

Science and Society
Spring 1998. Vol.n62. No.1
Special issue:
Friedrich Engels- A Critical Centenary Appreciation
Joost kircz and Michael Löwy, Guest Editors.

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Engels and Natural Science: A Starting Point

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IN MAKING AN ASSESSMENT OF Friedrich Engels and his relation to science, it is essential to clearly realize its political context. Engels and Marx never had a “*l’art pour l’art*” approach to analyzing the world: for them understanding the world around us is the key to changing it. It is exactly this goal of consciously changing the world that drove Engels to spend so much time trying to understand science.

If we follow the intellectual development of Marx and Engels, we see a permanent battle against idealism as well as against mechanical (vulgar) materialism. In their realist world view they consider all human activities as a complex interplay between biological capacities (one may even say genetic potentialities) and societal constraints. It is these societal constraints (including the man-made changes to nature) that shape human behavior and action and hence are the locks on human emancipation which have to be released.

After investigating for so many years the dialectics of the political, social, and economic aspects of society in a historical materialist framework, Engels saw two obvious extensions.

1) The notion that if all expressions of human social activity are essentially dialectical, some profound dialectics must reside in a lower, more elementary level of nature. That is to say, the structure of non-living nature must induce some of its fundamental characteristics into the higher forms of reality, firstly into living nature and subsequently into thinking — human — nature. This train of thought gives rise to investigations of finding basic “dialectical laws” of nature, which might

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serve as the starting point for higher forms of dialectical interactions characterizing human society.

2) The notion that all conscious human activities, expressing the quest to understand and change the human environment, have to be in concert with non-living nature (otherwise nothing happens), as well as a transcendence of it. Human understanding of the organization of nature is a slow and complex historical process. Our understanding of nature is on the one hand an expression of (non-human) nature, as source of this very thinking, as well as on the other hand, an ever-changing human mental construction in which the human mind transcends its sensual perceptions in the creation of models and theories. All crystallizations of thinking in language immediately pose the problem of the whole and the parts. Every definition of an object excludes a part from the whole; thus, every human theory of nature is characterized by first defining

separate objects (detached from their environment), which are combined again by appropriate interacting forces (forces that are reduced to zero in the case of "detached" objects). So all scientific descriptions of nature deal with mutually interacting objects, which together comprise reality. Consequently Engels states that all truly scientific thinking has to be dialectical. This notion is expressed in the idea that scientists are unintentionally (or unconsciously) dialectical (all modern materialist thinkers from Spinoza on emphasize the impossibility of fully understanding objects in isolation).

Engels' Contributions

Engels' contributions are important on several different levels. First of all, he stresses the historicity of science and its development as a function of emerging capitalism. See for instance his notes "From the History of Science" (Engels, 1976, 184—201). The real breakthrough of this concept started in 1931, with the contributions of the Russian delegation to the International Congress on the History of Science and Technology in London. Especially the contribution of Boris Hessen, "The Social and Economic Roots of Newton's 'Principia'," had a large impact (Hessen, 1931). These unexpected presentations inspired a whole new generation of left activists. This current which emerged in England (*e.g.*, Bernal, Caudwell, Haldane, Needham, etc.; see Werskey, 1988) and spread rapidly

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around the world (*e.g.*, Struik) created the new field of the sociology of science.

The sociology of science mainly analyzes science as embedded in, struggling with, or slavishly following the actual (hegemonic) culture. It studies how the sciences became what they are, in their socio-historical context. It is not my intention here to dwell on the details, but it is important to note that most of the classic "Marxist" treatises on this subject put too great an emphasis on the economic, military, and political aspects that mould and constrain science, and too little on the ideological and conceptional components of the development of ideas.

Second, Engels made contributions to the epistemology and ontology of science: an aspect that goes far beyond the notion of science as a social activity, but raises the basic questions of understanding and changing the world. The difference with the first aspect is like that between history for the sake of understanding the present, and history as a tool for creating the future.

Both aspects are intertwined, but in Engels' works not always clearly distinguished. The reason is that Engels is mainly a polemicist. Especially in *Anti-Dühring*, Engels wants above all to fight against Dühring's ideas, which he sees as a dangerous intervention in German social-democratic politics. On the one hand he paints a picture with a broad brush and makes sweeping statements; on the other hand he goes into many minor details to reinforce his arguments in the refutation of Dühring's claims (Benton, 1979, 101—143).

His working method in *Anti-Dühring* is distinctly different from that of Marx's economic studies. Engels proves his points by the use of examples and not by applying or developing scientific theories. He is happy with identifying formal dialectical oppositions as sufficient evidence and proof for a dialectical approach to analyzing the world. He is not even particularly concerned with the exactitude of his statements. It is the broad political picture (the world view) that counts. Jean van Heijenoort, Trotsky's most brilliant assistant during his exile from Prinkipo to Coyoacán, left politics in 1948, ending up as a world-renowned logician (Burdman Feferman, 1993). Apart from his political farewell (Heijenoort, 1948) he wrote a critique of Engels, which

was only published in 1985 in his collected Essays (Heijenoort, 1985, 123—152). In this critique he analyzes Engels' remarks on mathematics, and confronts them with the real state of the art of mathemat-

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ics in Engels' time, ". . . for Engels' views on mathematics are part of his 'dialectical materialism,' and their examination gives valuable insight into this doctrine."

Van Heijenoort makes mincemeat of Engels' account of mathematics, proving that Engels was reading already old-fashioned books, repeated stupid mistakes, and simply did not know about the real contemporary discussions in mathematics. Van Heijenoort attacks Engels' philosophical baseline that all knowledge is ultimately rooted in tangible reality. However, he often misses the point that Engels, in his sarcastic polemical style against Dühring & Co., wants to fight metaphysics. Engels wants to show that common sense "contradictions" and "negations" are transcended in mathematics (*e.g.*, his sloppy discussion of complex numbers) in an attempt to establish that all knowledge is rooted in reality and is developed from there to higher levels of abstraction. Van Heijenoort debunks many of Engels' arguments, but does not provide new insights into ways of understanding abstract thinking as a human capability of material life. Van Heijenoort, a rigorous thinker, states that his critique must have consequences for dialectical materialism, but he does not formulate these consequences (this might be the reason that he only published his works almost 40 years later). This is not strange, as van Heijenoort is too sophisticated (and certainly not a falsificationist) to try to disprove a world view with an attack on examples. Van Heijenoort never became an anti-socialist, but tried to seek comfort in the clean and abstract world of logic, without, unfortunately, ever entering the real discussions of dialectics and materialism.

Engels' main point is that "contradictions" are the essence of advanced science. In calling almost all oppositions a (dialectical) contradiction or negation, he ignores the monumental step taken by mathematics in the 19th century, which transformed the field into an axiomatic game detached from physical reality. In an amateurish overview of mathematics he simply keeps hammering away at the fight against idealism. He tries to prove his point with an avalanche of examples (not an uncommon practice in his time).¹

For Engels the "objective" dialectical foundation of non-living nature is so obvious and the number of verifiable examples so large

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that even if he makes a mistake on one point, the overwhelming evidence will never be threatened. After all, for him mathematics is just a human expression of reality and not reality itself:

But as in every department of thought, at a certain stage of development the laws abstracted from the real world become divorced from the real world, and are set over against it as something independent, as laws coming from outside, to which the world has to conform. This took place in society and in the state, and in this way, and not otherwise, pure mathematics was subsequently applied to the world, although it is borrowed from the same world and only represents one section of its forms of interconnection — and it is only just precisely because of this that it can be applied at all. (Engels, 1972, 46.)

¹ In his private notes Engels realizes very well that matters are more complicated. "The general law of the change of form and motion is much more concrete than any single concrete example of it" (Engels, 1976, 222).

This is exactly where van Heijenoort challenges Engels. The human brain is able to create “if—then” constructions that have nothing to do with tangible realities (examples borrowed from nature) at hand. The human brain transcends the dialectics of non-living nature and gives rise to a new level of social, human thinking: a direct link is broken. If this were not the case, all coherent mental constructions could be mechanically applied backwards to the world, a completely undialectical, deterministic approach with strong predestinationist implications. Unfortunately, it is just this type of “linear” connection between world and mind that wreaked havoc with science in the USSR. Interestingly, in his collected notes published under the title *Dialectics of Nature*, Engels argues against uniformly applicable laws and theories (Engels, 1976, 239); unfortunately, this insight was lost on the polemical battlefield.

In *Anti-Dühring* we find 1) the ontological view of reality as an ever-changing flux of interpenetrating and mutually shaping matter, as well as 2) the epistemological view of scientific theories as expressing (not completely, but certainly approximately) this (ontological) dialectics in a continuing series of ever more encompassing descriptions or models. The success of a theory consists in its correct mirroring of reality. The continuation of this line, of proving the correctness of basic assumptions by amassing more and more evidence, became a whole industry, especially in the tradition of the Stalinist movement (Hörz, 1976; Hörz and Pöltz, 1980; Bitsakis, 1983).

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Four Questions

Science, as the expression of human knowledge of the world, including humankind, is indeed a necessary but, fortunately, not a sufficient ingredient in building a practice of political action for socialism. Since Engels’ attempts to grasp science in a dialectical framework, many discussions and political fights have seen the light of day. In all this, four central problems stand out:

- 1) Is science a weapon in the fight for socialism?
- 2) Is socialism itself a science?
- 3) Does a socialist outlook help the development of science?
- 4) Does a socialist science exist?

The discussion is mainly centered around two approaches. On the one hand, we have the typical Stalinist tradition of semi-religious extrapolations from Engels’ works. The backbone of Engels’ thoughts as expressed in *Dialectics of Nature* and *Anti-Dühring* is taken as a set of undisputed truths, which only need further development and elaboration. The aim is to build on and expand the already established train of ideas as a rock-solid foundation for further action.²

² An extreme example is given by L. Bazhenov (1975, 1—16): “Consequently, Dialectical Materialism insists that all properties of matter, both familiar and hitherto unfamiliar to us, exist apart from, and independently of the mind. This implies that the philosophical definition of Lenin indicates the unchallenged epistemological baseline of any conceivable science-based description of matter, that is to say, it characterizes the latter’s relation to mind which remains intact throughout all transformations of matter and its inherent properties.” Although Lenin’s definition, as given in *Materialism and Empiriocriticism* — “matter is a philosophical category denoting the objective reality which is given to man by his sensations, and which is copied, photographed and reflected by our sensations, while existing independently of them” — is an acceptable realist starting point, the apodeictic extension to all conceivable future understanding sounds more Jesuitical than Marxist, alas for Lenin.

Linked to this tradition are the attempts to prove that even the most advanced sciences are dialectical. The problem with this kind of exercise is that it only adds improved examples of dialectics in science and biology. It does not, however, transcend the old adage of Spinoza that defining is also negating.

On the other hand we see attempts to critically defend Engels by placing him in his historical context (Benton, 1979). Here the issue is identified, without developing further ideas, in the spirit of Engels: an attack on capitalism based on modern science (and not only on <page 68>

the consequences of modern science applied by capitalism). Nevertheless, works of this type place Engels in his 19th-century context (Gregory, 1977), a demand for historical contextuality which is in line with the program of the master himself.

Let me now try to discuss the four questions in more detail.

1. *Is science a weapon in the fight for socialism?* Already from first principles one can say that knowing the world is the key to changing it. For socialist politics, defined as the conscious way of political action, in which the analysis of the available possibilities is the guide for politics, we can say that science is a weapon for action. The more we know about the mechanisms and interactions in nature, the better we can steer our changes of nature in concert with and not against a healthy continuation of life. However, science is never context-free. The development of a particular science and particular ideas is heavily influenced by the hegemonic ideology. In cosmology, for instance, we see that the Big Bang theory, which is after all a very young theory, accrues a lot of credit not only because it more or less fits the scarce data,³ but because it is ideologically a marvel for all those who would like to see a “beginning of time” or a firm moment of creation for the world.

Nevertheless, even if a certain science is cast in a contemporary ideological framework (remember Marx’s remark that Darwin projected British bourgeois society onto the animal world), all honest steps forward in understanding the world antagonize established power structures, which always base themselves on perceived natural reasons of existence. The emancipation of humankind and the possibility of making choices are limited by nature. Not all our fantasies are possible; hence the essence of science is closely related to human freedom. As Engels in a famous statement underlines:

Freedom of the will therefore means nothing but the capacity to make decisions with a real knowledge of the subject. Therefore the freer a man’s judgment is in relation to a definite question, with so much the greater necessity is the content of this

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judgement determined; while the uncertainty, founded on ignorance, which seems to make an arbitrary choice among many different and conflicting possible decisions, shows by this precisely that it is not free, that it is controlled by the very object it should itself control. Freedom therefore consists in the control over ourselves and over external nature which is founded on knowledge of natural necessity; it is

³ Let us not forget that all big bang theories are certainly based, next to the Helium-Hydrogen ratio in the universe (as far as we can measure it), on the measurements of red shifts in energy spectra, which are considered solely as the result of Doppler shifts from receding stars. Other suggested mechanisms for red shifting (which do not “falsify” expansion of the universe, but at least question the completeness of this claim), such as the one based on correlations between source fluctuations proposed by Emil Wolf and his collaborators, are not taken seriously (Wolf, 1987). Top scientists like Halton Arp, who dropped out of the mainstream, are simply ignored (Arp, 1987).

therefore necessarily a product of historical development. (Engels, 1972, 125.)

Having said that, one has to realize that scientific results can nonetheless obtain a trans-historical status. All technological results of science (ballpoint pen, steam engine, or H-bomb), born and developed in historically well-defined socioeconomic environments, remain at our disposition forever.⁴

This is why emancipatory knowledge can turn into its opposite and become a destructive force, as is clearly illustrated by the ecological disasters worldwide and the use of science and medicine in torture, oppression, and warfare. Engels' notion of freedom as knowledge of necessity reflects a deep insight into the need for knowledge in order to create a feedback and control system to steer the forces that humankind liberates in its path of progress. The understanding of nature, and of humankind as a part thereof, is a precondition to avoiding human self-destruction.⁵

In the discussion on the value of science for socialism, we have to realize that the two aspects of science, as enlightenment of the human mind and as product of a historical period, are very often mistreated. In its most positivistic form, science as such is seen as a faithful approximate description of reality and hence itself acquires trans-historical aspects. Proponents of such a current only want to change the societal superstructure to reach Nirvana, by applying science in the socialist way. Most of the time science is then equated with technology, as with the hyper-optimistic plans of the 1920s and 30s in the USSR, the result of which can be seen in the ecological disaster there.

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True science, that is to say the structuring of the permanent human endeavor to satisfy innate curiosity and the drive to prosperity, is always at odds with established knowledge. The essence of dialectical materialism is just this emphasis on the permanent flux of interacting ideas and concepts, in a continuing process of proposal, challenge and transcendence. Only by pushing the limits of understanding of our world and of the lethal consequences of alienated technology applied for the sake of dictatorial power, as well as by digging deep in the unknown canyons of aggression in human behavior, can we begin to surpass the current state of barbarism.

2. *Is socialism itself a science?* In the fight against pipe-dreaming and eschatological kladderadatch, the ideas worked out in the second and third sections of *Anti-Dühring* (parts of it published separately as *The Development of Socialism from Utopia to Science*) are landmarks in socialist politics. Nevertheless, they are only the beginning, the first round, against idealism, and Engels positioned himself firmly in a rock-solid materialist corner. But science as well as politics cannot live without a teleological component. Curiosity and the dream of revealing, changing, and discovering new facts or connections are the prime ingredients for human emancipation. This teleological component is however tightly interlaced with the methods used to reach a goal; the mutual determination of ends and means is fundamental (Trotsky, 1974). The dream of a better

⁴ Here is not the place to expand on the historical and sociological relations of invention and discovery, on the one side, and their applications, on the other. It is sufficient to say that both are products of a historical period, with the annotation that the consequences of applications are truly directly, but not fully, determined by the socioeconomic super-structure.

⁵ On another level it is interesting to refer to the popularity of cybernetics in the former Soviet Union during the 1960s and early 1970s, as an attempt to control complex interacting processes. See Graham (1987, ch. 8).

world can never be fulfilled without an in-depth knowledge of the mechanisms and intricacies of human biology, psychology and social behavior. For that reason we reach the kernel of the problem: as socialist emancipation is a movement from within and not something that is delivered from the outside, we can never simply apply a method or a science to society or nature in order to understand and change it. All science is a permanent struggle between the real world and our historically determined knowledge. Science always starts with a question, which along with some eternal aspects (why are we alive?) is oriented towards socially accepted problems. In other words, active science is always an expression of contemporary needs and demands. It is important to emphasize that, as the mainstream of science is typically embedded in a social—historical context, it is characteristic that with hindsight other developments could be envisaged.⁶

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This proves that, although the course of successful science is socially determined, the “if—then” capacity of the human mind is intrinsically able to select directions. This means that a conscious choice for emancipation, or rather an emancipatory science, links an in-depth knowledge of the dynamics of contemporary society with a strong teleological understanding: not in the sense that a well-defined endpoint is envisioned (utopia), but that well-defined behavioral goals exist, such as a democratic inter-human relationship that appreciates human biological and intellectual variety.

Contrary to this, one can define as dialectical engineering or technology the tradition based on Engels’ limited works on the dialectics of nature: the program of proving dialectics as being everywhere and applying the three laws of dialectics to each new problem. For the development of a socialist science, Engels lacked time to develop his program. The only place where a more or less worked out praxis of socialist science is developed has been in economics. So unfortunately on this point Engels can only serve as a source of inspiration and not as a source of knowledge.

In a most important study Patrick Murray (1988) analyzes Marx’s scientific works in order to reveal the methodological aspects. It is tempting to devote much space to this study, as it follows Marx in his development from his doctoral dissertation to the writing of *Capital*. For our purpose here it is sufficient to stress the importance of the concept of the immanent approach, which is the basis of dialectical continuity in science. Unlike in Hegel, as Murray states,

There are no pure, preconceptional, or prelogical empirical atoms. But what is the relationship between the conceptual structure or logic of the investigating scientist and the character of the objects under scientific scrutiny? This is the crucial question that Marx puts to Hegel, and in its light crude empiricism may be considered potentially dangerous. (*Ibid.*, 40.)

Marx’s drive for an immanent critique of Hegel’s philosophy and later of capitalism reveals also their historical specificity.

Marx accepts Hegel’s demand for a unity of form and content in scientific knowledge. Method ought not to be some abstract, formalized procedure hovering over the specific content of science. Rather, method needs to take its shape from the specific object under scrutiny. . . . For Marx the dialectical presentation

⁶ An interesting example is Rindler’s conjecture that everything was in place for Bernhard Riemann to develop relativity theory, 50 years before Einstein (Rindler, 1994).

of the system of political economy is possible only through

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the most thoroughgoing empirical and conceptual study of that system.... Marx's strictures against logic as a third party (that expresses, rather than reconciles, contradictions) apart from the specific object of a science and its specific logic allows him less space for general methodological considerations than Hegel enjoyed. (110—111.)

It is here that we immediately see the difference between a mature study such as *Capital*, which analyzes in depth all developments and contradictions of early industrial capitalist society, and polemical works like *Anti-Dühring*. Marx's science in *Capital* is an immanent study and critique of his subject. The internal antagonisms, as well as the formal expressions thereof (such as money as the expression of the contradiction between use-value and exchange-value), plus new analytical tools (like the notion of labor power, in contradistinction to labor) are conceived: all this with the clear goal of overcoming capitalism by understanding its internal movements. In that sense we can speak of socialism as a science. In no way have we yet seen such an approach to natural science and biology. On the contrary, after Engels' enthusiastic recognition that in natural science everything can be cast in a simple dialectical framework, everybody seems only too happy to just provide new and better examples. Instead of analyzing science and its fundamental abstractions from within, only the possible political and philosophical repercussions of particular scientific theories are challenged.

Socialism as a science can only deal with the natural sciences by fully absorbing them and criticizing them from within. Otherwise all activities remain on the level of formal categorization and moral despair.

3. *Does a socialist outlook help the development of science?* In point one I have already mentioned the fact that some sciences radiate a strong ideological content. One can dislike this content, but denouncing such developments on ideological grounds does not help at all. The bizarre experiences in the former USSR with ideologically driven research proves this point (see, for a good, fairly recent, overview of relevant works, Graham, 1989). An interesting example is V. A. Fock (1964) in his works on relativity and gravitation theory. Fock remained his whole life a staunch "dialectical-materialist." It is certainly no formality or act under political pressure that in the introduction to his famous book on gravitation theory he explicitly states:

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The philosophical side of our views on the theory of space, time, and gravitation was formed under the influence of the philosophy of dialectical materialism, in particular under the influence of Lenin's *Materialism and Empiric Criticism...* - We wish to state this here, although the book does not explicitly touch on philosophical questions. (Fock 1964)

As said above, science is not only cast as function of a particular socioeconomic environment; otherwise we would indeed have seen, e.g., different solid-state physics in the USSR and the capitalist world. But certainly directions are triggered and ideas are formed under the influence of a world view. Fock's critique of Einstein is a clear immanent approach with a strong materialist bias. From pure analysis of the theory, it is clear to every trained theoretical physicist that the so-called General Relativity Theory is less relativistic than the so-called Special Relativity Theory, and is in fact "only" a theory of gravitation. Fock put great emphasis on the difference between the formal logical demand for general covariance (the fact that the form of physical laws is independent of the coordinate system in which they are expressed) of a theory and the physical reality that leads him to his conclusions. One can argue (certainly with hindsight) that no world

view is needed, but that argument does not help us in the understanding of science in the making. Fock's research here is clearly influenced by his materialist world view.

Nevertheless we have to be very critical of Fock. His materialist realism might sound correct in the fight against idealistic approaches, but the dialectical component is badly missing. In his discussions of Quantum Mechanics (Fock, 1971), Fock works on the same lines as, e.g., Rosenfeld in defending complementarity as a final solution to the problem. Complementarity is the idea worked out by Niels Bohr, one of the founders of modern physics, that in the microscopic world we have the choice to describe phenomena with either a particle model or a wave model, but the two representations of physical reality will never meet. Léon Rosenfeld was a close collaborator of Bohr and considered himself a Marxist. Strangely enough, on the one hand he criticized Bernal for being too simplistic (Rosenfeld, 1956), while on the other hand, in his famous 1953 article "Strife About Complementarity," he praised complementarity as an absolute solution, indeed a dialectical transcending, for the perceived final dichotomy between the wave and the particle picture of matter (*ibid.*, 446—4~4).

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Science is taken here as absolute, and no new concepts or ways of describing the riddles our mind encounters are allowed, by not more than the blinding splendor of the formal transcendence of particles and waves in "complementarity."⁷

How different is the attitude of David Bohm — in my opinion one of the few truly Marxist thinkers in physics. Bohm's personal life as a refugee from the United States is most interesting (Peat, 1997). Harassed by McCarthyism, he remained remarkably aloof from blunt Marxist phrases. But he sometimes seems just to be trying to rephrase Marxism in non-Marxist language. Especially during the 1950s and 60s, a period in which he also scrutinized Hegel's *Logic*, he wrote a series of most interesting contributions to the philosophy of science. In an article "On the Problem of Truth and Understanding in Science," Bohm (1964) argues strongly against the idea of a context-free truth, and insists on the close connection between understanding (which "is implicit, in the sense that it is logically prior to all words and thoughts"; 214) and truth as "two sides of a totality" (218). Against positivism, pragmatism and operationalism he states:

The problem described above seems to arise, at least in part, in the effort to refer truth to something fixed, definite, and final, either a subjective crite~ non which we are to choose once and for all, to be applied in research, or else an objective truth that is supposed to exist somewhere "out there" in a finished form, and which we are supposed to approach step by step, or to accumulate bit by bit. But it may be that truth is none of these. Perhaps it is something that has no fixed and final forms or limits within it, so that it cannot be known in its totality nor approached nor accumulated nor even referred to some definable criterion by which it can be recognized. Instead, what may happen is that both truth itself and the methods and criteria for establishing it must be understood afresh from moment to moment, because everything is always changing, so that the problem is, in some respects, fundamentally new on each occasion on which the question of truth is to be considered. (219—220.)

The Marxist echoes can clearly be heard. "Thus we are led to consider truth, not as fixed and finished, but, rather, as coming into

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⁷ An interesting overview of the discussions on quantum mechanics in the 1940s and 1950s within the communist movement is given by Andrew Cross, 1991.

being anew from moment to moment” (221). In other words, our understanding of reality is like a moving target, ever more encompassing but never final (this idea is discussed in Kircz, 1994).

In another contribution Bohm (1960) expands on the point that scientific facts are theory-laden and that predictability (the holy cow of the standard scientific criteria for evaluating a theory) is a typical result of classical mechanics. He questions this dogma in relation to quantum mechanics, and stresses again the point that science is concerned with the dynamics of relationships within a totality. The clear immanent type of critique with which Bohm tries to confront modern physics has a striking resemblance to Marx’s approach.

This discussion does not solve the problem of the helpfulness of a socialist outlook for better or more far-reaching scientific research. Good will and intentions do not generate good science. The only thing human investigations can accomplish is a proper analysis of the intrinsic tensions and dynamics of those parts of the world around us that we are able to research. However, the choice of subject and the choice of direction and method are certainly influenced by the researcher’s world view. A socialist outlook is more likely to base a research program on the analysis of antagonistic forces within a larger totality than on the quest for final solutions. Furthermore, seeing research as part of a larger totality might help to curb unwanted results and applications.

4. *Does a socialist science exist?* Within the context of a paper on Friedrich Engels we can be brief on the issue of socialist science. Neither Engels nor Marx ever made excursions into the future. All attempts to move in that direction, especially in the USSR, ended in disasters and enormous losses of intellectual and human resources. From where we are now, which is a position of re-evaluating Engels and Marx in context, it is sufficient to state that a science policy and the scientific interests of the scientists will clearly be influenced by the political and philosophical outlook of a socialist future. As said already above, the integration of research subjects into a larger whole, and a movement against the splintering of science as we see it now, will certainly help to move in the right direction. In that sense an ecological consciousness will certainly have a great influence. From where we now can see, we can only defer the answer to the question of socialist science until after the completed socialist revolution.

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Conclusions

In this paper I have tried to take Engels as a starting point for some notions about science. The study on the relationship between non-living nature and humankind is still in its infancy. We see strong sociological currents which try to avoid the deep questions by reducing the problem to the applications of science, and to leave out the underlying quest for the relationship and co-determination of humankind and its physical—biological basis. These currents leave the door wide open for socialist (or any other) “applications” that do not appreciate the totality of humankind and nature but are in principle idealistic hopes that we can mould the world without mediations (see also Kircz, 1994). It is Engels’ great contribution to realize that nature and humankind are too intricate a whole to leave the interplay out of the analyses. Engels spent an enormous amount of energy in learning as much as he could about the natural sciences. He was, however, too occupied and obsessed with polemical struggles to be able to do more than state the problem in its first and highly unfinished form. A century later, we can only look back critically and with the necessary modesty to see how little has been accomplished since. Instead of becoming demoralized, we can better learn from Engels’ spirit, optimism, and enthusiasm in continuing our research, in understanding how we can change the world into a democratic and

socially progressive place for living.

Postscript

Over the last years we have experienced, mainly in the USA, an aggressive polemic between scientists and defenders of new-age and postmodern conceptions.⁸

In the light of the above discussion, it is sufficient to say that Engels' battle against obscurantism and idealism is now also extended to strong anti-materialist sociological relativism. Now and then, these currents are based partly on the old misunderstanding of the difference between physical reality and the human socially determined representation thereof. Engels died a

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century ago; his first salvos did not last for long. His work is badly in need of a second round.

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⁸ For example, the elaborate discussions on the hoax article by Alan Sokal in the journal *Social Text*, as well as the antiPomo book by Gross and Levitt (GL, 1994) and the New York Academy of Science Conference, "The Flight from Science and Reason" (GLL, 1996).

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