Chicken Soup for the Out-of-Step Scholar's Soul[*]

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Abstract

This paper argues that the long-standing predominance of a particular approach to science neither makes it uniquely scientific nor superior to rival approaches. To do so it examines the dominant scientific explanation of the 17th and early 18th centuries: the mechanical philosophy. The mechanical philosophy episode demonstrates the fragility of even the most entrenched scientific wisdoms and provides encouragement for out-of-step scholars everywhere.

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> "A school of thought is to be viewed as a single individual who talks to himself for a hundred years and is quite extraordinarily pleased with himself, however silly he may be."
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> – *Johann Wolfgang von Goethe* ([1821] 1998: 14)

1 Introduction

As any out-of-step scholar working in the discipline of economics will tell you, the peer-review process sometimes feels more like an exercise in futility for the masochistic than a process that advances economic science. Nearly every academic economist has probably felt this way at least a few times in his career.[1] But besides experiencing this sentiment much more often, the out-of-step scholar experiences the unpleasantness of an unsuccessful attempt to navigate academic peer review in a "special" way.

The peer-review process tells the unlucky, conventional economist that his paper can't be published because its instrumental variable is invalid and its formal model relies on unjustified assumptions. It tells the unlucky, out-of-step economist that his paper can't be published because it contains neither econometrics nor a formal model. The peer-review process tells the unlucky, conventional economist that his contribution's value added is too small to merit publication. It tells the unlucky, out-of-step economist that his contribution is negative value added: its publication would put economic science back several years—or several centuries. The peer-review process tells the unlucky, conventional economist that his paper has been rejected because its argument has serious flaws. It tells the unlucky, out-of-step economist that his paper has been rejected because it contains no economics.

Faced with repeated rejections of his work on these grounds, the out-of-step economist often feels hopeless. This short paper supplies a partial antidote to that sense of

[1] This is true even of those who have made some of the most important contributions to economics. See, for instance, Gans and Shepherd (1994).

hopelessness. We offer a tale of encouragement for the out-of-step scholar. That tale's moral is simple: you needn't be out-of-step, and thus subjected to the peculiar punishments our discipline's refereeing process sometimes subjects you to, forever. There may be a light at the end of your unconventional tunnel.

During the late 17th and early 18th centuries a scientific school called the mechanical philosophy reigned supreme. The core doctrine of the school was that the only valid components of a genuinely scientific explanation comprised the varying extensions, different locations in space, and particular motions of material bodies. Its adherents rejected the notion of a force acting at a distance (e.g., gravity, as Newton modeled it, or electro-magnetism, as Maxwell understood it), deeming it an "occult" style of explanation and intrinsically unscientific.

The mechanical philosophers concentrated their research on devising models that purported to capture the essentials of various physical phenomena in nets woven only from their anointed causal factors, showing little concern for whether the abstractions they constructed accurately depicted real entities and processes. When they encountered phenomena that on their surface resisted reduction to mechanical causes, the mechanists invented hypothetical mechanisms to account for them, rendering their system adaptable to otherwise ill-fitting observations or experimental results. After close to a century of enjoying a monopoly on determining what ventures were entitled to the appellation "scientific," the mechanical philosophy lost its preeminence. Today it's a nearly forgotten byway in which science dallied on its journey toward truth.[2]

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[2] Various episodes in more recent scientific history, such as Einstein explaining gravity as a curvature in space instead of as a force acting at a distance, could reasonably be viewed as a revival of the type of theory favored by the mechanical philosophy. But we aren't making any metaphysical claims about the ultimate status of mechanical explanations. Our argument is historical: the mechanical philosophy didn't provide the framework

In what follows the discerning reader will note several similarities between the mechanical philosophy, its devotees' treatment of dissident ideas, and its sway over its discipline, and the dominant approach to economics that pervades the science of economics today. The mechanical philosophy's story reminds us that what most scholars currently see as sensible needn't last forever and that once out-of-step scholars may someday cease to be so.

2 The Mechanical Philosophy

The story of the mechanical philosophy is unknown to those only familiar with the history of science presented in popular works or scientific textbooks. It's ignored because it doesn't advance the message these accounts hope to convey. Murray Rothbard (1995) called such whitewashing the "Whig history of science," though it might also be called the Voltarian or Enlightenment history of science. In the case of the mechanical philosophy, such whitewashing was inspired by the triumphant success of Newtonian mechanics in the 18th century and subsequently advanced by intellectuals eager to propagate this new natural philosophy.

According to the story these intellectuals devised, after the decline of ancient Greek civilization and the rise of Christianity, the project of understanding the world scientifically was abandoned. During the Middle Ages superstition was substituted for science.[3] Only with the work of Copernicus in the 16th century did this trend finally begin to reverse. At the beginning of the 17th century further scientific progress was spearheaded, most notably by Galileo and Kepler. This progress culminated several decades later in the system of

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needed to make progress in a number of fields and in fact stifled progress in several fields within the context of its time.

[3] See Grant (1996) against this view.

understanding the physical world Newton created. Per this account, once religion released science from its stranglehold, science surged ahead along a straight and well-marked road.

The chief obstacle to universal acceptance of this myth was that its tellers had to ignore large parts of the actual history of science to make their story work. Among these significant omissions is the tale of the mechanical philosophy, which dominated scientific theorizing during the most of the 17th and early decades of the 18th centuries. This school of thought, whose members included Descartes, Gassendi, Boyle, Hobbes, and many other notable thinkers, was widely seen as a rational advance over earlier schools of natural philosophy, primarily because it sought to banish all "occult explanations," such as forces acting at a distance or the attribution of any active qualities to matter, from acceptable scientific discourse.

Although the mechanical philosophy took on somewhat different forms in the writings of its various proponents, it can be summarized without too much distortion as being based on the "unfounded ontological reduction of the number of primary qualities to two: 'matter and motion'" (Kuhn 1952: 18). In this reduction matter was forbidden from having any active principles. Descartes, who was perhaps the foremost promoter of mechanism, succinctly stated its guiding principle: "I considered in general all the clear and distinct notions which our understanding can contain with regard to material things. And I found no others except for the notions we have of shapes, sizes and motions" (quoted in Sargent 1995: 32).

In pursuing their research program the mechanical philosophers had a notable enthusiasm for developing models that could account for any phenomenon observed in nature purely on the basis of the size, shape, and motion of particles of matter. However, they paid scant attention to determining whether or not the mechanisms posited by their models really existed. Their focus was on having *some* model that fit their paradigm available for explaining any physical process. Thus “A generic kind of corpuscularism, making use of ad hoc postulated particles invented at the whim of the natural philosopher, appears in many texts dating from the middle of the seventeenth century onwards” (Dear 2001: 100).

For instance, the most obvious explanation of magnetism is as an attractive force. But “occult” entities like attractive forces were anathema to the mechanists. To demonstrate that his system could do without such mysterious powers, Descartes devised a mechanical model of magnetic attraction in which the Earth and other magnetic bodies emit continual streams of microscopic, screw-shaped particles which, as they pass through the pores he hypothesized were present in any iron object, draw the iron towards the magnet.

Along the same lines, “In *De Corpore* [Thomas] Hobbes . . . presented a mechanical explanation of the production of cold and ice, both of which he attributed to a ‘constant wind’ that pressed upon bodies.” A liquid freezes when this wind “raises the parts of it in such a way that the uppermost parts become pressed together and thus ‘coagulated’” (Sargent 1995: 202-03). Similarly, Robert Boyle and Robert Hooke explained the relationship they discovered between the volume of a certain amount of air and the ambient pressure by “the supposition that air consists of particles like little coiled springs, like wool, which ‘consists of many slender and flexible hairs; each of which may indeed, like a little spring, be easily bent and rolled up, but will also, like a spring, be still endeavouring to stretch itself out again’” (Pyle 1995: 476).

Such models will strike those educated in modern science as absurd. But at the time they were put forward the society of respectable, mainstream scholars generally viewed them as representing the most progressive understanding of science, indicating the proper route of advance past the barriers erected by the dogmatic natural philosophy of Aristotle and his Islamic and Scholastic followers. With the benefit of hindsight it’s clear that the mechanical philosophy simply replaced Aristotelian restrictions on science with its own, perhaps even more limiting, presuppositions.

The mechanical philosophy's narrow and rigid definition of science automatically dismissed rival approaches as unscientific, stunting the growth of knowledge and derailing scientific inquiry for decades. The subject matter of physics was most amenable to mechanical explanations. However, even here, widespread commitment to strict mechanism had stifling effects in several fields. For instance, "By the end of the 17th century, the mechanical philosophy, which encouraged optics early in the century, and which furnished the idiom in which all students of optics . . . discussed the science, had become an obstacle to further progress." As a result "optics stagnated for a century" (Westfall 1977: 64).

In other sciences the supremacy of the mechanical paradigm was still more obstructive. Westfall (1977: 69) summarizes "the story of chemistry in the second half of the [17th] century [as] the story . . . of its subjection to the mechanical philosophy, since the growing role of mechanisms in chemical literature appears less to have sprung from the phenomena than to have been imposed on them by external considerations."

In lieu of striving to discover the basic, most general causal factors generating the initial appearance of irreducible diversity displayed by chemical phenomena, the mechanical chemists' efforts were chiefly expended in constructing a mechanical model to explain chemical processes constructed using purely mechanical components. "The mechanical philosophy did not in itself offer a chemical theory. On the contrary, it was potentially adaptable to almost any theory" (Westfall 1977: 71).

The mechanist preoccupation with mechanical-based model building, *per se*, was true even of leading chemists of the time, including Nicolas Lemery, the preeminent French chemist of the 17th century. "Like his fellow mechanical chemists, [Lemery] seemed possessed by a mania to explain every property and every phenomenon" in this fashion

(Westfall 1977: 73). For example, Lemery's theory of why acids often dissolve metals proposed that the particles composing an acid sport the microscopic equivalent of daggers, which skewer the smooth particles characterizing a metal and then pry the metallic particles apart from their kin. A metal could be precipitated back out of a solution by adding another substance, one whose particles move in such an agitated fashion that they break off the points of those acidic blades, thereby releasing the particles of metal from their captors.

The most prominent, and arguably best, chemist of the 17^{th} century was Robert Boyle. However, "the development of a satisfactory chemical theory as such was not Boyle's goal. Chemistry represented to him a means to demonstrate the validity of the mechanical philosophy of nature" (Westfall 1977: 77). In fact "his mechanical philosophy appears to have operated to thwart the most promising aspect of his chemistry" (Westfall 1977: 79). As Thomas Kuhn (1952: 13) notes, "the form of atomism developed by philosophers and applied to physics in the seventeenth century embraced concepts inconsistent with the development of such fundamental chemical notions as element and compound. These impediments to chemistry are manifest in the chemical theory of . . . Robert Boyle."

According to Westfall (1977: 81), "since there were no criteria by which to judge the superiority of one imagined mechanism over another, the mechanical philosophy itself dissolved into as many versions as there were chemists . . . It is difficult to see that the mechanical philosophy contributed anything to the progress of chemistry as a science." He ends his examination of the chemistry of the period by concluding that "In no area of science was the tendency to imagine invisible mechanisms carried to such extremes" (1977: 81).

The reign of the mechanical philosophy similarly hindered the growth of biological science. It's no coincidence that one of the major biological discoveries made during the period—the recognition that the heart is a pump serving to circulate blood throughout the body—was the achievement not of a mechanical philosopher, but of an animist, William

Harvey. Descartes didn't accept Harvey's breakthrough. Instead he argued that the heart is a sort of heat engine that expands the blood, forcing it to flow through the circulatory system.

The mechanical biologists emphatically rejected the possibility that anything resembling a "formative virtue" could direct the transformation of a fairly simple entity into a much more complex one. When they were confronted with the discovery of mammalian eggs under the microscope, the mechanists hypothesized that a fully formed animal was contained inside each egg. A natural extension of this theory was that, if the inhabitant of any egg were a female, then one would find her own eggs inside her. Each of these eggs held one of her fully formed offspring. If female, all these offspring bore the eggs of the generation to follow theirs, and so on. Thus it appeared quite likely "that the entire human race was present already in Eve" (Westfall 1977: 100). The most obvious alternative explanation of the discovery in question views an embryo as developing in stages of successive differentiation. However, this view suggests the operation of "occult organizing forces . . . but the mid-eighteenth century, with its strong preference for the mechanical ideas set forth by Descartes . . . was not the ideal time to propose intangible driving impulses" (Pinto-Correia 1997: 171).

Mechanistic biological theories like those described above weren't formulated based on mechanical philosophers' critical examination of biological phenomena. Before even turning their attention to the concrete realities with which the world of living creatures confronted them, they had already concluded that *only* mechanical explanations qualified as truly scientific. Consequently their theorizing revolved around figuring out how to squeeze the embarrassment of unwieldy and complex patterns exhibited by living processes into their self-limited choice of pre-formed moulds. "[Mechanistic biology] did not arise from the demands of biological study; it was far more the puppet regime set up by the mechanical philosophy's invasion" (Westfall 1977: 104).

The mechanical philosophy gradually lost its authority over matters involving scientific legitimacy during the first half of the 18^{th} century. Its decline can be attributed primarily to two factors: the increasingly apparent arbitrariness and complexity of the models it offered and the recognition of the tremendous explanatory economy of Newton's distinctly non-mechanical theory of gravity. The inequality of the contest between mechanism and Newtonianism was manifest in mechanical philosophers' attempts to develop a plausible gravitational model of their own that could compete with Newton's. This project led them to propose obviously unworkable theories in which all celestial bodies were held to be surrounded by vortices of "subtle matter," which somehow drove objects composed of grosser matter down towards the body from all directions at once.

Based largely on its founder's country of birth, Newtonianism most rapidly supplanted the mechanical philosophy in Great Britain where the former was the clear victor by the beginning of the century. In contrast, the mechanical philosophy held sway in France until roughly mid-century when Voltaire's vigorous advocacy of Newton's system finally overcame the clout of the country's native son, Descartes. Thus it took time for Newton's theory to gradually gain acceptance outside his homeland and permeate the scientific attitudes of those in surrounding areas.

Importantly, during this shift in the dominant scientific paradigm, science sometimes moved forward by going "backward" to concepts the mechanical philosophers had previously rejected as unscientific. For instance, Newton's theory of gravity implied that one material body was somehow able to affect another one without the pair having any direct physical contact. On publishing his ideas, the Cartesians widely derided Newton for forwarding "manifest stupidity" (Pinto-Correia 1997: 171). Mainstream scholars saw his theory as a regression into murky and unintelligible terrain haunted by the "occult forces" Renaissance naturalism posited.

Newton frankly claimed the very reversion to antique theories his critics held against him as a virtue. He attributed his success in advancing mathematics to having launched his explorations from a careful study of the ancient Greek geometers. Newton rejected the idea that his advances proceeded from the contemporary ideas of Cartesian analytical geometry, which he described as “the Analysis of the Bunglers in Mathematicks” (Westfall 1980: 379-80).

Furthermore, several unconventional theories proposed during the reign of the mechanical philosophy, theories then rejected as unworthy of serious consideration by the scientific mainstream, were eventually resuscitated in the wake of the mechanical philosophy’s demise. Consider, again, Newton. Newton’s conjecture that all material bodies are composed of only a very few elementary particles, and that what appear to be chemical elements are really compounds of those building blocks, and, therefore, could be transformed into each other, was seen as an unsightly blemish on his great career for two centuries.

However, as Pyle (1995: 433) notes, “This criticism seems unfair and unwarranted. In the first place, the Newtonian matter-theory is remarkably close to what we now believe to be the truth. Chemical species do only arise at a ‘molecular’ level, i.e. as a result of the aggregation of simpler (and chemical neutral) constituents. The chemical atom of Dalton is a highly complex structure, made up of neutrons, protons, electrons, etc., held together by powerful interparticulate forces of various kinds. The transmutation of the so-called ‘chemical elements’ is physically possible although, as Newton foresaw, highly difficult owing to the strength of those forces.”

3 Concluding Remarks

The tale of the mechanical philosophy should provide some comfort to out-of-step economists who confront the challenges this paper began with. This tale demonstrates the fragility of even the most entrenched scientific "wisdoms" and suggests that once-derided approaches to understanding the world can come to displace currently fashionable approaches even when such displacement appears impossible.

However, the process that can lead to such displacement isn't inevitable. It requires out-of-step scholars to continue their out-of-step work. Unconventional researchers mustn't placidly drift with the prevalent scientific tide like so many jellyfish bobbing in the waves. If Newton had taken this attitude, we might still be stuck with the mechanical philosophy. The greatest scientists have often been the ones who had the courage to swim against the current of their time. There's no reason to think economics is an exception in this regard.

Two lessons from the rise and decline of the mechanical philosophy are especially important for out-of-step scholars to keep in mind as they search for energy to continue being out-of-step. First, it's not the case that a real science must forget its forefathers. Sometimes the impetus needed to surmount some barrier blocking progress can be provided by the ideas of a long-dead thinker. This was partly the case with Newton, whose ideas finally triumphed over the mechanical philosophy, and could very well be the case in economics as well.

Under the weight of popular scientific preconceptions in the economics profession, the field of history of economic thought is quickly dying. Only a rapidly shrinking number of departments offer courses in the subject. There are only a handful of jobs available in history of thought each year. And the field is generally looked down on by the rest of the economics profession. This is unfortunate. But those who have retained their interest—a group in economics whose membership overlaps significantly with those seen as out-of-step more generally—should forge ahead, as they may be in the best position to contribute to the advance of economic knowledge in the long run.

Second, and perhaps most important, it's not the case that science always makes steady progress. Science sometimes enters cul-de-sacs that it must eventually back out of in order to move forward again. Although the mechanical philosophers' monopoly on science stunted advances in knowledge, it was ultimately dislodged and, free from its fetters, science again was able to progress. If out-of-step scholars are willing to continue their work, there's no reason to that this couldn't also happen in economics, no matter how dim the chances appear at present.

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