Essays 1704: preface). In this way Leibniz rejected the claim that the connection between a particular sensation and its mechanical cause is the result of a perfectly arbitrary divine decree; by the Principle of Sufficient Reason, there can be no such arbitrariness in the world (New Essays II.8.13 and following, IV.6.7). Thus, it would seem, the distinction between sensations and ideas of the intellect is not a matter of kind, but a matter of degree, degree of distinctness and confusion.

An important part of this account of sensation was Leibniz's doctrine of *petites perceptions* (minute perceptions). Like Descartes, Leibniz believed that we think all the time.

However, unlike Descartes, he denied that we are always conscious of what we think. He held that 'at every moment there is in us an infinity of perceptions, unaccompanied by awareness or reflection; that is, of alterations in the soul itself, of which we are unaware because these impressions are either too minute and too numerous, or else too unvarying, so that they are not sufficiently distinctive on their own' (New Essays preface). Though we do not apperceive (that is, consciously perceive) each of them individually, these unconscious perceptions have their effects on us. They are what underlie and explain sensation, as suggested earlier. Furthermore, they also have their effect on the conscious choices that we make (New Essays II.20.6).

Finally, Leibniz also had a clear position in the debate then raging in the intellectual world over Malebranche's view that we see all things in God, that is, that ideas do not exist in finite minds, but only in the mind of God, where they are seen by finite intellects without actually being in them (see Malebranche, N. §2). Leibniz quite clearly rejected Malebranche's view: 'Even if we were to see everything in God, it would nevertheless be necessary that we also have our own ideas, that is, not little copies of God's, as it were, but affections or modifications of our mind corresponding to that very thing we perceived in God' (Meditations [1684a] 1989: 27; compare Discourse §29).

9. Epistemology: knowledge and probability

In a famous passage of the *Monadology* (§§31–2) Leibniz writes: 'Our reasonings are based on *two great principles, that of contradiction*, in virtue of which we judge that which involves a contradiction to be false, and that which is opposed or contradictory to the false to be true, and *that of sufficient reason*, by virtue of which we consider that we can find no true or existent fact, no true assertion, without there being a sufficient reason why it is thus and not otherwise'. These two principles correspond to two different kinds of truths, 'those of *reasoning* and those of *fact*' *Monadology* §33).

A truth of reason can be known with certainty by a finite demonstration consisting of a finite number of steps containing simple ideas, definitions, axioms and postulates; these truths are necessary and can be known a priori. Sensation can give us particular instances of these truths, but can never attain the kind of universality one finds in necessary truths. As Leibniz wrote in the preface to the *New Essays*: 'necessary truths, such as we find in pure mathematics and particularly in arithmetic and geometry, must have principles whose proof does not depend on instances nor, consequently, on the testimony of the senses, even though without the senses it would never occur to us to think of them'.

While Leibniz agreed with Descartes that such truths are innate, he distanced himself from Descartes' appeal to clear and distinct perception. Against those who appeal to Descartes' axiom that 'whatever I clearly and distinctly perceive about a thing is true or is assertable of the thing in question', Leibniz objected that 'this axiom is useless unless we use criteria for the clear and distinct, criteria which we have made explicit' (Meditations [1684a] 1989: 26–7). While Leibniz agreed with Descartes that we have an innate capacity to recognize these innate truths, as a practical matter, he preferred to constrain the mind by formal rules of logic, unlike Descartes, who rejected formal logic (see §10 below).

Since in all predications, the concept of the predicate is contained in the concept of the subject, all knowledge is in principle a priori; if we only had sufficient knowledge of the subject, we could see everything that is true of it, contained in its complete concept. But this is only possible for God. Humans, incapable of performing the analysis that will reveal the truth a priori must make appeal to the senses in order to discover truths of fact. In fact, Leibniz thought, 'we are all mere Empirics in three fourths of our actions' (Monadology §28).

Because of the importance of empirical knowledge, Leibniz called for a genuine logic of probability. The modern theory of probability was born in the 1650s with the correspondence between Pascal and Fermat, and then with Christiaan Huygens' little treatise, *Tractatus de ratiociniis in aleae ludo* (Treatise on reasoning in games of chance) (1657). The theory very quickly developed in the seventeenth century, as new practical applications were quickly found. But Leibniz was not satisfied that it had yet been applied to the most general question of all, the kind of reasoning we do about matters of fact on the basis of sensation when demonstration is impossible. And so, in the *New Essays* (IV.2.14) he called for a new science: 'I maintain that *the study of the degrees of probability* would be very valuable and is still lacking, and that this is a serious shortcoming in our treatises on logic. For when one cannot absolutely settle a question one could still establish the degree of likelihood on the evidence, and so one can judge rationally which side is the most plausible.... I suspect that the establishment of an *art of estimating likelihoods* would be more useful than a good proportion of our demonstrative sciences, and I have more than once contemplated it'. But even though Leibniz may have contemplated it, he himself never made a serious attempt to develop the logic of probability that he called for here. However, his call was heard by David Hume, who saw his *Treatise* as, in part, answering Leibniz's challenge.

10. Logic and language

From his youth, Leibniz dreamed of constructing a perfect, logical language, 'a certain alphabet of human thoughts that, through the combination of the letters of this alphabet and through the analysis of the words produced from them, all things can both be discovered and judged'. This programme, which Leibniz called the 'universal characteristic', gets its first expression in the very early work, *Dissertatio de arte combinatoria* (Dissertation on the art of combinations) (1666). But it is most fully developed later, from the mid-1670s into the 1680s.

Leibniz's programme had two parts. First, one must assign characteristic numbers to all concepts that show how they are built up out of simpler concepts. Leibniz tried a number of schemes for this, but one strategy was to assign simple concepts prime numbers, and then assign complex concepts the product of the characteristic numbers of its constituent simple concepts. The second part of the programme was then to find simple mechanical rules for the truth of propositions in terms of the characteristic numbers of their constituent concepts. Leibniz's fundamental rule in his *Universal Characteristic* was the principle discussed above in connection with his metaphysics: a predicate is true of a subject if and only if its concept is contained in the concept of the subject. If the concepts in question can be expressed numerically, then Leibniz thought that the rule can be given a mathematical form as well, and the truth of a proposition could be established by a simple arithmetical calculation. Leibniz's project in these writings was to show

how this basic intuition about truth could be extended to propositions that are not in simple subject-predicate form. He also sought to extend the programme to formalize the validity of the standard inferences in Aristotelian logic. Even if he could not assign definite characteristic numbers to particular concepts, Leibniz tried to show that for certain configurations of premises and conclusions, if the premises are true (on his definition of truth), then so too must be the conclusion.

The programme was very ambitious; if it were successful, it would allow the truth or falsity of any proposition, necessary or contingent, to be determined by calculation alone. However, it soon dawned on Leibniz that the idea of finding all the conceptual dependencies necessary to express the contents of notions numerically was utopian in the extreme, particularly given the doctrine of infinite analysis of contingent truths Leibniz came to in the late 1680s. This realization still left in place the more modest programme of validating patterns of inference. But even this more modest programme turned out to be beyond Leibniz's ability to bring to completion, and after the early 1690s he seems to have given up trying to make it work, although he returned to it from time to time.

But even though this particular programme collapsed, the idea of formalism was quite basic to Leibniz's thought. Part of the reaction against the Aristotelian philosophy of the schools was an attack on formal logic. Descartes, Locke and others in the seventeenth century argued that we all have an innate ability to recognize truth, what was often called intuition, and that we should cultivate that capacity, and not waste our time learning formal rules. While Leibniz certainly agreed that we do have the innate capacity to grasp certain truths, he still thought that formalism is very important ((Leibniz to Elisabeth of Bohemia, 1678). Much of our reasoning is 'blind' or symbolic, Leibniz thought, conducted through the manipulation of symbols without having a direct hold on the ideas that underlie the symbols. For that reason we must have clear and unambiguous symbol systems, and strict rules for manipulating them (Meditations).

This view is evident in the papers on the Universal Characteristic. But it also underlies another project of the same period, the differential and integral calculus, one of Leibniz's greatest accomplishments, worked out by 1676 and made public from 1684. Though others before him had solved many of the particular problems his calculus could solve, problems relating to tangents, areas, volumes and so on, Leibniz invented a simple notation, still used in the calculus ('d' to represent the operation of differentiation, and '∫' to represent the operation of infinite summation (integration)), and worked out a collection of simple rules for applying these operations to equations of different kinds. In this way, Leibniz was able to produce simple algorithms for solving difficult geometrical problems 'blindly', by manipulating certain symbols in accordance with simple rules.

Another issue closely connected with Leibniz's logic is that of relations. In the *Primae veritates* (First truths) [1689] 1989: 32) Leibniz wrote: '*There are no purely extrinsic denominations* [that is, purely relational properties], denominations which have absolutely no foundation in the very thing denominated.... And consequently, whenever the denomination of a thing is changed, there must be a variation in the thing itself'. In this way, all relations must be, in some sense, grounded in the non- relational properties of things. But it is not clear that Leibniz held that relations had to

be reducible to non-relational predicates of things. In one example he gives, he paraphrased 'Paris is the lover of Helen' by the following proposition: 'Paris loves, and by that very fact [*eo ipso*] Helen is loved'. While this certainly relates the relation 'A loves B' to two propositions that have the form of simple subject-predicate propositions ('A loves' and 'B is loved'), it should be noted that the predicates in question ('loves' and 'is loved') would seem to be implicitly relational; whether this is an accidental feature of the example Leibniz chose or a clue to Leibniz's views is a question of some dispute. Furthermore, it is important not to ignore that which connects the two propositions ('and by that very fact'), without which one cannot say that the two non-relational propositions capture the relation 'A loves B' (Leibniz 1966: 14). Other texts suggest that individuals properly speaking have non-relational properties, and that the relations between things are something imposed by the mind onto the world: 'My judgement about relations is that paternity in David is one thing, sonship in Solomon another, but that the relation common to both is a merely mental thing whose basis is the modifications of the individuals' (Leibniz to Des Bosses, 21 April 1714). But in saying that the relations between individuals are 'merely mental', Leibniz does not necessarily mean to dismiss them. He wrote: 'God not only sees individual monads and the modifications of every monad whatsoever, but he also sees their relations, and in this consists the reality of relations and of truth' (Letter to Des Bosses, 5 February 1712).

In addition to formal languages, Leibniz was also keenly interested in the study of natural languages. Like many of his contemporaries, he was interested in the controversies over the question of the Adamic language, the language spoken in Eden and from which all modern languages supposedly derive. This, among other motivations, led him to the empirical study of different languages and the etymology of words (see Universal language).

11. Natural philosophy

Leibniz is read today largely for his philosophical writings. But in his day, he was, if anything, better known for his work in mathematics and natural philosophy. Like many of his contemporaries, Leibniz was a mechanist. Indeed, he was in a sense a much stricter mechanist than the Cartesians. Because of his doctrine of pre-established harmony (see §6 above), one can always give a purely mechanistic explanation of any physical phenomenon, even in humans, unlike in the Cartesian system, where causal interaction between mind and body, direct or occasional, can disrupt the laws governing the body. However, Leibniz's version of the mechanist programme departed significantly from other main versions of the programme of his day, particularly the Cartesian version.

Leibniz rejected the Cartesian analysis of body as extended substance (see §4 above). Instead, he argued that we must go to a deeper level of analysis, behind the extension of bodies to the substances that are the ultimate constituents of reality. Below the level of inanimate extension there are tiny organisms, souls joined to organic bodies which Leibniz, in at least one period of his thought, considered genuine corporeal substances. At a deeper level still there are the non-extended simple substances or monads that ground the reality of corporeal substances. On this view, the extended bodies of the Cartesian world are phenomena, aggregates of substances that are unified by virtue of being confusedly perceived together.

Leibniz also rejected Descartes' central law of nature. For Descartes, God conserves the same quantity of motion in the world, the size times the speed of bodies taken together (see Descartes, R. §11). But Leibniz argued that what is conserved is not bulk times speed, but bulk times the *square* of speed, mv^2 , a quantity associated with what he called *vis viva* or living force (see Motion §3). To defend this view, he used a cluster of a posteriori arguments which assumed the Galilean law of free-fall (the distance fallen is proportional to the square of the speed acquired in free-fall) together with the Principle of the Equality of Cause and Effect, in accordance with which there is always as much ability to do work in the cause as there is in the full effect. Leibniz showed that, on these assumptions, the Cartesian conservation law entails that the ability to do work can either be gained or lost in certain circumstances, whereas on the assumption of the conservation of mv^2 , this does not happen. Leibniz used this strategy in the *Brevis demonstratio* (Brief Demonstration of a Notable Error of Descartes) (1686a), where he first published this result. In addition, he offered an a priori argument in which, arguing from certain abstract notions of motion, action and effect, together with an intuitive principle of the conservation of effect, he reached the same conclusion (Discourse §17; Dynamics preliminary specimen). This challenge to Descartes' conservation law elicited numerous responses from the Cartesian community in what came to be called the *vis viva* controversy.

Leibniz saw the replacement of the conservation of the quantity of motion by the conservation of mv^2 as leading us to introduce into the world of physics something over and above the purely geometrical qualities of size, shape and motion that pertain to the extended substance of the Cartesians. This something is what he called force, the new science of which he named dynamics. While force can cause motion and is sometimes manifested in motion, Leibniz carefully distinguished the two. In emphasizing the distinction between force and motion, Leibniz was rejecting not only the Cartesian tradition, but his own early physics where, following Hobbes, he identified force with motion.

Leibniz recognized a variety of different kinds of forces in nature. At the most fundamental level, he distinguished between primitive and derivative forces, and between active and passive forces. Thus, in all, there are four basic kinds of force: primitive and derivative active force, and primitive and derivative passive force. Active force is of two sorts, living force (*vis viva*), which is associated with bodies actually in motion (a ball moving with a definite velocity), and dead force, which is associated with the instantaneous push from which actual motion results, as in gravitation or elasticity. Passive force, on the other hand, is the force that arises in reaction to the active force of another body. It also has two varieties, impenetrability (the force that prevents two bodies from occupying the same place at the same time) and resistance (the force that opposes new motion). The distinction between primitive and derivative force is quite different. Primitive force, active and passive, is the metaphysical ground of activity and passivity, that in a body by virtue of which it is capable of acting (doing work) or resisting. Derivative forces, for Leibniz, were particular states of activity and passivity that exist in a body at a particular time. In this way, primitive force is not a measurable quantity, but something in body that grounds the reality of the derivative forces, which are measurable quantities.

This notion of force was linked directly to Leibniz's notion of corporeal substance: 'Primitive active force, which Aristotle calls first entelechy and one commonly calls the form of a substance, is another natural principle which, together with matter or passive force, completes a corporeal substance' ('Note on Cartesian natural philosophy' [1702] 1989: 252). At least in the 1680s and 1690s, when Leibniz recognized corporeal substances, the primitive forces seem to have been the form and matter of the corporeal substances that ground the reality of the physical world. Derivative forces would then be interpreted as the momentary states of these corporeal substances. The position is somewhat different after Leibniz began to doubt the reality of corporeal substance (see §5 above). Then, he wrote, 'I relegate derivative forces to the phenomena, but I think that it is obvious that primitive forces can be nothing but the internal strivings of simple substances, strivings by means of which they pass from perception to perception in accordance with a certain law of their nature' (Leibniz to de Volder, 1704 or 1705). In this way, the dynamics can be regarded as another perspective on the same entities discussed in Leibniz's more metaphysical writings.

Leibniz held that these forces (or better, the motion that they cause) obey rigorous mathematical laws. These laws include the conservation of living force, mv^2 , virtually equivalent to the modern law of the conservation of kinetic energy, and the conservation of bulk times the velocity (a vector quantity), mv , identical to the modern law of the conservation of momentum. (Because Leibniz's conservation of mv involved the directionality of the motion, it is distinct from the Cartesian conservation of quantity of motion, which Leibniz rejected.) While he disagreed with Descartes about the specific contents of the laws, he can be seen as advancing the Cartesian programme of building a physics grounded in mathematically expressible conservation laws. But even though Leibniz's laws are expressible in mathematical terms, they – like the forces that they govern – are grounded in certain metaphysical principles that are imposed on the world by the wisdom of God: 'Although the particular phenomena of nature can be explained mathematically or mechanically... nevertheless the general principles of corporeal nature and of mechanics itself are more metaphysical than geometrical' (Discourse §18).

One such general metaphysical principle was noted in connection with the establishment of Leibniz's conservation law, the Principle of the Equality of Cause and Effect. But there were others as well. Leibniz made frequent use of the Principle of Continuity, according to which nothing happens through a leap. Leibniz used this principle to refute Descartes' laws of impact, where small changes in the initial conditions (say the comparative sizes of the bodies in question, or their motion) can result in radically different results. This principle was also used to refute atomism. If there are perfectly hard atoms, not made up of smaller separable parts, then in collision their motion would change instantaneously at the moment of impact. So, Leibniz concluded, there cannot be any such atoms in nature. Indeed, he used this argument to conclude that every body, no matter how small, is elastic. Leibniz also made appeal to the Principle of Plenitude to argue that there can be no vacuum or empty space in the world, since if God *can* create something consistent with his other creations, he *must* do so. Finally, as seen below, Leibniz used the Principle of Sufficient Reason in connection with his relativistic account of space and time.

The very fact that the world is the product of divine wisdom allowed Leibniz to appeal to final causes in his physics. This differentiates him from both Descartes and Spinoza, both of whom rejected final causes. Leibniz agreed with both that everything in nature can be explained through efficient cause alone – that is, through the laws of motion alone. But often, particularly in optics, it is much easier to solve problems by appealing to God's wisdom, and discovering the way in which a most perfect being would have created his universe (Discourse §22; Specimen of dynamics 1695a: part I). However, the appeal to final cause only supplements the understanding of nature by efficient causes, and does not replace it. It is another manifestation of divine harmony that the explanations by efficient causes and by final causes always coincide: '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.... These two kingdoms everywhere interpenetrate each other... so that the greatest obtains in the kingdom of power at the same time as the best in the kingdom of wisdom' ((Specimen of dynamics [1695a: part I] 1989: 126–7).

So far we have been discussing Leibniz's work in relation to that of other mechanists, particularly those of the Cartesian school. But it is also important to understand Leibniz's relations with another contemporary and often bitter rival, Isaac Newton.

In opposition to Newton, who held an absolutist conception of place and space, Leibniz argued that space is 'only relations or order or orders of coexistence, both for the actually existing thing and for the possible thing one can put in its place' (Remarks on Foucher [1696] 1989: 146). If Newton were right, Leibniz argued, and there was absolute space, then God could create a world in which what is currently east and west are exactly reversed, for example. But if so, by the Principle of Sufficient Reason, then God could have no reason to create one such world over another. Given that he did, he cannot have been faced with such a choice. Leibniz concludes that the two purported Newtonian worlds are really just one world, a world in which space is just constituted by the relations between things (Leibniz to Clarke, 3rd paper §5). Newton's absolutist account of space was supposed to ground an absolutist account of motion as well. For Newton, motion was the change of place of a body with respect to absolute space. Leibniz rejected this too, arguing that motion is a completely relativistic notion, a matter of the relation between bodies over time and that alone (Specimen of dynamics part I; Leibniz to Huygens, 12/22 June 1694).

Leibniz also rejected Newton's theory of universal gravitation. He read Newton as holding that gravity is an essential property of matter as such, and he was appalled. For Leibniz, all change in body had to happen through the intermediary of contact and collision; the idea of action at a distance that seemed to underlie Newton's theory of universal gravitation was an intellectual disaster, a treasonable abandonment of the new mechanical philosophy and a return to the worst abuses of the schoolmen. Leibniz, whose early mechanism seemed so radical at the time, could not adjust to the new Newtonian philosophy, soon to take over the intellectual world (see Clarke, S.; Newton, I.).

While the emphasis here has been on the aspects of Leibniz's work in physics most relevant to his philosophical programme, he was much more widely interested in the natural world. He left

notes on engineering problems, on chemistry, on geology and on curious observations in natural history including the report of a talking dog, and a goat with an odd hairstyle.

12. Ethics and political thought

Although Leibniz's ethical and political writings are not widely read today, they constitute an important part of his corpus, unsurprising, given Leibniz's own involvement in politics.

Leibniz's ethical and political thought, squarely within the natural law tradition, was based on the notions of justice, charity and virtue (see Natural law). Leibniz wrote: 'Charity is a universal benevolence, and benevolence the habit of loving or of willing the good. Love then signifies rejoicing in the happiness of another, or, what is the same thing, converting the happiness of another into one's own' *Codex Iuris Gentium Diplomaticus* (The diplomatic code of the law of nations) [1693: introduction] 1988: 171). In a note on felicity (Leibniz [c.1694–8] 1988: 83–4), he connected justice, wisdom, and virtue to charity: 'Virtue is the habit of acting according to wisdom... Wisdom is the science of felicity, [and] is what must be studied above all things.... To love is to find pleasure in the perfection of another. Justice is charity or a habit of loving conformed to wisdom. Thus when one is inclined to justice, one tries to procure good for everybody, so far as one can, reasonably, but in proportion to the needs and merits of each'.

For Leibniz, human justice is the same as God's justice, though, of course, less perfect. Leibniz wrote in the *Monita quaedam ad S. Puffendorffii principia* (Observations on the Principles of Pufendorf) ([1706] 1988: 69): 'In the science of law... it is best to derive human justice, as from a spring, from the divine, to make it complete. Surely the idea of the just, no less than that of the true and the good, relates to God, and above all to God, who is the measure of all things'. Similarly, Leibniz wrote in *Méditation sur la notion commune de la justice* (Meditation on the common concept of justice) ([1702–3] 1988: 60) that 'as soon as [the concept of justice] is founded on God or on the imitation of God, it becomes universal justice, and contains all the virtues'.

In so far as charity is defined in terms of universal love and benevolence, justice is something quite distinct from power. This is true even for God. 'Justice, indeed, would not be an essential attribute of God, if He himself established justice and law by His free will'. In this sense, God is as bound by the eternal laws of justice as he is bound by truths of reason: 'Justice follows certain rules of equality and of proportion [which are] no less founded in the immutable nature of things, and in the divine ideas, than are the principles of arithmetic and of geometry' (Observations on Pufendorf [1706] 1988: 69). (Here, perhaps is the origin of the theodicy problem for Leibniz: if God is bound by the same ideal of justice that binds us, then we must show how the works of the all-perfect creator can be seen to conform to that ideal.) So, too, are we bound by a standard of justice that exists independently of our wills.

Leibniz recognized three degrees of justice. The lowest, a minimal sort of justice, is simply not to harm others. The second degree is to give each their due, what it is that is owed to them. The highest, though, is to behave with genuine beneficence toward others, and to do that which will promote their happiness; this is what Leibniz calls piety (Leibniz to Coste, 4 July 1706: appendix).

Leibniz's conception of justice as the charity of the wise also placed virtue and obligation outside of the scope of a contract. For Hobbes, for example, the notion of justice arises from a contract that we make with one another in forming a society, and the notion of justice has no applicability outside that framework. Commenting on Shaftesbury in 1712, Leibniz wrote: 'Our illustrious author refutes with reason...those who believe that there is no obligation at all in the state of nature, and outside government; for obligations by pacts having to form the right of government itself, according to the author of these principles, it is manifest that the obligation is anterior to the government which it must form' (Leibniz 1988: 196). Indeed, he noted, there are societies, among the native Americans for example, in which the sovereign thought necessary by Hobbes is altogether absent: 'entire peoples can be without magistrates and without quarrels, and...as a result men are neither taken far enough by their natural goodness nor forced by their wickedness to provide themselves with a government and to renounce their liberty'. In people sufficiently wise, then, justice and charity are sufficient to hold society together, without the need of a contract.

But Leibniz was a practical politician, as well as a theorist of politics. He generally worked for a Europe unified under the leadership of a unified church, a Christian Europe in which there are no conflicts between different Christian states. This, in part, is what was behind his plan for the reunification of the Catholics and the Protestants. It was also behind his attempt, as early as 1671, to persuade the French to attack Egypt, a non-Christian country, rather than to invade the Netherlands. In practice, however, Leibniz was an opponent of French expansionism under Louis XIV (as much as he was an admirer of French culture), and a supporter of a union of Protestant countries in Northern Europe (his *Mars Christianissimus* (1684b) was a brilliant satire directed against Louis XIV's foreign policy). He was also an active participant in the successful campaign in support of the claim of the House of Hanover for the throne of England.

13. The Leibnizian tradition

It is important to remember when considering Leibniz's influence that much of what we now know of Leibniz's writings was unknown to his readers for many years after his death. The full dimensions of Leibniz's thought emerged only slowly, as new texts came to light. Indeed, there is still no complete edition of his work.

At the time of his death, and in the decade afterwards, only a small selection of Leibniz's texts was available. There were a fair number of publications in mathematics and physics, some legal writings and some documents collected in connection with his unfinished history of the house of Hanover. In philosophy, however, there were only a few essays. During his lifetime, Leibniz had published *Meditations on Knowledge, Truth, and Ideas* (1684a), the *New System* (1695b), *On Nature Itself* (1698) and the *Theodicy* (1710). The Leibniz–Clarke correspondence was published soon after his death, and a Latin version of the *Monadology* appeared in 1721. On the other hand, the *New Essays* did not appear until 1765, and works that we now consider central, such as the *Discourse on metaphysics*, did not appear until 1846. Many of his philosophical writings and correspondence had to await the monumental edition of C.I. Gerhardt, which appeared between 1875 and 1890. Many texts have yet to appear.

Despite the relative paucity of his available writings, Leibniz was much read and debated in the eighteenth century. One of his early supporters was the German professor Christian Wolff who had corresponded with Leibniz during his life. He composed numerous volumes expounding a Leibnizian philosophy in an ordered and orderly way. Wolff's systematic philosophy made it ideal for the academy, and his ideas were widely influential. But there were opponents, particularly a group of pietist theologians at the University of Halle, but others as well, including Maupertuis, Crusius, Condillac and, most famously, Voltaire, who made Leibniz into the comical Dr Pangloss of his *Candide*. Kant received his philosophical education in the atmosphere of this debate between the Leibnizians and the anti-Leibnizians in the German intellectual world. His philosophy, both pre-critical and critical, shows the marks of his knowledge of Leibniz's writings.

List of works

Many of Leibniz's writings, including some of the most important of them, remained unpublished during his lifetime. As a consequence, some of them can be dated only approximately.

Leibniz, G.W. (1768) *Leibnitii opera omnia* (The complete works of Leibniz), ed. L. Dutens, Geneva, 6 vols; repr. Hildesheim: Olms, 1989.

(Contains a wide range of Leibniz's papers, both inside and outside philosophy, many of which have not been reprinted since the eighteenth century. It gives the best sense of what Leibniz meant to his contemporaries.)

Leibniz, G.W. (1849–63) *Mathematische Schriften* (Mathematical writings), ed. C.I. Gerhardt, Berlin and Halle: A. Asher & comp. and H.W. Schmidt, 7 vols; repr. Hildesheim: Olms, 1962.

(Still the most complete collection of Leibniz's papers and letters in mathematics and physics, in the original languages, many of which are directly connected to his more philosophical interests.)

Leibniz, G.W. (1875–90) *Die philosophischen Schriften* (Philosophical writings), ed. C.I. Gerhardt, Berlin: Weidmannsche Buchhandlung, 7 vols; repr. Hildesheim: Olms, 1978.

(Still the most complete collection of Leibniz's philosophical papers and letters in the original languages.)

Leibniz, G.W. (1923–) *Sämtliche Schriften und Briefe* (Collected writings and letters), ed. Deutsche Akademie der Wissenschaften (before 1945, Preussische), Berlin: Akademie Verlag.

(This is to be the new complete critical edition of Leibniz's writings in the original languages, edited to the highest standards. Currently still in its early stages, it must be supplemented by earlier editions. In recent years it has been supplemented by a 'Vorausedition', giving pre-prints of editorial work in progress.)

Leibniz, G.W. (1666) *Dissertatio de arte combinatoria* (Dissertation on the art of combinations), Leipzig; repr. in *Die philosophischen Schriften*, vol. 4; partial trans. L.E. Loemker in *Philosophical Papers and Letters*, Dordrecht: Reidel, 1969.

(Leibniz's first important publication, concerning the theory of mathematical combinations, together with various philosophical digressions. It also contains a suggestion of his later concern with a universal language.)

Leibniz, G.W. (c. 1680–2) *De libertate* (On freedom), in *Textes inédites*, vol. 1, ed. G. Grua, Paris: Presses Universitaires de France, 1948; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(Interesting essay on human and divine freedom and contingency, unpublished in Leibniz's lifetime.)

Leibniz, G.W. (1684a) 'Meditationes de cognitione, veritate et ideis' (Meditations on knowledge, truth and ideas), *Acta Eruditorum* (November 1684): 537–542; repr. in *Leibniz: opera omnia*, vol. 4; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(Important explanation of Leibniz's views on concepts, truth and knowledge.)

Leibniz, G.W. (1684b) *Mars Christianissimus* (Most Christian War-God), Cologne; trans. P. Riley in *Leibniz: Political Writings*, Cambridge: Cambridge University Press, 1988.

(A satire on the diplomatic policies of Louis XIV.)

Leibniz, G.W. (1686a) 'Brevis Demonstratio erroris memorabilis Cartesii' (Brief demonstration of a notable error of Descartes), *Acta Eruditorum* (March 1686): 161–163; repr. in *Mathematische Schriften*, vol. 6; trans. L.E. Loemker in *Philosophical Papers and Letters*, Dordrecht: Reidel, 1969.

(A refutation of Descartes' law of the conservation of quantity of motion in physics.)

Leibniz, G.W. (1686b) *Discours de métaphysique* (Discourse on metaphysics), 1846; ed. H. Lestienne, Paris: Alcan, 1907; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(Unpublished in Leibniz's time, this is a central text in which Leibniz gives an exposition of some central elements of his metaphysics as of 1686.)

Leibniz, G.W. (1686–90) *The Leibniz–Arnauld Correspondence*; repr. with related letters and documents in *Die philosophischen Schriften*, vol. 2: Weidmannsche Buchhandlung, 1875–90, 1956; trans. and ed. H.T. Mason, Manchester: Manchester University Press, 1967.

(Very important series of letters exchanged between Leibniz and the Cartesian philosopher Antoine Arnauld just as Leibniz was setting out his mature philosophy, providing a kind of commentary on themes developed in the Discourse. Although unpublished in his lifetime, Leibniz probably intended it for publication.)

Leibniz, G.W. (c. 1689a) *De libertate* (On Freedom), in *Textes inédites*, vol. 1, ed. G. Grua, Paris: Presses Universitaires de France, 1948; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(Another essay on contingency and freedom, unpublished in Leibniz's lifetime, which makes use of his infinite analysis account of contingency.)

Leibniz, G.W. (1689b) *Primae veritates* (First truths); repr. in *Opusculæ et fragments inédits*, 1903; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(An important, unpublished summary of Leibniz's metaphysics as of the 1680s. Originally thought to have preceded the 1686 composition of the *Discourse*, it is now firmly dated at 1689.)

Leibniz, G.W. (1690) *Dynamica* (Dynamics), in *Mathematische Schriften*, vol. 6; partial trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(Unpublished in Leibniz's time, this is a systematic exposition of Leibniz's physics. Apart from the translation of the preliminary discourse in Ariew and Garber, the bulk of this work has not been translated from the original Latin.)

Leibniz, G.W. (1692) *Protogæa*, 1749; French trans, ed. B. de Saint-Germain and J.-M. Barrande, Toulouse: Presses Universitaires du Mirail, 1993.

(A treatise on geology and the early days of the earth, written as the first part of Leibniz's history of the House of Hanover.)

Leibniz, G.W. (1693) *Codex Iuris Gentium Diplomaticus* (The diplomatic code of the law of nations), Hanover; partial trans. P. Riley in *Leibniz: Political Writings*, Cambridge: Cambridge University Press, 1988.

(Collection of diplomatic papers, with a long introduction on political philosophy.)

Leibniz, G.W. (c. 1694–8) *La félicité* (Felicity); repr. in *Textes inédites*, vol. 1; trans. P. Riley in *Leibniz: Political Writings*, Cambridge: Cambridge University Press, 1988.

(Important but unpublished note from the 1690s in which Leibniz discusses his theory of justice as the charity of the wise man.)

Leibniz, G.W. (1695a) *Specimen dynamicum* (A specimen of dynamics), Part I, *Acta Eruditorum* (April 1695); repr. (Parts I and II) in *Mathematische Schriften*, vol. 4; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(Important work that links the technical physics of the *Dynamica* with more philosophical themes. Only Part I was published during Leibniz's life.)

Leibniz, G.W. (1695b) 'Système nouveau de la nature et de la communication des substances' (New system of the nature and the communication of substances), *Journal des Sçavans* (27 June 1695): 294–300; repr. in *Die philosophischen Schriften*, vol. 4; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(A popular presentation of Leibniz's metaphysics, featuring the first public presentation of the hypothesis of pre-established harmony.)

Leibniz, G.W. (1695c) *Dialogue effectif sur la liberté de l'homme et sur l'origine du mal* (An actual dialogue on human freedom and on the origin of evil); repr. in *Textes inédites*, vol. 1; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(This seems to be a record of a dialogue that actually took place between Leibniz and Baron Dobrzensky, counsellor of state and war of Brandenburg.)

Leibniz, G.W. (1696) 'Remarques sur les Objections de M. Foucher' (Remarks on the objections of M. Foucher), *Histoire des ouvrages des Savans* (February 1696): 274–276; repr. in *Die philosophischen Schriften*, vol. 4; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(An excellent but brief account of Leibniz's view on the problem of the continuum.)

Leibniz, G.W. (1697) *De rerum originatione radicali* (On the ultimate origination of things); repr. in *Die philosophischen Schriften*, vol. 7; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(This important brief essay on creation and contingency remained unpublished until the nineteenth century.)

Leibniz, G.W. (1698) 'De ipsa natura' (On nature itself), *Acta Eruditorum* (September 1698): 427–440; repr. in *Die philosophischen Schriften*, vol. 4; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(Significant essay on the importance of introducing genuinely active individuals into the world, against the Cartesian position that bodies are bare, extended substances.)

Leibniz, G.W. (1702) 'Note on Cartesian natural philosophy'; repr. in *Die philosophischen Schriften*, vol. 4; trans. R. Ariew and D. Garber in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(Untitled by Leibniz and not published in his lifetime, this is an important summary of the philosophical aspects of Leibniz's dynamics.)

Leibniz, G.W. (1702–3) *Méditation sur la notion commune de la justice* (Meditation on the common concept of justice); trans. P. Riley in *Leibniz: Political Writings*, Cambridge: Cambridge University Press, 1988.

(Unpublished in Leibniz's lifetime, this is an important source for understanding his political philosophy.)

Leibniz, G.W. (1704) *Nouveau essais sur l'entendement humain* (New essays in human understanding), 1765; repr. in *Sämtliche Schriften und Briefe*, series 6, vol. 6; trans. P. Remnant

and J. Bennett as *New Essays on Human Understanding*, Cambridge: Cambridge University Press, 1981.

(Unpublished in Leibniz's lifetime, this is a point-by-point discussion of Locke's *Essay Concerning Human Understanding*.)

Leibniz, G.W. (1706) *Monita quaedam ad S. Pufendorfii principia* (Observations on the Principles of Pufendorf); repr. in *Leibnitii opera omnia*, vol. 4, part 3; trans. P. Riley in *Leibniz: Political Writings*, Cambridge: Cambridge University Press, 1988.

(Unpublished in his lifetime, these are Leibniz's comments on the political thought of Samuel Pufendorf, the seventeenth-century jurist.)

Leibniz, G.W. (1710) *Essais de Théodicée* (Essays on Theodicy), Amsterdam; trans. E.M. Huggard as *Theodicy*, La Salle, IL: Open Court, 1985.

(A treatise in which Leibniz attempts to justify the ways of God to man. Much of the work is a response to the writings of Pierre Bayle.)

Leibniz, G.W. (1712) *Jugement sur les oeuvres de Mylord Shaftesbury* (Judgment of the works of the Earl of Shaftesbury); repr. in *Leibnitii opera omnia*, vol. 5; trans. P. Riley in *Leibniz: Political Writings*, Cambridge: Cambridge University Press, 1988.

(Unpublished in Leibniz's lifetime, this is a free-ranging discussion of Shaftesbury's work that includes much of interest for Leibniz's political thought.)

Leibniz, G.W. (1714a) *Monadologie*, 1721; repr. in *Die philosophischen Schriften*, vol. 6; critical edn, ed. A. Robinet, *Principes de la nature et de la grâce...et Principes de la philosophie ou monadologie*, Paris: PUF, 1986; trans. R. Ariew and D. Garber as *Monadology* in *Leibniz: Philosophical Essays*, Indianapolis, IN and Cambridge, MA: Hackett Publishing Company, 1989.

(Central text, not published during his lifetime, in which Leibniz gives a summary of his metaphysics at the end of his life.)

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(Significant essay on the importance of introducing genuinely active individuals into the world, against the Cartesian position that bodies are bare, extended substances.)

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(The first publication of many of Leibniz's papers on logic, language, and related areas of metaphysics, published in the original languages; this collection shaped earlier twentieth-century views of Leibniz's programme as driven by his logic.)

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(The first publication, in the original languages, of a valuable selection of writings concentrating on ethical, political and theological subjects.)

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(An excellent collection of Leibniz's moral and political writings, with a useful introduction.)

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(A widely available translation of a selection of Leibniz's most important philosophical texts.)

References and further reading

Adams, R.M. (1994) *Leibniz: Determinist, Theist, Idealist*, Oxford: Oxford University Press.

(An important recent monograph that focuses on questions of contingency, natural theology, substance and body in Leibniz. Highly recommended for the serious student.)

Aiton, E.J. (1985) *Leibniz: A Biography*, Bristol: Hilger.

(A recent biography in English.)

Broad, C.D. (1975) *Leibniz: an Introduction*, Cambridge: Cambridge University Press.

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(Still the best study of Leibniz's programme for logic and related areas.)

Duchesneau, F. (1994) *La Dynamique de Leibniz* (Leibniz's Dynamics), Paris: Vrin.

(A good recent study of Leibniz's programme for physics.)

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(A classic study of the connection between Leibniz's dynamics and his metaphysics.)

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(A good study focusing on questions relating to logic and language.)

Jolley, N. (1995) *The Cambridge Companion to Leibniz*, Cambridge: Cambridge University Press.

(A recent collection of articles surveying the various aspects of Leibniz's thought, but focusing on his philosophy.)

Mercer, C. (1998, forthcoming) *Leibniz's Metaphysics: Its Origins and Development*, Cambridge: Cambridge University Press.

(A lively study of Leibniz's early philosophy and how it evolved into the mature thought.)

Müller, K. and Krönert, G. (1969) *Leben und Werk von G.W. Leibniz. Eine Chronik* (The life and work of G.W. Leibniz: a chronology), Frankfurt: Klostermann.

(An exhaustive summary of what is known about Leibniz's life, whereabouts, and when he was working on what, with documentation, arranged chronologically.)

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(Despite some inaccuracies, the best guide to the publication of Leibniz's writings, from his lifetime to the 1930s.)

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(Advances the view that Leibniz's metaphysics is grounded in his formal logic. While the main thesis is now generally rejected, it was highly influential, and the book contains many still-valuable discussions.)

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(While it focuses on what Leibniz was thinking in the crucial mid-1680s, this is also an excellent commentary on some of the most important philosophical themes in Leibniz's thought. Highly recommended for the serious student.)

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(A journal that focuses on studies of Leibniz and his age. In addition to its regular issues, it also publishes numerous supplementary volumes containing collections of essays, conference proceedings, and short monographs that pertain to Leibniz and related issues in the history of philosophy.)

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(A caricature of Leibniz appears in this popular tale in the person of Dr Pangloss. It is available in numerous modern editions, both in French and in English translation.)