Richard T. W. Arthur, *Leibniz*. Cambridge: Polity Press, 2014; 231 pages.

Reviewed by Ohad Nachtomy, Bar Ilan University

Leibniz scholars are familiar with the fine work of Richard Arthur. Arthur is the translator and editor of the superb volume *The Labyrinth of the Continuum: Writings on the Continuum Problem, 1672-1686*. (New Haven: Yale University Press, 2002), and the author of many articles on Leibniz's philosophy of science, space, time, metaphysics, and especially the composition of continuum and Leibniz's analysis of the infinite. Arthur's articles are typically dense, extremely well documented, and often draw on complex and little known historical background in early modern sciences and mathematics. For these reasons, Arthur's articles are as challenging as they are rewarding.

Arthur's present publication is of a different sort. This time Arthur has composed an introductory book to Leibniz's philosophy. This volume addresses not only experts, but also students in introductory courses on Leibniz as well as the general public. By drawing on Arthur's previous works, it offers to Leibniz students his original interpretations as well as his reconstruction of Leibniz's development in an abbreviated and unified form. Whether the book will become popular among students without much background in Leibniz, remains to be seen. I am in fact a bit skeptical about that. The prose is still dense and presupposes a fair amount of (historical and scientific) background. But, perhaps in spite of the author's original intentions, the book will turn out to be most useful to Leibniz's advanced students.

Unlike most classical introductions to Leibniz's philosophy (which are usually based on later and familiar texts such as the Monadology), Arthur takes a historical and developmental approach. He seeks to present Leibniz's philosophy as it develops and grows out of his early notes and papers, which are presented as a response to the problems the young philosopher was trying to solve (4).

The book holds a useful chronological sketch of Leibniz's life and work, an introduction, and eight chapters:

2. Logic, Language and the Encyclopedia Project
3. Natural Philosophy and the Science of Life
4. Mathematical Philosophy
5. The Reform of Metaphysics
6. Dynamics: The Physics and Metaphysics of Action
7. The Philosophy of Space and Time

8. Morals and Politics
9. Leibnizian Posterity

Readers who are familiar with the Leibnizian corpus will recognize that this order of chapters attempts to track and correspond to Leibniz's actual notes and various pieces of writings. Of course, Leibniz's texts do not divide according to any neat classification, as he was always preoccupied with many things at the same time. But one can see here that Arthur seeks to show how Leibniz's earlier writings on Logic and Language, Natural Philosophy and the life sciences, and especially his mathematical work were crucial to his reform of metaphysics, the introduction of substantial forms; his Dynamics or the theory of forces (that, as we know, are constitutive of substances), his view of monads; and his original views on space and time (clearly articulated in the late correspondence with Newton via Samuel Clarke).

The most original aspect of Arthur's approach is the following: rather than resorting to some first and fundamental principles that presumably inform Leibniz's philosophy, Arthur attempts "to show how Leibniz's metaphysics developed through the attempt to solve various more specific problems in the life sciences, theology, physics and mathematics" (5). The emphasis on the primary role of the sciences is especially interesting in light of current interpretations of Leibniz as well as a common perception of philosophy at his time. Descartes, for examples, places philosophy at the foundation or core of all knowledge and the particular sciences in the peripheries. Descartes' work provides the best known image (and argumentation) for this picture. He sees philosophy as the basis for all scientific knowledge, analogous to the roots of a tree with geometry and mathematics as the methodological trunk and the special sciences as its branches, growing and nourishing, as it were, on the basis of first philosophy. The structure of his *Principles of Philosophy* strongly supports this picture. Leibniz is often presented in this way, so that his many scientific pursuits are seen as a sort of marginalia, illustrating his wide interests as the last Renaissance-man (who could master all the sciences of his time).

Arthur's approach is radically different. According to Arthur, scientific problems drive and nourish Leibniz's philosophy (or better his metaphysics). The result is a rather controversial picture of a Leibniz "who never intended to deny that substances have real bodies," and never intended to promote an idealistic picture in which space and time are mere relations, but rather that space and time cannot be understood independently of the existence of substances (5). This seems to be the

main aim of Arthur's approach. Let me now look at chapters 2, 3, and 4 in order to substantiate this claim and get a better sense of how Arthur goes about implementing his program.

Chapter 2. Logic, Language, and the Encyclopedia Project

In this chapter Arthur is looking at Leibniz's logic *as he understood it*, that is, logic in the context of his early projects of a universal language, real characteristics, and an encyclopedia of all (possible) knowledge, all of which stem from his early work on the combinatorial art. Leibniz's actual understanding of logic is thus very different from the view that Russell has placed as the center of Leibniz's philosophy – a logic that basically amounts to turning Leibniz's theory of truth into a denial of relations. I think Arthur's approach leads to a much better appreciation of the complexity and richness of Leibniz's philosophy. Starting from his ideas about the Alphabet of human thought, his early theory of real definition; the Real Characteristic; the Universal Language; the Encyclopedia of all possible knowledge; as well as his view of Natural Language, give us a much better sense of how Leibniz has arrived at his theory of truth, so that in every true proposition the predicate is in the subject, and the view (presented explicitly in the Discourse of Metaphysics) that every individual substance has a complete concept that includes every one of its predicates. At the center of these early works (and Leibniz's incredible optimism about their usefulness) stand some combinatorial assumptions about the way in which concepts are built up from simple ones, so that all consistent combinations also yield all possibilities and all inconsistent combinations yield impossibilities. Seen against this background, Leibniz's development of his well known logical/metaphysical views seems much less naïve and makes much better sense (and, I should add, does not involve a facile rejection of relations).

Chapter 3. Natural Philosophy and the Science of Life

To exemplify Arthur's argument in this chapter, I will cite several passages in which he addresses Leibniz's account of organism, and the difference between organic and inorganic matter, culminating in his distinction between natural machines and artificial machines, in terms of which he articulates the distinction between living and non-living beings.

Arthur writes:

In a text from 1680-86 whose full title is *The Body of Man, as of any Animal, is a sort of Machine*, [Leibniz] argues that "any machine is best defined in terms of its final cause, so that in the description of its parts it is therefore apparent in what way each of them is coordinated with the others for its intended use." The best way to describe a clock, for example, is as a machine made to tell the time, so that "the function of a clock-hand lies in its uniform motion for some period of time" (LH III, 1, 2, §1; Smith 2011, 290). Such an artificial machine cannot move itself, however, or sustain itself in existence: it requires an external agent to set it in motion, and once it has used up its stored energy, it stops. The body of an animal is a superior kind of machine in that it has organs for nutrition and excretion which enable it to nourish itself, importing through its interaction with its environment the energy necessary to sustain itself. Also, even though it may cease or die when it is no longer able to sustain itself as a body of that kind, it has reproductive organs: "machines of this kind are able to produce other machines similar to themselves" (LH III, 1, 2, §3; Smith 2011, 292). (71-72)

Thus organic bodies are self-moving, self-sustaining, and self-replicating machines. As Leibniz tells the vitalist Georg Stahl in their controversy on the nature of life in 1709-10, organism is really a mechanism, although "a more exquisite one" (Stahl 1720, 6-7; Smith 2011, 326). And the organs these machines must possess to perform these functions, such as digestive and reproductive organs, are themselves very complex mechanisms. But also, as we have seen, organic bodies possess a dominant form or monad, and since the monad is indestructible and always has a body, its organic body cannot be completely dissoluble, no matter what transformations it may undergo. Moreover, since any body, however small, presupposes such a form for its activity and actuality, an organic body must consist in machines within machines to infinity. (72-73)

We can make an artificial machine like a clock, building it up out of inorganic bodies like its metal cogs, pendulum and hands; but these parts are not themselves machines contributing to its function by their own self-directed actions, as is the case with an organic body. To make an organic body we would have to be able to make machines within machines to infinity, with all their actions coordinating to produce the actions of that body.

For Leibniz, what makes a natural machine 'the same machine in its least parts' is its possession of a substantial form or monad. It does not have to have the same parts from one instant to another, so long as the parts it does have

> contribute to its own functions and end. For this it needs to be the source of its own actions, and also to have a law or "program" for the development and unfolding of these actions. Each of these two aspects of Leibnizian forms is crucial (73).

And, as Arthur adds: "it is the internal law governing the unfolding of the states of a substance that accounts for it having a genuine unity, as opposed to the accidental unity of an artificial machine (73)."

I fully agree with Arthur that both a single source of its action and a single program (or law) of its actions is required for Leibniz's account of natural machines and, more generally, to his account of living beings. I also think that the notion of a program is essential for understanding Leibniz's functional (rather than physical) characterization of natural machines as involving machines within machines *ad infinitum*.[1] But let me just note that there is a slight vacillation here between seeing the notion of natural machine as applying to the *body* of an individual substance, the animal, or to the individual's substance, or the animal itself. I believe that this ambiguity has its source in the texts – and perhaps Leibniz moves from applying the notion of a machine to the body in the earlier texts to the substance in the later ones.

Chapter 4. Mathematical Philosophy and Leibniz's use of the infinite

The way Arthur sees the relation between Leibniz's mathematical work and his philosophy is expressed clearly in the following passage.

> Leibniz's main interest in mathematics, however, was fuelled by his fascination with the infinite. It is not an exaggeration to say that his whole philosophy was framed by his passion for the infinite and the indivisible, from his earliest theory of indivisibles of motion to his mature depiction of monads as infinite series of states produced according to the law of the series. And many of his other characteristic doctrines were also inspired by his mathematical work related to the infinite and the continuum. His analysis of body as an infinite aggregate lacking unity, his solution to the problem of contingency in terms of an analogy with incommensurable proportions, his conception of derivative forces as instantaneous modifications, and his sophisticated understanding of teleological behaviour in terms of the optimization of paths, all owe a substantial debt to his mathematical understanding (79).

It would be a slight overstatement to present Leibniz's philosophy as a mathemati-

cal one (and the other chapters clearly show that other sciences play an essential role). But Arthur is surely right to point out the immense significance and trace the impact of Leibniz's work on the infinite had on his philosophy.

In my view, the use of infinity poses one of the most (if not the most) interesting questions of Leibniz's philosophy. On the one hand, Leibniz is using infinity in almost every one of the major concepts of his metaphysics. In addition to the concepts Arthur mentions in the above-cited-passage, infinity figures in Leibniz's view of God, of possible worlds, of actual individual substances, of complete concepts, of the infinite perceptions of the monads and their interrelations, and the two great labyrinths (human freedom and the composition of the continuum). On the other hand, since the early 1670s, and clearly since his reading of Galileo's *Dialogue on Two Sciences*, Leibniz argues that both infinitely small and infinitely large magnitudes are contradictory notions and therefore are impossible. Indeed, this is a fundamental result for Leibniz, and as Arthur has shown, the rejection of infinitely small magnitudes is one of distinctive features in Leibniz mathematical approach. But if Leibniz denies infinite number (large or small), how can he use infinity so extensively in his philosophy?

While Arthur does not present his view in this way in the volume under consideration, I believe that much of his scholarly work can be seen as addressing this puzzle in terms of Leibniz's development. Arthur has reconstructed Leibniz's development and the various strategies he has adapted to deal with this issue through his approach to the question of the continuum in a very careful and precise way (pp. 79-86). In the present book, Arthur builds on his previous work in presenting a very informative summary of the steps that led Leibniz "from indivisibles to fictions." By fictions he refers to Leibniz's celebrated position that infinitesimals are not beings but rather "useful fictions". Arthur argues that, due to a syncategorematic interpretation of the infinitely small, by 1676 Leibniz could use infinitesimals in calculations and avoid the mystery – and indeed the contradictions – that their would-be existence would involve.

Here is Arthur's masterful summary:

> Leibniz's solution to the continuum problem falls into two parts. On the one hand, a body is a plurality, indeed, an infinite plurality: it is just all the unities or simples presupposed in all its actual parts. "In actual things, the simples are prior to the aggregates" (GP ii 379; LDB 141). The reality of any phenomenal body is constituted by an infinity of these unities or monads; since such a unity is presupposed in any actual part of the body, their multiplicity

> "is greater than any number whatever" (GP ii 282; LDV 333). To perceive or understand something as continuous, on the other hand, is to abstract from all the particularities of existence, to perceive it as an ideal thing, and "in ideal things the whole is prior to the part" (GP ii 379; LDB 141). "There are no divisions in it except those made by a mind" (GP ii 278; LDV 327). Its parts are indeterminate, and can be assigned as needed. Thus a continuous whole can be treated as if it consists in an infinity of infinitesimals; but although by such means one can represent truths, there are not such things in reality as infinite wholes or infinitely small parts. (85)

Arthur's position surely clarifies much of Leibniz's use of the infinity. However, some interesting questions remain. For instance, I am wondering if the precedence of parts to wholes in aggregates and the inverse in case of ideal things holds in the case of true substances as well. I suspect that it does not – but to the best of my knowledge, this is something that has been taken for granted by most Leibniz scholars without much of an argument. I am also wondering whether Leibniz's view of God as infinite belongs to the category of magnitude. I suspect that it does not. If so, are there other categories, or senses of infinity in Leibniz's philosophy that are not covered by Arthur's analysis? I suspect there are. In particular, I suspect that there are some non-quantitative senses of infinity. And, in fact, I suspect that that they apply not only to God, the most perfect being, but also to less perfect beings, such as created substances. This brings me to a related question: are there degrees of infinity for Leibniz? I think there are. But this is not the place to develop these questions. Let me just say that these are questions that Arthur's work has helped me to formulate and pursue. It is beyond doubt that his present work will further help us advance our understanding of Leibniz's work.

But I do not have any more time or space to bring these out, nor to report or comment on the other fascinating chapters of this book. I can only hope this review would serve to wet the appetite of readers and encourage them to study this whole book carefully. Let me end this review by paraphrasing my comment which appears on the book's back cover:

> This is a lucid, informative, and original book. With marvelous clarity and erudition, Arthur paints a very sympathetic and useful picture of Leibniz's philosophy, its context, and its development. Leibniz scholars will appreciate the original positions Arthur takes and the solid arguments (textual and conceptual) he assembles to support them. It is a very significant addition to Arthur's superb work and one in which a new picture of Leibniz's philoso-

phy and development emerges. In my view, it is a must read for any serious student of Leibniz.

Ohad Nachtomy
10 Habanim St.
Zichron Yaacov
30900 Israel
ohadnachtomy@mac.com

Note

[1] See my "Leibniz on Artificial and Natural Machines Or What It Means to Remain a Machine to the Least of Its Parts", in *Machines of Nature and Corporeal Substances in Leibniz*, Justin E. H. Smith and Ohad Nachtomy (Eds.), Springer, The New Synthese Historical Library, 2010.