François Duchesneau, *Les Modèles du vivant de Descartes à Leibniz.* Paris: Vrin, 1998. Pp. 402.

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Nowadays "philosophy of biology" is taken to be the special study of a set of issues concerning selection, adaptation, and the characterization of a species. Though the reduction of biology to chemistry and physics remained a topic in the general philosophy of science syllabus through the 1970s, the concept of life subsequently lost even this marginal foothold in the curriculum. Hans Driesch was the last vitalist of any scientific standing and, after the 1930s, vitality was declared a purely subjective phenomenon and turned over to the phenomenologists for their exclusive use. Meanwhile, the history of biology has experienced a similar truncation. Influential historians of science from Michel Foucault to Richard Westfall, have denied that there was a science of life before the end of the 18th century. Charles Coulton Gillespie said that there was no objective science of life before Darwin.

In the historiography of philosophy, determination is negation and these narrowed definitions have had an unfortunate influence. An understanding of the development of the physical sciences of the 17th century in the hands of Kepler, Galileo, Boyle, Huygens, and Newton has long been agreed by general historians of philosophy to be indispensable to an interpretation of the doctrines and programmes of Descartes, Locke, Leibniz and Berkeley. Recognition of the equal relevance of the life sciences to 17th century metaphysics and epistemology has only lately arrived. But just as the philosophy of biology has been welcomed everywhere as an addition to academic philosophy, there is reason to hope that historiography will catch up. François Duchesneau's long overdue study shows how this application might be made.

There is no doubt, meanwhile, of the role played by the new quantitative physics. Questions regarding the nature of the fundamental unit of *matter*, the reality of *force*, the external or self-regulation of the *cosmos*, the nature of *light* and *heat* vs. dark and cold, and questions regarding our access to the nonobvious facts about the world, shaped the new metaphysics and epistemology. The writings of Gerd Buchdal were path-breaking in showing this to be true, and it is now well understood that the new philosophy differed from the Aristotelian in its rejection of "forms," "visible species," and supernumerary causes. At the same time, it differed from the mechanical philosophy of the ancients in being theo-mechani-

cal, rather than atheistic, and informed by optics with respect to its theory of qualities. For the destruction of the theory of material images implied by the theory of lenses was the *sine qua* non of dualism, as John Schuster first showed in his remarkable study of Descartes's formation as a natural philosopher.

In a number of his earlier books, Duchesneau examined such topics as the relationship between Locke's medical interests and his empiricism and skepticism, the problems of sensibility and reactivity in the 18th century, and the search for the fundamental unit of life. *Modèles du vivant* now advances and defends the broader hypothesis that the texts of 17th century philosophy were shaped by philosophers' curiosity regarding the living creature and by their acquaintance with the researches of Harvey, Swammerdam, Sydenham, and Malpighi. What makes Duchesneau's programme of interpretation convincing is his juxtaposition of the most familiar texts of Descartes, Spinoza, Locke, and Leibniz with, first, their own less familiar texts, and second, with the distinctly unfamiliar and for most of us inaccessible essays of bio-medical writers famous in their own times but now largely forgotten, such as Frances Glisson and George Ernst Stahl, as well as with the semi-familiar writings of More and Cudworth and Gassendi. This even-handed treatment, ignoring the difference between the subsequently calumniated and the subsequently celebrated, is effective in supporting the book's central thesis.

The central questions the philosophers were asking, which they hoped the experimental and observational study of the body would answer (and would answer in a way not hopelessly destructive of moral and religious values), were these: *Which* things are alive? Which have the properties of perception and self-motion? What differentiates living from non-living? Living from dead? What is the difference between the sick body and the well body? Can living forms possibly emerge out of a nonliving substrate? Can life possibly be reborn in dead matter? What was the ultimate origination of living things and by what means—natural or supernatural—is the succession of generations assured?

In the case of the life sciences, as well as in the case of the physical sciences, all basic questions were addressed within a conceptual space established by Christian Aristotelianism on one hand, and the materialism of the ancient atomists on the other. The increasing availability of printed texts afforded an opportunity to compare and contrast these two influential world systems. The mere possibility of a mechanical theory of the animal and the none-too-sharp dividing line between plants and minerals, especially crystals, seemed to count against the Aristotelian doctrine of the three grades of soul. On the other hand, the difficulty

of explaining function and capability by reference to observed structure, even with the help of the microscope, put mechanism in doubt. It prompted recourse to a variety of supramechanical agents: plastic natures, hylarchic principles, *animae* and *animalulae*, *archei* and the spirit of nature. Meanwhile, theology was a stimulus to metaphysical creativity when it came to formulating theories of personal immortality in the face of the advancing front of disenchanted nature. Since neither Aristotle nor the atomists had believed in personal immortality, these efforts were at least not hampered by the drag of traditional doctrine. Yet learning about the animal body involves a good deal of slicing into and tearing up; the very fact this is seen as permissible poses a tacit challenge to the idea of a specially-concerned God.

Epistemologically, knowledge of the living and properly functioning body presents a well-known paradox. While the "behaviour" of sun, moon, stars, projectiles, the pendulum and the balance can be observed or manipulated without destroying or hurting them, the body has to be killed or at least hurt in order to be studied in any depth, in which case it is no longer living or properly functioning. Bacon famously said that, in order for us to master it, nature had to be "vexed." But, writing in the first quarter of the 17th century, Bacon probably had in mind only such minor stresses as might be involved in carrying clocks down into mines where they do not usually go, not the highly-vexing-for-everybody evisceration of living criminals that had been practiced in ancient times. Soon, however, experimental physiology, while observing decent limits with respect to humans, became a teeth-gritting attempt to observe the intermediate phase between life and death, in the hope of capturing the proper object while preventing its flight or sudden expiry. Mice were slowly asphyxiated under bell jars; stray dogs had to be tied down so as to have their blood transfused; the beating heart was, however briefly, revealed to the eye of the experimenter. Beyond the practical difficulties of procedure, the overwhelming problem of the life sciences was systematicity. There were, in short, no foundations, nothing comparable to Descartes's announcement that matter consisting only in extension, everything outside the soul of man was susceptible of mathematical handling combined with pretty good results. (It was this feature that led writers like Westfall to deny that all this *activity* with regard to animals and animal tissues could really be considered science.) The investigator was faced with a baffling array of organs and structures of seemingly infinite micro-complexity that gave little clue as to what they were for and how they worked. And where the course of illness or the cause of plague was concerned, what could any empiricist do except observe,

record, tabulate? Duchesneau argues that, insofar as they were devoid of first principles and despite the lack of obvious similarity between clockworks and human anatomy, it was *modeling* that was the key to method in the early modern life sciences wherever they were most fruitful.

Duchesneau begins with a contrast between two near contemporaries, Jean Baptist van Elmont and William Harvey. He then moves to Cartesian science and the animal machine, and to Descartes's attempt to construct a theory of generation, thence to Pierre Gassendi, whose blend of teleology, atomism, and theology defies simple classification, and to Spinoza and the *conatus* concept. Later chapters are devoted to the English reaction to Descartes, to preformation and preexistence; to Locke and the physician Thomas Sydenham, then back to the Continent with Claude Perrault and G. E. Stahl, ending with a chapter on Leibniz and the concept of organism. All that is missing (from the perhaps somewhat chauvinistic and Anglophone perspective of this reviewer) is a sustained treatment of Robert Boyle's contributions to physiology and the theory of the living, and a discussion of Anne Conway's doctrines, whose alleged influence on Leibniz were the subject of a well-known article by Carolyn Merchant.

As Duchesneau is familiar to readers of the *Review* as the author of two books on Leibniz, *Leibniz et la méthode de la science* (1993) and *La dynamique de Leibniz* (1994), I shall conclude with an account of his last chapter.

Leibniz has always had a reputation as an "organic" thinker, though this reputation does not rest on what is known of his physiological ideas, but on his antireductive metaphysical doctrines and on the impression of a genuine "biophilia" in the sense of E.O. Wilson created by his many references to plants and animals. As Duchesneau remarks, he is the first theorist to use the term "organism" in its modern sense. (For Conway, for example, clocks had "organic," but not vital unity; that is to say, they consisted of parts functioning as a whole.)

Everyone remembers how Leibniz, walking in the gardens of Herrenhausen, challenged his companion to find two leaves that were exactly alike and how he used the negative result of this experiment to illustrate his metaphysical doctrine of the impossibility of material atomism and the uniqueness of every genuine individual. Leaves, not snowflakes—this is important. Surprisingly, the idea of a single category for plants and animals and only for plants and animals was not stable in the 17th century. There was still imperfect consensus as to what was alive and what was otherwise life-bringing, or life-enhancing, or, for that matter, life-destroying—diseases? seeds? chrysalises? stars? comets? vapors? Leibniz was unusually firm in his insistence that plants and animals comprised a single

category and were exhaustive of it, and he understood this to mean that each microorganism, and each plant as well as each higher creature had future-oriented activity, memory-traces, and present awareness and was infinitely complex. A living creature was a machine that was made up of smaller machines, and so on forever. According to the terms of his metaphysics, perception and appetition are properties of simple, partless substance and therefore incapable of reductive explanation or elimination as mere response to a stimulus respectively. However, the treatment of experience and will as properties of the immaterial atom, monad or soul, did not, in Leibniz's view, exclude the possibility of a complete and deterministic physiological account of the processes occurring in the human brain and body (including, as we learn from the *New Essays*, the perception of color and the occurrence of choice followed by action). Leibniz engaged in a lengthy polemic with Stahl over the need for a biomedical soul, which Stahl, as a chemist, believed to be indispensable.

The purity of the doctrine of parallelism, however implausible or difficult to work out in detail, was nevertheless marred by Leibniz's reversion to the concept of a "dominant" monad, which, if it performs any function at all, has to have a physiological equivalent, or be considered in violation of parallelism, and which is technically superfluous if it has no function. It was further marred by Leibniz's desire to integrate, for theological reasons another superfluity or intrusion, the *vinculum substantiale* into his notion of a corporeal substance. Duchesneau devotes considerable discussion to these tensions, and these sections will be welcomed by students of Leibniz's theory of substance.

In conclusion, Duchesneau is to be thanked for this richly-documented, clearly-written and entirely original study. It is a landmark in the interpretation of 17th century philosophy, and raises a number of fascinating issues meriting further research.