# LEIBNIZ: PROPHET OF NEW ERA SCIENCE

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JÜRGEN LAWRENZ

# LEIBNIZ: PROPHET OF NEW ERA SCIENCE

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Leibniz: Prophet of New Era Science,
by Jürgen Lawrenz

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*I dedicate this work to the memory of*
*Gerd Lassner*
*A great man of science and a sincere friend.*

# Contents

# Method of Citation · Abbreviations

I have in every case of a quotation from Leibniz indicated the work (book, paper or letter) in which it appears. Since all the works quoted herein are available in English translations, the following abbreviations serve to locate the edition cited:

AG *Philosophical Essays*. Translated and edited by Roger Ariew and Daniel Garber. Hackett Publishing, Indianapolis 1989.

FW *Philosophical Texts*. Translated and edited by Richard Francks and R. S. Woolhouse. Oxford University Press 1998.

L *Philosophical Papers and Letters*. Edited by Leroy E. Loemker. D. Reidel Publishing Co., Dordrecht 1969.

LA *The Leibniz-Arnauld Correspondence*. Edited and translated by H. T. Mason. Manchester University Press 1967.

LC *The Leibniz-Clarke Correspondence*. Edited by H.G. Alexander. Manchester University Press 1956.

NE *New Essays on Human Understanding*. Translated by Peter Remnant and Jonathan Bennett. Cambridge University Press 1996.

NS *Leibniz's 'New System' and Associated Texts*. Translated and edited by R. S. Woolhouse and Richard Francks. Clarendon Press, Oxford 1997.

P *Philosophical Writings*. Edited by G. H. R. Parkinson. J. M. Dent & Sons, London 1973.

PL *Logical Papers*. Translated and edited by G. H. R. Parkinson. Clarendon Press, Oxford 1966.

TH *Theodicy*. Edited by A. Farrar; translated by E. M. Huggard. Routledge, London 1951.

W Leibniz Selections. Edited by Philip Wiener. Charles Scribner's Sons, New York 1951.

The standard editions:

G *Die philosophischen Schriften von G. W. Leibniz*. Edited by C. I. Gerhardt. 7 vols. Berlin 1875-90; reprinted Olms, Hildesheim 1978.

GM *G. W. Leibniz: Mathematische Schriften*. Edited by C. I. Gerhardt. 7 vols. Berlin & Halle 1849-63; reprinted Olms, Hildesheim 1962.

*Translations from German-language sources*

Nearly all translations from German-language sources are my own, including some primary sources (e.g. Feuerbach, Heidegger). They are identified as such in the footnote references and I take full responsibility for their accuracy.

*Typographical Conventions*

All quotations are offset from the text margins.

*Quotations from Leibniz's works appear in italic type.*

Quotations from all other sources appear in reduced-size Roman type.

In-text quotations are consistently indicated by the use of double quotation marks.

*Leibnizian Principles*

Since these occur in many contexts throughout, they are marked by the use of italics.

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I wish to express my gratitude to the following individuals for their generous help, ready accessibility to discussion, encouragement and support with references, including in some cases unpublished writings of their own.

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# Foreword

By Prof. Gerd Lassner

It is becoming increasingly evident today that the formerly much-maligned system of Leibnizian philosophy may serve us for the relevant classification of the most recent scientific knowledge. In the last few years such conceptions as the Anthropic Principle, the Many-Worlds-Hypothesis etc. have acquired scientific respectability, while their philosophical interpretation leads us back to Leibniz.

With this work Jürgen Lawrenz has made an outstanding contribution to the endeavour of tracing the actual mathematical-scientific developments back to their philosophical sources in Leibniz's system. Its scope extends from classical Einsteinian relativity and quantum mechanics through to the most recent problems animating sciences such as quantum cosmology, chaos and complexity theories, the basis of life in the universe, and the roles of information and entropy in cosmic evolution. Notably, a central place is accorded to the latest results of quantum gravity, a science which has now achieved results in its mathematico-physical investigations which can only be properly understood in the context of the Leibnizian space-time conception. Jürgen Lawrenz, with his very pointed demonstrations, proves himself to be thoroughly conversant with the essentials of the autonomous disciplines from which these results emanate. He is masterful in his exposé of their philosophical roots in the system of Leibniz. His selection of quotations shows his command. The author demonstrates a comprehensive perspective on the literature and expertise in his manner of disposition.

In virtue of its manner of presentation, Lawrenz's work is apt to stimulate interdisciplinary cooperation among scientists and theologians. To support this contention, I propose

to examine the idea of a "Best of all Possible Worlds".

In the eyes of educated society in the 18th and 19th centuries, the caricaturisation of Leibniz's "Best World" idea at the hands of Voltaire brought discredit upon the philosophy. However, at the beginning of the 21st century, the situation has fundamentally changed. For example, the call for a determination of the (presumably) 19 free parameters of the unified field theory from general, mathematical or philosophical principles is expressed in nearly every conspectus of this subject. Similarly, the importance and effectiveness of string theory rests on its ability to dispense with all but one of these free parameters. But all this is precisely the physics aspect of Leibniz's theory of the "best of all worlds". Everything, down to the values of nature's constants, must be as they are. God would not have created a different world, because it would be less perfect in its functionality and the cosmos could not contain life. The modern formulation of the Anthropic Cosmological Principle is nothing other than the concept of a "best possible world". God did not choose the natural constants, e.g. the mass of protons or electrons, willy-nilly. Without a sufficient reason, i.e. arbitrarily, God would not have created anything. Accordingly Leibniz, in his dispute with Newton, rejected the spatial void. God did not create an empty space because the distribution of matter in it would be altogether arbitrary. All this figures once again as a concrete reference-marker to the conception of God in Leibniz's system.

Jürgen Lawrenz has depicted these aspects in the connection between current physics research and the classical (frequently disparaged and mocked) Leibnizian philosophical system very clearly. He displays a high degree of competence in the literature upon which he has drawn in support of his point of view. Moreover, commonly heard or merely feasible counter-arguments are noticed and also evaluated.

It deserves mention, that just these universal constants within otherwise chaotic processes comprise a further confir-

mation that in God's creation nothing is arbitrary, not even the so-called random or chaos processes. This monograph applies to these issues a rigorous and correct philosophical assessment. In these problematic aspects, one can see again how comprehensively Jürgen Lawrenz has researched the relevant contemporary scientific literature.

Similar comments are appropriate to his treatment of Everett's many worlds and parallel worlds interpretation of quantum mechanics. In a philosophical perspective, this happens to be an especially intriguing problem, because the whole dialectics of a single and best universe in Leibniz's sense needs to be brought to bear on it. In connection with Everett's parallel worlds interpretation, the need for a suitable philosophical foundation for modern science in general and physics in particular is quite evident. This problem, too, is correctly treated in Jürgen Lawrenz's essay; and its entailment with the concept of quantum entanglement shown, which is so important for the new domain of quantum computerisation.

The work excels with its judiciously chosen quotations. At the same time, the author remains modestly in the background. The way he places particular nuances reveals a remarkable familiarity with international developments and independence in arriving at his results.

In its form, the work is a remarkable monograph, which may be read with great profit by interested parties in diverse fields. It may serve, as it stands, as an instruction manual for students. It is suitable as an introductory text into contemporary scientific problems not only for students of the humanist curricula, but also for students in theology, natural science, mathematics and information theory as an introduction into the relevant philosophical issues of the same.

## *Author's Note*

Gerd Lassner was one of the 100 great mathematicians of the 20th century, according to the Dakota Genealogical Project.[1] He held for many years the Professorship of the Mathematical Sciences at Leipzig University and became Director of the Nuclear Research Institute in Berlin, as well as Director of Education of the Leibniz Institute.

It was our shared interest in Leibniz, and not least the project from which this book grew, that brought us together for several years of rewarding philosophical correspondence.

Lassner was very enthusiastic about my project and placed the review of which a portion serves as this Foreword at my disposal. In his opinion, the book could furnish the groundwork for a completely new interpretation of Leibniz's science and philosophy; and he suggested to me that we should co-author such a work, with him taking reponsibility for the mathematics and physics, while I would take care of the metaphysical aspects. But he was undergoing stem cell therapy at the time, and only 60 pages of the manuscript were written before he succumbed to his disease.

It is only fitting in these circumstances that I dedicate this book to his memory.

1 http://www.genealogy.math.ndsu.nodak.edu/id.php?id=25086.

# Introduction

Our literate civilization has a long memory. So many ideas and discoveries which seemed new at one time, are found to have unexpected precursors. Even so, the winged phrase of "old wine in new bottles" mostly obscures fundamental differences. Copernicanism may have been 1700 years old when the Canon of Frauenburg finally published it, yet neither the ancient Aristarchus nor the scholastic Nicolaus Cusanus had the faintest notion of the empirical ramifications of an heliocentric planetary system for astronomy. Similarly the atoms of Democritus down to the modern Gassendi have little more than their name in common with Dalton's elements: One is a philosophical concept, the other an empirical datum. There is no need to go on, because these examples typify the situation. The "old wine" is invariably revealed as a vintage unpalatable to the new taste and completely transformed.

This point seemed advisable to be made at the outset, in order to set the lighting at a proper angle for our age. For in contrast to the above specimens, many of Leibniz's fecund ideas remain qualitatively unchanged even in their latest incarnation. For example, his disquisitions on *force* are not primitive versions of the conceptions held in the present age, but fundamental, *kat exochen*. His prognostications on sundry 'metaphysical' items such as time, space, motion, identity, continuity etc. are not the idle speculations of a nouveaux scholastic, but a rigorously elaborated system of criteria for research and discovery, as valid today as then. But the reader need not take my word for it. There is ample testimony from writers as diverse as Hans Reichenbach and Julian Barbour,

whose scientific predilections differ as much from each other as from Leibniz, yet both received stimulus and insight from the same source.

A little vignette may help to illuminate the situation. Here is a passus from a book written by the American theoretical physicist Leo Smolin, aimed at a popular audience of whom very few, perhaps none, would ever have heard the name Leibniz before:

> ". . . we settled down to sherry around the fireplace and began to talk physics and philosophy. He [Julian Barbour], playing the role of the English gentleman to his brash American guests, asked first what we had been working on. I told him of my efforts to construct a theory to unify quantum theory with space and time. He listened politely, then asked if I had ever read Leibniz. When I replied, no, he said, "Well, perhaps you ought to", and began to explain to me how Leibniz's philosophy could provide the starting point for a theory of cosmology."[1]

It must seem an extraordinary situation to picture two late 20th century astrophysicists digging up a dusty old philosophy from 300 years ago and seeking inspiration from it—indeed nothing less than help in laying the foundations for their own cosmology!

This is the point which it was my purpose to stress. For the strangest thing is: These men are not looking in the direction of Newton, the patron saint of western science, but of his almost discredited arch-rival Leibniz! The plain-speaking reason is that Newton has nothing more to tell them, whereas Leibniz's work is a gold mine of pioneering ideas that has not been tapped before.

Nevertheless the reader might still wonder what Leibniz has up his sleeve that Barbour and Smolin's philosopher colleagues at university could not explain to them?

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1 *Life of the Cosmos*, p. 277.

But this is one of those vexed issues on which students of philosophy might wring their hands. Leibniz scholars are not, generally speaking, *au fait* with the trends of modern science. Leibniz may well have been the last of the great thinkers with a vision large enough to encompass both metaphysical speculation and empirical science. His intrusion into current-day affairs therefore suggests that empirical science went through a curve of high technical achievement, before finding itself at the end of this road in precisely the kind of conceptual culde-sac that its contempt for metaphysics seemed destined to bring on.

Since the rise of complexity and chaos as new categories of the scientific enterprise, we appear to be heading for a 'paradigm shift' such as Thomas Kuhn's study of scientific revolutions intimated.[2] Not only physics and astronomy, but chemistry, biology, various mathematical disciplines, morphology, artificial intelligence, symbolic logic, librarianship, even language itself as a research subject are finding themselves situated on shifting ground. As eyes are turning away from age-old certainties, they find that casting a glance into the enormous legacy of Leibniz's papers is apt to offer guidance on many fundamental criteria which demand precisely the kind of metaphysical input that has been bad-mouthed from Hobbes to Mach and beyond. Even the idea of a "best possible world", on which Voltaire in his day poured all the venom of his satirical wit—even this idea with its tremendous repercussions on the subject of modal logic and the so-called 'anthropic principle' in astrophysics—has recently been subjected to minute scrutiny and found to yield astonishingly rich insights.

Even so a perusal of state-of-the-art research reveals that Leibniz's thinking is not everywhere acknowledged. Scientific writers who pick up their colleagues' ideas through journals

2 Kuhn (1996); esp. Ch. 11 & 13.

and conference papers are often unaware of Leibniz as their ultimate source. Yet Ortega y Gasset once observed that the "ten chief principles of philosophy" owe, except for one, their presently accepted formulation to Leibniz. Moreover, Ortega emphasises that seven of these even originated with Leibniz in their present form ("which is not to suggest that they did not have their own prehistory"); and being a philosopher with an exceptionally acute talent for verbal precision, Leibniz succeeded in imposing their articulation on subsequent philosophical thought.[3]

This may at any rate explain why Leibniz remains an *eminence grise*, despite his burgeoning importance to science. It might be said that *his disappearance behind his principles* is largely responsible for this state of affairs.

## AIMS OF THIS BOOK

The purpose of this monograph is accordingly to furnish a detailed account of the impact of Leibniz's metaphysics on today's science as reflected in the writings of contemporary scientists and philosophers of science. It seeks to provide access to the philosopher's uniquely insightful and indeed prophetic essays by presenting for each chapter and each subsection a brief glance over the field to be discussed, followed by elucidations drawn from Leibniz's papers and those of his present-day compeers.

The target audience is philosophers wishing to become acquainted with the trends of today's science, and scientists wishing to come to grips with the philosophical principles underlying their research. The author's hope is that readers brought up on philosophy will find the ubiquitous presence of one history's great metaphysicians helpful in their effort to understand the direction of contemporary fundamental sci-

3 Ortega (1966), pp. 14-5.

ence, as conversely readers reared in the discipline of scientific work may find it useful to gain entry into the world of these arcane concepts from within their own disciplines.

Hence the book presents a fully interdisciplinary perspective. Each of the seven major sections sweeps across one of today's dominant paradigms, giving voice alternately to Leibniz and researchers at work on those issues. Confrontations between leading explorers in those fields and Leibniz are not hard to find, but dispersed over many papers and books. Hence there was much point to assembling the published views of scientists meeting face to face with Leibnizian doctrines in a critical survey. For the future it seems essential that these ideas attain greater currency among a broader sampling of readers, since it is undoubtedly of benefit to delve into the original formulations and the context from which they emerged.

Not the least consideration for the studies in this volume was the hope that appropriate effort on the side of philosophy and of science to understand each other is not only desirable, but also highly rewarding. Philosophy and science belong to the same cultural enterprise. Their divorce has created an unhealthy split in the value systems whose maintenance is their explicit brief. A future for science without philosophy is as dubious and undesirable as the converse. Neither of them can properly discharge their function without mutual influence and cross-pollination.

As an author I have taken pains to avoid prejudice creeping into my text. From a writer whose point of departure is philosophy this may be too much to ask; but I am encouraged in my effort by the unquestioned probity of many leading scientific lights who are happy to take the fruits from Leibniz's tree and acknowledge the gift without compunction. Their impartiality has been a model for me in this study. The reader should not infer from this, however, that critical watchfulness is eschewed where and when it is called for!

This text concentrates on Einsteinian relativity, physics and quantum cosmology, complexity and chaos theories, the origins of life and the electronic cosmos. The one notable absentee from these pages is mathematics: There was no need for dealing with Leibniz's achievements and influence in this department, since it has been the principal bearer of his historical fame outside of philosophy. But it is precisely his metaphysics that is invading modern theoretical research departments. One glance at the contents list should orient the reader and persuade him or her that there is hardly a strand of contemporary research on which Leibniz did not have something important to say. Accordingly this book may also serve as a textbook, especially for younger scientists and doctoral candidates in natural philosophy, for whom many exciting and fecund perspectives may be opened up by immersion in these chapters.

*Notabene:* A note of explanation seems necessary to help readers of other books of mine to alleviate the impression that some of the recurring issues discussed in this work stand in contradiction to the terms and criteria I have espoused as a philosopher. However, this is explained by the need for adopting the multiplicity of approaches of the many authors being discussed in this volume. Since my underlying purpose was to draw the Renaissance of Leibniz's thought in state of the art science to full recognition, prudence dictated authorial reticence on a number of crucial doctrinal issues. This seemed all the more important as it cannot be claimed as yet that a panoramic vision has settled over these multifarious trends. They remain in flux; their direction is fraught with continuing uncertainties and ambiguities; and the whole process is hardly in sight of a firm goal. In a word, the book testifies to an intermingling of two temporally wide apart theoretical structures, whose elements of innate propinquity are tentatively recognised, but will require continued exertion before they can blend in the way that is prognosticated for them in these pages.

# LEIBNIZ: PROPHET OF NEW ERA SCIENCE

# I

# Leibniz's Principles

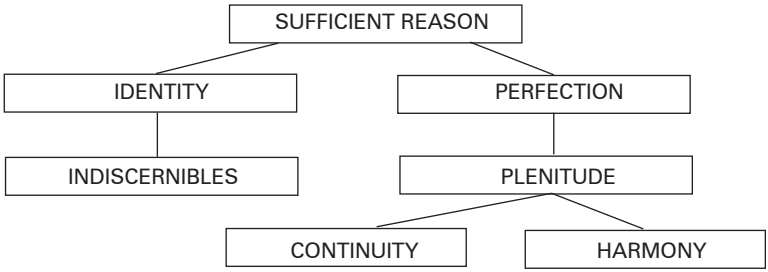
IT MAY STRIKE ANY READER as somewhat disconcerting to find a philosopher dead for almost 300 years being harnessed to the causes of scientific research of which he could not have the faintest inkling. Yet authorities of the rank of Albert Einstein, Hans Reichenbach and Hermann Weyl drew attention to Leibniz's relevance to their work over 80 years ago. These eulogies, however, were merely brief torchlights and restricted to the (then) new theories of relativity and quantum mechanics—both as deeply philosophical as any scientific paradigm in history.

The paradox that greets our eyes in today's world, however, is the persistently *growing* importance of Leibniz to scientific research. His papers are increasingly scrutinised for help on fundamental criteria, for principles to anchor topical agendas, and for explanations on what scientists are *looking for* and *looking at*. The italicised terms reflecting the fact that all research is (in Th. Kuhn's celebrated phrase) "theory-laden", it is of overriding importance that some intelligible prior notion informs the search for either new results or valid principles—the kind of thinking that in former times was at the core of natural philosophers' work. Yet post-Leibnizian philosophy, unremittingly dominated by Newtonian science, has virtually abandoned its authority in this field, leaving only Leibniz to carry the candle. The astonishing situation has therefore arisen that Newtonian cosmology, absorbed into the texture of relativity theory as a special instance, figures historically as the bridge over which Leibnizian cosmology is now marching into the present century.

Accordingly it is appropriate to commence proceedings with a review of Leibniz's principles. They are, so to speak, the scaffolding of his entire philosophy. The reader will thus gain the necessary familiarity, as well as having a convenient source of consultation in his or her traversal of the bulk of the book.

This is not to suggest, of course, that Leibniz relied only on these principles. Nevertheless they form a group—a self-enclosed cluster of conceptual units. Their consistency as a set facilitates cross-reference from one to another, as none exists self-sufficiently on its own. For example, the *Principle of Identity* would be incomplete without being buttressed by the *Principle of Sufficient Reason,* the latter being required to vouch-safe existence before there can be a question of identity. This inter-connectedness is crucial, so that it is correct to speak of the set as the 'parent modules' of Leibniz's thinking.

To illustrate this kinship visually, I reproduce here an hierarchical representation to depict the relationships, prior to a discussion of the principles themselves.[1]




*1) Principle of Sufficient Reason*

This is fundamental in all three aspects of our metaphysical, logical and empirical relations to reality. To say that a thing exists is to make borrowings on *changeable* states of existence.

1 Cf. Rescher (1967), p. 57.

Hence for something to be empirically in the world is a *contingent* fact, since evidently no empirical existents persist unchanged forever. Thus their cause needs to be explained, if only because it is possible for them *not* to exist.

Accordingly for every existent a sufficient (i.e. complete) reason must be available; while conversely failure to discover a sufficient reason is tantamount to raising doubt on the item's existence. So the principle has the function of grounding existents. As mentioned above, the question of the identity of an existent cannot be settled without a prior assurance that the item can claim indubitable existence.

The logical formulation of the principle by Leibniz states that a proposition couched in subject-predicate form is true if the predicate is included in the subject (*praedicatium inest subjecto*):

> *An affirmative truth is one whose predicate is in the subject; and so in every true affirmative proposition, necessary or contingent, universal or particular, the notion of the predicate is in some way contained in the notion of the subject, in such a way that if anyone were to understand perfectly each of the two notions just as God understands it, he would by that very fact perceive that the predicate is in the subject.*[2]

This definition stipulates (as L. J. Russell observed) that "whatever can be predicated of a substance must be contained in the notion of the substance", and in addition that "the notion of a substance must be something in the substance permanently and without alteration."[3] The reader coming to Leibniz perhaps for the first time needs to understand here that this is roughly analogous to the grammarian's "dead corpse". The adjective is in the noun; accordingly it is bad form to speak like this. But in the language of substances, the naming of attributes cannot be avoided, because substances

2 *Necessary and Contingent Truths*, P 96.
3 L. J. Russell (in Woolhouse 1981), p. 104.

can have many attributes without being sufficiently defined by them. Thus "a dead, rigid, rotting and stinking corpse" is sufficiently defined only by adjective 'dead', the others being contingent on circumstances that may (e.g.) not be true if the corpose is maintained in a freezer. Hence only the predicate 'dead' belongs to it necessarily.

Analogously, my existence is adequately explained by recourse to my parents. The word "son" includes the unstated predicate "of a father and a mother". However, in this case sufficient reason is not satisfied because necessity has not been shown in full depth (they may never have met, or one of them may have been infertile, or they may never have been born etc.). Once we pursue this parents of parent sequence further, we run into an infinite regress where only the sampling technique of induction can help us. But this is tantamount to contingently amassing facts without hope of ever getting to the bottom.

In a word, sufficient reason must involve a *complete* individual notion. And so we note, as a first criterion, that every true proposition is analytical (predicate in notion). Leibniz explains:

> *An analogy comes to mind between truths and propositions which seems admirably to clarify the whole matter . . . Just as the smaller number is contained in the larger in every proportion (or an equal in its equal), so in every truth the predicate is contained in the subject. And just as in every proportion between homogeneous quantities an analysis of equal or proportional terms can be carried out by subtracting the smaller from the larger, . . . until there is no remainder or on to infinity, so also can we establish any analysis of truths, always substituting for a term its equivalent, so that the predicate will be resolved into elements already contained in the subject. But just as in proportions the analysis is sometimes completed and we arrive at a common measure which is contained in both terms of the proportion an integral number of times, while sometimes the analysis can be continued to infinity, as in comparing a rational number with a surd, . . . so also truths are sometimes demonstrable or neces-*

> *sary, and sometimes free and contingent, so that they cannot be reduced by any analysis to identities as if to a common measure. This is the essential distinction between truths as well as proportions.*[4]

Couturat explains this as meaning that "every truth may be grounded and proved by analysis", so that the principle can support the Principle of Identity. "In consequence (he writes) every truth must be testable by the Principle of Identity. One could call it the Principle of Universal Intelligibility."[5] In addition, the adjective 'sufficient' denotes "not only that it is possible to state a necessary condition . . . but also that it is always possible to give a *full* explanation of it".[6]

An implication is that truth cannot be a merely human convention. Nor does it depend on the arbitrary will of God, as Descartes somewhat ingenuously maintained. Rather, truth must be securely grounded in the impossibility of contradicting the 'why' of anything that exists, *that* it exist in virtue of a sufficient reason for its existence:

> *. . . nothing happens without a cause or a determining reason; that is, without something by which one can explain a priori why something is present rather than not present, why it is thus and not completely otherwise. This great principle is present in all things and no example can ever be cited to contradict it.*[7]

Attention has been drawn to infinite regress. These are cases of contingent truths; but although they belong to another category to be dealt with *infra*, it is convenient here to attend to Leibniz expostulating on the distinction:

> *In contingent truths, though the predicate inheres in the subject, we can never demonstrate this, nor can the proposition ever be*

4 *On Freedom*, L 265-6.
5 Louis Couturat, "Sur la métaphysique de Leibniz", under the title "Über Leibniz' Metaphysik" in Heinekamp (1988), pp. 58-9 (my translation).
6 Parkinson (1965), p. 63. Emphasis added.
7 *TH*, §44.

> *reduced to an equation or an identity, but the analysis proceeds to infinity . . .*[8]

It is not unimportant to mention here that Leibniz apparently espouses the synonymity of 'cause' and 'reason'. Now in English usage, the word 'reason' frequently doubles up for 'cause'—"the reason this thing moves is because it has an engine". I mention this casualness because it tends to exercise scholars, as if Leibniz had a tendency "to confuse reason and cause"[9] and not pay attention to the difference between a 'reason *for*' and a 'cause *of*'. Had Leibniz been interrogated, he may of course have insisted that the synonymity must stand, since a cause is nothing other than an 'ultimate or determining reason'. Moreover, the German language seems also less finicky, relying on context to resolve reason and cause from the same word '*Grund*'.[10] Thus it seems to me that modern commentators reading the ensuing quote could have hardly a leg to stand with any claim to *confusion*:

> *A reason is a known truth whose connection with some less well-known truth leads us to give our assent to the latter. But it is called a 'reason', especially and par excellence, if it is the cause not only of our judgement but also of the truth itself—which makes it what is known as an 'a priori reason'. A cause in the realm of things corresponds to a reason in the realm of truths, which is why causes themselves—and especially final ones—are often called 'reasons'.*[11]

In any case, our burgeoning science is making it ever more difficult to account for the cause of one or another phenomenon. Science cannot admit God into its theories, and so a great deal of philosophical speculation is compelled to contend with arguments of chance beginnings, seemingly at the opposite

8 *Critical Thoughts on … the Principles of Descartes*, L 407.
9 Mates, pp. 158-60.
10 Cf. Heidegger's treatise *Der Satz vom Grund* (1955), where '*Grund*' carries the twofold meaning of 'rockbottom' and 'ultimate reason'.
11 *NE*, 476.

pole from the principle of sufficient reason. The issue, which may be stated at once, revolves largely around the question whether the Creator was bound to such 'rules' as Leibniz was wont to promote. For Newton and his successors through to the maturity of Einstein, it was axiomatic that the universe is finite and created in finite time, that time is 'absolute', that the elemental constitution of matter is corpuscular.[12] Finally that God was completely at liberty in his choices of when, how and by which criteria to create it.

To Leibniz, these criteria smacked of arbitrariness, and he set about 'defending' the Almighty of this charge. Creation *ex nihilo* and at an instant which would be indefinable owing to the homogeneity of 'time' and 'void' was, to him, an impossible thought construct. This is not to say that God was constrained, but significantly that the principle of sufficient reason goes begging. As to atoms, we would have to accept that God created things which differ *solo numero;* but then one should wonder why atoms *a, b, c* . . . etc. occupy the place they do rather than any other, and once again we are bereft of sufficient reason. However God does nothing without good reason, so the atomic theory cannot be true as stated.

For Leibniz, this principle (in company with all his logical principles) was innate, and being innate meant that it came from God and therefore with good reason again.[13]

*2) The Principles of Identity and Contradiction*

All scholars are agreed that the principles of sufficient reason and of contradiction occupy pride of place in Leibniz' canons of logic. Leibniz wrote about them:

12 I write 'corpuscular' rather than 'atomic', since Newton described himself as a corpuscularian and was critical of the atomic theories of such as Gassendi. It is not a differentiation that would keep anyone sleepless today.

13 I cannot in this place go into further details; but a reader interested in pursuing the full ramifications of the Principle of Sufficient Reason is invited to consult Lawrenz (2010), Ch. 10 "Grounding Existents", p. 236ff.

> *Our reasonings are based upon two great principles: the first, the Principle of Contradiction, by virtue of which we judge that false which involves a contradiction, and that true which is opposed or contradictory to the false; and the second, the Principle of Sufficient Reason, by virtue of which we observe that there can be found no fact that is true or existent, or any true proposition, without there being a sufficient reason for it being so and not otherwise, although we cannot know these reasons in most cases.*[14]

But the Principle of Contradiction doubles up as the Principle of Identity and is regarded in such light by Leibniz, as a passus from his correspondence with Clarke shows, where he speaks of "the principle of contradiction or of identity". Gottfried Martin points out the difference in application:

> We stress the principle of being when we speak of the principle of identity, whilst we are concerned primarily with the principle of knowledge if we speak of the principle of contradiction.[15]

Hence "identity affirms the constancy of an ontological determination". Contradiction, on the other hand, is considered to be mainly about the logic of propositions, as noted above in the quotation from the *Monadology*. "Leibniz sees an immediate connection between the ontological and the epistemological significance of the principle," Martin writes, "something real cannot be simultaneously itself and its opposite, something real cannot embrace a characteristic and its opposite."[16] Thus a simple resolution offers itself in respect of propositions: they are either true or false. The statement, 'This square has three angles' is false. This is expressed by Leibniz as follows:

> *First of all, I assume that every judgement (that is, affirmation*

14 *Mon.*, 31-2.
15 Martin, p. 4.
16 Ibid.

> *or negation) is either true or false and that if the affirmation is true the negation is false, and if the negation is true the affirmation is false; that what is denied to be true—truly, of course—is false, and what is denied to be false is true; that what is denied to be affirmed to be affirmed and denied to be denied is to be affirmed. Similarly, that it is false that what is false should be true, and what is false false. All these are usually included in one designation, the Principle of Contradiction.*[17]

Thus we come by the following essential insight:

> The ontological determination which is called for by the principle of identity expresses itself in the cognitive determination which is called for by the principle of contradiction. To say that reality is expressed in true and false propositions and, conversely, that true and false propositions represent reality, is to say that this principle is a principle of being and cognition.[18]

It is of some importance to reflect that Leibniz considered the principle of contradiction to be innate and pressed this claim together with others of a similar nature in his *Nouveaux Essais*, whose shaft is aimed at Locke's contention that all knowledge is the result of experience. Leibniz argues, cogently enough, that some kinds of ideas cannot be the result of experience, for they precede any experience. Check, for example, the idea of being:

> *I should very much like to know how we could have the idea of being if we were not beings ourselves and did not thus have being within ourselves.*[19]

One might especially point to logic itself, which cannot be reduced in any way. The entailments of logic are a form of understanding with which we are born, they are part of our native intuitive equipment, while experience in logic comes

17 *On the General Characteristic*, L 225.
18 Martin, p. 5.
19 *NE*, 85.

with the study of its more advanced methods. In this aspect of the problem the difference between logic and numbers comes to the fore, for as much as it might be acceptable to claim that the concept of unity, which lies at the base of our number spectrum, may be derived *as a concept* from the experience of numerable items in the world, yet the intuition of logical entailment such as we find in any syllogism has always been taken for granted, from Aristotle onwards, and questioned only in the 20th century as a result of the burgeoning of neurophysiological knowledge. The latter does not, however, contradict this intuition of logical entailment; it merely seeks to uncover its neurological basis.

We seem compelled, therefore, to agree with Leibniz that some primitive notions must be innate, because a mind-endowed human needs such minimal faculties in order to perform life-preserving evaluations. Sophistication on the contrary arises from the application of these notions to practical tasks, including teaching, which may be said to be the path towards an enrichment of our cognitive faculties.

The suggestion also has a bearing on the subject of 'God's thoughts'. Leibniz found himself obliged at various times to rebut opinions that primitive truths depend on God's will, that (so Descartes) he might as easily have decided on 3x3=9 as 3x3=10. In the *Theodicy*, Leibniz counters this with some sarcasm on the limitations of the mental equipment of thinkers who propound such notions, claiming that

> *there are propositions which are eternally true because of their own nature and not because of divine ordination, which are not true by virtue of a free decision of His will, but rather are recognised by Him as being necessarily true, because their nature demands it.*[20]

Leibniz's point absolves the constraint on God's free will, for it may be said that the forming intellect, in creating the

20 *TH*, §190.