

During the Scientific Revolution of the sixteenth and seventeenth centuries, a new “mechanical” model of the universe emerged. It described the world – including life, passions and consciousness – exclusively in terms of material parts in motion. In *The Restless Clock*, Jennifer Riskin spells out how this model provided us with a distinct and effective way of knowing the world, and became an important factor in the origins of Western modernity. At the same time, however, it “banished from nature purpose, sentience, and agency”. Persistent contradictions inevitably emerge between ideas of a mechanical world and the qualities of living things, such as autonomy and will. Riskin uncovers and traces disputes that revolve around such contradictions, and demonstrates how they lead us back to the question of who and where we are in the observable and measurable universe that emerged in the Scientific Revolution.

There are other historical moments surrounding the emergence of modernity, and their echoes, too, continue to characterize our own time. Among them are the fall of Constantinople in 1453, the end of the Hundred Years War in the same year, Columbus’s landing in the Americas in 1492, and the Reformation in 1517. All these momentous episodes are relevant for Riskin, too, as she captures key changes and novelties that we usually associate with the emergence of modernity. They include, for example, the transition from ancient and medieval natural philosophy to modern science (the former ascribes to nature such qualities as souls, forms, essences and powers, in the tradition of Aristotle, while the latter confines itself to material and observable aspects of nature), the crucial idea of the emancipation of the self as an autonomous being, free from rule through others, through grasping rationally knowledge about the world, and conflicts between theological and secular accounts of nature, which negotiate a fully determined, predictable mechanical world with interventions from either an omnipotent creator or from humans who exercise free will.

Elaborate mechanical objects were built in the late Middle Ages as parts of cathedral clocks and organs, and soon after for municipal clock towers and noble homes. The Catholic Church was, as Riskin emphasizes, mechanical machinery’s earliest main patron. She also emphasizes the “humming and whirring” of the seemingly ubiquitous machinery at the time, claiming that “Europe during the later Middle Ages and the Renaissance was alive with mechanical beings”. When, by the mid-seventeenth century, human and animal machinery famously began to flourish in scientific and philosophical discussions, mechanical images of living creatures were already a familiar sight. They preceded the mechanistic world view, and Riskin asks us, accordingly, to think our way back into what automatic machinery signified before Descartes developed a mechanistic world view: it was, among other things, alive.

René Descartes first proposed the mechanistic world view, and stated that animals were machines. Central to Riskin’s enterprise is her suggestion that he did not mean that they were lifeless. Descartes’s ideas have been continuously challenged and distorted over the years, starting with his contemporaries such as Christiaan Huygens, and soon after by such influential figures as Gottfried Wilhelm Leibniz and Julien Offray de La Mettrie, and to this day. Contemporaries adamantly claimed that Des-

Machine learning

Thinking about how the world is seen to work

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THE RESTLESS CLOCK

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cartes took animals to be inanimate, experiencing no sensations or emotions. They even turned this into a polemical rumour that certain philosophers were treating their pets badly. This radical (and inaccurate) version of Descartes’s philosophy – which he himself protested against – obviously seemed implausible to many contemporary and later philosophers: it interferes with many of our basic experiences with animals. La Mettrie’s overriding project, furthermore, as Riskin explains, was to “deflate the imperial self” that Descartes’s new philosophy had established. Descartes’s suggestion at the time – that by rational reasoning we can transcend the materiality of our bodies – is the foundation of modern philosophy, and it is to this day the core of theories that claim that humans are free and autonomous. In his own time, Descartes’s suggestions were such a profound extension of traditional ideas of how human selves and their reasoning work that they naturally provoked a great deal of resistance. Such resistance is a common byproduct of any radical shift in ideas and beliefs in the history of science and the history of philosophy.

In scientific accounts of life and living things, Descartes’s mechanistic world view has brought up, ever since it came into being, conflicting positions on how to describe such phenomena as will, purpose and agency. Riskin draws our attention to a parallel but lesser-known history of science over the past 400 years, which speaks precisely to such conflicting positions: a dialectic between a brute-mechanist tradition and an active-mechanist tradition. Seventeenth-century mechanicism was indeed a powerful and ultimately dominant novel account of the world, but throughout her study, Riskin demonstrates that, since the Scientific Revolution, there have been competing forms of science – those that do assume agency or purpose in nature, and that do not outsource them to a realm that is not subject to scientific scrutiny. In many histories of science, such dialectics get lost, and retrieving them is the main goal of Riskin’s account.

In the life sciences in particular, there have been and still are a variety of modes of explaining seemingly goal-directed motion on the part of a living thing. Some can hardly be described without at least some assumption, if only metaphorically, of agency or purpose. There are also, perhaps even better-known, those notorious changes in the shape of living forms: they happen over a lifetime, such as the transformation of an egg or an embryo into a living animal, or change of living forms over generations, such as in Darwin’s theory of the transformation of species. Such theories equally inevitably commit themselves to ideas of whe-

ther there is purpose or direction in the ways that living beings change from earlier forms into later ones. In particularly impressive passages, Riskin recounts personal conversations with a scientist, in which we learn that appeals to agency in scientific accounts of living phenomena (such as a cell, a molecule, or a gene) are not allowed. And yet the scientist at the same time admitted that “biologists do it constantly, just as a manner of speaking”. They do not mean it literally. Such manners of speaking, of course, interfere heavily with the methodologies that underlie modern science and philosophy – the very methodologies that bestow credibility onto scientific knowledge. Historians, as Riskin says, generally do not believe in manners of speaking, in particular since manners of speaking are inseparable from manners of thinking, of reasoning, and of producing knowledge about the world.



The Basin of the Scribes (a device to specify the exact amount of blood taken from a patient), from al-Jazari’s *The Book of Knowledge of Ingenious Mechanical Devices* (1315)

What moves forward Riskin’s intellectual and political interventions is indeed her mobilization of history, both inside and outside the natural sciences. “History Matters” is the title of her concluding chapter. In it, she uses two comprehensive notions of history: first, history in the sense of a set of more or less chronological events in certain periods, which, specifically in the history of science, amounts to an account of change over time in the production and validity of knowledge about nature; and, second, historical ways of conceptualizing the world – that is, the ways that one positions oneself as somebody who speaks with some authority about the past and the people, institutions and natural world in it.

Riskin uses the first notion of history to point out when historians, philosophers and scientists get their history wrong. Scientific ideas may be

misrepresented in content (sometimes, not always, intentionally), or ascribed, sometimes for very specific purposes, to the wrong era or person, such as in the case of Descartes as described above: contemporaries and later philosophers ignored Descartes’s protests and ascribed to him a version of his claim (namely, that animals are machines) that he never suggested or believed in in the first place. Then there is the important desire in the modern age, in particular in the life sciences, to put up firewalls between science and other realms of society, such as religion. Scientists and philosophers often use faulty historical terms to argue for such firewalls, for example when they project their own desire onto past, often famous, scientists, assuming that they aimed, just like us in the present, to protect science from religion, when instead, past scientists were protecting religion from science, for example to ensure a monopoly on agency to a supernatural God. Another key example is the incorrect priority claim. Occasionally, scientists declare that they came up with a key theory, or a ground-breaking experimental result or engineering design, for the first time in history, and that they even beat an immediate competitor to it. Famous examples of such scientific priority disputes include that between Francis Crick, James Watson and Rosalind Franklin about the spatial structure of the DNA molecule, and the one between Isaac Newton and Leibniz about mathematical calculus. The purpose of making a priority claim, either in real time or retrospectively, and taking the risk of being historically wrong, is to create a positive self-image for one’s scientific discipline and to add visibility and sensation to one’s own (or someone else’s) research results. Making a scientific priority claim enables one to say that one does not “just” have significant scientific results, but that they are a truly pioneering feat. Cyberneticists in the early Cold War are one of Jessica Riskin’s key examples. They claimed priority for their idea and design practice of “feedback mechanisms”, which they both found in nature and built into machines. But on the basis of her study, Riskin is in a position to demonstrate that feedback mechanisms existed both in theory and in practice in antiquity already. “Not knowing history”, she says, “the cyberneticists were condemned to repeat it.”

But Riskin also uses history as a way of thinking about the world, not just as a way of getting facts about the past right. “Historical understanding is integral to scientific understanding”, she claims, as she explores discussions among biologists and philosophers about directed mutation, drawing on work by Lamarck, Darwin, August Weismann and Richard Dawkins. This concern – the lack of humanistic and historical thinking in scientists’ and philosophers’ work – bookends her study. Jessica Riskin shows us the many ways in which scholars have sought to understand those parts of the world that are material, movable and predictable, and those that are characterized by agency, passions, chance, suffering and consciousness, as well as the tricky areas where they overlap. She mobilizes powerful examples from the history of the life sciences of where and how attempts at explaining these areas have succeeded and failed. Her journey takes us everywhere in the best possible way as she probes the limits of our efforts to explain – through science and through history – how the world works inside and outside the realm of our agency, purposes and reasoning.