of the world but also partly in what counts as a simple (for us) theory. Lewis is able to connect this characterization of laws with his accounts of counterfactuals, causation, explanation and necessity so as to recapture a number of the important connections among these notions.

There are two main difficulties with Lewis's (and other Humean) views. The first is that the necessity it assigns to laws seems less than the necessity they possess and seem to bestow on events which conform to them. The second is a symptom of the first. It is that there seem to be straightforward counterexamples to Humean Supervenience. It is not difficult to imagine two worlds in which different laws obtain but in which the course of events are the same. For example in one world it is a law that when k and k' particles interact they annihilate one another but this is not a law in another world. In both worlds k and k' particles never interact (although it is nomologically possible for them to do so) and the two worlds are exactly the same with respect to particular events.

There are two kinds of non-Humean views which have been proposed. One account attempts to explain laws in terms of some other concepts. The other takes lawhood as primitive. ARMSTRONG proposes an account of the first kind according to which a law statement expresses a relation of "nomic necessity" between properties. For example, it is a law that *F*s are followed by *G*s which says that exemplification of *F*-hood brings about exemplification of *G*-hood. Relations of nomic necessity do not supervene on the actual course of events but in some way bring about the course of events. There are two chief difficulties for non-Humean views. One is providing an epistemology for laws since it is not easy to see how we can have epistemological access to laws metaphysically construed. Another is clarifying how laws are related to events which conform to them so that they bestow on them the appropriate necessity. The relation seems to be neither a logical nor a causal one.

In view of problems with Humean and non-Humean views a radical eliminativist view of laws has recently been advocated by Bas VAN FRAASSEN (1989). According to him the non-Humean account of laws is close to being a correct account of the philosopher's concept of law but we have no reason to believe that there are such laws. Van Frassen thinks that scientific practice can be accounted for without employing any metaphysically charged notion of law. The trouble with van Fraassen's skeptical view is that the concept of a law and related notions seem to be involved at every level of description and so disbelieving in laws may entail disbelieving in much else. For example, according to functionalist accounts pain is analyzed in terms of a state's lawful relations to other states. If this analysis is correct and if we have no reason to believe in laws then we also have no reason to believe in pains. (*See* FUNCTIONALISM.)

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BARRY LOEWER

Leibniz, Gottfried Wilhelm (1646–1716) Born in Leipzig, where he received most of his education. Leibniz declined the

offer of a professorship at the University of Altdorf, from which he received his doctorate in law in 1667. He sought more interesting opportunities in the career of a legal and intellectual advisor to German princes. His first patron, Baron Johann Christian von Boineburg, sent him on a mission to Paris, where he lived from 1672 to 1676, deepening his understanding of Cartesianism and other movements in contemporary French thought, and studying mathematics. During this period he did a large part of the work that made him an inventor of the calculus of infinitesimals. After brief visits to England and Holland, he settled in Hanover at the end of 1676, to enter the service of the Dukes (later Electors) of Hanover. He made his home there for the rest of his life, though he traveled once to Italy, and often to other parts of Germany, becoming in 1700 the first president of what would develop into the Prussian Academy in Berlin.

Though it is probably his contributions to metaphysics that command the most attention today, Leibniz was occupied with almost the whole range of intellectual activity of his time, including geology, physics, mathematics, theology, jurisprudence, German history, and historiography, as well as the political and other practical interests of his employers. With such diversity of interests, he never found the time to write a comprehensive, book-length statement of his philosophy. The two best known of the books that he did write (Leibniz, 1710 and 1705; the latter not published during his lifetime), are composed in the form of commentaries on the work of Pierre Bayle (1647–1706) and LOCKE, respectively. Leibniz's philosophy is found chiefly in shorter papers, only a few of them published in his lifetime, and in some of the thousands of letters that he wrote to most of the leading European intellectuals of his day. Thousands of pages of his manuscripts, mostly written in Latin and French, rarely in German, are preserved in the state library at Hanover. Some that bear on metaphysics have never been published at all, and many that are published have never been translated into English.

Despite the largely fragmentary form of his literary remains, Leibniz's metaphysics is strikingly systematic. During most of the twentieth century the deservedly influential work of RUSSELL (1900) and Couturat (1901) has focused the attention of interpreters on papers written in the 1680s but not published until the nineteenth and twentieth centuries, in which Leibniz appears to derive many of his characteristic metaphysical theses from a remarkable doctrine about the nature of *truth* (Leibniz, 1969, pp. 267–70, 307–14). He held that "in every true affirmative proposition, necessary or contingent, . . . the notion of the predicate is in some way included in that of the subject . . . ; otherwise I do not know what truth is" (Leibniz, 1969, p. 337). Leibniz infers that there is a reason for every truth (the principle of sufficient reason); and from that he infers that no two individual things can differ only in number (the principle of the identity of indiscernibles).

An individual substance, on this view, must have (in GOD's mind) a concept so complete that every thing that will ever be true about the substance follows from its concept. From this Leibniz infers that "there are no purely extrinsic denominations", but that all of a substance's relational predicates must be expressed by internal properties that it has. And since it has relations (at least trivial ones) with every other substance in, and every fact about, the whole world of which it is a part, it follows that each substance contains within itself a complete expression of its universe, and thus corresponds perfectly with every other substance. Inasmuch as "all the future states of each tiling follow from its own concept", Leibniz argues further, all created substances are causally independent of each other. None of them acts, in metaphysical strictness, on another. Their perfect correspondence is explained, according to Leibniz, by his famous doctrine of pre-established harmony. God alone does act on created substances, causing their *existence*, though their *states* are normally produced by their own natures. God has created a set of substances whose natures are so harmonious that each successive state of each substance,

though determined by the nature of that individual substance alone, mirrors the corresponding states of all the others (Leibniz, 1969, pp. 268–9).

Now these consequences certainly do not all follow logically from Leibniz's theory of truth considered by itself. The mutual causal independence of created substances, for example, does not follow from the completeness of their individual concepts apart from some concrete causal structure in the substance, isomorphic with its concept. That Leibniz believed in such a structure is clear. He identified it with the *substantial forms* of scholastic Aristotelianism (Leibniz, 1969, pp. 307–8), and no turning point was more important for the development of his metaphysics than his decision, in the late 1670s, to try to rehabilitate that scholastic notion (Robinet, 1986, pp. 245–51). The substantial form, for Leibniz, is an internal, active causal principle in an individual substance. The individual concept of the substance is to express the substantial form, and the completeness of the concept mirrors the causal determination of all the states of the substance by the form.

In keeping with his Aristotelian inspiration, Leibniz saw the substantiality of a thing as constituted primarily by this principle of activity. This grounded one of his main objections to the occasionalism of MALEBRANCHE. The latter's denial of metaphysical reality to all the apparent causality in created things threatened, in Leibniz's eyes, to deny all substantial reality to the things themselves (Leibniz, 1956, p. 502).

For Leibniz as for ARISTOTLE, the substantial form is a teleological principle (*see* TELEOLOGY). Much more than Aristotle, Leibniz conceived the causal and teleological action of the form on the model of the purposive action of a soul. It is as if each substance sings its parts in the universal harmony by knowing and intentionally following a "score", corresponding to its complete individual concept, that is built into its substantial form – though such knowledge and intentionality is wholly or partly unconscious in all finite substances (Leibniz, 1989, pp. 84–5). Being constituted by such forms, all substances have "something analogous to sense and appetite" (Leibniz, 1969, p. 454).

Leibniz had several reasons for this rather mentalistic conception of substances. Of these the most important for the structure of his philosophy – fully as important as the predicate containment theory of truth – is an argument about simplicity and complexity (*see* SIMPLICITY, PARSIMONY). If a whole is divided, or divisible into parts – parts that are, or would be, as substantial as the whole is – then the reality of the whole, Leibniz argued, consists in the reality of the parts, and the reality of the parts is prior to the reality of the whole. Hence if a thing is divided, or divisible, to infinity, and is not ultimately composed of anything indivisible, there will be an infinite regress. The reality of the thing will consist in the reality of parts whose reality consists in the reality of parts whose reality consists in the reality of parts whose reality consists in the reality of parts . . . and so on to infinity. This regress will be vicious because there will be in the whole hierarchy of parts of parts no "reality not borrowed", as Leibniz put it (Russell, 1900, p. 242). That is, nothing in this thing will possess reality in its own right; and where nothing has reality in its own rights. Leibniz inferred, there is no reality at all. In order to have any reality in itself, a composite thing must be composed ultimately of indivisible things, because only indivisibles can have reality in their own right (Leibniz, 1989, p. 85; 1969, pp. 535–9, 643). (*See* PART/WHOLE.)

Lelbniz used this argument to attack DESCARTES's conception of body as a substance whose essence is extension. It belongs to the essence of extension, as traditionally conceived, that every extended thing is composed of extended parts, which, as extended, are themselves composed of extended parts, and so on to infinity. Because of this regress, the extended as such has no reality in its own right, Leibniz argued; and if bodies have metaphysical reality in them at all, they must be composed ultimately of indivisible, and hence unextended, entities. These indivisible, ultimately real entities are the simple substances or *monads* of Leibniz's metaphysics. (*See* ATOMISM.)

What qualities can these simple, unextended substances have in themselves? Surely they must have some, but these can hardly be the "mechanical" qualities of Cartesian physics, which presuppose extension. Our own souls are for Leibniz our one accessible model of a simple substance, and he accordingly proposes perceptions and appetitions as the intrinsic qualities of all simple substances – though with the qualification that all the perceptions of most substances, and most of the perceptions of all finite substances, are so confused as to be wholly subconscious. In some contexts Leibniz speaks of "primitive forces" as the most fundamental properties of simple substances (the "primitive active force" being identified with the substantial form). But primitive forces intrinsic to a substance must be tendencies of the substance to have certain intrinsic qualities; what could these be? At bottom, in a simple substance, they can only be perceptions, Leibniz seems to have thought; and the internal forces of simple substances he conceived as appetites. "Indeed, considering the matter carefully, we must say that there is nothing in things but simple substances, and in them, perception and appetite" (Leibniz, 1989, pp. 180–1; cf. ibid., pp. 214–15).

Extended bodies can be viewed, in the Leibnizian system, as *aggregates* of simple substances. At the same time they can be viewed as mere *phenomena*, albeit "well founded phenomena", having a double dependence on the perceptions of the simple substances. (1) Leibniz was a sort of conceptualist about UNIVERSALS, numbers, relations, and in general about abstract objects and indeed about all sorts of object other than concrete, actual individuals (*see* CONCRETE/ABSTRACT). All such entities, he thought, exist only as objects of perception or thought. He held, accordingly, that aggregates as such, even aggregates of simple substances, depend for their existence on beings that perceive them (Leibniz, 1989, p. 89). (2) Bodies, as aggregates, are further dependent on perception inasmuch as the grouping of simple substances into corporeal aggregates (which monads belong to which aggregates) depends on relations among their perceptions. (For fuller development of this interpretation of Leibniz's philosophy of body, *see* Adams, 1994, chs. 9–12; and for a contrasting interpretation *see* Garber, 1985.)

God has several foundational roles in the Leibnizian metaphysics. The simple, purely positive properties, from which all the properties of other things are derived by limitation or logical construction, are identified with the perfections of God. Necessary truths and pure possibilities, independent of human thought and of actual exemplification, have their being in God's understanding of them. The pre-established harmony depends on God's creative power and wisdom. Indeed the harmony of things in general is explained by God's selection and creation of the "best of all possible worlds". These metaphysical roles of the deity play a central part in several arguments that Leibniz offers for the actual (and indeed necessary) existence of God (Leibniz, 1969, pp. 303–6, 484–91, 646–8).

It is clear, especially in Leibniz's discussions of the ontological argument, that he sees a deep metaphysical connection between perfection and EXISTENCE. This led him into inconclusive speculation about the nature of existence. In various places he suggests that for a thing to exist *is* for it to be chosen by God, or, alternatively, to be more perfect (or part of a more perfect whole) than anything inconsistent with it. But these definitions, which threaten to trivialize Leibniz's conception of creation, do not ultimately form part of his philosophy (Adams, 1994, ch. 6).

An extensive DETERMINISM follows from several fundamental features of Leibniz's philosophy. God's choice of the best of all POSSIBLE WORLDS would not be assured of having its perfectly optimific effect, if it did not determine every detail of the actual world, for even the slightest deviation from the divine plan would yield an inferior world. The effect of God's creative choice is simply the existence of certain finite substances (infinitely many of them); but this suffices, in Leibniz's system, to determine the world in every detail. For every state of every substance follows from its complete individual concept, and is determined by its

substantial form. The pre-established harmony depends on this determinism. If the states of created substances were not all determined by their natures, God would have to keep intervening to assure their continued coordination.

Leibniz explicitly acknowledges the deterministic character of his thought. He maintains that determinism is compatible with FREE WILL (*see* the extended essay), which he understands in terms of the intelligence and self-determination of the agent and the contingency of the event (Leibniz, 1710, p. 303). There are two main lines of argument by which he tries to make room in his system for contingent truths. (1) He holds that actual facts are contingent in so far as they have alternatives that are possible in themselves even if they could not have been chosen by the perfect deity who necessarily exists (Leibniz, 1989, p. 21). (2) He recognizes only formally demonstrable truths as necessary, and only finite proofs as demonstrations. So although the concept of the predicate is contained in that of the subject in every truth, only those that can be proved by a finite analysis are necessary; the others, which depend on an infinite complexity of factors, are contingent in Leibniz's view (Leibniz, 1989, pp. 28–30, 94–8; cf. Adams, 1994, ch. 1, and Sleigh, 1990, ch. 4).

See also MONAD, MONADOLOGY.

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ROBERT MERRIHEW ADAMS

Leibniz's Law *see* IDENTITY OF INDISCERNIBLES

Leśniewski, Stanistaw (1886–1939) Leader of the Warsaw school of logic and philosophy between the wars, where he taught many excellent logicians, most notably TARSKI. Leśniewski's publications and unorthodox logical systems are characterized by extreme care and rigor. His major efforts went into constructing and improving his three logical systems. These are: protothetic, a system of propositional logic with quantifiers and higher-order functors; ontology, a generalized term logic also constructible to any finite order; and mereology, a formal theory of PART/WHOLE and aggregates. Leśniewski created his system in response to RUSSELL's Paradox, as a foundation for mathematics without the PLATONISM and sloppiness of WHITEHEAD and Russell's (1910–13) *Principia Mathematica* or the intuitive incomprehensibility of Zermelo's sets. (*See* CLASS, COLLECTION, SET.)

Like his hero FREGE, Leśniewski decried formalism, insisting that his logical systems