

Engels's Philosophy of Science

Introduction

Neither Marx nor Engels wrote what we would call "philosophy of science." If we want to construct one, we must be anachronistic, since "philosophy of science" is a very recent invention. Their situation and, accordingly, their problems are not ours. Still, the effort is required since their socialism--in explicit contrast to all others-- was called by them "scientific." Moreover, for historically pertinent reasons, it was Engels's later writings which both contain Engel's efforts at articulating what I am calling his philosophy of science, and, of even greater importance it was just these views which laid the foundation for dialectical materialism, the "official" philosophy of 20th century Marxism-Leninism.

It can hardly be doubted that "dialectical materialism" has been one of the most influential general philosophies of the twentieth century. In terms of sheer numbers, no philosophy has ever counted as many adherents. It became, of course, the philosophy of the Soviet Union and was a critical part of the education of all Soviet citizens. After the Second World War, it became also the official philosophy of much of Eastern Europe and then, as part of Maoist philosophy, was the basis of education in China. For example, the distinction between "metaphysics" and "dialectics," still in common use in the former Soviet Union and in China appeared first in Engels.

I believe that one would have to ignore most of what Marx wrote to try to make a case that Marx was a "dialectical materialist" as that has come to be understood (Carver, 1983), and I believe also that the philosophy of science which can be constructed from what Marx had to say (Sayers, 1979), including what was not intended for publication by him, differs significantly from the one which I construct from Engels's texts. I do not in what follows attempt to make such a case.

The Immediate Background

Marx was, of course, deeply immersed in the fundamental problems of philosophy, but in a well-known text, he insisted that the demands of "the critical critics" could be realized only by "the negation of philosophy as philosophy" (Easton and Guddat, 1967: 256). By the 1850s, Marx and Engels turned to other matters. It was easy for later thinkers to believe that having "settled accounts" with "the German ideology," Marx and Engels would thereafter do "science." But two problems went unnoticed, problems which by the 1870s had become very clear to Engels.

First, they had not escaped *having* an epistemology and ontology. Engels, of all people, knew that this was quite impossible. "Natural scientists believe that they free themselves from philosophy by ignoring or abusing it," he wrote. "They cannot, however, make any headway without thought, and for thought they need determinations." Taking these unreflectively from common sense or from the "little bit of philosophy compulsorily listened to at the University, or "from uncritical and unsystematic readings," they are "no less in bondage;" indeed, they are held in bondage to the "worse vulgarized relics of the worst philosophers" (*Dialectics*, 209-210). Sadly, as I have tried to show elsewhere (Manicas, 1987), this remains true, especially of too much of what is written--and done--by otherwise highly sophisticated social scientists.

Second, there were a host of pressing questions generated by the claims from the *Communist Manifesto* on, that their socialism was scientific. Unfortunately, the very idea of science was still very much contested. Not only could competing conceptions make their own case, but a "scientific socialism" could be--and is--subject to some profoundly different understandings. Engels tried to meet the challenge and to clarify their position. Whether he did this well or badly

is of some importance. "Scientific socialism" owes much to Engels.

Like all of us, Engels was time-bound; but he was neither philosophically unsophisticated nor ignorant either of the science of his day or of the debates about the science of his day. To carry out his project of clarification Engels studied current science. He tells us that he "went through as complete as possible a `moulting'...in mathematics and the natural sciences, and spent the best part of eight years on it." The inquiry was hardly without its presuppositions. Engels was clear on this. Having already arrived "a conception of nature which is dialectical and at the same time materialist," he needed

to convince [himself] in detail...that the amid the welter of innumerable changes taking place in nature, the same dialectical laws of motion are in operation as those which in history govern the apparent fortuitousness of events (*Anti-Duhring*, 16).

The direct motivation for Engels's belated efforts to answer these questions was attacks on Marx and Engels by socialists who were materialists, committed, like Engels, to the idea that "science" was the only way to truth (Carver, 1983, Chapter 5). Engels's first response was *Herr Eugen Duhring's Revolution in Science* (1877/78), first published in *Vorwärts* and then as a book. Three chapters then also became the widely circulated, *Socialism: Utopian and Scientific* (1880, English, 1892 with a new Introduction by Engels). In *Ludwig Feuerbach and the Outcome of Classical German Philosophy* (published in 1886 in *Die Neue Zeit* and then as a book in 1888), Engels returned to older issues regarding the relation of their philosophy both to Feuerbachian materialism and the "old materialism" of Karl Vogt, Jacob Moleschott and Ludwig Buchner (Gregory, 1977). Engels worked on the materials to be found his *Dialectics of Nature* between 1873 and 1886, but the incomplete text we have was not published until 1927. It is the last of Engels's belated efforts to set out a "dialectical" view of science. But before turning to Engel's responses to the challenges, it will be helpful, perhaps essential to set the philosophical context of this response.

What is Philosophy of Science?

What we think of as "philosophy of science" is a very recent invention, dating only from the 1950s. The idea of science, at that time, was quite unproblematic--even if as I would insist, it should not have been. Assuming then that everyone knew what science was, philosophy of science could, it was assumed, provide a "rational reconstruction," showing in detail both its "logic" and the ground of its claims to truth. It was conceived, accordingly, as a part of analytic epistemology.

It could offer a clear account of scientific terms and of theory, of scientific explanation and of how scientific propositions are warranted. Given such a "rational reconstruction," it could then address unresolved questions, for example, regarding the unity of the sciences or the "reduction" of theory, and it could offer normative advice regarding successful scientific practice. It could show, for example, how cognitive meaning was given to theoretical terms in a scientific vocabulary.

Philosophy of science in the present century is, of course, dominated by writers we think of a "logical empiricist," even though there was room in the argument for differences, e.g., whether the appropriate logic for science aimed at confirmation or falsification, whether "instrumentalist" or "realist" interpretations of theory were preferred (or perhaps, as Nagel insisted, there was no real difference on this score) and whether and how science could be "unified."

In speaking then of Engels's philosophy of science, we need to notice that, first, there is very little in his writings that even looks vaguely like philosophy of science in this sense. As we noted (but cannot be overstated), at the time that he was writing, the idea of science was not settled. "Science" (*episteme, scientia, Wissenschaft*) still very much carried its older sense: The use of reason and observation to find knowledge. Moreover, such knowledge could be of God as well as of Man and Nature. As Benton (1979, 108) has said, Engels did reflect on the epistemology and methods of science, but he shared with many of his contemporaries in offering "a general account of the nature and structure of the world, its interconnexions and forms of motion, as well as a conception of the place of the human species in that world--its origins and prospects." There is, thus, no oddity in seeing that much of the argument was between idealists and materialists--what may seem for us, wrongly in my view, very much dated metaphysical concerns.

But we need to notice, second, that logical empiricist philosophers of science have a general metaphysics or philosophy of nature, even if it was thought otherwise. For example, a presupposition of the analytic/synthetic distinction, as that became received dogma, was that there was no necessity in the world. Engels insisted that this could not be true. Of course, the logical empiricist project began to unwind just as it became a standard subdiscipline of philosophy. Today, at least among philosophers, all of its main propositions have been challenged. Moreover, we are today much less comfortable that we even know what science is. Like it or not, we may still be concerned with the questions that concerned Engels. There may be, accordingly, lessons still to be learned.

Materialism, Idealism and Positivism

Three views prevailed in philosophy in the middle of the 19th century: idealism, materialism and positivism. But bad textbooks have contributed to considerable confusion over all three. If we are to locate Engels's philosophy of science properly both in terms of its historical place and as regards contemporary debate, it will pay us to get as straight as possible on all three (Mandelbaum, 1971).

Positivism

August Comte, the philosopher who coined the term, "positivism" (and "sociology") gave us also an adequate characterization of positivism. Its key, if not defining feature, is this: The positivist rejects metaphysics, understood as inquiry into existences which go "beyond" experience. For Comte, metaphysics was the near relative of theology in that "the mind supposes, instead of supernatural beings, abstract forces, veritable entities...inherent in all beings and capable of producing all phenomena." The positivist, by contrast, has "given over the vain search after Absolute notions, the origin and destination of the universe, and the causes of phenomena." Comte, influenced by Kant, had no interest in explaining the subjectively phenomenal. Moreover, once Hume's notion of causality became widely taken for granted, positivists too could search for causes, except that they would now be construed as "invariant relations." Comte is not rejecting causes as empirically knowable constant conjunctions. He is rejecting the idea of causes as productive powers which have witnessable effects, both as regards the relation of noumenal "objects" and as regards nonempirical "forces."

We should emphasize that the doctrine just defined might equally be termed "empiricist,"

owing as it does to the British empirical tradition which takes a decisive turn with Berkeley's critique of matter and includes Kant who, once awakened from his dogmatic slumber by Hume, sought to find a firm basis for the new science.

There are, of course, enormous differences between philosophies of science which are rooted in British empiricism and those which are rooted in Kant, even if by the end of the 19th century, points of critical potential difference, whether, e.g., causality is to be understood as an a priori category of mind or as a psychological propensity, tended to be less critical. But as regards the present problem, they are in total agreement. As Lenin (1970, 88) rightly noted, "they both *in principle fence off* the 'appearance' from that which appears, the perception from that is which perceived, the thing-for-us from the 'thing-in-itself.'" Of course, it was true, as Lenin further notes, that "Hume does not want to hear of the 'thing-in-itself', he regards the very thought of it as 'metaphysics' (as the Humeans and Kantians call it); while Kant grants the existence of the 'thing-in-itself', but declares it to be unknowable', fundamentally different from the appearance, belong to a fundamentally different realm, the realm of the 'beyond' (*Jenseits*), in accessible to knowledge but revealed to faith" (1970, 88). On the present definition, positivists restrict scientific knowledge to the phenomenal or empirical and for purposes of science, they put aside metaphysical questions about the "ultimate" character of "the external world."

The Humean critique of causality relates to a second feature of positivism/empiricism. If explanation cannot proceed from principles that go beyond those directly derived from observation, what counts as a scientific explanation? For the positivist, as Comte insisted, "what is now understood when we speak of an explanation of facts is simply the establishment of a connection between single phenomena and some general facts." This is, of course, what we now call "the covering law model of explanation." Science aims, accordingly, to establish "general laws." Positivists gave this idea a definite and clear sense: "general laws" were "invariable relations of succession and resemblance." While the constraint that such relations be invariable raised enormous problems, it was taken for granted that general laws were empirical: whenever this, then that. The difficulty, recognized, for example, by J.S. Mill, was how to distinguish "empirical laws" understood by him, rightly, to lack any sort of necessity and "ultimate laws" which give us license to infer from the past to the future. Contemporary empiricist philosophers continue to struggle with understanding why only some regularities support counter-factual conditionals, often thought to be the test of a general law.

We might note in passing that late nineteenth positivists, e.g., Mach and Duhem, held that science does not even try to explain; it only describes. Writing in 1906, Pierre Duhem offers, e.g., that "to explain...is to strip reality of the appearances covering it like a veil, in order to see bare reality itself," but this is metaphysics. For him, "A physical theory is not an explanation. It is a system of mathematical propositions deduced from a small number of mathematical principles, which aim to represent as simply, as completely, and as exactly as possible a set of experimental laws" (Duhem, 7, 19).

Putting aside the enormous sophistication produced by logical empiricist philosophers in this century (drawing on late 19th century arguments by Mach, Hertz, Poincare and others), and putting aside differences between them, we can say with some assurance that mainstream, taken-for-granted logical empiricist philosophy of science is positivist in the sense defined by Comte. Engels's relation to positivism will require discussion.

Materialism

What then of materialism? First, there is the question of whether materialism is a metaphysical position. Some have denied this; but these writers have tended to conflate positivism and materialism, despite explicit disavowals of materialism by positivists, beginning with Comte but including Herbert Spencer, Thomas Henry Huxley, Ernst Mach, and in recent philosophy, Rudolf Carnap.

It is true that materialists and positivists share in holding that theological propositions have no place in science. But they do this for very different reasons: the materialist for ontological (metaphysical) reasons: there are, for them, no non-material beings, the positivist because he rejects metaphysics as scientifically irrelevant. Positivists can be agnostics, theists or atheists; they can be empirical realists or phenomenologists and they can follow either Hume or Kant as regards their epistemology. In any case, they need not assume that "reality" is "material," or better, that the independent existence of "matter" assures the existence of a world independent of "mind." We need a definition that allows for a positivist rejection of metaphysics but one which is broad enough to include all sorts of materialists. Mandelbaum writes,

Taken in its broadest sense, materialism is only committed to holding that the nature of that which is self-existent is material in character, there being no entities which exist independently of matter. Thus, in this sense, we would class as materialist anyone who accepts all of the following propositions: that there is an independently existing world; that human beings, like all other objects, are material entities; that the human mind does not exist as an entity distinct from the human body; and that there is no God (nor any other non-human being) whose mode of existence is not that of material entities (1971, 22).

In this sense, materialists are all atheists (but may be pantheists or secular humanists) and they are metaphysical realists, however much they may differ as regards questions of how the independently existing world is known and how mind is to be accounted for. Idealists, then, deny a self-existent material reality. Neo-Kantian and Hegelian versions, of course, have been the historically most important versions of idealism.

Marx and Engels rejected idealism for materialism. So too did Feuerbach, Dühring, Buchner, Moleschott and Vogt. Mandelbaum says that, strictly speaking, Feuerbach was not a materialist since on his reading, Feuerbach rejected metaphysics for "anthropology." Since Feuerbach explicitly rejected idealism and theism and since both Marx and Engels understood him to be a materialist, we should include him under our broad definition. Feuerbach's views, like John Dewey's and perhaps also Marx's, fit, though not neatly, into the three-part scheme. That is, one might prefer to offer a fourth category, e.g., naturalism or humanism. Marx was explicit, of course, in arguing that there was truth in both idealism and materialism and that his view, naturalism or humanism, was a resolution of this. I see nothing like this in Engels. A main problem is to see just where Engels departs from these other "materialists." But we need first to see what Engels stands on positivism.

Engels and Positivism

Engels never directly confronted positivism. Although in both the *Feuerbach* and the *Anti-Dühring*, Engels ranges widely across pertinent philosophical issues, he never mentions Comte or

positivist philosophy. Comte is mentioned twice in the *Dialectics of Nature*, in his outline and then in a fragment on the question of the classification of sciences. He notes there that this classification was "copied from Saint Simon" (*Dialectics*, 250). Among the natural philosophers, Helmholtz is treated most prominently (as we shall see) but no mention is made of Kirchoff, Ostwald, or Mach, all of whom promoted positivist versions of science (Passmore, 1966). Their main contributions come slightly after Engels had completed his "moult" and this may explain their absence.

Indeed, for Engels, there are but "two great camps:" idealists and materialists. "Those who asserted the primacy of spirit to nature and, therefore, in the last instance, assumed world creation in some form...comprised the camp of idealism. The others, who regarded nature as primary, belong to the various schools of materialism" (*Feuerbach*, 31). For him, "the great basic question of all philosophy, especially of modern philosophy, is that concerning the relation of thinking to being" (30). Engels says that this question has two sides: one is distinctly metaphysical in precisely Comte's sense. It engages in what, for Comte is a "vain search" for "absolute notions." For example: "Did god create the world or has the world been in existence eternally." It seems clear enough for Engels this question was not only intelligible, but forced: One had to be either an idealist or a materialist.

Engels's dichotomy was Lenin's point of departure against the Machists, surely the most important of the late 19th century positivists. In his important (and too little studied) *Materialism and Empirio-criticism* (1908), Lenin defended Engels's materialism against those "bold warriors, who proudly allude to the 'modern theory of knowledge', 'recent philosophy' (or 'recent positivism'), the 'philosophy of the natural sciences' or even more boldly, 'the philosophy of natural science of the twentieth century'" (*Empirio-criticism*, 7). For Lenin, these views, for all their arrogant claims to have settled matters as regards science, were all idealist. Indeed, they were unsophisticated, even incoherent idealisms to boot. The ground for Lenin's conclusion had, of course, been given by Engels's "two great camps" dichotomy.

The "other side" to his "great basic question" is this: "What relation do our thoughts about the world surrounding us stand to this world itself? Is our thinking capable of the cognition of the real world" (*Feuerbach*, 31). This problem was an old one in philosophy, as in ancient skepticism, but as Engels recognized, by the time that he was writing, it had definitely taken the form of what Rorty (1979, 139-140) has usefully called, "veil of ideas" skepticism--"the problem of getting from inner space to outer space--the 'problem of the external world' which became paradigmatic for modern philosophy."

Idealists have no difficulty with an answer since, as Engels summarizes things, "what we perceive in the real world is precisely its thought-content--that which makes the world a gradual realization of the absolute idea has existed somewhere from eternity, independent of the world and before the world" (32). Engels here offers that this answer, at best, is trivial. No one would deny that "thought can know a content which is from the outset a thought-content" but that "what is here to be proved is already tacitly contained in the presupposition," a consequence of what Ralph Barton Perry was later to term "the ego-centric predicament." But having bought into the problem--at least so it seems, he does not here give a materialist answer to the question which he has raised.

It is fair to say, I think, that Engels foundered badly on this question. Most of his remarks are fragmentary and unclear at best. In a letter to Conrad Schmidt, written in 1895, he gave what is

perhaps the clearest statement of his position:

The identity of thought and being, to express myself in Hegelian fashion, everywhere coincides with your example of the circle and the polygon...the concept of a thing and its reality run side by side like two asymptotes always approaching each other yet never meeting. But although a concept has the essential nature of a concept and cannot therefore *prima facie* directly coincide with reality, from which it must first be abstracted, it is still more than fiction, unless you are going to declare all the results of thought fictions because reality has a long way to go round before it corresponds to them, and then only...with asymptotic approximation (1942, 527).

Engels surely assumes reality is whatever it is, quite independently of our cognition of it and that knowledge must "mirror" it. Moreover, he seems not in the least concerned with developing Marx's powerful suggestions in the *Theses on Feuerbach*, well summarized by Avineri: For Marx, "getting acquainted with reality constitutes shaping and changing it. Epistemology ceases to be a merely reflective theory of cognition, and becomes the vehicle for shaping and moulding reality (1968, 68). Engels's concern with Feuerbach, unlike Marx's, is not as much Feuerbachian epistemology as his views of religion and morality. These need not be pursued here.

Engels well recognized, however, that positivist (including Kantian) epistemologies had to be rejected. Thus, he could *not* have said with some of the positivists, e.g., Duhem, that our concepts and ideas are *convenient* fictions, useful in prediction and control--and that is the end of the matter. Nor, in Kantian fashion, could he have said that by virtue of the *a priori* forms of intuition, empirically real spatio-temporal objects exist *only* in our representations of them.

Engels and "the Agnostics"

Kant's transcendental idealism did undercut skepticism regarding the empirical world; but it did this at price that Engels could not pay. Kant had affirmed that there are existences which were not empirically real and that these were causally implicated in our experience: But as noumenal, they were unknowable things-in-themselves. Indeed, his transcendental skepticism, as Westphal (1997, 3) argues, was "an integral part of Kant's aim `to deny knowledge in order to make room for faith,' where this `faith' in fact amounts to practical knowledge of the reality of freedom and God."

That Engels had little patience with "agnostics" is clear in the remainder of the argument in the *Feuerbach*. After suggesting that idealists trade fallaciously on the truism that whatever is known is known in terms of concepts and ideas, he considers Hume and Kant as two "who question the possibility of any cognition (or at least an exhaustive cognition) of the world" (32).

Engels seems to hold (with Hegel) that a theory of knowledge must guarantee, at least ideally, an exhaustive cognition of the world and he seems confident that the (positivist, "agnostic") posture has already been refuted. He asserts first that "what is decisive in the refutation of this view has already been said by Hegel--in so far as this was possible from an idealist standpoint" (*Feuerbach*, 32). He does not say what Hegel said to refute this, but there is a footnote provided by the Soviet editor of the text, L. Rudas, which calls our attention to a text in Engels's *Historical Materialism*.

Versus the "the agnostic" view of Kant and Hume, that "it is possible that we can correctly perceive the properties of a thing but are not able to grasp the thing itself by any sense or thought process," Engels had argued:

To this Hegel has replied long ago; if you know all the qualities of a thing, you know the thing itself; nothing remains then but the fact that the said thing exists outside of us, and as soon as your senses have taught you this fact, you have grasped the last remnant of this thing, Kant's celebrated unknowable thing-in-itself (*Feuerbach*, 32).

This is hardly an adequate summary of Hegel's refutation. It seems to capitulate to the ego-centric predicament in that whatever is known is experienced and to merely ignore Kant's main point. On the other hand, if some recent scholarship is correct (Inwood, 1987), Hegel's own tendency "is to dismiss Kant's views without explanation" (Sedgwick, 1993). Still, as Viren Murthy reminds me, a great deal is at stake.

Hegel had undermined Kantian dualism, of course, but at a price. Whether one terms this an "objective idealism" or an idealism in "a thoroughlygoingly new sense of the word," can not be argued here (Findlay, 1966; Westphal, 1988; Phippen, 1989, 1993; Sedgwick, 1993). Similarly, but quite impossible to develop here would be the effort to see precisely what features of Hegel's systematic philosophy Engels appropriated and here assumes. We would need to begin, likely, with Hegel's analysis of "the Matter of Fact," "The Thing," "Properties," "The Law of Phenomena," and the notion of "A Force and its Manifestation." All of this of course is included--but is also obscured--by saying that Marx and Engels found it necessary to stand Hegel on his head. Indeed, if Engels read Hegel in the way that Kenneth Westphal reads Hegel, Engels's appropriation was more in way of a reconceptualization than a turning upside down. Westphal insists, rightly I think, that Hegel's main objection to Kant was his transcendental skepticism. Hegel offered instead an idealism which was an epistemological realism:

Hegel's brand of idealism is a kind of ontological holism according to which all parts of the world are fundamentally interrelated, where these interrelations are fundamentally conceptual relations. On his view, concepts are, in the first place, structures in the world. Only on this basis do concepts become, the second place, conceptions in our language and in our heads as well (1989: 142).

And Sedgwick (1993) constructs an anti-Kantian, Hegelian line of argument that could easily have appealed to Engels. She writes:

A proper appreciation of the role of the 'I think' yields the conclusion that we have no cognitive access to an extra-conceptual content. From the fact that we have no access to an extra-conceptual content it follows that we cannot invoke that content as evidence that there are limits to what we can know, or as evidence that we know is 'mere appearance.' We have therefore no grounds for restricting the objectivity of our concepts to an objectivity that is merely 'for us' and not also attributable to things themselves. Since for Hegel there are no intuitions which are not for us conceptualized intuitions, there can be no appeal outside the determinations of thought to secure the objectivity of the concept. The

objectivity of a concept is a function not its being 'anchored' in empirical intuition, but of its relation to other concepts in the system of a priori thought-forms (1993, p. 283).

It is easy to show, I think, that Engels's did agree with Hegel that "all parts of the world are fundamentally related." But why hold that the relations were "fundamentally conceptual," still less, that they were knowable a priori? On "materialist" grounds, the world was self-subsisting and the system of "thought-forms" could then be merely a "reflection" of the "dialectically" constituted material reality? I return to this.

Materialism and Transcendental Realism

Further insight into Engels's "realism," is provided by his second line of argument against the unknowable thing-in-itself. Engels writes:

the most telling refutation of this as of all other philosophical fancies is practice, experiment and industry. If we are able to prove the correctness of our conception of a natural process by making it ourselves, bringing it into being out of its conditions and using it for our purposes into the bargain, then there is an end of the Kantian incomprehensible "thing-in-itself." The chemical substances produced in the bodies of plants and animals remained such "things-in-themselves" until organic chemistry began to produce them one after another, whereupon the "thing-in-itself" became a thing for us... (*Feuerbach*, 33).

Engels insists that, given their "theoretical and practical refutation," by Hegel and then by the achievements of recent science, the efforts of Neo-Kantians in Germany and Humeans in England are "scientifically a regression and practically merely a shamefaced way of surreptitiously accepting materialism while denying it before the world" (*ibid.*).

Engels holds that science has itself established some form of materialism. His appeal to practice in support of this suggests another line of argument. We have empirical knowledge of the properties of the "things" of experience, but we have more than this. Versus Kant, we now also have knowledge of what underlies and produces these properties. Science has generated and tested theories about heretofore unwitnessable causal mechanisms. To take Engels's example, in molecular chemistry, given our theory, we are able to identify alizarin as $C_{14}H_6O_2(OH)_2$, the compound which produces a distinctive red color. Knowing exactly what it was, gave us the capacity also to produce it synthetically from coal tar.

We can, perhaps, get clearer on this critical issue by considering what had been a problem since Newton, the status of "forces" in nature. Put briefly, because Newton was with those who, "rejecting substantial forms and occult qualities, have endeavored to subject the phenomena of nature to the laws of mathematics," he famously declared *hypothesis non fingo*--after it had been charged that his notion of universal gravitation had reintroduced "occult qualities." In his second letter to Bentley, Newton wrote:

You sometimes speak of Gravity as essential and inherent to matter. Pray do not ascribe this notion to me; for the Cause of Gravity is what I do not pretend to know, and therefore would take more time to consider it (Quoted by Harré, 1964, 107).

Looking for the "Cause of Gravity" is precisely what Comte would have called "the vain search" for "absolute notions." While Newton offered a number of highly speculative though mechanical accounts of the mechanism of gravitation, he was never satisfied with his efforts. Many writers, including as we shall notice Engels, were led to conclude that even if Newton allowed for the existence of non-observables, e.g., atoms, he was positivist in disclaiming appeal to unobservable "forces." Indeed, the problem reappears in a number of places in Engels's writings.

He argues, rightly I think, that "the notion of force is derived from the activity of the human organism within its environment." Because our actions can give motions "a predetermined direction and extent," "the idea of *causality* becomes established." He assents that "the empiricism of observation alone can never adequately prove necessity. *Post hoc* but not *propter hoc*" (*Dialectics*, 228). And, "Hume's scepticism was correct in saying that a regular *post hoc* can never establish a *propter hoc*. But the activity of human beings *forms the test* of causality" (*Ibid.* 230). Although it is hardly clear, Engels would seem to assent to the idea that causes are productive powers in *some* sense (Harré and Madden, 1975). But if this is so far innocent,

in order to save having to give the real cause of a change brought about by a function of our organism, we substitute a fictitious cause, a so-called force corresponding to the change, then we carry this convenient method over to the external world also, and so invent as many forces as they are diverse phenomena (*Dialectics*, p. 80).

This looks very positivist. Instead of appealing to a force, we should identify the "general laws" governing phenomena: the conditions which are invariantly associated with the outcome. This view, expressed by Comte, had been articulated by Berkeley in his critique of matter. For Berkeley "the set of rules, of established methods, wherein the Mind we depend on excites in us the idea of Sense, are called the *laws of nature*; and these we learn by experience..." (*Principles*, pt. 1, XXX). In terms very reminiscent of Berkeley, Engels writes:

When we know how much mechanical motion a definite quantity of heat motion is converted, we still do not know anything of the nature of heat...To conceive heat as a form of motion is the latest advance of physics, and by so doing the category of force is sublated to it (*Dialectics*, 281).

And earlier,

In mechanics, the causes of motion are taken as given and their origin is disregarded only their effects being taken into account (86).

That is, it seems that once one has the "general laws," there is no need to search for metaphysical causes.

But an alternative interpretation is possible. Again, Engels holds that Hegel was on the right track. But instead of pursuing his very fragmentary reference, it will be better to pursue this problem by considering Engels's criticism of Helmholtz.

Saying that a force explains some outcome adds nothing. Indeed,

with just as much right as Helmholtz explains physical phenomena from so-called refractive force, electrical force of contact, etc., the mediaeval scholastics explained temperature changes by means of *vis calorifica* and a *vis frigifaciens* and thus saved themselves all further investigation of heat phenomena (*Dialectics*, 82).

Again, it might appear that Engels is taking a rather straightforward positivist line here. But I think that this is not the case. His point rather is that inquiry has been prematurely foreclosed. On this view, which surely would be endorsed by Helmholtz, the problem was to identify the causal mechanisms, named by the "force," witnessable or not, which would explain the outcome. "Refractive force" is then a promissory note for a mechanism yet to be fully theorized and confirmed. Thus, according to Engels, by acknowledging that forces name ""objectified natural laws," "the conditions for which are still rather complicated," Helmholtz should also see that the appeal to forces as explanations is not a vindication of our knowledge, but is a sign of "our lack of knowledge of the nature of the law and its mode of action" (*ibid.*).

Some of these "conditions" may be directly known; others will have to be inferred. Thus, "atoms and molecules cannot be observed under a microscope, but only by the process of thought" (*Dialectics*, 205).

One way to go is to hold that the problem of going from what is in experience to what is not in experience is not philosophical but scientific. That is, we reject transcendental skepticism and give scientific reasons for the inference from what is known (in experience) to what is unknown (not in experience but nonetheless knowable). Although the problem needs to be developed in considering further Engels's materialism, we can note here that on this view, there need be no commitment to an unknowable substratum, matter. For example, the mechanical theory of heat, he says, is "a hypothesis," "inasmuch as no one has up to now seen a molecule, not to mention one in vibration" (*Dühring*, p. 76). That "vibrating molecules" were not "seen," however, was not a reason to eliminate them from playing explanatory roles. Indeed, in a fragment in the *Dialectics of Nature*, Engels refers to Newton as an "inductive ass" (205). I think that the Soviet editor guesses correctly that this regards Newton's *hypothesis non fingo* which Engels likely did see as an unwarranted restriction on scientific explanation. This suggests that Engels gave a positivist reading of Newton from an anti-positivist point of view.

On this interpretation, Engels (like Helmholtz) assumes a realism of the sort more recently defended by so-called "critical realists" (Bhaskar, 1975; Harre, 1987). While there are points of difference, these writers accept the idea that a valid scientific explanation can appeal to what is, in principle, a non-observable causal mechanism which *produces* empirical outcomes.

Since the issues continue to haunt philosophy of science (and general epistemology), we might here consider another alternative to the problem of experience and reality, implicitly rejected by Engels and explicitly rejected by Lenin who assumed that he was elaborating the views of Engels. They are the views of Engels's approximate contemporary, Herman Helmholtz.

Engels understood Helmholtz to be neo-Kantian and this was correct. But was he also inconsistently a materialist, as Lenin argued (*Empirio-criticism*, 220)? Because Helmholtz insisted that "our concepts and ideas are effects wrought upon our nervous system and our consciousness by the objects that are perceived and apprehended," Lenin held that he was a materialist. Helmholtz had written: "the word *Ursache* (which I use here precisely and literally)

means that *existent something which lies hidden behind the changes we perceive*. It is the hidden but continuously existent basis of phenomena" (1971, p. 521). The question is: What is the character of this "existent something"? Lenin assumed, presumptuously, that it must be material.

For Helmholtz, there are objects "outside" of us, and perception will be explained physiologically. But: "none of our sensations give us anything more than signs for external objects...and we learn how to interpret these signs only through experience and practice" (1971, p. 196). Our perceptions are mediated, but "representations" of the world "out there."

Lenin seems to have supposed that this was a Kantian move and depending on how one reads Kant, it might well be. It is clear, in any case, that for Helmholtz there was a structured independently existing world and that trial and error learning gives us knowledge of it. Whether this could be termed Kantian (or neo-Kantian) again depends on how one reads Kant (Westphal, 1997; Allison, 1981, 1989).

But however this may be, why did Lenin reject this approach? What bothered Lenin (Engels is silent on this) was the idea that experience was a 'sign' and *not* an 'image' or 'reflection' of the independently existing external world. Lenin is clear that:

if sensations are not images of things, but only signs or symbols which have "no resemblance" to them, then Helmholtz's initial materialist premise is undermined; the existence of external objects becomes subject to doubt; for signs or symbols may quite possibly indicate imaginary objects, and everybody is familiar with instances of such signs or symbols (*Empirio-criticism*, 222).

Lenin is uncomfortable with Kantian transcendental doubt. The question of what exists independently of us is open. But it is more open than Lenin seems to realize. Lenin seems not to notice that such doubt surely does make possible a transcendental idealism--Kant's preferred position. As noted, contrary to Lenin, Kant did not withhold causal powers from the thing-in-itself.

But Helmholtz was adamantly realist. Lenin quotes him: "the realist hypothesis is the simplest we can construct; it has been tested and verified in an extremely broad field of application" (*Empirio-criticism*, 222). This surely sounds much like the Engels approach which we discussed in the foregoing. It left Lenin unsatisfied. One can only wonder why? Probably what bothered Lenin was that this was a representational theory of perception in the sense that because we see, e.g., a red apple, it doesn't follow that there are red apples "out there." On the Helmholtzian view, there is an object in real space and time, describable in terms of physics and chemistry, and, as a function of our optical and central nervous system, we see this object *as* a red apple. Unlike Hegel, but like Engels, Lenin was trapped in the mirror metaphor. Like Engels, he wanted a "reflection," a correspondence of concept and reality.

Of course, we can only speculate, finally, as to why both Engels and Lenin were unimpressed with this sort of transcendental realist answer to the problem they had struggled with. Quite probably, Engels's view that Hegel had already solved the problem was sufficient to prevent him from pursuing this sort of line. But whether Hegel's solution was available to his materialism still needs to be considered.

Versus "Old Materialism"

Engels rejected "the shallow and vulgarized form in which the materialism of the

eighteenth century continues to exist today [1888] in the minds of naturalists and physicians, the form which was preached in the 'fifties by Buchner, Vogt and Moleschott" (*Feuerbach*, 35-36). For reasons having to do with the condition of science itself, this materialism was "predominately mechanical." It mistakenly applied mechanistic standards, still valid in physics, to chemical and biological phenomena.

Engels is not a reductionist materialist in at least one of the very obvious senses of that term. He seems to have agreed with Comte that nature is stratified in the sense that higher levels, e.g., the organic, depend upon lower levels, the chemical and physical, and that each level exhibits "higher unities." He wrote:

If I term physics the mechanics of molecules, chemistry the physics of atoms, and furthermore biology the chemistry of proteins, I wish thereby to express the passing of each of these sciences into another, hence both the connection, the continuity, and the distinction, the discrete separation between the two (*Dialectics*, 252).

One may wish that Engels's had said more on this critical issue, but especially on the question of the human sciences, where on occasion, at least, he leaves himself open to a reductionist reading. Most critically, of course, is how Engels would treat consciousness. (I have in mind an argument in *Feuerbach* (59) against the "old materialists.")

Engels identified a second "specific limitation" of older materialism, also the result of the state of natural science in the eighteenth century. This limit was its "inability to comprehend the universe as a process--as matter developing in a historical process" (*Feuerbach*, 37). The idea that we think of the universe in terms of process is, of course, critical and requires us to see how Engels's dialectics is his response. But the text raises a prior and important question, relevant to much of the account of the foregoing. It is the idea that matter develops in a historical process. This is at best perplexing, especially if, as is usually the case, matter is conceived as a "substance" capable of carrying properties. I conclude that this was not Engels's conception, but again, he is nowhere clear about what he does mean.

I noted earlier that we can give scientific reasons for the inference from what is known to what is unknown (but knowable) and that on this view, there need be no commitment to an unknowable substratum, matter. Nowhere, as far as I can tell, does Engels consider Berkeley's critique of matter as *unessential* to science. Moreover, even if science required something external to mind, as Kant had argued, this did not need to be "material substance." But it could be a self-subsisting external world. The point may be missed.

One could hold that the atoms of physics are *real bodies* much in the way that Galileo and Locke seem to have understood them. One can hold to this and still repudiate matter as *substance*--as Locke had done. As Engels says:

matter as such is pure creation of thought and an abstraction. We leave out of account the qualitative differences of things in lumping them together as corporeally existing things under the concept matter. Hence matter as such, as distinct from definite existing pieces of matter is not anything sensuously existing (*Dialectics*, 255).

Of course, all abstractions are creations of thought but might some not be "pure" creations

of thought in the sense that there is a reality to which they refer? Consider here both the abstraction "canine" or as in Marx, "abstract homogeneous labor." However, if an abstraction is a "pure creation of thought" then may we not say that there is nothing real to which it refers? While there may well be subatomic particles, atoms and molecules--in addition to the visible things of nature, there is no such thing as homogeneous, undifferentiated matter, a substance or substratum in which properties inhere. Engels would not be bothered by the empiricist critique of matter since, on this view, he has shifted ground: There can be no question that there are independently existing things which are mind independent. That philosophers have thought otherwise is evidence of their ingenuity and, perhaps, of the fact that modern epistemology was founded by theologically motivated philosophers. Another way to put this is to say that Engels has no patience with skepticism regarding either empirical or transcendental reality. Materialists affirm an independently existing natural world; accordingly, the real questions about it are now scientific: How do we explain the phenomena of experience.

It is thus that the progress of science proves materialism thus defined. It did not prove the existence of matter, but it did establish the truth of the realist hypothesis, which as Helmholtz had said "has been tested and verified in an extremely broad field of application."

It is now easy to make sense out of the idea of matter developing in a historical process. Some of these existences at least have "histories" in a fairly straightforward sense. The solar system developed from "rotating nebular masses" and organisms evolved from the non-living. In a sense, then everything in the universe changes, is in process and at least as regards some of these things, we need "history" if we are to understand their origin and perhaps also their nature. Versus Duhring, who "reduces motion to mechanical force," for Engels "*motion is the mode of existence of matter*" (*Anti-Duhring*, 71). or as Engels insisted in *Dialectics of Nature*: "Motion, as applied to matter, is change in general" (248). On the present reading, this would mean that everything which exists is changing, a key feature of Engels's dialectical view of nature. Indeed, the laws of motion are, for Engels, dialectical laws.

Dialectics

I have avoided engaging what is surely the most distinctive and influential feature of Engels's philosophy of science. The fundamental notions of dialectics as set out by Engels are familiar enough. Indeed, in the hands of his erstwhile epigones, they have been too familiar, reduced to postulates which presumably characterize all of reality and which thus call for an appropriate sort of thinking, not found in the work of bourgeois philosophers and scientists--Hegel excepted.

The subheading in *The Dialectics of Nature* to the section entitled "Dialectics" reads: "the general nature of dialectics to be developed as the science of interconnections, in contrast to metaphysics" (*Dialectics*, p. 62). That this is a "science of interconnections" is, I think, most critical since it strongly suggests that Engels did follow Hegel in holding that "all parts of the world are fundamentally interrelated"-- except of course that Engels's holism was materialist. Thus,

The whole of nature accessible to us forms a system, an interconnected totality of bodies, and by bodies we understand here all material existences extending from stars to atoms, indeed right to particles, in so far as one grants the existence of the last named (*Dialectics*,

p. 70; see also *Feuerbach*, 58).

Engels identifies "three great discoveries" which have propelled "by leaps and bounds" a dialectical view of the universe: the discovery of the cell, the transformation of energy and Darwinian theory (*Feuerbach*, 58). He follows Hegel in saying that this understanding is not metaphysics, presumably because dialectics does not investigate "things as given, as fixed and stable" and instead investigates processes. The "laws of dialectics are "abstracted" from "the history of nature and human society." They are "nothing but the most general laws of these two aspects of development, as well as of thought itself." And indeed they can be reduced to three:

The law of the transformation of quantity into quality and vice versa;
The law of the interpenetration of opposites;
The law of the negation of the negation.

All three were developed by Hegel, but his mistake

lies in the fact that these laws are foisted on nature and history as laws of thought, and not deduced (inferred) from them.... If we turn the thing round, then everything becomes simple, and the dialectical laws that look so extremely mysterious in idealist philosophy at once become simple and clear as noonday (62).

The famous "placed upon his head" metaphor, articulated in the *Feuerbach* (54) becomes here perhaps a preferable "turn the thing round." We *infer* the laws from independently existing reality; they are abstractions from it. Of course, "dialectical logic" contrasts with "the old formal logic" in that it denies that cause/effect, negative/positive, chance/necessity, and identity/ difference are exclusive polarities. Presumably, dialectical thought enables us to grasp dialectical reality. Indeed, as suggested earlier, we have knowledge to the extent that our thoughts are "the conscious reflex" of this reality. But versus idealism, dialectical thought is not constitutive of reality. What then is the character of a dialectical reality and how does a dialectical logic help us? There are two critical questions.

The first, of course, is the problem, already noticed, of how ideas are presumed to "mirror" or be "conscious reflexes" of the independently existing reality? Engels floundered badly on this problem. Nor, parenthetically, can it be said that Lenin's efforts in the *Empirio-Criticism*, following Engels, helped. Second, as Terrell Carver asks:

If the 'dialectic of concepts' is 'the conscious reflex of the dialectical motion of the real world'--nature and history--where 'these laws assert themselves unconsciously'--how is it that these laws, which could with sufficient sophistication be perceived by men, then be applied 'consciously'(Carver, 1983, 140).

What would be the result? Would the result be, Carver wonders, a reduction in the "'seeming accidents' through which 'external necessity' is asserting itself?" To answer this, we need to raise questions regarding the character of the three laws as universally pertinent. They seem either to do too little or to do too much.

Many pages of *Anti-Duhring* are devoted to illustrating the three laws. One may concede that, e.g., one can generate the series of normal fatty acids, each qualitatively different by "the simple addition of elements" (*Anti-Duhring*, 145). But we can reasonably ask, will this be true of all qualitative change? Surely there are qualitative changes and differences, for example, aging or tensile strength which involve some other mechanisms?

The point is clearer as regards the third dialectical law, referred to by Engels as "the kernel" of dialectical process. Duhring had made a "shrill attack" on Marx. It is well responded to by Engels who, quoting the famous text from Marx's *Capital*, shows that there are no dialectical miracles in which the contradictions of thesis-antithesis magically bring forth a synthesis. Instead, Marx proceeded empirically, "on the basis of historical and economic facts." The contradictions in the system of capitalism are concrete and specific. There are structural requirements which, if reproduced, produce consequences inconsistent with continuing system reproduction. This is, for capitalism, the "negation of the negation." But as Stedman Jones (1975, 22) pointed out:

Engels has proved something else, something that he did not intend to prove and something which he does not seem to be aware of having proved: that is, that the Hegelian dialectic of *Capital* is superfluous, that fundamental dialectical laws...are mere redescriptions of processes which have been established by quite different means.

The point is easily generalized. The law is a general law which "holds good in the animal and plant kingdoms, in geology, in mathematics, in history and philosophy." Of course, Engels is able to give (as with the first dialectical law) a host of illustrations. But he gives away the problem when he acknowledges that:

It is obvious that in describing any evolutionary process as the negation of the negation, I do not say anything concerning the *particular* processes of development (*Anti-Duhring*, 160).

As Engels well recognized, for each of these particular processes of change, there are particular mechanisms. Marx proceeded *empirically*; so do the geologist, biologist and other scientists. The problem with the laws of dialectics is not that they are miraculous or mysterious, but that they are very nearly vacuous. In this they compare neatly with Herbert Spencer's inductively generated super-generalization, "the law of evolution," to wit:

There is a change from an incoherent homogeneity to a coherent heterogeneity, accompanying the dissipation of motion and the integration of matter (1976, 325).

One might hold, however, that unlike the Spencerian law, dialectical laws are heuristically valuable since they guide us in our search for knowledge. This is surely contestable.

First, the appeal to dialectics has, if anything, tended to foreclose inquiry prematurely. That is, just as with the appeal to "force" as an explanation, it has been all too easy for inquirers to assume a dialectical process (that one or more of the laws applies) and then to fail to see that one needs, as Engels acknowledges, to be empirical, to identify the particular mechanisms at work. Calling for "dialectical thinking" is too often an excuse to abandon the analysis, to flee in the face

of causal complexity, or sometimes to assume an account in which Humean causes get caught in an unhelpful, potentially infinite regress. Engels was acutely sensitive to this sort of thing, but his own famous "in the last analysis" as regards historical causation, is a symptom of this unfortunate tendency. One does not need dialectics to affirm that effects can be causes and that for many processes at least, what causes change is often itself changed. Although Duhring was mistaken as regards Marx's *Capital*, one may wonder how many of "Marx's faithful followers" have rested content with the assertion that some process is "dialectical?" Worse, how many have used the idea like a bludgeon against the unconvinced?

Second, Engels is committed to rejecting the "old method of investigation and thought which Hegel calls `metaphysical.'" The approach erroneously prefers "to investigate things as given, as fixed and stable" (*Feuerbach*, 55). In *Anti-Duhring*, he writes:

To the metaphysician, things and their mental images, ideas, are isolated, to be considered one after the other apart from each other, rigid, fixed objects of investigation given once and for all. He thinks in absolutely irreconcilable antithesis... Positive and negative absolutely exclude one another; cause and effect stand in an equally rigid antithesis one to the other (28).

And in *Dialectics of Nature*, we read:

The *law of identity* in the old metaphysical sense is the fundamental law of the old outlook: $a = a$. Each thing is equal to itself. Everything was permanent, the solar system, stars, organisms. This law has been refuted by natural science bit by bit... Abstract identity, like all metaphysical categories, suffices for ordinary use, where all dimensions or brief periods of time are in question...For natural science in its comprehensive roles, however, even in a single branch, abstract identity is totally inadequate (1972, 216).

There are at least three questions. First, are there any "things" which are not impermanent? Second, do these "things" lack "identity" because they change? And third, can we dispense with "things" and think only in terms of "processes?"

One can admit that all the "things" in empirical reality are in process, changing and impermanent, but do we want to include here, the theoretical "things" of particle physics, or of molecular chemistry? And if we do, what sense are we to make of this? Thus, we may admit with Engels that "the plant, the animal, every cell is at every moment of its life identical with itself and yet becoming distinct from itself...in short, by a sum of incessant molecular changes which make up life...(*Dialectics*, 214). Still, it is the plant or the cell which undergoes change. Indeed, we can explain the change of cell (and of a plant) by seeing that in transaction with other structures, its molecular structure is being altered.

It seems, indeed, that in order to explain change, we need abstract identity. We know, for example, that water can change: it can become salty or evaporate or freeze. It cannot explode. These are "natural necessities," which, although denied by empiricisms, seem ill-suited to Engels's dialectical view. Molecular chemistry tells us what water *is*. It is *essentially* H₂O. By virtue of its molecular structure (and the laws of chemistry), it has the causal powers it has. Contrary to the empiricist, there is necessity in what it can and cannot become. No doubt, this idea, clear enough

in Marx, is also being promoted by Engels. And of course, water does none of these things of itself and in isolation. To explain what it has done or is likely to do, we need to see exactly how it stands to other "things" with other causal powers. Here, Engels might have followed Marx and held that "things" (including systems like capitalism!) have "tendencies" such that how they change and what they change to is a function of what they are--the law of identity in "the old metaphysical sense." But we need also to add here, that nothing in this view commits us to the idea that any particular outcome is inevitable. If the water is to become salty, then NaCl must be added to it and this may or may not happen. If capitalism is to be replaced by socialism, then a great many things will need to happen.

This last remark suggests the final problem. Dialectical laws also do too much. Here we need to seek the sense of Engels' often repeated claim that nature and history are "governed by inner, hidden laws." For example:

Nothing of all that happens--whether in the unnumerable *apparent* accidents observable upon the surface of things, or in the ultimate results which *confirm the regularity underlying these accidents*--is attained as a consciously desired aim (*Feuerbach*, my emphasis, 58).

Granted that, "in so far as we ignore man's reactions upon nature"--an assumption made at our peril--natural outcomes are not "consciously desired." But what are we to make of the emphasized phrases here? Despite what appears as accidental, are outcomes necessary? Later, in commenting on history, he writes:

Historical events thus *appear* on the whole to be likewise governed by chance. But where *on the surface* accident holds sway, there actually it is always governed by inner, hidden laws and it is only a matter of discovering these laws (*ibid.*).

David Hillel-Ruben suggests that the "rational kernel" in Hegel's philosophy that Engels wanted to appropriate was this:

There is no special reason why a materialist outlook should not stress the necessary development, opposition, and change in things--which is what Engels as well as Marx took to be the rational core of the dialectic--without asserting that the finite necessarily changes into the infinite, or subject to object; only the latter of which are genuinely idealistic formulations (1979, Vol. 1, 55).

This could well be correct, but very much depends upon how necessary development, opposition, and change is to be construed. There are two more or less obvious construals.

First, it may be construed so that outcomes are both causally explainable *and* contingent--a consequence of the approach sketched in the foregoing. On this view, we may well be able to explain what we could not, *in principle*, have predicted. The second construal denies this. Presumably, with knowledge of "the hidden, inner laws," explanation and prediction will be symmetrical. Hegel's idealist eschatology is replaced by a materialist eschatology.

The main question can be simply put: Is there for Engels genuine contingency in nature and

in history? Many commentators (Bender, 1974; Lichtheim, 1963; Avineri, 1975) have concluded that there is not. As Stephen Philon reminds me, Joseph Ferraro (1992) thinks otherwise.

Ferraro argues that a dialectical understanding of necessity allows for chance. What could this mean? He says, rightly, that Engels rejected "determinism" as that is usually understood. On this view, not only is everything caused, but all outcomes are produced by

an irrevocable concatenation of cause and effect, by an unshatterable necessity of such nature indeed that the gaseous sphere, from which the solar system was derived, was already so constituted that these events had to happen thus and not otherwise (*Dialectics*, 219).

This is, of course, the familiar--positivist--understanding of determinism. Engels argues that that "with this kind of necessity...we do not get away from the theological conception of nature." Whether it is the eternal decree of God, or Kismet or necessity, for science it is all the same. We cannot trace "the chain of causation" and hence, "necessity remains an empty phrase" (*ibid.*).

This would seem to allow for genuine chance and thus to be decisive in favor of Ferraro's reading-- except that Engels has already rejected the "metaphysical" opposition between necessity and chance. As Engels understands this view, what (in positivist terms) is "brought under laws" is thus explained and comes under the heading of necessity. What cannot be so explained is a chance occurrence. For Engels:

Anyone can see that this is the same sort of science as that which proclaims natural what it can explain, and ascribes what it cannot explain to supernatural causes; whether I term the cause of the unexplicable chance, or whether I term it God...Both are only equivalents for: I do not know, and therefore do not belong to science (218).

Given that Engels acknowledges that we shall not (in his example) be able to account for *all* the properties of a single pea-pod, it is unclear why he objects to "metaphysical" chance? He seems to think that this trivializes necessity. Thus,

If the fact that a particular pea-pod contains six peas, and not five or seven, is of the same order as the law of motion of the solar system...then as a matter of fact chance is not elevated into necessity, but rather necessity degraded into chance (220).

There is a move hinted at by Ferraro who sees that Engels frequently notices that laws of nature apply *ceteris paribus*. This would allow that the laws of motion and some fact about a particular pea-pod are *not* "of the same order." For example, while everything is "governed" by the laws of motion, these laws cannot, of themselves explain or predict anything. Engels writes:

The eternal laws of nature also become transformed more and more into historical one. That water is fluid from 0°-100°C. is an eternal law of nature, but for it to be valid, there must be (1) water, (2) the given temperature (3) normal pressure. (*Dialectics*, 238).

This would seem to be a confusion. The laws of chemistry are not "transformed" into historical

laws even if they must applied concretely and therefore historically. What, in any particular case, H₂O does will be a function of all the other causes operating at that time and place. Moreover, these particular collocations of causes are, as Engels sees, historical. It is just here where we have genuine contingency. On this view, contingency is not to be identified with chance if that means absolutely inexplicable. Everything is caused and, in principle, can be explained even if, in principle, it could not have been predicted. But it follows also that, for example, evolutionary history could have been different (Gould, 1986). Another way to say this is to say that *while there are laws of nature, there are no historical laws*.

The foregoing is, I believe, perfectly consistent with Darwin whose "epoch-making work" was, for Engels, the fatal blow against "metaphysics." But Engels was not, however, clear on any of the critical issues. And he was not, I think, just because of his commitment to Hegelian holism (Stedman Jones, 1975). In *Dialectics of Nature*, after he rejecting determinism and the (metaphysical) opposition between chance and necessity, he writes:

In contrast to both conceptions, Hegel came forward with the hitherto quite unheard-of propositions that the accidental has a cause because it is accidental, and just as much also has no cause because it is accidental; that the accidental is necessary, that necessity determines itself as chance, and on the other hand, this chance is rather absolute necessity (220).

Many readers, perhaps content with their capacity "to think dialectically" have concluded that for Engels, "in the last analysis," there is no genuine contingency in nature or in history. It is just this view which ultimately has been the disaster for the "scientific socialisms" which, philosophically, have been dialectical materialisms.

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