

Capital as a Theory of Metabolism

Despite recent robust discussions of “Marx’s ecology,” one still repeatedly hears the critical view that a systematic illustration of Marx’s ecology is not possible. Critics argue that there are only sporadic ecological references in his written works, demonstrating that Marx’s ecological interest was unfortunately not a serious one and thus his overall theory is fatally flawed.¹ In this vein, Jason W. Moore argues that John Bellamy Foster’s theory of “metabolic rift” inevitably “has reached an impasse.”² Though the potentiality of a classical Marxist approach is widely undervalued by first-stage ecosocialists, their critique at least brings up an important challenge for a further development of an ecological critique of capitalism oriented to Marx’s own method and system. However, they mistakenly believe that Marx’s theory of metabolism does not have a systematic character related to his value theory in *Capital*. This is why critics argue that Foster and Burkett merely gather Marx’s isolated and sporadic remarks about ecology, and their analysis is misunderstood as an “apocalyptic” warning about ecological catastrophes.³

Only a *systematic* analysis of Marx’s theory of metabolism as an integral part of his critique of political economy can convincingly demonstrate, against the critics of his ecology, how the capitalist mode of production brings about various types of ecological problems due to its insatiable desire for capital accumulation. And why radical social change on a global scale, one that consciously constructs a cooperative, non-capitalist economic structure, is indispensable if humanity is to achieve a sustainable regulation of natural and social metabolism.

In this chapter, I provide a systematic interpretation of *Capital*, arguing that Marx’s critique of metabolic rifts can be consistently developed from his value theory. His analysis of abstract labor reveals the

fundamental tension between a reified commodity production and a sustainable intercourse with nature. Marx's *Capital* analyzes this tension to demonstrate that capital as the "subjectification" (*Versubjektivierung*) of value can interact with nature only in a one-sided manner, insofar as, according to the logic of capital, the squeezing of abstract labor constitutes the sole source of the capitalist form of wealth. With this insight, *Capital* prepares a theoretical foundation for further analyses of the historically specific dynamics of production in capitalism, in which the logic of capital radically modifies and reorganizes the incessant material interaction between humans and nature and finally even destroys it. In this context, Marx's "theory of reification" is of great importance, because it explains how capital, going beyond the production process, transforms human desires and even all of nature for the sake of its own maximal valorization.

By dealing with the relationship between "ecology" and "reification," it becomes necessary to displace the focus of the critique of political economy from social and economic "forms" to the "material" (*stofflich*) dimensions of the world. The material dimensions undergo various discrepancies and disharmonies precisely as a result of economic form determinations. Though Marx often points to the significance of "matter" (*Stoff*) in *Capital* and its preparatory manuscripts, the material dimension of his critique was largely underestimated in recent debates within Western Marxism. Good examples of this are "*Kapitallogik*" by Hans-Georg Backhaus and Helmut Reichelt, the "new reading of Marx" of Michael Heinrich and Ingo Elbe, and the "New Dialectics" of Chris Arthur and Tony Smith.⁴

Thus, after describing the labor process as a transhistorical metabolism, in this chapter I will make a "detour" to a Japanese interpretation of Marx that is seldom heard in the West, that which is based on the "Kuruma School." With this Japanese reading of *Capital*, it is possible to construct a stable theoretical foundation for further analysis in terms of how Marx thought of the exhaustion of the labor force and the soil not just as manifestation of the contradictions of capitalism but as a place of resistance against capital.

THE LABOR PROCESS AS TRANSHISTORICAL METABOLISM

To reveal the historical modifications of the metabolic interaction between humans and nature through the economic logic of capitalism, we must first deal with the *transhistorical* and universal aspect of

production abstracted from concrete social aspects. Indeed, it is this type of abstraction that Marx carries out in chapter 5, "Labor Process," in volume 1 of *Capital*, elaborating on the metabolic interaction between humans and nature as the production of use values "independent of any specific social form." In this chapter Marx defines labor as "a process between man and nature, a process by which man, through his own actions, mediates, regulates, and controls the metabolism between himself and nature."⁵ Furthermore, labor is characterized as a specific *human* activity, in that in contrast to the instinctive operations of animals (such as spiders weaving webs or bees constructing honeycomb cells) humans are able to work upon nature *teleologically*, realizing an idea in their heads as an object in the external world. Labor is a purposeful and conscious act of production, a mediation or regulator of the metabolic interaction between humans and nature.

Labor as a metabolic mediation is essentially dependent on and conditioned by nature. Human production cannot ignore natural properties and forces; humans must acquire their assistance in the labor process. Thus labor cannot arbitrarily work upon nature; its modification faces certain material limitations:

When man engages in production, he can only proceed as nature does herself, i.e. he can only change the form of the materials. Furthermore, even in this work of modification he is constantly helped by natural forces. Labor is therefore not the only source of material wealth, i.e. of the use-values it produces. As William Petty says, labor is the father of material wealth, the earth is its mother.⁶

Nature as the "mother" of material wealth provides not just objects of labor, but it also actively works together with producers during the labor process. Marx in *Capital* recognizes the essential function of nature for the production of any material wealth, and this aspect will without doubt remain essential for a post-capitalist society. Concrete labor as a regulator of this permanent metabolic interaction between humans and nature not only takes away from nature but also gives back the products of labor, including waste, to the sensuous world. In this way, a circular process proceeds as an untranscendable material condition of human life.

Marx summarizes the labor process as a material process:

The labor process . . . is purposeful activity aimed at the production of use values. It is an appropriation of what exists in nature for the

requirements of man. It is the universal condition for the metabolic interaction [*Stoffwechsel*] between man and nature, *the everlasting nature-imposed condition of human existence*, and it is therefore independent of every form of that existence, or rather it is common to all forms of society in which human beings live.⁷

This definition of the labor process clearly indicates the fundamental physiological and transhistorical fact that the production and reproduction of humans must without exception occur through constant interaction with their environment. In other words, it is only through this incessant intercourse with nature that humans can produce, reproduce, and, in short, live on the earth.

This definition is only a beginning of Marx's theory of metabolism, and so the labor process is presented here only "in its simple and abstract elements."⁸ Indeed, the statement that human production is inevitably dependent upon nature alone seems banal. Marx cautions elsewhere against its overvaluation because these types of transhistorical conditions are "nothing more than the essential moments of all production," and they are only "characteristics which all stages of production have in common, and which are established as general ones by the mind; but the so-called *general conditions* of all production are nothing more than these abstract moments with which no real historical stage of production can be grasped." Obviously, it is not possible to fully develop Marx's ecological critique of capitalism out of "a few very simple characteristics, which are hammered out into flat tautologies."⁹ Any attempt to find an ecological aspect in Marx's discussion of the labor process alone will remain abstract and futile. Its further characterization is required to avoid a merely moralistic critique that we should respect nature because we owe our existence to it. If one is to develop Marx's ecology as a part of his economic system, it is necessary to comprehend the modern destruction of the environment in its relation to the capitalist mode of production as a historically specific stage of human production. It is exactly this task that Marx undertakes with his theory of value and reification in *Capital*. He demonstrates why the transhistorical process between humans and nature can only be mediated *in a one-sided manner* by a specific historical form of labor in capitalism.

REIFICATION AS THE KERNEL OF MARX'S THEORY

Marx's *Capital* begins with an analysis of "the commodity" as the "elementary form" of the capitalist mode of production. The commodity

has two aspects, “use value” and “value,” and the labor that produces commodities also possesses characteristics that include “concrete useful labor” and “abstract human labor.” Concrete useful labor suggests a series of qualitatively different types of labor, such as weaving and tailoring, which, accordingly, produce qualitatively diverse use values such as linen and coats. This aspect of human labor as a concrete activity that produces various use values through the modification of matter expresses a physiological, material, and transhistorical moment of the metabolic interaction of humans with their environment. Marx’s characterization of concrete labor is not controversial. On the contrary, his claim that abstract labor is also *material* has been highly contentious.

Abstract human labor that creates the value of commodities within society with commodity production is, according to Marx’s definition, abstracted from all concrete characteristics, so it is invisible and untouchable. Moreover, he states quite explicitly that value as such is a pure social construction. But he also clearly maintains that abstract labor is physiological and transhistorical: “All labor is *an expenditure of human labor-power, in the physiological sense*, and it is in this quality of being equal, or abstract, human labor that it forms the value of commodities.”¹⁰ He also writes: “However varied the useful kinds of labor, or productive activities, it is a physiological fact that they are functions of the human organism, and that each such function, whatever may be its nature or its form, is essentially the expenditure of human brain, nerves, muscles and sense organs.”¹¹ This “physiological fact” is true of any expenditure of labor power, and in this sense abstract labor is also as material and transhistorical as concrete labor.

Writing against this claim in *Capital*, Isaak Rubin’s interpretation has found a wide audience, and a number of Marxists such as Michael Heinrich, Riccardo Bellofiore, and Werner Bonefeld today argue that abstract labor is neither material nor transhistorical, but a purely social form of labor characteristic only of the capitalist mode of production.¹² Against this dominant current, it is necessary to emphasize that Marx’s theoretical aim in chapter 1 of volume 1 of *Capital* is often not correctly understood, and this leads to the claim that Marx’s theory is fundamentally “ambivalent.”¹³ Actually, a consistent interpretation of Marx’s explanation of abstract labor is not only possible but also all the more important in the current context because it constitutes the theoretical basis for a systematic analysis of his ecology. As I will argue, ecology provides an eminent example of how the focus on the materiality of abstract labor can open up an attractive and productive reading of Marx’s value

theory. In this context, it is worth taking a look at an important Japanese interpretation of Marx presented by Samezo Kuruma and Teinosuke Otani.¹⁴

Heated debates on the first three chapters of volume 1 of *Capital* occurred in Japan as well. The Kuruma school put forth one of the most consistent interpretations, which will function here as a basis of the current investigation. Kuruma's contribution to Marxist study is relatively unknown, with some exception in Germany, where his name has attained distinction thanks to his fifteen volumes of *Marx-Lexikon zur politischen Ökonomie*, which his student Teinosuke Otani and others co-edited. Kuruma's main work, *Marx's Theory of the Genesis of Money: How, Why and Through What Is a Commodity Money*, is largely neglected.¹⁵ So I hope this chapter will help introduce the unknown legacy of Samezo Kuruma to readers outside of Japan.

Marx, in beginning his analysis in *Capital* with the category of the commodity, first deals with the characteristics of simple commodity production.¹⁶ Commodity production is a form of social production that is founded on a historically specific division of labor. In his *History of Political Economy*, Samezo Kuruma (along with his co-author Yoshiro Tamanoi) explicates the specific characteristics of commodity production, pointing to "private labor" as the key to comprehend the modern relations of production.¹⁷ By doing so, Kuruma follows Marx's explanation in *Capital* about the social division of labor based on "private labors." Marx writes:

Objects of utility become commodities only because they are the products of the labor of private individuals who work independently of each other. The sum total of the labor of all these private individuals forms the aggregate labor of society. Since the producers do not come into social contact until they exchange the products of their labor, the specific social characteristics of their private labors appear only within this exchange. In other words, the labor of the private individuals manifests itself as an element of the total labor of society only through the relations which the act of exchange establishes between the products, and, through their mediation, between producers.¹⁸

Marx clearly argues that *only* products of labor made by "private labors" carried out by "private individuals" become commodities. The concept of "private labor" should not be confused with labors that are

carried out by individuals in isolation from social production just for the sake of private enjoyment and hobby. Rather, the concept characterizes those labors that are a part of the social division of labor (in which people are dependent on others' products) but nonetheless carried out "independently of each other," without any social arrangement, so that producers must produce without knowing what other individuals actually want.

Kuruma explains how the "social division of labor" founded on private labor can be successfully arranged. The sum total of all available labors in one society is finite without exception because its members can only work for a certain amount of time in a year. This is simply a physiological fact. In any society where individuals cannot satisfy their own needs and are dependent on others, an adequate "allocation" of the entire supply of labor into each branch of production must be somehow arranged and realized so that the reproduction of a society can actually take place. If some of the necessary products are oversupplied and others are undersupplied, the needs of individuals will not be satisfied, and further production will not alter this fact. Moreover, the successful reproduction of society also requires an appropriate mode of "distribution" of products to the members of society. The allocation of the sum total of labor and the distribution of the sum total of products are two fundamental and transhistorical material conditions for the existence of society.¹⁹

To comprehend the specificity of the modern social division of labor, it is helpful to compare it with other, non-capitalist forms of social production. In forms of the social division of labor not based on private labor, allocation and distribution are regulated by a certain personal will, *before* labor activities are actually carried out, whether the method of this organization is despotic, traditional, or democratic. As a result, the sum total of society's labor can be allocated into each concrete labor and the products can also be distributed among members of society. This kind of social production is possible because social needs are always known before the act of production. If the entire production is arranged in accordance with this knowledge about society's needs, the labor of each individual *directly* possesses a social character, owing to its guaranteed contribution to the reproduction of the society.

Since a society with commodity production, like all other forms of society, is subjected to this transhistorical material condition, it is necessary for such a system to somehow organize the allocation of labor and the distribution of products. Commodity production differs significantly from other forms of the social division of labor in that the activity of

labor carried out by individuals is organized *as a private* act, which does not become a part of the entire social labor at the moment of labor's execution. It is thus necessary to realize the adequate "allocation" and "distribution" not before but *after* labor is performed. Private labors as such thus do not possess any immediate social character and do not constitute a part of entire social labor. In the moment of production, the possibility always exists that labor is exercised in vain for some products that will not find any needs for them. In a society with commodity production, there is a *real contradiction* that in spite of the mutual material dependence of all producers—which forces everyone to step into a social contact with others for the sake of satisfying one's own needs—the labors of individuals must be carried out as a matter of fully private calculations and judgments. According to Kuruma, this real contradiction requires a "detour" in order to realize the continuation of social production and reproduction under private labor.²⁰

Kuruma argues that this detour takes place when private producers relate to each other through the mediation of the products they produce. Since they cannot directly relate to each other, they must first come into contact with others through the reified relation of "the act of exchange between the products." When their products actually satisfy the needs of others through a commodity exchange and prove their social characteristics as use values, it is *retrospectively* possible to confirm the social character of expended private labor that is now considered socially useful labor. On the one hand, since the product actually met the needs of people, the successful commodity exchange means that the allocation of this labor took place fruitfully and was not wasted in the production of something that society does not need. On the other hand, the distribution of products among members of society occurs at the same time, through this exchange between commodities. This is the specific way of organization of the material conditions of production and reproduction under commodity production.

This social relation among private producers becomes possible thanks to certain material characteristics of labor's products. In other words, the social contact mediated by such products is possible because the material use value can be an object of others' desire. Since private producers mutually desire others' products, the sociality of a use value enables producers to have mutual contact. This sociality of a use value is dependent on whether it can satisfy a certain human need (which is, of course, socially conditioned), but it is fundamentally based on a material characteristic of each product.

There still remains a difficulty: it is still necessary to comprehend what functions as a *criterion* in the exchange of diverse products. The use value of each product is so different that there seems to exist no common measure for the exchange. However, as Marx argues, such a measure does exist, and it is this measure that characterizes the commodity exchange. In commodity exchange, in contrast to other forms of exchange, the *value relation* is characteristic. Marx writes that it “is only by being exchanged that the products of labor acquire a socially uniform objectivity as values, which is distinct from their sensuously varied objectivity as articles of utility.”²¹ Commodities with qualitatively different use values go into an equivalent relation of value in the process of commodity exchange. “Value” functions as a common criterion through which various products are made comparable. Mediated by the value relation between various commodities, private labors can relate to one another as social ones. Since value is required because of the specific characteristic of private labor, it is not a natural property of matter, and it does not exist in other forms of social production. Value is a “purely social” character of a thing that, independent of material characteristics, exists only under the historically specific social relations of commodity production.

Marx maintained that the “substance” of value is abstract labor. He said that, as a result of abstracting from concrete characteristics of labor, private labors are objectified in products as an expenditure of human labor power, in the physiological sense. In terms of the relationship between “value” and “abstract labor” it is clear first of all that the category of value has an essential connection with a specific modern social division of labor. The objectification of abstract labor as value necessarily occurs within societies with commodity production because the social allocation of the sum total of all available labor must take place. As objectification of abstract labor, value is a purely social property of matter with which private producers can enter into a social contract with others. As a pure social construction, value does not possess a sensuous form that we can touch or smell like a use value. Marx thus appropriately calls value a “phantom-like objectivity” because abstract labor cannot be materially objectified after abstraction of all concrete aspects. It appears only in a “phantom-like” manner.²²

However, it does not follow that abstract labor is also “purely social.” Rather, it is necessary strictly to distinguish “value” and “abstract labor.” Many argue that when value is purely social, abstract labor is also purely social because it is value-creating labor. This explanation is simply not

very convincing because it says no more than that "value-creating-labor creates value." This is merely a circular argument.

Thus it is necessary to differentiate value and abstract labor and make the content of the latter more fruitful. As said, value is purely social because in a specific society with commodity production, where social contact among private producers can only take place through the mediation of their products, one aspect of human labor must be objectified as value. In other words, the objectification of abstract labor occurs only through this specific social behavior of private producers that unconsciously but forcibly emerges under commodity production.

Abstract labor is, in contrast, physiological because it plays a social role in a transhistorical fashion in any society. Insofar as the total quantity of labor as expenditure of the human labor force is inevitably limited to a certain finite amount at any time, its adequate allocation for the sake of the reproduction of society is always of great significance for the reproduction of society. Labors as concrete labors are diverse and not compatible to each other, but they are *physiologically* the same and comparable in that, without exception, they consume a part of the finite sum of labor in the society. This aspect of abstract labor is essential in any social division of labor and thus plays a transhistorical role, as Marx argues: "In all situations, the labor-time it costs to produce the means of subsistence must necessarily concern mankind, although not to the same degree at different stages of development."²³ Any society must pay attention to the sum total of labor because it has to use it cautiously in order to attain necessary products every day of every year.

To sum up, in a society with commodity production, due to the private character of labor a social contract can only be realized through the social character of matter, that is, use values that become the object of other people's desires. In the exchange between different use values, value is required as their common criterion, in which abstract labor as one aspect of human labor is objectified through social praxis as a pure social character of matter. In this way, the allocation of social labor is unconsciously carried out through value, and the distribution of products takes place through commodity exchanges as well.

Now, it is understandable that abstract labor in societies with commodity production also functions as a specific social form of private labor. In other types of society, concrete labors are directly social labor despite the variety of their content because the allocation of the entire labor is arranged before performing concrete labors. As seen above, private labor, in contrast, does not possess such a social character in

itself, so that the performance of concrete labor as such cannot arrange an adequate allocation of the sum total of labor. In a society with commodity production, abstract labor instead of concrete labor functions as a historically specific social form of labor in the moment of exchange, so that private labors can be socially comparable and related to one another. In other words, private labor can attain a socially meaningful form only with the aid of the "generality of labor," as abstract labor in which their diversity disappears. Marx's point is that a certain material aspect of human activity, in this case labor's pure physiological expenditure, receives a specific economic form and a new social function under capitalistically constituted social relations.

In this way, capitalist social relations bring new social characteristics into the transhistorical metabolic interaction between humans and nature. The allocation of the entire labor and the distribution of the entire product under commodity production are arranged through the mediation of "value," that is, objectified abstract labor. There is no conscious agreement on the general production among producers because they simply follow price changes in the market. Value is the fundamental sign for producers with regard to what they should produce. Since social production is nothing but the regulation of the metabolic interaction between humans and nature, value is now its mediator, which means that the *expenditure of abstract labor* is primarily taken into account in the metabolic process. Other elements of that metabolic interaction, such as concrete labor and nature, in contrast play only a secondary role and are taken into account only as long as they relate to value, even if they continue to function as essential material factors in the labor process. Insofar as abstract labor is also a material element of the labor process, its expenditure cannot completely ignore other material elements that work with it. However, thanks to the material elasticity of these elements, they can be subordinated to abstract labor. A germ of a contradictory relationship lies between nature and humans, and it grows to a great antagonism between nature and society with the development of capitalist production. This point is decisive for the systematic illustration of Marx's ecology. In order to follow its concretization in reality, we will now continue Marx's discussion about the *theory of reification* in *Capital*.

Since private producers can only relate to each other through the mediation of commodity exchange, it is necessary that they behave in such a way that the products of their labor attain a unique social property so that they can exchange diverse use values under a single common criterion, that is, "value." In other words, value is a social power that private

producers unconsciously bestow on their products of private labor for the sake of constructing social ties. Marx emphasizes in a famous passage that this social practice is not a conscious but an unconscious act:

Men do not therefore bring the products of their labor into relation with each other as values because they see these objects [*Sachen*] merely as the material [*sachliche*] integuments of homogeneous human labor. The reverse is true. By equating their different products to each other in exchange as values, they equate their different kinds of labor as human labor. They do this without being aware of it.²⁴

Without equating products as values in the market, the social contacts necessary for social production and reproduction are not possible. This is an objective reality. This social practice of equating “different products to each other in exchange as values” is thus *forced* upon the members of the society as an unconscious act that is necessary for the material existence of society.

With a particular focus on Marx’s theory of reification, Teinosuke Otani, a student of Samezo Kuruma, developed the theoretical structure of the first three chapters of the first volume of *Capital*, revealing the fundamental characteristics of societies with commodity production. According to Marx’s own description, here is the basic characteristic of reification under commodity production:

To the producers, therefore, the social relations between their private labors appear as what they are, i.e. they do not appear as direct social relations between persons in their work, but rather as material relations between persons and social relations between things.²⁵

Otani characterizes this inversion within modern society as the “reification of a person,” that is, as an alien domination of things that exerts its influence independent of human consciousness. This inversion of the world emerges out of the objective social structure in which the social relations of the producers do not directly appear as relations between persons but only as relations between things. Consequently, the “social character of labor” transforms into the “value character of labor product,” the “continuity of labor in time” into the “value quantity of the labor product,” and “social relation” into the “exchange relation of labor products.”²⁶ This inversion is not a mere epistemic fallacy, in the sense of concealing and mystifying some kind of “essence” of fundamental

human relations, but is a practical and objective phenomenon because private producers in reality cannot relate to one another without the value-mediated commodity exchange in the market. Human practice is inverted into the movement of labor products and dominated by it, not in a person's head, but in reality. As Marx writes: "Their own movement within society has for them the form of a movement made by things, and these things, far from being under their control, in fact control them."²⁷

Producers are interested in the proportion of exchange with other commodities in order to effectively satisfy their own needs, but they cannot control this proportion—it constantly changes and does so suddenly against their calculations and expectations. Rather, producers are controlled by the movement of values, without guarantee that they can actually exchange their products with other use values they want. They do not even know whether they can exchange their products at all. The movements of commodities and money confront the producers as something alien because these determine the behavior of producers, and not the other way round. There exists an actual inversion of the relationship between the subject and the object, whose analogy Marx finds in religion: "This is exactly *the same* relation in the sphere of material production, in the real social life process . . . as is represented by *religion* in the ideological sphere: the inversion of the subject into the object and *vice versa*."²⁸ This objective inversion extends to the entire society with further self-developments of value as "money" and "capital."

Despite the reified movement that appears independent of the will of the producers, it is evidently not possible for a commodity to go into the market as an independent "subject." Commodities need humans as their "bearers (*Träger*)" who bring them to the market and exchange them for the sake of consumption. This commodity exchange is, of course, regulated by value. In this way, reification modifies human behavior and desires as the logic of value independently penetrates humans, turning them into the "bearers of commodities," wherein a further practical inversion of the world emerges. In order to realize the exchange of commodities, the possessors of a commodity must relate to each other in the market, recognizing each other as the "owner" of the commodity. In the exchange process, their functions are abstracted and reduced to a mere "bearer" of their products as commodities, which Otani, following Marx, calls the "personification of things."²⁹ The more the social power of commodity, money, and capital expands over the world, the more human functions are subordinated and integrated to these reified, economic relations in accordance with the logic of value. Out of these

modifications emerges a model of modern subjectivity, which internalizes the “rationality” of this inverted world, so that “Freedom, Equality, Property, and Bentham,” as Marx bitinglly characterizes the capitalist market, become absolutized as the universal norms, without taking into account the fundamental inverted structure of this society, what Otani calls “homo economicus illusion.”³⁰

As indicated, this “homo economicus illusion,” the false view glorified by capital’s apologists, is the reflex of the actual inversion in the objective structure construed in the society based on private labors. The social inversion gets strengthened even further with this illusion because individuals not only observe the surface of the world and accept economic categories such as “value” and “commodity” while unaware of the inverted social structure that produces them, but they also, in conformity with this illusion, gradually internalize a new subjectivity with a set of behaviors and judgments, on the basis of which they *consciously* come to obey the bourgeois utilitarian ideals of “freedom,” “equality,” and “property.” These new desires and views of the world in many cases determine the mode of behavior as an objective force, because without conforming to a certain type of social rationality in the inverted world individuals cannot survive under these social relations. They often do not have plausible alternatives other than following the rules if they wish to live under the current social and economic system. Through social practice, the social relations of this inverted world are constantly reproduced and in the end naturalized. Obeying the economic reduction of subjectivity, individuals voluntarily function as bearers of commodity and money. As a result, they appropriate a series of norms, rules, and other value standards as sole markers of human “rationality.”

Due to the reified construction of the social structure, capitalists are, on the one hand, forced by the logic of the system to reduce any “unnecessary” costs, including those of sanity, health, and safety for the workers, to pressure the labor force as much as possible for the valorization of capital, and constantly seek to increase productivity without thinking about the sustainable reproduction of natural resources. Laborers are compelled, on the other hand, to work harder than ever, are disciplined under the directions of the capitalists, and are forced to withstand poor working conditions if they wish to sell their labor forces successfully. No matter what they wish, the threat of losing a job is enough to make workers endure a bad situation so that they can receive the wages necessary

for the purchase of their means of subsistence. All these behaviors reproduce the objective inversion of society and deepen workers' dependence on commodities and money.

The first three chapters in *Capital* volume 1 show that the modification of the material world begins with the category of "value." The inversion of relations between persons into relations between things causes not only alien, reified domination of the actions of individuals—"reification of persons"—but also causes the modification of human needs and rationality, that is, the "personification of things." Reification of the world deepens in the course of deducing further economic categories, to the extent that value first becomes independent as "money" and then becomes even stronger when value becomes a definite subject as "capital" and begins actively to transform the entire world.

"FORMS" AND "CONTENT"

Marx showed in his analysis of the commodity in *Capital* how the inverted, alienated economic form determinations not only transform ordinary judgments about the world, but also affect the material dimensions of humans in, for example, desires, will, and behaviors. However, such modifications are not limited to the human side, because Marx analyzed capitalist transformations of the material world in various spheres. As we will see, this methodological approach overcomes the confusion and dualism of "form" and "material" in classical political economy. Marx's critique of political economy can be understood, in this sense, as encompassing a dialectic of material spheres. Marxists generally conceive the historicity and sociality of economic forms as the kernel of Marx's project, but this discussion goes into the second, often neglected, aspect of "material" in his political economy.

Marx in the *Grundrisse* criticized a "fetishistic" misunderstanding that comes from the identification of social characteristics with natural properties of things:

The crude materialism of the economists who regard as the *natural properties* of things what are social relations of production among people, and qualities which things obtain because they are subsumed under these relations, is at the same time just as crude an idealism, even fetishism, since it imputes social relations to things as inherent characteristics, and thus mystifies them.³¹

Ricardo, for example, defined capital as “accumulated (realized) labor (property, objectified labor), which serves as the means for new labor.” He abstracted the economic “form” of capital, Marx argued, so that he ended up emphasizing only the “content” or the simple material of capital as “*a necessary condition for all human production*.”³² In Ricardo’s analysis of economic forms, the form determination of capital is transformed into a material property of a thing and consequently naturalized as a transhistorical condition of production. Marx’s first critique denounces this clumsy separation of “form” and “content” among classical political economists. Their fetishism is due to the unmediated identification of economic forms with a natural property of their material bearers.

Nonetheless, Marx also recognized a gradual progress among the classical political economists to build up economic categories precisely as a result of the separation of “form” and “content.” The second aspect of his critique is directed at this point. He argued that this separation alone is not enough for the construction of a science. In contrast, Marx pointed to the necessity to analyze as economic categories not only the economic “form” but also “material” itself, because material properties play a specific economic role under certain social relations as a result of the development of capitalist categories, as seen in the example of “fixed” and “floating” capital.

Marx explicitly stated in the *Grundrisse* that material properties also require a theoretical analysis as economic categories in that their characteristics can reveal the specificity of capitalism. In the last part of the *Grundrisse* where Marx finally singled out the commodity as the first category of his critique of political economy, he wrote:

The commodity itself appears as unity of two aspects. It is *use value*, i.e. object of the satisfaction of any system whatever of human needs. This is its material side, which the most disparate epochs of production may have in common, and whose examination therefore lies beyond political economy.³³

This seems to confirm the traditional reading of Marx’s critique of political economy as an analysis of economic forms, but then he continues to argue in the next sentence:

Use value falls within the realm of political economy as soon as it becomes modified by the modern relations of production, or as it, in turn, intervenes to modify them. What it is customary to say about

it in general terms, for the sake of good form, is conditioned to commonplaces which had a historic value in the first beginnings of the science, when the social forms of bourgeois production had still laboriously to be peeled out of the material, and, at great effort, to be established as independent objects of study.³⁴

Classical political economy was with “great effort” gradually able to separate the economic “form” from the “material” and to treat the former as “independent objects of study.” The separation marks great progress for political economy, but it is valuable only in “the first beginning of science,” for the classical school could comprehend the categories only in abstract forms, which it rapidly transformed into mere “commonplaces.” In order to save political economy from falling into this banality, Marx proposed a more nuanced way of treating “form” and “material.” It is in this method where Marx’s originality becomes apparent, in contrast to his predecessors like Smith and Ricardo.

In his analysis, the material aspect of wealth that is common to all the stages of production first lies outside the scope of an investigation of political economy, because political economy analyzes the “social forms” that reveal the particular characteristics of capitalist wealth and its production. Nonetheless, since capitalist commodity production like other modes of production cannot exist without material elements such as labor power, means of production, and raw materials, Marx treated the material side of the production process simply as “a given presupposition—the material basis in which a specific economic relation presents itself.”³⁵

However, this presupposition does not mean that the material side should never be taken into consideration in an analysis of economic relations. Marx maintained the opposite in the quoted passage: where use value is “modified” through the modern economic relations and even “intervenes to modify them,” it becomes the subject of scientific observation. Marx emphasized in the *Grundrisse* that in addition to the description of economic forms, the capitalist modification of use values through economic-form determination is an important object of political economy.

This is not an isolated, minor remark in the *Grundrisse*. Marx emphasized at other places that use value functions as an economic category under certain economic relations:

As we have already seen in several instances, nothing is therefore more erroneous than to assert that the distinction between use value

and exchange value, which falls outside the characteristic economic form in simple circulation . . . falls outside it in general. We found, rather, that in the different stages of the development of economic relations, exchange value and use value were determined in different relations, and that this determination itself appeared as a different determination of value as such. Use value itself plays a role as an economic category. Where it plays this role is given by the development itself.³⁶

Marx again criticized the absolute opposition of form and material because their various relations represent economic relations. In reality, the economic forms cannot exist without "the material basis." In many cases, Marx said, "use value itself plays a role as an economic category." It is a "bearer" *par excellence*, whose material properties are penetrated by economic relations. Like the "personification of things," the objective materialization of economic form determinations in the inverted world is not an epistemological inversion, but this "materialization" (*Verdinglichung*) of economic relations is to be understood as the deepest modification of a material property of a use value, as the "ossification" of social relations of production.³⁷

Notably, Marx did not lose his interest in this topic even in the last stage of his life. He wrote in his *Notes on Adolph Wagner's Lehrbuch der politischen Ökonomie* in 1881: "Use value plays an important part quite different from its part in economics hitherto, but *nota bene* it still only comes under consideration when such a consideration stems from the analysis with regard to economic formations, not from arguing hither and thither about the concepts or words 'use value' and 'value.'" ³⁸ Here again, Marx clearly emphasized the economic role of the material side of use value that contributes to comprehending the specificity of the capitalist system under certain conditions.

Marx's point is that the capitalist modifications of material characteristics are not limited to people's desires and behaviors but extend to properties of the things themselves. These modifications increase "in the different stages of the development of economic relations," and are more and more captured in his descriptions as the analysis moves from abstract categories to concrete ones. According to Marx, a thing under social relations does not simply exist with given natural properties but is historically modified by capitalistically constituted economic relations, so that the economic determination now comes to be ossified into a thing. It ultimately "appears as a *thing*, just as value appeared

as the quality of a thing and the *economic determination* of the thing as a *commodity* appeared as its quality as a thing; and just as the social form assumed by labor in money expressed itself as the *qualities of a thing*.”³⁹ With the development of capitalist production, various material dimensions are gradually modified by this process of “materialization” (*Verdinglichung*)—that is, modification of material properties according to the logic of capital—in such a way that the valorization of capital can proceed under more favorable conditions. Both the analysis of material in Marx’s treatment and his form analysis point to the historical specificity characteristic to capitalist relations and even their contradictions. Moreover, this process of transformation must not be analyzed from the perspective of capital alone but also from the material side, especially in terms of the entire metabolic interaction between humans and nature. Marx’s critique of political economy fulfills this double theoretical task in contrast to the classical political economists.⁴⁰

Despite Marx’s clear remarks about the economic role of the “material basis,” its importance is often underestimated among Marxists compared to the form analysis. This tendency is not coincidental because many Marxists developed their interpretations based on the pure sociality of abstract labor.⁴¹

Alfred Sohn-Rethel’s interpretation is a typical one in this context, as he argued: “In fact, ‘not an atom of matter’ enters into the objectivity of commodity as values, upon which the socializing effect of exchange is dependent. Here the socialization is a matter of pure human composition, uncoupled from humans’ metabolism with nature.”⁴² Sohn-Rethel’s form analysis surely recognizes the pure social character of the objectivity of value, but he reduces value to a mere social relation existing in the commodity exchange and the abstract labor to a pure social construct. Consequently, value is separated from the metabolism between humans and nature in his explanatory scheme.

Since Sohn-Rethel completely cut off the category of “value” from its material aspects, focusing only on its purely social character, he ended up falling into a dualism of “first nature” and “second nature”:

I include the entire formal side of commodity exchange under the expression of *second nature*, which should be understood as a pure social, abstract and functional reality *in opposition to the first or primary nature*, in which we find ourselves on the same level with animals. In the expression of the second nature as the form of money, what is specifically human attains its first, objective, distinct and real

manifestation in the history. It comes to exist due to the necessity of a socialization *dissociated from any modes of operation of material metabolism between humans and nature*.⁴³

Sohn-Rethel opposed the first (animal-like, natural) nature to the second (specific human, social) nature. It is true that the social power of value does not include any "material content" of the commodity because it is a product of social praxis. However, one cannot infer that the objectivity of value has nothing to do with the transhistorical necessity of human metabolism with nature.

Marx's point is actually the opposite. As seen above, Marx in *Capital* consistently asked why the emergence of such a pure social category of value is at all necessary in capitalism. As an answer, Marx claimed that it is because the transhistorical metabolic interaction between humans and nature must be organized despite the private character of labor, and this metabolism can only be mediated by the pure social value. Thus the most fundamental reason for the existence of value indicates the material and transhistorical necessity to regulate the metabolism between humans and nature. This explanation must be contrasted to Sohn-Rethel's problematic understanding because he could not provide a convincing reason why abstract labor in society with commodity production must be objectified into commodities as value. Rather, he simply assumed that abstract labor is also purely a social construct. His dualism separates "value" from the "human metabolism from nature," because abstract labor as "second nature" has nothing to do with the transhistorical natural metabolism.

This opposition of the transhistorical and the historical in Sohn-Rethel's *Intellectual and Manual Labour* risks theoretical one-sidedness, as if value had nothing to do with the transhistorical sphere of production. If Marx's critique of political economy is primarily understood as "form analysis," this neglect of the material dimension does not seem so problematic because its examination *at first* "lies beyond political economy." However, as soon as one confronts Marx's detailed notebooks on natural sciences and asks how they can be integrated into the project of *Capital*, the absolute separation of "value" and "metabolism between humans and nature" becomes extremely problematic. Sohn-Rethel's explanation does not provide a key for understanding how a scientific investigation of the "first nature" can contribute to his critique of political economy whose primary field is supposedly the "second nature."

The debate on the material character of abstract labor is not an irrelevant deviation from the theme of Marx's ecology. The concept of abstract

labor as a “pure social” category has serious consequences. It makes it much harder to explain why the capitalist dominance of abstract labor, to which no material property belongs, destroys various dimensions of the universal metabolism of nature more devastatingly than ever. In order to avoid a vague statement that the dominion of a social abstract destroys nature, it is necessary to explain the connection between abstract labor and social and natural metabolism by comprehending value in its relation to the latter’s “eternal necessity.” The strict opposition between “nature” and “society” excludes the influence of economic determinations over the material dimensions. In contrast, it is Marx’s aim to reveal how the material natural properties receive social modifications and internalize them as their own thing-like properties, and how, particularly because of this entanglement of material and social properties, there emerge real contradictions. That is to say, the material natural properties cannot be completely subsumed under capital. Out of this limit to capital, various “living contradictions” come to exist even if the exact manifestations of these contradictions are not predetermined thanks to the “elasticity of capital,” and are strongly dependent on the development of technologies and natural sciences. Marx’s theory of reification comprehends the contradictory process of the capitalization of the material world and the conditions for its transcendence.

An analysis of Marx’s project thus needs to go beyond the earlier interpretation and include the analysis of the material world as a central object of study. This analysis is primarily about how the capitalist mode of production tends to undermine the material conditions for the sustainable, that is, how production, by the logic of reification, organizes a social practice increasingly hostile to nature, resulting in a crisis of sustainable human development.

The material contradiction of capitalism is implicated at the abstract level of generalized commodity production in the first three chapters of *Capital*. But this is not sufficient. The tension between “form” and “material” crystallizes more clearly with the development of the category of “capital.” Marx analyzes how capital, this “automatic subject,” radically reorganizes the metabolic interaction between humans and nature and finally destroys it.

THE CAPITALIST TRANSFORMATION OF METABOLISM

Marx’s explanation of the inverted world in *Capital* contributes to comprehending the necessity of disturbance in the material world under

capitalism. Without explaining the dynamics immanent to the capitalist mode of production, Marx's ecology would be reduced to a simple proposition that capitalism destroys the ecological system because capitalists seek to attain profits with no care at all about environmental sustainability. This would be against Marx's "materialist method." Thus investigation of the objective social structure is also required because Marx's method is opposed to those approaches that simply aim at introducing new "moralistic" or "correct" values that claim to be environmentally friendly. In contrast, Marx examined in a detailed manner how the mediation of the social and natural interaction between humans and nature by the logic of capital's valorization organizes social production and circulation in such a way that their metabolic interchange necessarily gets disrupted. While the capitalist mode of production structures a particular human metabolism with nature on a national and global scale, the forces of nature are, though elastic, always limited in various ways, resulting in eco-crises in multiple spheres.

Since the allocation of the sum total of labor and the distribution of the sum total of products in capitalism are arranged through the mediation of value, the metabolic interaction between humans and nature is inevitably carried out under the primacy of abstract labor. As mentioned earlier, this mode of mediation contains within itself a certain tension, because the concrete material dimensions of humans-nature interaction can only be taken into account within the value expression in a very limited and deficient manner. This characterizes an important difference in relation to all other forms of social production, where the various material (and even ecological) aspects are normally incorporated at the moment of "allocation" of social labor and the "distribution" of products.⁴⁴

The fact that humans work upon nature under the primacy of value might not seem so ecologically unfriendly. However, the problem of this reified mediation appears more distinctively with the emergence of fully developed "capital," because value then functions not just as a "mediation" of social production, but now becomes the "goal" of production. Capital threatens the continuation of humanity's metabolism with nature by radically reorganizing it from a perspective of maximally squeezing out abstract labor.

Once again, remember that according to Marx the category of "value" in a society of generalized commodity production is an economic category that shows an essential connection with material conditions for the reproduction of the metabolism between humans and nature. The particularity of capitalism is that, due to "private labors" and "reification,"

the production and reproduction of a society can proceed only with the mediation of value. Private producers socially relate to each other only with the aid of value, to secure the existence of society (more or less!).

With “money” the power of reification increases. As Marx explains, value incarnates itself as an independent object—money—that bestows a specific social use value to a commodity, gold. Gold functions as a “general equivalence” that is “directly exchangeable with other commodities.” This social power of direct exchangeability means that its possession allows the acquisition of any desired object, and this generates a new desire for money hoarding, which is “boundless in its nature.”⁴⁵

Yet an even more radical change occurs when the sole objective of the production becomes the maximal objectification of abstract labor. With the subjectification of value as “capital,” the transformation of the world proceeds even more drastically:

On the other hand, in the circulation M-C-M [money-commodity-money] both the money and the commodity function only as different modes of existence of value itself, the money as its general mode of existence, the commodity as its particular or, so to speak, disguised mode. It is constantly changing from one form into the other, without becoming lost in this movement; it thus becomes transformed into an automatic subject. If we pin down the specific forms of appearance assumed in turn by self-valorizing value in the course of its life, we reach the following elucidation: capital is money, capital is commodities. In truth, however, value is here the subject of a process in which, while constantly assuming the form in turn of money and commodities, it changes its own magnitude, throws off surplus-value from itself considered as original value, and thus valorizes itself independently.⁴⁶

In the circulation of C-M-C [commodity-money-commodity], the process is directed at the final goal of a use value that one can only attain through commodity exchanges in the market. Here value mainly operates as a general measure for various products of private labors, and so at the end of the process value disappears together with the consumption of the desired use value. In other words, value simply functions as a mediator of social metabolism. With gold, value becomes an independent object as money, so that one can own value as a thing and hoard money. However, money must be exchanged with another use value sometime in the future if it is to function as money at all.

The economic determination of value as “capital” brings about a totally different situation. Value as capital is an “automatic subject” that repeatedly goes through the process of $M-C-M'$ [M' includes surplus value] without losing its determination as capital and even grows bigger. The pure sociality of value turns into an infinite movement because the sole goal is pure quantitative increase. Value itself, or more precisely its valorization, has become the final goal of production. Surely enough, money as an independent value is always the beginning and the end of the process of $M-C-M'$, but even this money is but a temporary figure for capital because its valorization can only take place through constant changes in forms (*Formwechsel*) between commodities and money. As Marx says, value is thus an “encompassing subject” of the process of $M-C-M'$, in which “it alternately assumes and loses the form of money and the form of commodities, but preserves and expands itself through all these changes.”⁴⁷ The entire process of production is still dependent on use values as the bearers of capital. However, this material component of production is now subordinated to the pure quantitative movement of capital. In accordance with this new economic characteristic of value as capital, the transhistorical “labor process” must be fundamentally reorganized as capital’s “self-valorizing” process.

The statement that the metabolic interaction between humans and nature mediated by labor represents an “eternal natural necessity” in every society is abstract. The entire process of social production now takes a more concrete shape as Marx analyzes it in relation to transformations by capital according to the logic of its valorization. Through this new objective of the production process, abstract labor also receives an additional, specific economic function, namely, the sole source for increasing capitalist wealth.

Capital treats labor only as a means for its endless self-valorization, in which concrete labor yields to the primacy of abstract labor. What matters in capitalist production is no longer the satisfaction of social needs, as they are only casually satisfied under the anarchy of capitalist competition. The desire for capital accumulation can never be satisfied with a certain qualitative use value; it is an “endless” movement of an incessantly growing quantity.⁴⁸ As a consequence, all of capitalist production is directed at squeezing out abstract labor, and this one-sided expenditure of human labor power cannot help but distort humanity’s relation to nature. Since both labor power and nature are important for capital *only* as a “bearer” of value, capital neglects the various aspects of these two fundamental factors of production, often leading to their exhaustion.

Indeed, Marx's *Capital* carefully describes how this neglect of material dimensions in the labor process leads to the erosion and destruction of human life and the environment.

As value becomes a subject in the form of "capital," this new subject, following its "blind and measureless drive, its insatiable appetite for surplus labor," aims at the objectification of abstract labor into commodities as encompassingly and effectively as possible.⁴⁹ This is now the main objective of social production. In contrast, this specific drive did not appear in precapitalist societies because surplus labor was generated only through the exercise of external compulsion. There was no motivation to work further once basic needs were satisfied, and the range of use values was, accordingly, relatively small. There existed the producer's "intimate tie" with the earth despite the relations of personal-political exploitation and dominion.

The situation is totally different in capitalist society. Marx carefully illustrates the destructive uniqueness of capitalist production in chapters on "The Working Day" and "Machinery and Large-Scale Industry" in volume 1 of *Capital*. Referring to parliamentary reports and investigations by factory inspectors and commissioners, Marx depicts the modern transformations of the labor process as a result of its "formal" and "real subsumption" under capital. These chapters, a couple hundred pages long, are often neglected by theoreticians as boring, inessential detours from the main dialectical development of economic categories under capitalism. The predominance of capital is a real process since the inversion manifested in the subjectification of capital is not taking place in our heads but exists objectively in social production. Marx's careful treatment of the concrete lives of workers indicates his strong interest in those transformations that cause workers to fall into a slave-like condition with regard to their moral, social, physical, and intellectual lives. One can say that Marx's project in *Capital* is not primarily motivated by the goal of overcoming Hegel's idealist philosophy but is fundamentally characterized by his sympathy for the actual situation of the working class.⁵⁰

If *Capital* were reduced to a mere dialectical development of the economic categories of bourgeois society, Marx's project would be mainly about a *conceptual* reconstruction of the capitalist totality. On the contrary, it is important to emphasize that Marx seriously analyzed empirical materials in his investigation of capitalist society. In this context, these two chapters in *Capital* are exemplary because they deal not only with the process of the destruction of the material world by the logic

of capital but also with the manifestation of capital's limits. That is to say, they reveal the way that the social formation of the inverted world causes a series of contradictions. Even if capital constantly tries to overcome contradictions with technological development and scientific discoveries, capital cannot fully establish its mastery over the material world and ends up devastating the social and natural metabolism, which ends up inducing resistance against the regime of capital.

Marx first illustrates the disharmony of the metabolic interaction between humans and nature, paying particular attention to the human side. Capital both extends and intensifies the working day for the sake of the effective valorization of capital, during which the performance of concrete labors is subordinated to the primacy of the expenditure of abstract labor. Without doubt, this production of "absolute" and "relative surplus value" causes alienation and suffering in workers' lives. Even if there are certainly "physical limits to labor-power" and "moral obstacles" for capital, both of them possess a "very elastic nature."⁵¹ Capital attempts with its "boundless thirst for surplus labor" to profit from this elastic characteristic of human labor power and to appropriate the labor beyond a given limit, even all twenty-four hours of the day.⁵² Since the labor process is primarily the place for producing surplus value, capital, following its own formal logic, exploits labor power without caring about the lives of individual workers. Consequently, the tendency toward impoverishment strengthens itself, so that workers lose their free time due to the extension of the workday, even though disposable time is essential for physical recovery from work and for the cultivation of the mind.

The elastic nature of labor power, which enables the intensification and extension of the workday, has certain material limitations.⁵³ The boundless desire of capital inevitably confronts the "exhaustion" of labor-power:

By extending the working day, therefore, capitalist production, which is essentially the production of surplus-value, the absorption of surplus labor, not only produces a deterioration of human labor-power by robbing it of its normal moral and physical conditions of development and activity, but also produces the premature exhaustion and death of this labor-power itself. It extends the worker's production-time within a given period by shortening his life.⁵⁴

Capitalist production asks for a "cruel and incredible extension" of the workday not simply because it is the most direct way to an absolute

increase of surplus labor and surplus value, but also because the constant operation of the factory avoids physical and moral depreciation and allows constant capital to be used more efficiently, saving time, for example, by not having to warm up the machines in the morning. Capital valorizes itself with a sacrifice of welfare and the security of workers: "What could be more characteristic of the capitalist mode of production than the fact that it is necessary, by Act of Parliament, to force upon the capitalists the simplest appliances for maintaining cleanliness and health?"⁵⁵ As Marx carefully depicted, the working class suffers from various physical deformities, moral degradation, and premature death due to a dangerous amount of work that is harmful for health. There is, in effect, torture through overwork, night work, and Sunday work. Child labor also becomes the norm unless regulated by law, as was clearly documented in a series of parliamentary reports that Marx was reading. If children of seven or eight years of age are forced to work from six in the morning until ten at night, mental and physical diseases prevail. Despite the gravity of the situation, individual capitalists would not take any countermeasures against this situation unless they were compelled to do so by the enforcement of a law. A beneficent capitalist who did otherwise would find that his or her profit diminished if other capitalists failed to do the same.

This "blind and measureless drive" or "boundless thirst for surplus labor" is therefore not a moral deficit of individual capitalists. They are obliged to follow such behavior due to competition with other capitalists if they want to survive as capitalists. The decision to act in accordance with that blind drive appears rational to them, out of which emerges again a social consciousness and practice seeking after a more and more efficient exploitation of labor power. To be concerned about the life of workers appears as something unnecessary. The first watchword of the capitalists is: "*Après moi le déluge!* . . . Capital therefore takes no account of the health and the length of life of the worker, unless society forces it to do so."⁵⁶

When this type of decision making appears rational, individual capitalists are acting as the "personification of capital."⁵⁷ The social system that obliges them to adopt this mode of behavior is, however, totally irrational from another perspective because it makes sustainable reproduction of the laboring class impossible over the long term. The logic of capital does not know any limitation of surplus value because the pure quantitative movement of self-valorizing does not recognize the material aspect of labor-power: "We see then that, leaving aside certain extremely

elastic restrictions, the nature of commodity exchange itself imposes no limit to the working day, no limit to surplus labor."⁵⁸ So the limit of the labor day cannot be derived from the formal logic of capital alone, and this is why the restriction of the power of reification must be imposed through an external compulsion. This is how workers' conscious resistance against the "measureless drive" appears, and Marx illustrates this process as "the struggle for a normal working day."

In the context of a brutal extension of the workday, workers demand the enforcement of a normal workday and the prohibition of child labor in order to protect their existence. Since individual capitalists are not ready to accept such a regulation if other capitalists still continue to profit from the same old method, the enforcement of a normal workday of eight or ten hours must be by law. Marx in *Capital* carefully reproduces actual struggles between capitalists and workers in the legislation process. Even if the length of a normal workday varies in each society, depending on the power balance between the two classes, factory legislation as such is "the necessary product of large-scale industry" because otherwise reproduction of the working class would be impossible. It is remarkable that Marx highly values factory legislation and even calls it the "first conscious and planned [*planmäßig*] reaction of society against the spontaneously developed form of its production process."⁵⁹ For Marx, the "struggle for a normal working day" is strategically of great importance precisely because it consciously transforms the social practice that unconsciously bestows the power of reification. It is true that production as a whole still remains oriented toward the valorization of capital and workers are exploited. However, the restriction of the workday and the corresponding improvement of working conditions, with legislative clauses on health, sanity, wages, and education, are significant achievements of the nascent labor movement.

If one assumes that Marx would have rejected the legislation of a normal working day as a social democratic or reformist policy, one misses his point. On the contrary, Marx passionately supported social attempts for the regulation of the reified power of capital. This is because the legislation *results* from a conscious transformation of a reified social practice. Thus Marx, who was actively engaged in the International Workingmen's Association, wrote a text for the Congress of the IWA held in Geneva, from which he directly quotes in *Capital*: "We declare that the limitation of the working day is a *preliminary condition without which all further attempts at improvement and emancipation must prove abortive*. . . . The Congress proposes eight hours as the legal limit of the

working day.”⁶⁰ The restriction of the working day creates free disposable time, which also prepares workers for further struggles against the alien power of capital. This legislation is a first conscious regulation of the reified power of capital from the standpoint of the material characteristics of labor power.

In terms of the real subsumption of labor under capital, Marx also describes in the chapter “Machinery and Large-Scale Industry” how the material conditions of the labor process are radically reorganized for the sake of the production of relative surplus value. The capitalist mode of production reduces individuals to workers with “ossified particularities” confined to a narrow activity. The development of machinery enables capital to replace skilled labor with unskilled labor, and workers are robbed of independence and autonomy in the production process. As Harry Braverman splendidly explicates in *Labor and Monopoly Capital*, the dominance of capital is not simply based on its monopoly of the means of production, but rather on its monopoly of technology and knowledge. As a result of the real subsumption, the labor process is organized independently of workers’ skills, tradition, and knowledge, which Braverman argues is the “first principle” of the capitalist mode of production, namely the “dissociation of the labor process from the skills of the workers.” Capitalist production is freed from the abilities of workers and instead it manages them. Workers are no longer able to conduct labor based on their own conception. What Braverman calls the “second principle” of modern-day Taylorism, the “separation of conception from execution,” strengthens the dominion of capital.⁶¹ Marx defines labor as a unique human activity, due to its purposeful and conscious character, objectifying humanity’s ideal conception through the execution of labor. In its original shape, there is a unity of conception and execution. However, workers under the advanced capitalist division of labor are only accessories of machines. They are unable to impose their will upon the labor process; instead the latter is imposed upon them. Braverman shows that the dominance of capital is rooted in a much deeper dimension than is usually assumed. As a result of real subsumption, workers are not simply deprived of the objective means of production but also of their own subjective capacities, when neither technology nor knowledge as a material basis for autonomous production is accessible to them. These deficiencies are evident not just in the loss of object but also that of subject. This is why workers must be so thoroughly subjugated to the commands of capital in order to be able to produce something at all. Their degradation and domestication are as a result enormously facilitated.

The incessant revolution of the production process under this logic, however, dialectically creates *the conditions* for all-sided mobility, variety, and flexibility of these workers, who are therefore able to adapt to the different kinds of work required. Marx calls them “totally developed individuals.” Since capital constantly revolutionizes the entire production process mechanically and chemically and creates new spheres of production, the quick accommodation of workers to changing conditions becomes a “question of life and death” to capitalism:

But if, at present, variation of labor imposes itself after the manner of an overpowering natural law, and with the blindly destructive action of a natural law that meets with obstacles everywhere, large-scale industry, through its very catastrophes, makes the recognition of variation of labor and hence of the fitness of the worker for the maximum number of different kinds of labor into a question of life and death. This possibility of varying labor must become a general law of social production, and the existing relations must be adapted to permit its realization in practice. That monstrosity, the disposable working population held in reserve, in misery, for the changing requirements of capitalist exploitation, must be replaced by the individual man who is absolutely available for the different kinds of labor required of him; the partially developed individual, who is merely the bearer of one specialized social function, must be replaced by the totally developed individual, for whom the different social functions are different modes of activity he takes up in turn.⁶²

Out of this development of the capitalist mode of production there emerges the social necessity for publicly financed institutions for training workers' skills and knowledge. As Ryuji Sasaki rightly emphasizes, Marx, in addition to the struggle for a normal workday, emphasizes the strategic importance of “the establishment of technical and agricultural schools” and of “*écoles d'enseignement professionnel*,” in which the children of the workers receive a certain amount of instruction in technology and in the practical handling of the various implements of labor.⁶³ It is clear why Marx so highly values the technological education offered in publicly financed schools. These schools provide, even if only to some extent, the basis for the conscious reappropriation of knowledge and skills required in a labor process but monopolized by the capitalist technology. Marx calls this possibility of reappropriation “revolutionary ferments.”⁶⁴ Against the one-sided transformation of the labor process under its real subsumption

under capital, Marx finds in the reappropriation of knowledge and skills the construction of essential material conditions for the rehabilitation of workers' freedom and autonomy in the production process.

To sum up, Marx, after analyzing the destructive consequences of the pure economic determination of the labor process, illustrates the possibility and necessity for regulating, as an emancipatory progress of the labor movement, the formal logic of capital's valorization *from a perspective of the material side of labor power*. This analysis takes place in two steps. Marx first elucidates the pure economic form determinations, and then he investigates how it subsumes and transforms the production process, causing various resistances to it. His discussion about formal and real subsumption in *Capital* indicates his clear support for concrete attempts that consciously struggle against the destruction of labor-power through the regulation of the reified power of capital. His standpoint is one of more sustainable and autonomous social production. Obviously, the shortening of the workday and technological education alone do not transcend the capitalist mode of production, yet they create the essential foundations for further struggles against capital by protecting workers' lives from capital's blind and measureless drive for surplus value.

The discussion about the working day might at first glance seem as if it had nothing to do with Marx's ecology. However, it provides us with insight into capital's influence over the physical and natural sphere, for according to Marx there is another place where the contradiction of reification crystallizes, that is, nature.

CONTRADICTION OF CAPITAL IN NATURE

Marx's illustration of the labor process does not neglect the fact that nature is working together with humans, as he clearly designated both labor and the earth as the two "original factors" of the metabolic interaction between humans and nature.⁶⁵ The powers of both labor and nature function as common transhistorical elements in all types of production. If the whole production is organized under the primacy of abstract labor in a one-sided manner, one can infer from the previous observation that capitalist production, in addition to its exhaustion of labor power, causes the exhaustion of natural power as well. Marx pointed to the close connection between the two original factors as he problematized the wasteful usage of natural resources as well as labor powers in various places, even if he did not elaborate on the squandering of natural resources in as much detail as the cruel exploitation of labor power. This

is understandable in that Marx planned to deal with the problem of natural powers in the chapter on “ground rent” in volume 3 of *Capital*, but its manuscript remained unfinished. Nevertheless, there is no doubt that Marx intended to treat the problem of modifications of the metabolic interaction between humans and nature with a particular focus on the negative and destructive tendency of capitalist production.⁶⁶

This interpretation is confirmed by how Marx paralleled the destruction of workers’ lives and that of nature’s fertility:

Capital asks no questions about the length of life of labor-power. What interests it is purely and simply the maximum of labor-power that can be set in motion in a working day. It attains this objective by shortening the life of labor-power, in the same way as a greedy farmer snatches more produce from the soil by robbing it of its fertility.⁶⁷

This juxtaposition of “labor-power” and “fertility” of the soil is not arbitrary because labor is nothing but the realization of humans’ natural power. In both cases, Marx dealt with the exhaustion of natural power under the capitalist mode of production. Instead of simply focusing on the subjective factor of production, he analyzed the social transformation of the other objective side of it as well. As seen above, capital with its immanent logic of valorization is only interested in objectifying abstract labor into commodities as much as possible in the shortest period of time. The same indifferent attitude can be observed toward the soil, too, as a “greedy farmer” ends up “robbing it of its fertility.” One must thus comprehend the robbery of soil fertility in conjunction with the theory of reification because it is nothing but another manifestation of the contradiction of the one-sided mediation of the metabolic interaction between humans and nature.⁶⁸

If all of production is organized for this valorization, the destructive power over nature becomes stronger with the development of productive forces. In the *Manuscripts of 1861–63*, Marx explains why capitalist production inevitably and boundlessly exploits nature. It is in this context that the differentiation between the “formal” and “material” aspects of the production process becomes decisive. Marx argues that nature’s powers do not go into the “process of valorization” but into the “labor process”:

But, apart from fixed capital, all those productive forces which cost *nothing*, i.e. those which derive from the division of labor, cooperation, machinery (insofar as this costs nothing, as is for example the

case with the motive forces of water, wind, etc., and also with the advantages which proceed from the social arrangement of the workshop) as well as forces of nature whose application does not give rise to any costs—or at least to the degree to which their application does not give rise to any costs—enter into the labor process without entering into the valorization process.⁶⁹

An increase of productivity through “the division of labor, cooperation, machinery” brings about changes only on the material side of production (that is, the labor process) without, however, going into the formal side of production (that is, the valorization process), because the new increased social force of production does not require additional costs. The increased productivity appears under the monopoly of the means of production as a “productive force of capital,” and this allows capitalists to acquire a greater amount of surplus products, so that the price reduction of products not only increases the “relative surplus-value” but also provides “extra surplus-value,” if they can be produced with an amount of labor below the social average. This “extra surplus-value” offers the main motivation for capitalists to constantly revolutionize the production process.

With the application of natural forces to the production process, with the aid of natural science and technology, which is freely appropriated or has minimal costs that reduce the total production costs, it functions, Marx argues, in the same way as the social forces of capital attained through “the division of labor, cooperation, machinery.” The forces of nature go into the labor process and work together with human labor power. Their appropriation appears as the productive force of capital because knowledge and the means of their application are monopolized by capital: “Science, generally speaking, costs the capitalist nothing, a fact that by no means prevents him from exploiting it. ‘Alien’ science is incorporated by capital just as ‘alien’ labor.”⁷⁰ Even if they are not free, requiring some installation of machines or extra labor, new raw materials and auxiliary materials can reduce the constant part of the circulating capital and increase the productivity, so that the same amount of use value can be produced with lower costs. The “free natural power of capital” (land, wind, and water) and the availability of cheap raw materials and energy (wood, coal, and oil) exert a great influence upon the maximization of surplus-value.⁷¹ Thus, this is yet another example of “how *use value*, which originally appears to us only as the material substratum of the economic relations, itself intervenes to determine the economic category.”⁷²

This situation has negative implications. The instrumental behavior toward nature becomes dominant, as sciences are developed from the standpoint of utility for capital. There also emerges a tendency of capital toward brutal exploitation of the free forces of nature and to a global competitive race after cheaper natural resources. Capital strives for secure and cheaper access to natural resources while problems such as the pollution of air and water, desertification, and exhaustion of natural resources are neglected or viewed merely as externalities. The main principle of technological development is more efficient exploitation of labor power and natural resources with minimal costs. The aim of the application of technology in modern large-scale industry and agriculture is not sustainable intercourse with nature but its profitable employment. As labor power is exhausted and destroyed due to the intensification and extension of production for the sake of greater surplus value, the forces of nature also suffer from the same destiny.

Without a doubt, capital is concerned about the material dimensions of the world. Natural resources are carefully and economically treated, insofar as they go into the valorization process, because their value must be transferred to new products without any loss.⁷³ "Economy" of constant capital is in this sense an immanent tendency of the capitalist mode of production, including today's popular idea of green capitalism, which is based on reduction of waste and recycling. Capitalist economies are "*economies in the creation of waste, i.e., reduction of refuse to a minimum, and the maximum direct exploitation of all the raw and ancillary materials that enter the production process.*"⁷⁴ However, it is wrong to conclude from this description that according to Marx "this strong force will ultimately lead to a reduction of the production of waste by-products to zero."⁷⁵ Marx is neither so naïve nor does he believe that such a tendency is truly ecological. Recycling only occurs to the extent that it lowers production costs. Sustainable production is not an objective of these economies in the employment of capital. Insofar as massive commodity production and the squandering of free forces of nature continue under the capitalist system, there is no convincing reason to believe that capitalist production will become sustainable one day through economies of constant capital. Rather, with the development of productive forces under capitalism, the universal extravagant use of the forces of nature expands as capital pursues creating a "system of general utility" with lower costs.

Marx's ecological critique shows that a certain use value of nature is deeply modified under capitalism in favor of valorization, and that

this elasticity of nature is the reason for capital's intensive and extensive exploitation of nature. A number of anti-Marxists contend that Marx believed that ecological crises arise out of a human inability to sufficiently master nature, which will be overcome with the future development of the forces of production. They thus reject what they suppose to be Marx's anthropocentric and Promethean demand for the absolute mastery over nature as fatally unecological.⁷⁶ However, this type of critique misses Marx's theory of reification. The cause of modern ecological crises is not the insufficient level of technological development but *economic form determinations of the transhistorical process of metabolic interchange between humans and nature*.

The problem of capitalism's disturbance of natural metabolism cannot thus be resolved through an augmentation of productive forces. To the contrary, the situation often gets even worse because the capitalist form of technological and scientific development for the sake of attaining more profit continues to neglect the universal metabolism of nature. Capital's drive to exploit natural forces is "boundless" because these forces function as free or cost-minimizing factors in production. However, natural forces and resources are "limited," so the disturbance of the ecosystem arises out of the contradiction between nature and capital. In this context, Marx does not simply claim that humanity destroys the environment. Rather, his "materialist method" investigates how the reified movement of capital reorganizes the transhistorical metabolism between humans and nature and negates the fundamental material condition for sustainable human development. Accordingly, Marx's socialist project demands the rehabilitation of the humans-nature relationship through the restriction and finally the transcendence of the alien force of reification.

The capitalist tendency to degrade nature is derived from the law of commodity exchange. Capital pays for value as the objectification of abstract labor and not for social and natural forces that do not enter into the valorization process—though it fully appropriates the surplus products that they produce. Moreover, capital ignores costs that are necessary for the recovery of natural power after every use. Those costs that natural power requires due to its material characteristics are not reflected in the value of a commodity because value only expresses the expenditure of abstract human labor. Capital follows the logic of equivalent commodity exchange and justifies its own behavior. This discrepancy between "commodity value" and "natural properties" clearly indicates the unecological character of social production mediated by value.⁷⁷ As capital without

compulsion does not take any action against the destruction of workers' lives, it is also indifferent to various destructive consequences in nature because, according to its logic of equivalent commodity exchange, its procedure is fully justified in that it pays for every single value. This fact clearly shows that value cannot be an effective criterion for sustainable production.

Even if the recovery of the original condition after capital's extravagant use of natural resources costs a lot more in the future, capital cannot give up its freeloading, for the "elasticity of capital" is dependent on the elasticity of nature. Even if capital does not pay the costs for maintaining natural resources, these resources will not be exhausted immediately. Neither water contamination nor massive carbon dioxide emissions directly cause a crisis for capitalism. Rather, capital profits from this: through extensive and intensive appropriation of nature, capital not only increases productive forces but also counteracts any tendency for the rate of profit to fall. It attempts to compensate for this tendency with the mass production of cheaper commodities and with a usage of cheaper natural resources. However, these countermeasures only impose more burdens upon nature, and it is clear that these countermeasures cannot last forever. There is a material limitation for the capitalist squeezing the forces of nature, just as workers cannot avoid rapid physical and mental degradation under an excessive extension of the working day.

Remarkably, Marx in his later economic manuscripts pointed to cases where natural forces can no longer serve the valorization process "freely" because of their exhaustion:

The quantity of productive force of labor can increase in order to obtain the same or even decreasing produce, so that this increase of labor's productive force serves only as compensation of decreasing natural conditions of productivity—and even this compensation may be insufficient—as seen in certain cases of agriculture, extractive industry etc.⁷⁸

Marx was thus aware of those cases where the profit rate sinks as a result of the increasing costs of the floating part of constant capital. Consequently, capitalist production tries desperately to discover new sources and technological methods on a global scale in order to counter the falling rate of profit. Or it tries to produce a greater mass of commodities in order to compensate for a falling rate of profit with a larger *magnitude* of profit. As a result, capital undermines its own material

foundation even more rapidly, because individual capitalists are forced to accumulate at an accelerating rate to secure such an increase in the magnitude of profit.⁷⁹

Forced by economic competition, capital still does not hesitate to exploit nature ever more extensively and intensively without calculating the additional burdens of the ecosystem. Individual capitalists in this profit-driven society are not able to stop the destruction of nature; they must act with a popular motto of *Après moi le déluge*. Against this situation, Marx's socialism envisions an ecological struggle against capital. Ecosocialist strategy needs to aim at the construction of a sustainable humans-nature relationship through the restriction of reification. Otherwise, the capitalist development of productive forces only deepens the fundamental contradiction on an increasing scale:

The more the productivity of labor increases, the more the working day can be shortened, and the more the working day is shortened, the more the intensity of labor can increase. From the point of view of society the productivity of labor also grows when economies are made in its use. This implies not only economizing on the means of production, but also avoiding all useless labor. The capitalist mode of production, while it enforces economy in each individual business, also begets, by its anarchic system of competition, the most outrageous squandering of labor-power and of the social means of production, not to mention the creation of a vast number of functions at present indispensable, but in themselves superfluous.⁸⁰

In contrast to a popular claim that Marx was overly optimistic regarding the progressive character of capitalism, we find that he did not actually praise economizing on the means of production and labor under capitalist production. This is because such economizing only takes places for the sake of attaining greater profit. On the contrary, Marx emphasized that the capitalist development of production inevitably squanders the forces of labor and nature under its "anarchic system of competition."⁸¹ Despite the reduction of necessary labor time as a result of increasing productivity, the entire labor time will not be reduced in capitalism, but on the contrary is intensified and even extended in order to produce more surplus value. In addition, the unorganized system of production requires various mediating "superfluous" expenditures such as those devoted to accountants and investors, who also demand extra consumption of labor power and natural resources. Capitalist production is driven toward the

mass production of products that often do not find any effective demand, the inevitable result of anarchistic competition, so that a vast amount of commodities must be immediately discarded as garbage. On the social level, this anarchic development of productivity annuls the trivial economizing attempted by individual capitalists.

The capitalist mode of production must produce with its incessantly increasing productivity an enormous quantity of use values, which presupposes corresponding measureless desires for the realization of surplus values that squanders them. Under mass production the social use values multiply in various spheres, and the satisfaction of human needs becomes more and more dependent on commodity exchanges. Nonetheless, there emerges another material limitation to capital accumulation. No matter how much human desires proliferate, they are never infinite. In this material limitation there lies, in addition to the disturbance of "natural metabolism," another possibility of a disruption of "social metabolism": economic crisis due to overproduction. Economic crisis is nothing but the disturbance of material flux in the society by the economic form determination.

It has become clear that Marx, far from being optimistic about sustainable capitalist development in his theory of value, criticizes how the one-sided mediation of the metabolic interaction between humans and nature by abstract labor exhausts and desolates the forces of labor and nature. The main problem of capitalist eco-crises is not just that capitalism, as a result of wasteful mass production, will *sometime in the future* suffer from the increasing price and lack of raw materials (and a possible corresponding falling rate of profit) and will no longer efficiently satisfy human needs. Rather, the problem lies in the subjective experience of alienation, ensuring that the capitalist mode of production undermines the material foundation for sustainable human development due to the metabolic rift. Once the historical vocation of capitalism in increasing productive forces has been realized, the further development of human freedom and talents demands a transition to another stage of human history. However, as Marx argues, this transition is not an automatic one. It requires socialist theory and praxis.

At this point, it is possible to articulate a hypothesis addressing a remaining question of Marxism: Why did Marx so intensively study the natural sciences? Marx engaged in serious studies of a wide range of books in the fields of natural science, we can surmise, in order to analyze the contradictions of the material world as a result of its modifications by capital. To ground this hypothesis, the second part of this book

investigates Marx's treatment of agriculture, focusing on agricultural chemistry, geology, and botany. In this context, the German agricultural chemist Justus von Liebig plays a central role.