

Marx and the Rift in the Universal Metabolism of Nature

 monthlyreview.org/2013/12/01/marx-rift-universal-metabolism-nature/

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This article is an expanded and slightly altered version of a keynote address under the same title presented to the Marxism 2013 Conference in Stockholm on October 20, 2013. That address built on ideas introduced in the author's Rosa Luxemburg Lecture, "The Great Rift," presented to the Rosa Luxemburg Stiftung in Berlin on May 28, 2013.

The rediscovery over the last decade and a half of Marx's theory of metabolic rift has come to be seen by many on the left as offering a powerful critique of the relation between nature and contemporary capitalist society. The result has been the development of a more unified ecological world view transcending the divisions between natural and social science, and allowing us to perceive the concrete ways in which the contradictions of capital accumulation are generating ecological crises and catastrophes.

Yet, this recovery of Marx's ecological argument has given rise to further questions and criticisms. How is his analysis of the metabolism of nature and society related to the issue of the "dialectics of nature," traditionally considered a fault line within Marxist theory? Does the metabolic rift theory—as a number of left critics have recently charged—violate dialectical logic, falling prey to a simplistic Cartesian dualism?¹ Is it really conceivable, as some have asked, that Marx, writing in the nineteenth century, could have provided ecological insights that are of significance to us today in understanding the human relation to ecosystems and ecological complexity? Does it not rather stand to reason that his nineteenth-century ruminations on the metabolism of nature and society would be "outmoded" in our more developed technological and scientific age?²

In the following discussion I shall attempt briefly to answer each of these questions. In the process I shall also seek to highlight what I consider to be the crucial importance of Marx's ecological materialism in helping us to comprehend the emerging Great Rift in the earth system, and the resulting necessity of an epochal transformation in the existing nature-society metabolism.

The Dialectics of Nature

The problematic status of the dialectics of nature in Marxian theory has its classic source in Georg Lukács's famous footnote in *History and Class Consciousness* in which he stated with respect to the dialectic:

It is of the first importance to realise that the method is limited here to the realms of history and society. The misunderstandings that arise from Engels' account of dialectics can in the main be put down to the fact that Engels—following Hegel's mistaken lead—extended the method to apply also to nature. However, the crucial determinants of dialectics—the interaction of subject and object, the unity of theory and practice, the historical changes in the reality underlying the categories as the root cause of changes in thought, etc.—are absent from our knowledge of nature.³

Within what came to be known as "Western Marxism" this was generally taken to mean that the dialectic applied only to society and human history, and not to nature independent of human history.⁴ Engels, in this view, was wrong in his *Dialectics of Nature*, in attempting to apply dialectical logic to nature directly, as were the many Marxian scientists and theorists who had proceeded along the same lines.⁵

It would be difficult to exaggerate the importance of this stricture for Western Marxism, which saw it as one of the key elements separating Marx from Engels and Western Marxism from the Marxism of the Second and Third Internationals. It heralded a move away from the direct concern with issues of material nature and natural science that had characterized much of Marxian thought up to that point. As Lucio Colletti observed in *Marxism and Hegel*, a vast literature "has always agreed" that differences over philosophical materialism/realism and the dialectics of nature constituted the "main distinguishing features between 'Western Marxism' and 'dialectical materialism.'"

According to Russell Jacoby, “Western Marxists” almost by definition “confined Marxism to social and historical reality,” distancing it from issues related to external nature and natural science.⁶

What made the stricture against the dialectics of nature so central to the Western Marxist tradition was that dialectical materialism—in the sense that this was attributed to Engels and adopted by the Second and Third Internationals—was seen as deemphasizing the role of the subjective factor (or human agency), reducing Marxism to mere conformity to objective natural laws, giving rise to a kind of mechanical materialism or even positivism. In sharp contrast to this, many of those historical materialists who continued to argue, even if in a qualified way, for a dialectics of nature, regarded its complete rejection as threatening the loss of materialism altogether, and a reversion to idealist frames of thought.⁷

Ironically, it was none other than Lukács himself, who, in a major theoretical shift, took the strongest stand against the wholesale abandonment of the dialectics of nature, arguing that this struck at the very heart of not just Engels’s but also Marx’s ontology. Even in *History and Class Consciousness* Lukács, following Hegel, had recognized the existence of a limited, “merely objective dialectics of nature” consisting of a “dialectics of movement witnessed by the detached observer.”⁸ In his famous 1967 preface to the new edition of this work, in which he distanced himself from some of his earlier positions, he declared that his original argument was faulty in its exaggerated critique of the dialectics of nature, since, as he put it, the “basic Marxist category, labour as the mediator of the metabolic interaction between society and nature, is missing.... It is self-evident that this means the disappearance of the ontological objectivity of labor,” which cannot itself be separated from its natural conditions.⁹ As he explained in his well-known *Conversations* that same year, “since human life is based on a metabolism with nature, it goes without saying that certain truths which we acquire in the process of carrying out this metabolism have a general validity—for example the truths of mathematics, geometry, physics, and so on.”¹⁰

For the post-*History and Class Consciousness* Lukács, then, it was Marx’s conception of labor and production as the metabolic relation between human beings and external nature which was the key to the dialectical understanding of the natural world. Human beings could comprehend nature dialectically within limits because they were organically *part of it*, through their own metabolic relations. Even as sharp a critic of the dialectics of nature as Alfred Schmidt in his *Concept of Nature in Marx*, acknowledged that it was only in terms of Marx’s use of the “concept of ‘metabolism,’” in which he “introduced a completely new understanding of man’s relation to nature,” that we can “speak meaningfully of a ‘dialectic of nature.’”¹¹

The remarkable discovery in the Soviet archives of Lukács’s manuscript *Tailism and the Dialectic*, some seventy years after it was written in the mid-1920s (just a few years after the writing of *History and Class Consciousness* itself) makes it clear that this critical shift in Lukács’s understanding, via Marx’s concept of social and ecological metabolism, had already been largely reached by that time. There he explained that “the metabolic interchange with nature” was “socially mediated” through labor and production. The labor process, as a form of metabolism between humanity and nature, made it possible for human beings to perceive—in ways that were limited by the historical development of production—certain objective conditions of existence. Such a metabolic “exchange of matter” between nature and society, Lukács wrote, “cannot possibly be achieved—even on the most primitive level—without possessing a certain degree of objectively correct knowledge about the processes of nature (which exist prior to people and function independently of them).” It was precisely the development of this metabolic “exchange of matter” by means of production that formed, in Lukács’s interpretation of Marx’s dialectic, “the material basis of modern science.”¹²

Lukács’s emphasis on the centrality of Marx’s notion of social metabolism was to be carried forward by his assistant and younger colleague, István Mészáros in *Marx’s Theory of Alienation*. For Mészáros the “conceptual structure” of Marx’s theory of alienation involved the triadic relation of humanity-production-nature, with production constituting a form of mediation between humanity and nature. In this way human beings could be conceived as the “self-mediating” beings of nature. It should not altogether surprise us therefore that it was Mészáros who provided the first comprehensive Marxian critique of the emerging planetary ecological crisis in his 1971 Deutscher Prize Lecture—

published a year before the Club of Rome's *Limits to Growth* study. In *Beyond Capital* he was to develop this further in terms of a full-scale critique of capital's alienated social metabolism, including its ecological effects, in his discussion of "the activation of capital's absolute limits" associated with the "destruction of the conditions of social metabolic reproduction."¹³

Lukács and Mészáros thus saw Marx's social-metabolism argument as a way of transcending the divisions within Marxism that had fractured the dialectic and Marx's social (and natural) ontology. It allowed for a praxis-based approach that integrated nature and society, social history and natural history, without reducing one entirely to the other. In our present ecological age this complex understanding—complex because it dialectically encompasses the relations between part and whole, subject and object—becomes an indispensable element in any rational social transition.

Marx and the Universal Metabolism of Nature

To understand this more fully we need to look at the actual ecological dimensions of Marx's thought. Marx's use of the metabolism concept in his work was not simply (or even mainly) an attempt to solve a philosophical problem but rather an endeavor to ground his critique of political economy materialistically in an understanding of human-nature relations emanating from the natural science of his day. It was central to his analysis of both the production of use-values and the labor process. It was out of this framework that Marx was to develop his major ecological critique, that of metabolic rift, or, as he put it, the "irreparable rift in the interdependent process of social metabolism, a metabolism prescribed by the natural laws of life itself."¹⁴

This critical outlook was an outgrowth of the historical contradictions in nineteenth-century industrial agriculture and the consequent revolution in agricultural chemistry—particularly in the understanding of the chemical properties of the soil—during this same period. Within agricultural chemistry, Justus von Liebig in Germany and James F.W. Johnston in Britain both provided powerful critiques of the loss of soil nutrients in the early to mid-nineteenth century due to capitalist agriculture, singling out for criticism British high farming. This extended to the robbing, in effect, of the soil of some countries by others.

In the United States figures like the early environmental planner George Waring, in his analysis of the despoliation of the earth in agriculture, and the political economist Henry Carey, who was influenced by Waring, emphasized that food and fiber, containing the elementary constituents of the soil, were being shipped long distances in a one-way movement from country to city, leading to the loss to the soil of its nutrients, which had to be replaced by natural (later synthetic) fertilizers. In his great 1840 work, *Organic Chemistry and its Application to Agriculture and Physiology* (commonly known as his *Agricultural Chemistry*), Liebig had diagnosed the problem as due to the depletion of nitrogen, phosphorus, and potassium, with these essential soil nutrients ending up in the increasingly populated cities where they contributed to urban pollution. In 1842, the British agricultural chemist J.B. Lawes developed a means for making phosphates soluble and built a factory to produce his superphosphates in the first step in the development of synthetic fertilizer. But for the most part in the nineteenth century countries were almost completely dependent on natural fertilizers to restore the soil.

It was in this period of deepening agricultural difficulties, due to the depletion of soil nutrients, that Britain led the way in the global seizure of natural fertilizers, including, as Liebig pointed out, digging up and transporting the bones of the Napoleonic battlefields and the catacombs of Europe, and, more importantly, the extraction by forced labor of guano (from the excrement of sea birds) on the islands off the coast of Peru, setting off a worldwide guano rush.¹⁵ In the introduction to the 1862 edition of his *Agricultural Chemistry*, Liebig wrote a scathing critique of capitalist industrial agriculture in its British model, observing that "if we do not succeed in making the farmer better aware of the conditions under which he produces and in giving him the means necessary for the increase of his output, wars, emigration, famines and epidemics will of necessity create the conditions of a new equilibrium which will undermine the welfare of everyone and finally lead to the ruin of agriculture."¹⁶

Marx was deeply concerned with the ecological crisis tendencies associated with soil depletion. In 1866, the year before the first volume of *Capital* was published, he wrote to Engels that in developing the critique of ground rent in volume three, “I had to plough through the new agricultural chemistry in Germany, in particular Liebig and Schönbein, which is more important for this matter than all the economists put together.”¹⁷ Marx, who had been studying Liebig’s work since the 1850s, was impressed by the critical introduction to the 1862 edition of the latter’s *Agricultural Chemistry*, integrating it with his own critique of political economy.

Since the *Grundrisse* in 1857–1858, Marx had given the concept of metabolism (*Stoffwechsel*)—first developed in the 1830s by scientists engaged in the new discoveries of cellular biology and physiology and then applied to chemistry (by Liebig especially) and physics—a central place in his account of the interaction between nature and society through production. He defined the labor process as the metabolic relation between humanity and nature. For human beings this metabolism necessarily took a socially mediated form, encompassing the organic conditions common to all life, but also taking a distinctly human-historical character through production.¹⁸

Building on this framework, Marx emphasized in *Capital* that the disruption of the soil cycle in industrialized capitalist agriculture constituted nothing less than “a rift” in the metabolic relation between human beings and nature. “Capitalist production,” he wrote,

collects the population together in great centres, and causes the urban population to achieve an ever-greater preponderance. This has two results. On the one hand it concentrates the historical motive force of society; on the other hand, it disturbs the metabolic interaction between man and the earth, i.e. it prevents the return to the soil of its constituent elements consumed by man in the form of food and clothing; hence it hinders the operation of the eternal natural condition for the lasting fertility of the soil.... But by destroying the circumstances surrounding this metabolism...it compels its systematic restoration as a regulative law of social production, and in a form adequate to the full development of the human race.... All progress in capitalist agriculture is a progress in the art, not only of robbing the worker, but of robbing the soil; all progress in increasing the fertility of the soil for a given time is progress towards ruining the more long-lasting sources of that fertility.... Capitalist production, therefore, only develops the technique and the degree of combination of the social process of production by simultaneously undermining the original sources of all wealth—the soil and the worker.¹⁹

Following Liebig, Marx highlighted the global character of this rift in the metabolism between nature and society, arguing, for example, that: “for a century and a half England has indirectly exported the soil of Ireland without even allowing its cultivators the means for replacing the constituents of the exhausted soil.”²⁰ He integrated his analysis with a call for ecological sustainability, i.e., preservation of “the whole gamut of permanent conditions of life required by the chain of human generations.” In his most comprehensive statement on the nature of production under socialism he declared: “Freedom, in this sphere, can consist only in this, that socialized man, the associated producers, govern the human metabolism with nature in a rational way, bringing it under their collective control...accomplishing it with the least expenditure of energy and in conditions most worthy and appropriate for their human nature.”²¹

Over the last decade and a half ecological researchers have utilized the theoretical perspective of Marx’s metabolic-rift analysis to analyze the developing capitalist contradictions in a wide array of areas: planetary boundaries, the carbon metabolism, soil depletion, fertilizer production, the ocean metabolism, the exploitation of fisheries, the clearing of forests, forest-fire-management, hydrological cycles, mountaintop removal, the management of livestock, agro-fuels, global land grabs, and the contradiction between town and country.²²

However, a number of critics on the left have recently raised theoretical objections to this view. One such criticism suggests that the metabolic-rift perspective falls prey to a “Cartesian binary,” in which nature and society are conceived dualistically as separate entities.²³ Hence, it is seen as violating the fundamental principles of dialectical analysis. A related criticism charges that the very concept of a rift in the metabolism between nature and society is “non-reflexive” in that it denies “the dialectical reciprocity of the biophysical environment.”²⁴ Still others have suggested that the reality of the metabolic rift itself generates an “epistemic rift” or a dualistic view of the world,

which ends up infecting Marx's own value theory, causing him to downplay ecological relations in his analysis.²⁵

Here it is important to emphasize that Marx's metabolic-rift theory, as it is usually expounded, is a theory of ecological crisis—of the disruption of what Marx saw as the everlasting dependence of human society on the conditions of organic existence. This represented, in his view, an insurmountable contradiction associated with capitalist commodity production, the full implications of which, however, could only be understood within the larger theory of nature-society metabolism.

To account for the wider natural realm within which human society had emerged, and within which it necessarily existed, Marx employed the concept of the “universal metabolism of nature.” Production mediated between human existence and this “universal metabolism.” At the same time, human society and production remained *internal to* and *dependent on* this larger earthly metabolism, which preceded the appearance of human life itself. Marx explained this as constituting “the universal condition for the metabolic interaction between nature and man, and as such a natural condition of human life.” Humanity, through its production, “withdraws” or extracts its natural-material use values from this “universal metabolism of nature,” at the same time “breathing [new] life” into these natural conditions “as elements of a new [social] formation,” thereby generating a kind of second nature. However, in a capitalist commodity economy this realm of second nature takes on an alienated form, dominated by exchange value rather than use value, leading to a rift in this universal metabolism.²⁶

This, I believe, provides the basic outline for a materialist-dialectical understanding of the nature-society relation—one that is in remarkably close accord not only with the most developed science (including the emerging thermodynamics) of Marx's day, but also with today's more advanced ecological understanding.²⁷ There is nothing dualistic or non-reflexive in such view. In Marx's materialist dialectic, it is true, neither society (the subject/consciousness) nor nature (the object) is subsumed entirely within the other, thus avoiding the pitfalls of both absolute idealism and mechanistic science.²⁸ Human beings transform nature through their production, but they do not do so just as they please; rather they do so under conditions inherited from the past (of both natural and social history), remaining dependent on the underlying dynamics of life and material existence.

The main reason no doubt that a handful of left critics, struggling with this conceptual framework, have characterized the metabolic-rift theory as a form of Cartesian dualism is due to a failure to perceive that within a materialist-dialectical perspective it is impossible to analyze the world in a meaningful way except through the use of abstraction which temporarily isolates, for purposes of analysis, one “moment” (or mediation) within a totality.²⁹ This means employing conceptions that at first sight—when separated out from the overall dynamics—may appear one-sided, mechanical, dualistic, or reductionist. In referring, as Marx does, to “the metabolic interaction between nature and man” it should never be supposed that “man” (humanity) actually exists completely independently of or outside of “nature”—or even that nature today exists completely independent of (or unaffected by) humanity. The object of such an exercise in abstraction is merely to comprehend the larger concrete totality through the scrutiny of those specific mediations that can be rationally said to constitute it within a developing historical context.³⁰ Our very knowledge of nature, in Marx's view, is a product of our human-social metabolism, i.e., our productive relation to the natural world.

Far from representing a dualistic or non-reflexive approach to the world, Marx's analysis of “the metabolism of nature and society” was eminently dialectical, aimed at comprehending the larger concrete totality. I agree with David Harvey's observation in his 2011 Deutscher Prize Lecture that the “universality” associated with Marx's conception of “the metabolic relation to nature” constituted a kind of outer set of conditions or boundary in his conception of reality within which all the “different ‘moments’” of his critique of political economy were potentially linked to each other. It is true also, as Harvey says, that Marx seems to have set aside in his critique of capital these larger boundary questions, leaving for later on the issues of the world economy and the universal metabolism of nature.³¹ Indeed, Marx's wider ecological view remained in certain respects necessarily undifferentiated and abstract—unable to reach the level of concrete totality. This is because there was a seemingly endless amount of scientific literature to pore through before it would be possible to discuss the distinct, historic mediations associated with the

coevolutionary nature-society dialectic.

Still, Marx did not shirk in the face of the sheer enormity of this task and we find him at the end of his life carefully taking notes on how shifts in isotherms (the temperature zones of the earth) associated with climate change in earlier geological eras led to the great extinctions in Earth's history. It is this shift in the isotherms that James Hansen, the leading U.S. climatologist, sees as the main threat facing flora and fauna today as a result of global warming, with the isotherms moving toward the poles faster than the species.³² Another instance of this deep concern with natural science is Marx's interest in John Tyndall's Royal Institution lectures regarding the experiments he was carrying out on the interrelation of solar radiation and various gases in determining the earth's climate. It was quite possible that Marx, who attended some of these lectures, was actually present when Tyndall provided the first empirical account of the greenhouse effect governing the climate.³³ Such attentiveness to natural conditions on Marx's part makes it clear that he took seriously both the issue of the universal metabolism of nature and the more specific socio-metabolic interaction of society and nature within production. The future of humanity and life in general depended, as he clearly recognized, on the sustainability of these relationships in terms of "the chain of human generations."³⁴

The Rift in Earth's Metabolism

All of this leaves us with the third objection to Marx's metabolic-rift theory in which it is seen as outdated, and no longer of any direct use in analyzing our current world ecology, given today's more developed conditions and analysis. Thus the criticism has been made that the metabolic rift is "outmoded as a way to describe ruptures in natural pathways and processes" unless developed further to address ecosystems and dynamic natural cycles and to take into account the labor process.³⁵

Such a dialectical synthesis, however, was a strength of Marx's metabolic-rift theory from the start, which was explicitly based on an understanding of the labor process as the metabolic exchange between human beings and nature, and thus pointed to the importance of human society in relation to biogeochemical cycles, and to exchanges of matter and energy in general.³⁶ The concept of ecosystem itself had its origin in this dialectical-systems approach, in which Marx's friend E. Ray Lankester, the foremost Darwinian biologist in England in the generation after Darwin and an admirer of Marx's *Capital*, was to play a leading role. Lankester first introduced the word "œcology" (later ecology) into English in 1873, in the translation that he supervised of Ernst Haeckel's *History of Creation*. Lankester later developed a complex ecological analysis, beginning in the 1880s, under his own concept of "bionomics," a term viewed as synonymous with ecology. It was Lankester's student, Arthur Tansley, who, influenced by Lankester's bionomic studies (and by the early systems theory of the British Marxist mathematician Hyman Levy), was to introduce the concept of ecosystem as a materialist explanation of ecological relations in 1935.³⁷

In the twentieth century the concept of metabolism was to become the basis of systems ecology, particularly in the landmark work of Eugene and Howard Odum. It was Howard Odum, as Frank Golley explains in *A History of the Ecosystem Concept in Ecology*, who "pioneered a method of studying [eco-]system dynamics by measuring ...the difference of input and output, under steady state conditions," to determine "the metabolism of the whole system." Based on the foundational work of the Odums, metabolism is now used to refer to all biological levels, starting with the single cell and ending with the ecosystem (and beyond that the earth system). In his later attempts to incorporate human society into this broad ecological systems theory, Howard Odum was to draw heavily on Marx's work, particularly in developing a theory of what he called ecologically "unequal exchange" rooted in "imperial capitalism."³⁸

Indeed, if we were to return today to Marx's original issue of the human-social metabolism and the problem of the soil nutrient cycle, looking at it from the viewpoint of ecological science, the argument would go like this. Living organisms, in their normal interactions with each other and the inorganic world, are constantly gaining nutrients and energy from consuming other organisms or, for green plants, through photosynthesis and nutrient uptake from the

soil—which are then passed along to other organisms in a complex “food web” in which nutrients are eventually cycled back to near where they originated. In the process the energy extracted is used up in the functioning of the organism although ultimately a portion is left over in the form of difficult to decompose soil organic matter. Plants are constantly exchanging products with the soil through their roots—taking up nutrients and giving off energy-rich compounds that produce an active microbiological zone near the roots. Animals that eat plants or other animals usually use only a small fraction of the nutrients they eat and deposit the rest as feces and urine nearby. When they die, soil organisms use their nutrients and the energy contained in their bodies. The interactions of living organisms with matter (mineral or alive or previously alive) are such that the ecosystem is generally only lightly affected and nutrients cycle back to near where they were originally obtained. Also on a geological time scale, weathering of nutrients locked inside minerals renders them available for future organisms to use. Thus, natural ecosystems do not normally “run down” due to nutrient depletion or loss of other aspects of healthy environments such as productive soils.

As human societies develop, especially with the growth and spread of capitalism, the interactions between nature and humans are much greater and more intense than before, affecting first the local, then the regional, and finally the global environment. Since food and animal feeds are now routinely shipped long distances, this depletes the soil, just as Liebig and Marx contended in the nineteenth century, necessitating routine applications of commercial fertilizers on crop farms. At the same time this physical separation of where crops are grown and where humans or farm animals consume them creates massive disposal issues for the accumulation of nutrients in city sewage and in the manure that piles up around concentrations of factory farming operations. And the issue of breaks in the cycling of nutrients is only one of the many metabolic rifts that are now occurring. It is the change in the nature of the metabolism between a particular animal—humans—and the rest of the ecosystem (including other species) that is at the heart of the ecological problems we face.³⁹

Despite the fact that our understanding of these ecological processes has developed enormously since Marx and Engels’s day, it is clear that in pinpointing the metabolic rift brought on by capitalist society they captured the essence of the contemporary ecological problem. As Engels put it in a summary of Marx’s argument in *Capital*, industrialized-capitalist agriculture is characterized by “*the robbing of the soil: the acme of the capitalist mode of production is the undermining of the sources of all wealth: the soil and labourer.*”⁴⁰ For Marx and Engels this reflected the contradiction between town and country, and the need to prevent the worst distortions of the human metabolism with nature associated with urban development. As Engels wrote in *The Housing Question*:

The abolition of the antithesis between town and country is no more and no less utopian than the abolition of the antithesis between capitalists and wage-workers. From day to day it is becoming more and more a practical demand of both industrial and agricultural production. No one has demanded this more energetically than Liebig in his writings on the chemistry of agriculture, in which his first demand has always been that man shall give back to the land what he receives from it, and in which he proves that only the existence of the towns, and in particular the big towns, prevents this. When one observes how here in London alone a greater quantity of manure than is produced in the whole kingdom of Saxony is poured away every day into the sea with an expenditure of enormous sums, and what colossal structures are necessary in order to prevent this manure from poisoning the whole of London, then the utopia of abolishing the distinction between town and country is given a remarkably practical basis.⁴¹

Although problems of the nutrient cycle and waste treatment, as well as the relation between country and city, have changed since the nineteenth century, the fundamental problem of the rift in natural cycles generated by the human-social metabolism remains.

Marx and Engels’s approach to materialism and dialectics can therefore be seen as intersecting in complex ways with the development of the modern ecological critique. The reason that this story is so unknown can be traced to the tendency of Western Marxism to write off all of those (even leading scientists) who delved into the dialectics of nature—except perhaps as reminders of various follies and capitulations (notably the Lysenko affair in the Soviet Union).⁴² Here I am referring to such important critical figures, in the British context, as Levy, Christopher Caudwell,

J.D. Bernal, J.B.S. Haldane, Joseph Needham, Lancelot Hogben, and Benjamin Farrington—along with other, non-Marxian, materialists and socialists, such as Lankester and Tansley.⁴³ Later on we see a developing ecological critique drawing in part on Marx emerging in the work of such thinkers as Howard Odum, Barry Commoner, Richard Levins, Richard Lewontin, and Steven Jay Gould.⁴⁴ Although Frankfurt School thinkers made remarkable observations on the “domination of nature” by the “dialectic of the Enlightenment,” as well as on the negative environmental effects of modern industrial technology, it was not there, but rather within the more adamantly materialist and scientific traditions, that the main socialist contributions to ecological thought emerged.⁴⁵

Today we are making enormous advances in our critical understanding of the ecological rift. Marx’s metabolic approach to the nature-society connection has been widely adopted within environmental thought, though seldom incorporating the full dialectical critique of the capital relation that his own work represented. A cross-disciplinary research tradition on “industrial metabolism,” addressing material flows associated with urban areas, has developed in the last couple of decades. As Marina Fischer-Kowalski, founder of the Institute of Social Ecology in Vienna and the foremost representative of material-flows analysis today, noted in the late 1990s, metabolism has become “a rising conceptual star” within socio-ecological thought. “Within the nineteenth-century foundations of social theory,” she added, “it was Marx and Engels who applied the term ‘metabolism’ to society.”⁴⁶

The global ecological crisis is now increasingly understood within social science in terms of the industrialization of the human-metabolic relation to nature at the expense of the world’s ecosystems, undermining the very bases on which society exists. Marx’s concept of “social metabolism” (also sometimes referred to as “socio-ecological metabolism”) has been used by critical ecological economists to chart the whole history of human-nature intersections, together with the conditions of ecological instability in the present. This has led to analyses of modes of production as successive “socio-metabolic regimes,” as well as to demands for a “socio-metabolic transition.”⁴⁷ Meanwhile, a more direct linking of Marx’s metabolic-rift theory to the critique of capitalist society has allowed researchers in environmental sociology to carry out penetrating, historical-empirical inquiries into a whole range of ecological problems—extending to issues of unequal ecological exchange or ecological imperialism.⁴⁸

Much of this work of course has its roots in the recognition that the world is crossing crucial “planetary boundaries” defined by the departure from the conditions of the Holocene epoch that nurtured the growth of human civilization—a critical approach pioneered by Johan R ockstrom of the Stockholm Resilience Institute and leading climate scientists such as Hansen. Here the main concern is what could be called the Great Rift in the human relation to nature brought on by the crossing of the earth-system boundaries associated with climate change, ocean acidification, ozone depletion, loss of biological diversity (and species extinction), the disruption of the nitrogen and phosphorus cycles, loss of land cover, loss of fresh water sources, aerosol loading, and chemical pollution.⁴⁹

On Earth Day 2003, NASA released its first quantitative satellite measurements and maps of the “earth’s metabolism,” focusing on the extent to which the plant life on earth was fixing carbon through photosynthesis. This data is also being used for monitoring the growth of deserts, the effects of droughts, the vulnerability of forests, and other climate-change developments.⁵⁰ The issue of the earth’s metabolism is of course directly related to the human interaction with the environment. Humanity now consumes a substantial share of the global terrestrial net primary production through photosynthesis and that share is growing at unsustainable levels. Meanwhile, the disruption of the “carbon metabolism” through human production is radically affecting the earth’s metabolism in ways that, if not altered, will have catastrophic effects on life on the planet, including the human species itself.⁵¹ As Hansen describes the potential consequences of the Great Rift in the carbon metabolism in particular:

The picture that emerges for Earth sometime in the distant future, if we should dig up and burn every fossil fuel is thus consistent with...an ice-free Antarctica and a desolate planet without human inhabitants. Although temperatures in the Himalayas may have become seductive, it is doubtful that the many would allow the wealthy few to appropriate this territory to themselves or that humans would survive the extermination of most other species on the planet.... It is not an exaggeration to suggest, based on the best available scientific evidence, that burning all fossil fuels could result in the planet being not only ice-free but human-free.⁵²

Marx and Socio-Ecological Revolution

It is precisely here, when we confront the sheer enormity of the Great Rift in the earth's metabolism, that Marx's approach to the metabolism of nature and society becomes most indispensable. Marx's analysis stressed the rupture by capitalist production of the "eternal natural conditions," constituting the "robbery" of the earth itself.⁵³ But his analysis was unique in that it pointed beyond the forces of accumulation and technology (i.e., the treadmill of production) to the qualitative, use-value structure of the commodity economy: the question of human needs and their fulfillment. The natural-material use value of human labor itself, in Marx's theory, resided in its *real productivity* in terms of the genuine fulfillment of human needs. In capitalism, he argued, this creative potential was so distorted that labor power was seen as being "useful" (from a capitalist exchange-value perspective) only insofar as it generated surplus value for the capitalist.⁵⁴

To be sure, Marx did not himself follow out the full ramifications of this distortion of use value (and of labor's own usefulness). Although he raised the question of the qualitative, use-value structure of the commodity economy he was to leave it largely unexamined in his critique of political economy.⁵⁵ It was generally assumed in the context of mid-nineteenth-century capitalism that those use values that were produced—outside of the relatively insignificant realm of luxury production—conformed to genuine human needs. Under monopoly capitalism, beginning in the last quarter of the nineteenth century, and with the emergence more recently of the phase of globalized monopoly-finance capital, this all changed. The system increasingly demands, simply to keep going under conditions of chronic overaccumulation, the production of *negative* use values and the *non-fulfillment* of human needs.⁵⁶ This entails the absolute alienation of the labor process, i.e., of the metabolic relation between human beings and nature, turning it predominantly into a form of waste.

The first to recognize this in a big way was William Morris, who emphasized the growth of monopolistic capital and the waste associated with the massive production of useless goods and the "useless toil" that this entailed.⁵⁷ Morris, who had studied Marx's *Capital* carefully—and especially the analysis of the labor process and the general law of accumulation—emphasized more than any other thinker the direct connection between socially wasted production and socially wasted labor, drawing out the consequences of this in terms of human life and creativity and the environment itself. In his 1894 lecture "Makeshift," Morris stated:

I noticed the other day that Mr. Balfour was saying that Socialism was impossible because under it we should produce so much less than we do now. Now I say that we might produce half or a quarter of what we do now, and yet be much wealthier, and consequently much happier, than we are now: and that by turning whatever labour we exercised, into the production of useful things, things that we all want, and by...refusing to labour in producing useless things, things which none of us, not even fools want....

My friends, a very great many people are employed in producing mere nuisances, like barbed wire, 100 ton guns, sky signs and advertising boards for the disfigurement of the green fields along the railways and so forth. But apart from these nuisances, how many more are employed in making market wares for rich people which are of no use whatever except to enable the said rich to 'spend their money' as 'tis called; and again how many more in producing wretched makeshifts for the working classes because they can afford nothing better?⁵⁸

Others, including Thorstein Veblen at the beginning of the twentieth century, and Paul Baran and Paul Sweezy in the 1960s, were to develop further the economic critique of waste and the distortion of use values in the capitalist economy, pointing to "the interpenetration effect," whereby the sales effort penetrated into production itself, destroying whatever claims to rationality existed in the latter.⁵⁹ Yet, Morris remained unsurpassed in his emphasis on the effects of the capitalist-commodity-exchange process on the qualitative nature of the labor process itself, converting what was already an exploited labor force into one which was also engaged in useless, uncreative, empty toil—no longer serving to satisfy social needs, but rather squandering both resources and lives.

It is here that Marxian theory, and in particular the critique of monopoly capital, suggests a way out of capitalism's endless creative destructiveness. It is through the politicization of the use value structure of the economy, and the

relation of this to the labor process and to the whole qualitative structure of the economy, that Marx's dialectical approach to the metabolism between nature and society takes on potent form. U.S. expenditures in such areas as the military, marketing, public and private security, highways, and personal luxury goods add up to trillions of dollars a year, while much of humanity lacks basic necessities and a decent life, and the biosphere is being systematically degraded.⁶⁰ This inevitably raises issues of communal needs and environmental costs, and above all the requirement of planning—if we are to create a society of substantive equality, ecological sustainability, and freedom in general.

No transformation of the overall use-value structure of production is conceivable of course without the self-mobilization of humanity within a co-revolutionary process, uniting our multiple struggles. The combined ecological and economic contradictions of capital in our time, plus the entire imperialist legacy, tell us that the battle for such a transition will first emerge in the global South—of which there are already signs today.⁶¹ Yet, the underlying conditions are such that the revolutionary reconstitution of society must be truly universal in its scope and its aspirations, encompassing the entire globe and all of its peoples, if humanity is to succeed in pulling the world back from the brink of catastrophe brought on by capitalism's unrelenting creative destructiveness. In the end it is a question of the human metabolism with nature, which is also a question of human production, and of human freedom itself.

Notes

1. ↪ Jason W. Moore, "Transcending the Metabolic Rift," *Journal of Peasant Studies* 38, no. 1 (January 2011): 1–2, 8, 11; Mindi Schneider and Philip M. McMichael, "Deepening, and Repairing, the Metabolic Rift," *Journal of Peasant Studies* 37, no. 3 (July 2010): 478, 482; Alexander M. Stoner, "[Sociobiophysicality and the Necessity of Critical Theory](#)," *Critical Sociology*, online version (March 19, 2013): 6–7.
2. ↪ Schneider and McMichael, "Deepening, and Repairing, the Metabolic Rift," 481–82. See also Maarten de Kadt and Salvatore Engel-Di Mauro, "Failed Promise," *Capitalism, Nature, Socialism* 12, no. 2 (2001): 50–56.
3. ↪ Georg Lukács, *History and Class Consciousness* (London: Merlin Press, 1968), 24.
4. ↪ The term "Western Marxism" was first introduced by Maurice Merleau-Ponty in *Adventures of the Dialectic* (Evanston, IL: Northwestern University Press, 1973). It was seen as deriving from the work of Lukács (*History and Class Consciousness*), Karl Korsch, the Frankfurt School, and Antonio Gramsci, and extending to most Western philosophical Marxists. It drew its principal inspiration from the rejection of what were seen as positivistic influences in Marxism, and the concept of the dialectics of nature in particular. See Russell Jacoby, "Western Marxism," in Tom Bottomore, ed., *A Dictionary of Marxist Thought* (Oxford: Blackwell, 1983), 523–26.
5. ↪ For an important defense of Engels in this respect see John L. Stanley, *Mainlining Marx* (New Brunswick, NJ: Transaction Publishers, 2002), 1–61. In the dedication to their landmark book, *The Dialectical Biologist*, Levins and Lewontin write: "To Frederick Engels, who got it wrong a lot of the time but who got it right where it counted." Richard Levins and Richard Lewontin, *The Dialectical Biologist* (Cambridge, MA: Harvard University Press, 1985), v.
6. ↪ Lucio Colletti, *Marxism and Hegel* (London: Verso, 1973), 191–93; Jacoby, "Western Marxism," 524. See also Merleau-Ponty, *Adventures of the Dialectic*, 32; Jean-Paul Sartre, *Critique of Dialectical Reason*, vol. 1 (London: Verso, 2004), 32; Herbert Marcuse, *Reason and Revolution* (Boston: Beacon Press, 1960), 314; Alfred Schmidt, *The Concept of Nature in Marx* (London: New Left Books, 1971), 59–61; Steven Vogel, *Against Nature* (Albany: State University of New York Press, 1996), 14–19.
7. ↪ Gramsci explicitly argued that a complete rejection of the dialectics of nature would lead to "idealism" or "dualism" and the destruction of a materialist outlook, voicing this in a discussion of Lukács's *History and Class Consciousness*. Antonio Gramsci, *Selections from the Prison Notebooks* (London: Merlin Press, 1971), 448. For a sharp criticism of Western philosophical Marxism for its move away from materialism and any

- consideration of natural conditions see Sebastiano Timpanaro, *On Materialism* (London: Verso, 1975).
8. ↪ Lukács, *History and Class Consciousness*, 207.
 9. ↪ Lukács, *History and Class Consciousness*, xvii.
 10. ↪ Georg Lukács, *Conversations with Lukács* (Cambridge, MA: MIT Press, 1974), 43. Lukács added the following clarification on the social aspect in the same paragraph: “Since the metabolism between society and nature is also a social process, it is always possible for concepts obtained from it to react on the class struggle in history.”
 11. ↪ Schmidt, *The Concept of Nature in Marx*, 78–79.
 12. ↪ Georg Lukács, *A Defence of “History and Class Consciousness”: “Tailism and the Dialectic”* (London: Verso, 2003), 96, 106, 113–14, 130–31. The later Lukács recognized, like Marx, that the more contemplative materialism associated with Epicurus, Bacon, Feuerbach, and modern science could generate genuine discoveries in science through processes of sense perception and rational abstraction, particularly when accompanied (as Engels had emphasized) by experimentation. Ultimately, however, all of this was related to the development of the relations of production, which constantly transformed human metabolic interaction with nature as well as social relations. See Lukács, *History and Class Consciousness*, xix–xx, and *A Defence of “History and Class Consciousness,”* 130–32; John Bellamy Foster, Brett Clark, and Richard York, *The Ecological Rift* (New York: Monthly Review Press, 2010), 229–31. Note: my overall interpretation of Lukács’s dialectic has changed somewhat since the chapter cited here was written.
 13. ↪ István Mészáros, *Marx’s Theory of Alienation* (London: Merlin Press, 1970), 99–119, 162–65, 195–200, and *Beyond Capital* (New York: Monthly Review Press, 1995), 170–77, 872–97. Mészáros used “I” for industry rather than production in *Marx’s Theory of Alienation*, in his depiction of Marx’s conceptual structure, to avoid confusing it with “P” for property. But industry obviously means production.
 14. ↪ Karl Marx, *Capital*, vol. 3 (London: Penguin, 1981), 949.
 15. ↪ See John Bellamy Foster, *Marx’s Ecology* (New York: Monthly Review Press, 2000), 149–54.
 16. ↪ Liebig quoted in K. William Kapp, *The Social Costs of Private Enterprise* (New York: Schocken Books, 1971), 35.
 17. ↪ Karl Marx and Frederick Engels, *Collected Works*, vol. 42 (New York: International Publishers, 1975), 227.
 18. ↪ Foster, *Marx’s Ecology*, 155–62.
 19. ↪ Karl Marx, *Capital*, vol. 1 (London: Penguin, 1976), 637–38.
 20. ↪ Marx, *Capital*, vol. 1, 860; Brett Clark and John Bellamy Foster, “Guano: The Global Metabolic Rift and the Fertilizer Trade,” in Alf Hornborg, Brett Clark, and Kenneth Hermele, eds., *Ecology and Power* (London: Routledge, 2012), 68–82.
 21. ↪ Marx, *Capital*, vol. 3, 754, 959.
 22. ↪ See Ryan Wishart, “[The Metabolic Rift: A Selected Bibliography](#),” October 16, 2013, <https://monthlyreview.org/commentary/metabolic-rift/>; Foster, Clark, and York, *The Ecological Rift*; Paul Burkett, *Marxism and Ecological Economics* (Boston: Brill, 2006).
 23. ↪ Moore, “Transcending the Metabolic Rift,” 1–2, 8, 11.
 24. ↪ Stoner, “Sociobiophysicality and the Necessity of Critical Theory,” 7. It should be noted that Stoner aims his criticisms of the metabolic rift for its “non-reflexivity” at the present author rather than Marx directly. He does so based on the contention: “We must careful about ascribing the theory of metabolic rift to Marx, since he did not use this terminology, and was not driven to develop a theory based on such terminology.” However, Stoner, neglects to provide any explanation (other than a specious reference to Adorno) as to why he thinks all of Marx’s statements on the metabolism of nature and society and the rift in the social-ecological metabolism (from the *Grundrisse* in 1857–1858 up through *Notes on Adolph Wagner* in 1879–1880) are

actually non-existent or have been falsely attributed to him.

25. ↪ Schneider and McMichael, “Deepening, and Repairing, the Metabolic Rift,” 478–82. Schneider and McMichael argue that the rift in the metabolism between nature and society generates an “epistemic rift” in which nature and society become separated within thought, creating various dualisms that depart from a dialectical perspective. Remarkably, they carry this analysis into a partial criticism of Marx’s theory itself. In his value analysis, they suggest, Marx continually “risks a one-sided representation of the society-nature relationship,” himself falling prey at times to such methodological dualism, since “the abstraction of value and of nature discount ecological relations in capital theory.” Here they fail to recognize that Marx in the treatment of value relations was engaged in *critique*—of the value structure of capital itself. In his conception, capital fails to ground its value abstractions in ecological relations, and *this is* inherent in its character as an alienated mode of production. Marx makes this clear by sharply distinguishing *value* under capitalism from *wealth*—with the latter, as opposed to the former, having its source in both labor and the earth. See Karl Marx, *Critique of the Gotha Programme* (New York: International Publishers, 1938), 3.
26. ↪ Karl Marx and Frederick Engels, *Collected Works*, vol. 30, 54–66.
27. ↪ Such an analysis of course needs to be integrated with Marx’s value-theory-based critique. This was accomplished in Paul Burkett, *Marx and Nature* (New York: St. Martin’s Press, 1999).
28. ↪ Of course society, since it is materially produced, is also objective—a historical manifestation of the metabolism between nature and humanity. See Lukács, *A Defence of “History and Class Consciousness,”* 100–1, 115.
29. ↪ On the role of “isolation” as the key to abstraction in a dialectical approach to science and knowledge see Hyman Levy, *The Universe of Science* (New York: Century Company, 1933), 31–81, and *A Philosophy for a Modern Man* (New York: Alfred A. Knopf, 1938), 30–36; Bertell Ollman, *Dialectical Investigations* (New York: Routledge, 1993), 24–27; Paul Paolucci, *Marx’s Scientific Dialectics* (Chicago: Haymarket Books, 2007), 118–23, 136–42; and Richard Lewontin and Richard Levins, *Biology Under the Influence* (New York: Monthly Review Press, 2007), 149–66.
30. ↪ See István Mészáros, *Lukács’ Concept of Dialectic* (London: Merlin Press, 1972), 61–91.
31. ↪ David Harvey, “History versus Theory: A Commentary on Marx’s Method in Capital,” *Historical Materialism* 20, no. 2 (2012): 12–14, 36.
32. ↪ Karl Marx and Friedrich Engels, *MEGA IV*, 26 (Berlin: Akademie Verlag, 2011), 214–19. See also Joseph Beete Jukes, *The Student’s Manual of Geology*, third edition (Edinburgh: Adam and Charles Black, 1872), 476–512; James Hansen, *Storms of My Grandchildren* (New York: Bloomsbury, 2009), 146–47.
33. ↪ Michael Hulme, “On the Origin of ‘The Greenhouse Effect’: John Tyndall’s 1859 Interrogation of Nature,” *Weather* 64, no. 5 (May 2009): 121–23; Daniel Yergin, *The Quest* (New York: Penguin, 2011), 425–28; Friedrich Lessner, “Before 1848 and After,” in Institute for Marxism-Leninism, ed., *Reminiscences of Marx and Engels* (Moscow: Foreign Languages Publishing House, n.d.), 161; Y.M. Uranovsky, “Marxism and Natural Science,” in Nikolai Bukharin, et. al., *Marxism and Modern Thought* (New York: Harcourt, Brace and Co., 1935), 140; Spencer R. Weart, *The Discovery of Global Warming* (Cambridge, MA: Harvard University Press, 2003), 3–4; W.O. Henderson, *The Life of Friedrich Engels*, vol. 1 (London: Frank Cass, 1976), 262.
34. ↪ It is interesting to note in this regard that Marx’s friend Lankester was to emerge as the most virulent early twentieth-century critic of the catastrophic human destruction of species throughout the globe, particularly in his essay “The Effacement of Nature by Man.” See E. Ray Lankester, *Science From an Easy Chair* (New York: Henry Holt, 1913), 373–79.
35. ↪ Schneider and McMichael, “Deepening, and Repairing, the Metabolic Rift,” 481–82. Others have been even more critical, claiming that Marx’s analysis cannot be considered ecological because he did not use the word “ecology” (coined by Haeckel in 1866 but not in general use in Marx and Engels’s lifetime—according to the *Oxford English Dictionary* the first reference to the term in English, outside of translations of Haeckel’s

- work, was in 1893) and because he could not have known about “the development of chemical sciences that produced PCBs, CFCs, and DDT.” De Kadt and Engel Di-Mauro, “Failed Promise,” 52–54.
36. ↪The earth-system notions of biogeochemical cycles and of the biosphere had their origins in the work of the Soviet scientist V.I. Vernadsky in the 1920s, and reflected the extraordinary development of dialectical ecology in the USSR in this period—prior to the purges, directed at ecologists in particular in the 1930s. See Foster, *Marx’s Ecology*, 240–44.
 37. ↪See “Ecology,” *Oxford English Dictionary*, vol. 2 (Oxford: Oxford University Press, 1971), 1975; “Ecology,” *Oxford English Dictionary Online*; Ernst Haeckel, *The History of Creation*, vol. 2, translation supervised and revised by E. Ray Lankester (New York: D. Appleton and Co., 1880), 354; E. Ray Lankester, *The Advancement of Science* (New York: Macmillan, 1890), 287–387; Arthur G. Tansley, “The Use and Abuse of Vegetational Concepts Terms,” *Ecology* 16 (1935): 284–307; Foster, Clark, and York, *The Ecological Rift*, 324–34; Peter Ayres, *Shaping Ecology: The Life of Arthur Tansley* (Oxford: John Wiley and Sons, 2012), 42–44.
 38. ↪Eugene P. Odum, “The Strategy of Ecosystem Development,” *Science* 164 (1969): 262–70; Frank Benjamin Golley, *A History of the Ecosystem Concept in Ecology* (New Haven: Yale University Press, 1993), 70; Howard T. Odum and David Scienceman, “An Energy Systems View of Marx’s Concepts of Production and Labor Value,” in *Emergy Synthesis 3: Theory and Applications of the Emergy Methodology*, Proceedings from the Third Biennial Emergy Conference, Gainesville, Florida, January 2004 (Gainesville, FL: Center for Environmental Policy, 2005): 17–43; Howard T. Odum, *Environment, Power, and Society* (New York: Columbia University, 2007), 303, 276; John Bellamy Foster and Hannah Holleman, “A Theory of Unequal Ecological Exchange: A Marx-Odum Dialectic,” forthcoming, *Journal of Peasant Studies* (2014).
 39. ↪I owe this description of the viewpoint of modern soil science and the effects of the changing human metabolism on the nutrient cycle to Fred Magdoff. See Fred Magdoff and Harold Van Es, *Better Soils for Better Crops* (Waldorf, MD: Sustainable Agricultural Research and Education Program, 2009).
 40. ↪Frederick Engels, *On Marx’s Capital* (Moscow: Progress Publishers, 1956), 95.
 41. ↪Frederick Engels, *The Housing Question* (Moscow: Progress Publishers, 1975), 92; see also Marx and Engels, *Collected Works*, vol. 25, 460–62.
 42. ↪For a reasoned account of the Lysenko controversy see Levins and Lewontin, *The Dialectical Biologist*, 163–96.
 43. ↪See John Bellamy Foster, “Marx’s Ecology and Its Historical Significance,” in Michael R. Redclift and Graham Woodgate, eds., *International Handbook of Environmental Sociology*, 2nd ed. (Northampton, MA: Edward Elgar, 2010), 106–20.
 44. ↪See Barry Commoner, *The Poverty of Power* (New York: Bantam, 1976), 236–44; Levins and Lewontin, *The Dialectical Biologist*, and *Biology Under the Influence*; Richard York and Brett Clark, *The Science and Humanism of Stephen Jay Gould* (New York: Monthly Review Press, 2011).
 45. ↪It is noteworthy that in his 1932 article, “The Method and Function of an Analytic Social Psychology,” that played such a crucial formative role in the development of the Frankfurt School, Fromm emphasized the need to deal with the nature-society dialectic and pointed to the importance of Nikolai Bukharin’s *Historical Materialism*, saying that it “underlines the natural factor in a clear way.” Fromm could only have meant Bukharin’s use in this work of Marx’s concept of metabolism. (Erich Fromm, *The Crisis of Psychoanalysis* [Greenwich, CT: Fawcett Publications, 1970], 153–54.) The Frankfurt School, however, did not follow this path, which would have required a radical reconsideration of the whole, difficult question of the dialectics of nature. Consequently, thinkers such as Fromm, Horkheimer, Adorno, and Marcuse were later to make various broad, critical-philosophical observations on the domination of nature, which all too often lacked substantive, materialist reference points with respect to ecosystem analysis, ecological science, and ecological crises themselves. Although the critical apparatus that they were able to employ allowed them to perceive the

general conflict between capitalist society and the environment, the separation that had occurred between Western Marxism and natural science hindered further development in a field that demanded a critical or dialectical naturalism/realism and the recognition of nature's own dynamics. On this general problem see Roy Bhaskar, *The Possibility of Naturalism* (Atlantic Highlands, NJ: Humanities Press, 1979). On Adorno's limited recognition of the importance of Marx's concept of social metabolism see Deborah Cook, *Adorno on Nature* (Durham, UK: Acumen, 2011), 24–26, 103–4.

46. ↪ Marina Fischer-Kowalski, "Society's Metabolism," in Michael Redclift and Graham Woodgate, eds., *International Handbook of Environmental Sociology* (Northampton, MA: Edward Elgar, 1997), 122.
47. ↪ Helmut Haberl, Marina Fischer-Kowalski, Fridolin Krausmann, Joan Martinez-Alier, and Verena Winiwarter, "A Socio-Metabolic Transition Towards Sustainability?: Challenges for Another Great Transformation," *Sustainable Development* 19 (2011): 1–14. The authors of this article avoid attributing the origin of the concept of "social metabolism" to Marx, preferring to cite R.U. Ayres and U.E. Simonis as their first instance of the use of the concept, due to Ayres and Simonis's use of the category of "industrial metabolism" in a 1994 edited volume. Nevertheless, both Fischer-Kowalski and Martinez-Alier were clear in their earlier writings that the concept of "social metabolism" had its origin in Marx. Their failure to note that here may be related to the fact that this article seeks to avoid the question of capitalism altogether, tracing the contemporary ecological problem simply to "industrial society," contradicting in that respect earlier work by at least some of these authors.
48. ↪ Wishart, "[Metabolic Rift: A Selected Bibliography](#)."
49. ↪ Johann Rockström, et. al., "A Safe Operating Space for Humanity," *Nature* 461 (September 24, 2009): 472–75; Foster, Clark, and York, *The Ecological Rift*, 13–18.
50. ↪ "[NASA Satellite Measures Earth's Carbon Metabolism](#)," *NASA Earth Observatory*, April 22, 2003, <http://earthobservatory.nasa.gov>.
51. ↪ J.G. Canadell, et. al., "Carbon Metabolism of the Terrestrial Biosphere," *Ecosystems* (2000) 3: 115–30.
52. ↪ James Hansen, "[An Old Story But Useful Lessons](#)," September 26, 2013, <http://columbia.edu/~jeh1/>.
53. ↪ Marx, *Capital*, vol. 1, 637–38.
54. ↪ "Real labour," Marx wrote, "is purposeful activity aimed at the creation of a use value, at the appropriation of natural material in a manner which corresponds to particular needs." Marx and Engels, *Collected Works*, vol. 30, 55. Obviously the more the labor process is alienated and thus estranged from these essential natural and social conditions, the more it takes on an artificial, unreal form.
55. ↪ This is not to say that Marx was completely unaware of the problem of specifically capitalist use values and the wasted labor associated with it. On this see John Bellamy Foster, "James Hansen and the Climate-Change Exit Strategy," *Monthly Review* 64, no. 9 (February 2013): 14.
56. ↪ On the role of specifically capitalist use values in today's phase of monopoly-finance capital see John Bellamy Foster, "[The Epochal Crisis](#)," *Monthly Review* 65, no. 5 (October 2013): 1–12.
57. ↪ See William Morris, *William Morris: Artist, Writer, Socialist*, vol. 2 (Cambridge: Cambridge University Press, 1936), 469–82, and *Collected Works*, vol. 23 (New York: Longhams Green, 1915), 98–120, 238–54. Morris's stance here was closely related to the general ecological tenor of his socialism evident in his 1890 utopian novel, *News From Nowhere*. See also Harry Magdoff, "[The Meaning of Work](#)," *Monthly Review* 34, no. 5 (October 1982): 1–15.
58. ↪ Morris, *William Morris: Artist, Writer, Socialist*, 479. The ellipsis before the word "refusing" in the first paragraph of this quote replaces the word "not," which was clearly a typographical error in the preparation of the text.
59. ↪ Thorstein Veblen, *Absentee Ownership and Business Enterprise in Recent Times* (New York: Augustus M. Kelley, 1923); Paul A. Baran and Paul M. Sweezy, *Monopoly Capital* (New York: Monthly Review Press,

- 1966), and “[The Last Letters](#),” *Monthly Review* 64, no. 3 (July–August 2012): 68, 73.
60. ↪ John Bellamy Foster, Hannah Holleman, and Robert W. McChesney, “[The U.S. Imperial Triangle and Military Spending](#),” *Monthly Review* 60, no. 5 (October 2008): 10; “[U.S. Marketing Spending Exceeded \\$1 Trillion in 2005](#),” *Metrics 2.0*, January 26, 2006, <http://metrics2.com>; U.S. Bureau of Economic Analysis, National Income and Product Accounts, “[Government Consumption Expenditures and Investment by Function](#),” Table 3.15.5, <http://bea.gov>; “[U.S. Remains World’s Largest Luxury Goods Market in 2012](#),” *Modern Wearing*, October 22, 2012, <http://modernwearing.com>; “[Groundbreaking Study Finds U.S. Security Industry to be \\$350 Billion Industry](#),” *ASIS Online*, August 12, 2013, <http://asisonline.org>.
61. ↪ On this see Foster, “[James Hansen and the Climate-Change Exit Strategy](#),” 16–18, and “[The Epochal Crisis](#),” 9–10.