Marxian "Abstraction" and Contemporary Philosophy of Science*

Juraj Halas – PhD in Philosophy, assistant professor.
Comenius University.
Gondova 2, 814 99 Bratislava, Slovak Republic;
e-mail: juraj.halas@uniba.sk

The method of "abstraction" had been the centerpiece of earlier attempts at founding a Marxist philosophy of science – from Engels to Soviet Marxism. This paper confronts Marx's writings on abstraction with contemporary views of the method, stemming mostly from the analytic and (post-)empiricist traditions. In Section 2, I reconstruct the roles that abstraction was to play, according to Marx, in the construction of a scientific theory, focusing exclusively on his own writings. The analysis reveals certain rules, left mostly implicit in Marx, for the correct application of the method of abstraction. These are discussed in Section 3. The first rule states that concepts of the historically specific aspects of target systems (e.g., the capitalist economy) cannot be defined simply by means of transhistorical concepts. The second rule prohibits abstraction from the explanatorily relevant aspects which pertain, in Marx's vocabulary, to the "essence" of the target system. In Section 3, I confront Marx's notion of "abstraction" with contemporary statements on the method. It is shown that it covers both abstraction *and* idealization as understood in some modern accounts (notably, that of M. R. Jones). Under this approach, abstraction involves the tacit omission of properties, which are simply left unspecified. In contrast, idealization consists in the explicit counterfactual ascription of properties (and values of magnitudes). Finally, the representational goals pertaining to Marx's "abstraction" are discussed, using distinctions due to M. Weisberg. It is shown that Marx was a proponent of "minimalist idealization", focusing on the identification of causally relevant mechanisms that characterize all capitalist societies. I conclude with a suggestion for further research.

Keywords: Marx, abstraction, idealization, scientific method, representational ideals

Марксова «абстракция» и современная философия науки

Юрай Галас – доктор философии, доцент.
Университет им. Я.А. **Комен**ского.
Gondova 2, 814 99, Братислава, Словацкая Республика;
e-mail: juraj.halas@uniba.sk

Со времен Энгельса и вплоть до советского марксизма метод абстрагирования был центральной составляющей в отыскании марксистской философии науки. В этой статье марксовы представления об абстракции сопоставляются с современным пониманием этого метода, которое представлено в основном аналитической и (пост-) эмпиристской традициями. В разделе 2 автор реконструирует марксово понимание роли абстракции в построении научной теории, обращаясь исключительно к работам Маркса. Анализ позволяет выявить определенные правила применения метода абстрагирования, которые даны в работах Маркса в завуалированном виде. Эти правила обсуждаются в разделе 3. Так, первое правило

предполагает, что понятия, которые описывают историческую специфику капитализма, не могут быть определены через метаисторические категории. Второе правило запрещает абстрагирование от значимых для объяснения особенностей описываемого объекта, которые заключают его сущность. В разделе 3 марксово понятие абстрагирования сопоставляется с современными представлениями об этом методе. Показано, что это понятие заключает одновременно абстрагирование *и* идеализацию (в том ее виде, как она понимается в некоторых современных подходах – по преимуществу, в работах М.Р. Джонса). С точки зрения такого понимания, абстрагирование предполагает молчаливое игнорирование тех свойств, что остались неспецифированными. И, напротив, идеализация предполагает явное необоснованное приписывание свойств и значений величин. В заключении в рамках концепции М. Вайсберга обсуждаются репрезентативные цели абстрагирования. Показано, что Маркс был сторонником «минимальной идеализации», основанной на идентификации причинно значимых параметров, характерных для всех капиталистических обществ.

Ключевые слова: Маркс, абстракция, идеализация, научный метод, идеалы репрезентации

1. Introduction

The "method of abstraction" was the centerpiece of many 20th century attempts at constructing a Marxist philosophy of science. The goals of the latter were usually both descriptive and normative: to account for Marx's own scientific practice, especially in *Capital*, but also to provide a blueprint for Marxist efforts in other fields. The inspirations behind these attempts were varied, from Hegel (E. V. Ilyenkov) to Kant (G. della Volpe), from structuralism (L. Althusser) to post-positivism (L. Nowak and the Poznan School).

However, Marx himself wrote little on methodology per se. Never having composed the promised "2 or 3 sheets [on] the rational aspect of the method which Hegel not only discovered but also mystified" [Marx; Engels, 1983, p. 249], he left his disciples with fragmentary notes. Of these, the most important is the so-called Chapter on Method in the *Grundrisse*, at a mere thirty pages. Apart from that, there are bits and pieces scattered across *Capital* and the preparatory manuscripts, in the earlier "economic" writings (notably, *The Poverty of Philosophy*), and in private correspondence. This dearth of methodological material prompted those seeking a Marxist methodology to draw on a broader range of sources, especially the works of Engels and other theoreticians of German and Russian Social Democracy. Given the strength of 20th century Marxism as a political movement and a school of thought, Marxist methodology developed mostly independently – at a distance from mainstream philosophy of science.

The recent anniversary provides an opportune moment to examine Marx's methodological thinking anew. This paper is a contribution to such reappraisal. In Section 2 below, I summarize the main characteristics of Marx's method of abstraction and its role in the exposition of his theory, focusing exclusively on his own writings[1]. Based on Marx's criticisms of the use of abstraction in political economy, Section 3 proposes two rules for the correct application of the method which are largely implicit in Marx's work. In Section 4, I confront Marxian abstraction with recent accounts of the method developed by non-Marxist philosophers of science. I show that Marx's notion of "abstraction" covers two different procedures, which can be conveniently distinguished as abstraction and idealization. I then discuss the representational goals that motivate Marx's use of these methods.

2. Marx on Abstraction

Consider these two passages:

> In considering the labour-process, we began by *treating it in the abstract*, apart from its historical forms, as a process between man and Nature [Marx; Engels, 1994, p. 509; emphasis mine].

> If we put constant capital = 0, i.e. *if we abstract from its value* […,] the value of the total product = the value of the variable capital + the surplus value, = wages + surplus value [Marx; Engels, 1994, p. 80; emphasis mine].

There is a distinction to be made between the precise meanings of *abstraction* referred to above. However, let us first focus on what these passages have in common. In the first, Marx recalls that the analysis of the capitalist process of production in Chapter 5 (7 in the English translation) of *Capital* began with the "elementary factors" common to all labor processes throughout history. Only later does Marx's attention turn to the specific characteristics of the production process in a capitalist economy, i. e., to the valorization process. The second passage occurs within an examination of the formulae "*value of labor power / total value*" and "*surplus value / total value*" conceived as expressions of the rate of surplus value. Here, the part of total value which corresponds to the consumed portion of constant capital must be disregarded, as it does not affect "the ratio between surplus value and variable capital" [Marx; Engels, 1994, p. 80]. In both cases, the goal of abstraction is to "isolate" the object of inquiry from aspects or influences which, in a broad sense, are secondary at the given point of investigation.

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[1]   I cite the Marx-Engels Collected Works – adjusting the translation, if necessary, in accordance with the original published in the MEGA[2].

This is no accidental aspect of Marx's methodology. Marx believed that in "the structure of society […] all relations coexist simultaneously and support one another" [Marx; Engels, 1976, p. 167]. Society is thus a complex of elements and relations. At the most general level, Marx identifies production, distribution, consumption and exchange (or circulation) as distinct yet interrelated spheres of the economy [Marx; Engels, 1986, p. 17–37], each of which could be further analyzed into components. Any attempt to "lay bare the economic law of motion of modern society" [Marx; Engels, 1996, p. 10] must grapple with this systemic nature of its subject-matter. Marx believed that the method of abstraction, in the sense of "isolation" sketched above, plays a key role here:

> In order to present the laws of political economy in their purity, abstraction is made from these frictions, just as in pure mechanics abstraction is made from particular frictions which have to be overcome in each particular case of its application [Marx; Engels, 1994, p. 421].

Above, Marx refers to abstraction with regard to the *presentation* of the laws of political economy. In order to locate the use of abstraction in Marx's project more precisely, we can turn to the Foreword to *Capital*, where he outlines two distinct phases of his effort. The phase of *inquiry* serves "to appropriate the material in detail, to analyse its different forms of development, to trace out their inner connection". The second phase, that of *exposition*, should provide an "adequate description" of the "actual movement", in which "the life of the subject-matter is ideally reflected as in a mirror" [Marx; Engels, 1996, p. 19]. Using traditional terminology of the philosophy of science, the two phases can be likened to the contexts of discovery and justification. Inquiry is concerned with uncovering the "law of motion" of capitalist society through an analysis of empirical material and of existing theories. In contrast, the goal of exposition is to expound and justify the law, derive its consequences and show how it can be used to explain empirical phenomena and solve preexisting theoretical problems.

Due to the systemic nature of society, exposition can only proceed in a stepwise fashion, moving from aspects of the subject-matter which are viewed as explanatorily primitive to those that are considered as explanatorily derived. Marx noted that when such exposition is successful, "it may appear as if we had before us a mere a priori construction" [Marx; Engels, 1996, p. 19]. The method of abstraction, as a procedure of "isolation", serves an important role in this exposition. Marx confirms this when, anticipating the difficulties involved in reading the first few chapters of *Capital*, he refers to the heavy use of the "force of abstraction" [Marx; Engels, 1996, p. 8].

2.1. "Advancing from the abstract to the concrete"

Marx's more extended discussion of the role of abstraction is contained in the "Chapter on Method" of the *Grundrisse*, where it is couched in the language of Hegel's epistemology. Here, Marx comments on two modes of exposition of a social theory. The first starts with the description of the target system (i. e. the capitalist economy of a particular country) as it is given empirically, and proceeds to identify the basic aspects or mechanisms that govern the system. Marx terms this starting-point "concrete", since it is a description of a complex of many relations and properties. From the concrete, this mode of exposition moves on to the "abstract", i. e., to the simpler elements with fewer properties which together make up the system.

The second, converse approach to exposition begins with elements that have previously – in the phase of inquiry – been identified as explanatorily basic, and derives a more and more complex representation of the target system from these elements. Marx argues that this method of "advancing from the abstract to the concrete" is the "correct scientific method" [Marx; Engels, 1986, p. 38]. The first mode starts with what Marx terms a "chaotic conception of the whole", composed of elements or relations whose presence and function remains unexplained or underdetermined. The second approach, on the other hand, leads "by way of thinking to the reproduction of the concrete": an account of the target system as a "rich totality of many determinations and relations" [ibid., p. 37–38].

Marx employed the second approach in *Capital*, which famously starts with the analysis of the commodity. The latter is considered as the "elementary form" of wealth of capitalist societies [Marx; Engels, 1996, p. 35; transl. adjusted]. Marx then proceeds by deriving more "forms", such as money and capital. From the outset, the target system (the "real concrete" in the parlance of the *Grundrisse*) is the capitalist economy, but it is "treated in the abstract". Only some elements of the target system are present at any given moment, while others are disregarded. As more and more elements are introduced, the range of phenomena that the theory can explain is extended.

At various points in the exposition, Marx notes that certain investigations would be premature, since the necessary elements have not yet been introduced. For example, in the first chapter of *Capital*, he states that "Wages is a category that, as yet, has no existence at the present stage of our investigation" [Marx; Engels, 1996, p. 54]. Elsewhere in the volume, he argues that to explain the role of merchant's capital, "a long series of intermediate steps would be necessary, which, at present, when the simple circulation of commodities forms our only assumption, are entirely wanting" [Marx; Engels, 1996, p. 175]. Marx turns to the examination of both phenomena only later (in Part 6 of Volume I and in Part 4 of Volume III, respectively), when all the pieces are, to his mind, in place. For

example, the analysis of wages and their forms (time-wages, piece-wages) requires that the origin of surplus value in unpaid surplus labor has been established, and that the methods of extracting surplus value have already been analyzed.

Provisionally, we may conclude that when Marx speaks of "abstraction" as a method, he means a procedure by which certain aspects of a target system are selected for investigation, whereby other aspects remain disregarded. The method of exposition in *Capital* consists in the piecemeal introduction of aspects which one had been previously abstracted from: from the explanatorily basic to the explanatorily derived.

3. The adequacy of abstractions

In Marx's vocabulary, "abstraction" also signifies the *result* of the application of the method. In the spirit of 19th century semantics, Marx viewed all concepts as results of abstraction from empirical reality. "All human thought", he writes, relies on abstraction [Marx; Engels, 1998, p. 232], and economic categories "are only the theoretical expressions, the abstractions of the social relations of production" [Marx; Engels, 1976, p. 165]. In his brief methodological reflections, as well as in critical remarks aimed at political economists, Marx often pointed out the inadequacy of certain abstractions, using attributes such as "false", "empty" or "violent". These cases, in conjunction with what we know about the intentions of Marx's project, allow us to infer the rules for the correct application of the Marxian method of abstraction and the correct use of its results.

3.1. Historical specificity and "reasonable abstractions"

Consider the following examples, in which I have emphasized terms related to abstraction:

> In the first place, it is a *false abstraction* to regard a nation whose mode of production is based upon value, and furthermore is capitalistically organised, as an aggregate body working merely for the satisfaction of the national wants [Marx; Engels, 1998, p. 839].

> Consequently [modern economists say] capital is a universal and eternal relation given by nature-that is, provided one *omits* precisely those specific factors which turn the 'instrument of production' or 'accumulated labour' into capital [Marx; Engels, 1986, p. 23].

In both cases, Marx criticizes abstractions for disregarding those aspects of their target systems which he views as essential. In the first example, capitalism is reduced to production for use, which, according

Marx, obliterates its historically specific nature as a system of production for profit. The second example illustrates the reduction of capital to means of production. While means of production as such have existed in all societies, Marx argues they become capital only as part of a specific social relation. When capital is defined simply as "means of production" or "accumulated labor", this specificity disappears. The result of such abstraction is a thorough naturalization of capitalist relations which, according to Marx, serves apologetic purposes:

> To rescue the production *based on capital*, the orthodox economists […] ignore all its specific characteristics, all its conceptual definitions and rather conceive of it as simple production for *immediate use value*. [They] entirely abstract from its essential relations. *In fact*, to purify it of contradictions, they simply drop it and negate it [Marx; Engels, 1986, p. 338].

In contrast to both "classical" and "vulgar" political economy, attention to characteristics that distinguish capitalism from previous modes of production, and therefore hint at its transitory character, was paramount to Marx's project. He famously expressed this as a concern for the "*differentia specifica*" of capitalist production [Marx; Engels, 1996, p. 614]. However, Marx *did* also use concepts which refer to transhistorical features of modes production. As we saw in the first quote in Section 2, one such concept is that of the labor process; some of the others are use value, concrete labor, and means of production. Hence, Marx's critique of naturalizing abstraction is not aimed at *all* concepts and has to be specified more clearly.

Again, the discussion in the Introduction to the *Grundrisse* proves instructive. Marx deals here with the concept of "production in general":

> All epochs of production […] have certain features in common, certain common determinations. *Production in general* is an abstraction, but a reasonable abstraction in so far as it actually emphasises and defines the common aspects and thus spares us the need of repetition [Marx; Engels, 1986, p. 23].

Transhistorical concepts such as "production in general" may thus serve as useful instruments, e. g., in the very identification of historically specific features. However, Marx warns that they cannot be used to "grasp any real historical stage of production" [Marx; Engels, 1986: 26; transl. adjusted]. In other words, Marx's first implicit rule states that concepts for historically specific aspects of phenomena (of "real historical stages of production") must not be defined exclusively by means of terms referring to transhistorical phenomena (such as "production in general"). Explanations of historically specific phenomena using explanantia formulated exclusively in terms of such concepts would lead to the naturalization of their explananda[2].

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2   On the importance of historical specificity in Marx's methodology, see the detailed analysis in [Sayer, 1987].

3.2. Appearances, essences, and levels of abstraction

While the first rule prevents the projection of phenomena which correspond to a particular mode of production onto all modes of production, the second rule concerns the structure of a single mode of production. Consider the following passages, again with terms related to abstraction emphasized:

> Crass empiricism turns into false metaphysics, scholasticism, which toils painfully to deduce undeniable empirical phenomena by *simple formal abstraction* directly from the general law, or to show by cunning argument that they are in accordance with the law [Marx; Engels, 1988, p. 395].

> [Political economy] tries to rescue the law from collision with contradictory phenomena by a *violent abstraction* [Marx; Engels, 1996, p. 311].

> Through the process of a very *trivial abstraction*, arbitrarily *discarding* now one, now the other aspect of the specific relationship, [the capital relation] is reduced to abstract determinations of the simple circulation... [Marx; Engels, 1987, p. 476].

The first two examples deal with the relation of surplus value and its derived form, profit. According to Marx, surplus value is the result of unpaid surplus labor. However, already in classical political economy, it was accepted that capitals of equal size employing unequal ratios of "dead" and "living" labor (i.e., capitals of unequal organic composition) would earn equal profits on average. This is one of the "undeniable empirical phenomena" noted above. Thus, the amounts of surplus value actually produced by a capital and of profit earned generally will not coincide. This "contradiction" between equal profits and the labor theory of value led to theoretical inconsistencies (as, in Marx's view, in the Ricardian school), or to the abandonment of labor values. Marx classifies the former case as a "violent" or "simple formal" abstraction. The abstraction here is from the "intermediate terms" [Marx; Engels, 1996, p. 175] that could reconcile the law of value with profits determined by capital size: among others, the transformation of the value of advanced capital into cost price, the equalization of profit rates across industries, and the transformation of product values into prices of production. Instead of introducing these categories and showing how the law of value regulates production prices despite appearances to the contrary, the law of value is simply juxtaposed with the appearances – or "adapted" in conformity to them, as in Ricardo's "93 % labor theory of value".

The third example deals with "vulgar" economy that reduces more complex relations to simpler relations of commodity exchange. Thus the exchange between the capitalist and the worker is presented as a mutually beneficial exchange of "services", leaving out aspects such as

the dispossession of workers and the monopolization of the means of production in the hands of capitalists or the processes of valorization and accumulation which, in Marx's view, are at the heart of the capital relation.

In all of the three cases, the target of critique cannot be the reduction of historically specific aspects to transhistorical ones. After all, profit and surplus value are specific to capitalism, as are the capital relation and generalized commodity exchange. Rather, violent or trivial abstractions are problematic due to the "flattening" of distinct levels of abstraction. Marx believed that "all science would be superfluous if the outward appearance and the essence of things directly coincided" [Marx; Engels, 1998, p. 804]. Moreover, "in their appearance things often represent themselves in inverted form" [Marx; Engels, 1996, p. 537]. In the phase of inquiry, it is necessary to identify the essences (causes and mechanisms) *behind* the appearances (observable phenomena) – for example, by abstracting from the "frictions" of competition. The task of exposition is then to show how the causes and mechanisms operate to produce observable phenomena and how their operation is modified by the intervening factors[3]. The outward appearances that are the subject of Volume III of *Capital* (market price, profit and its forms, interest, rent) are traced through a series of levels of abstraction that stretches all the way back to the commodity in Chapter 1 of Volume I.

If this is not done, as in the first two cases above, contradiction looms large between "essence" (i. e., the law of value) and "appearance" (i. e., equal profits). Phenomena which are seemingly incongruent with the postulated law are left unexplained. Or, as in the third case, more complex relations are reduced to their phenomenal form, thus blocking their understanding. To summarize, Marx's second implicit rule of abstraction warns against abstracting from explanatorily relevant elements which are necessary for the proper representation of the target system.

This rule has an important corollary. Although Marx's main source of empirical material was contemporary Britain, the universe of discourse of his theory of the capitalist economy was not to be limited to it. Rather, the intent was to "present only the inner organisation of the capitalist mode of production, in its ideal average, as it were" [Marx; Engels, 1998, p. 818]. Thus the goal of abstraction in *Capital* was to include those aspects – mechanisms and the phenomena they produce – that characterize *any* capitalist economy, and to discard circumstantial aspects specific to 19th century Britain. However, as M. Heinrich points out, Marx was not entirely rigorous in implementing this program [Heinrich, 1989]. For example, the chapters on interest-bearing capital and credit crises in Volume III are deeply mired in the details of British banking. Marx's decision to assume a money commodity in his analysis of simple circulation is another controversial inclusion [Heinrich, 2014, p. 233ff].

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[3] For a more detailed discussion of Marx's distinction between *appearance*, *essence*, and the latter's *manifestation*, see [Hanzel, 2014].

4. Taking stock

Let us now turn to an appraisal of Marxian abstraction from the standpoint of contemporary philosophy of science. In the first subsection below, it is shown that Marx's term "abstraction" refers to two different procedures. I then examine the representational strategies that govern Marx's use of these two procedures.

4.1. Abstraction and idealization

I have introduced Section 2 with two examples. Both contain the term "abstraction" or its variations, but the nature of the procedure employed in each case is different. The first passage notes that abstraction was used in the analysis of the labor process to disregard its "historical forms". At the beginning of Chapter 5 (7), Marx simply states:

> We shall, therefore, in the first place, have to consider the labour process independently of the particular form it assumes under given social conditions [Marx; Engels, 1996, p. 187].

He then proceeds to enumerate and analyze the transhistorical aspects of any labor process. Only at the end of the first section of the chapter does Marx turn to the "characteristic phenomena" exhibited by the labor process under capitalism. In the second section, the labor process is analyzed with regard to the production of surplus value which Marx had abstracted from at first.

Similarly, at the very beginning of Chapter 1, Marx initially completely abstracts from value. He first examines the commodity as having two (relational) properties only: that of being a use value and that of having an exchange value. Through a series of arguments, Marx then introduces value as the property of all commodities, and exchange value is shown to be "only the form in which the value of commodities can manifest itself" [Marx; Engels, 1996, p. 48].

Another example of the same procedure concerns the first three chapters of Volume I as a whole, or what Marx calls the "simple circulation". After investigating the circuit $C - M - C$, Marx poses the problem of the possibility of the circuit $M - C - M'$ under equivalent exchange. Most of what follows in Volume I is dedicated to the production process of capital. In Volume II, Marx again returns to circulation, only this time as the circulation of capital. In the unpublished "6th Chapter" of *Capital*, Marx comments on this "circular" movement:

> As a *commodity*, the product of capital must enter into the process of the exchange of commodities […] In so far as this is merely a matter of formal changes […] the process has already been presented in what

we called ʿsimple circulation' […] But these commodities are now at the same time the repositories of capital […] And in this connection their circulation […] implies further determinations, which were alien to commodity circulation when it was considered in abstraction. We have now to consider, therefore, the circulation of commodities as the *circulation process of capital*. This will be done in [Volume II] [Marx; Engels, 1994, p. 383–384].

"Simple circulation" at the beginning of *Capital* is thus an abstract representation of the capitalist economy – it abstracts from capital itself. After capital is introduced and its production process analyzed, circulation is examined anew, no longer under abstraction from capital.

What all of these cases of abstraction have in common is that the set of aspects or properties being abstracted from is left unspecified. They are revealed only as they are explicitly introduced into the picture. Consider, now, the second example from Section 2, where the influence of constant capital is eliminated by ascribing it the value of zero. Two things stand out. Firstly, this ascription is counterfactual: a capitalist production process with no means of production is hypothetical at best, and the value of constant capital is generally nonzero. Secondly, such an ascription can only be made *after* the concept of constant capital has been introduced[4]. The procedure involved in this example is thus quite different from the procedure we have seen Marx use at the beginning of Chapter 1. There, the value of a commodity is not assumed to be zero – in fact, it is not assumed to be anything at all, since its very concept had not been introduced yet.

M. R. Jones suggests a useful distinction between "mere omission" of properties and the deliberate "misrepresentation" of properties of an object [Jones, 2005, p. 174]. The former involves the tacit leaving out of attributes of a target system, in the sense that the target system is represented as *neither* having *nor* not having those attributes. In Jones' terminology, this is "abstraction" proper. Except for the case of constant capital, all the examples of Marxian abstraction that I have dealt with here are of this kind.

Deliberate misrepresentations, on the other hand, involve the explicit counterfactual ascription of properties (including values of magnitudes) in the representation of an object. The representation is ascribed properties which the target system generally does not have. Jones' calls these "idealizations". From now on, I shall use Jones' terms to distinguish the procedures.

Compared to his use of abstraction, Marx's application of idealization is rather sparse. His criticisms of "violent" and other incorrect "abstractions", discussed above, all refer to abstractions proper. In the next section, I point out some more idealizations and characterize in more detail the epistemic goals which govern Marx's use of both methods.

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[4] From a different standpoint, W. Diederich comes to similar conclusions in his earlier critique of Nowak's account of Marx's method [Diederich, 1994].

4.2. Marx's representational goals

M. Weisberg introduced the distinction between three kinds of "idealization" in science: Galilean, minimalist, and multiple-models idealization (MMI) [Weisberg, 2007][5]. For our present purposes, we can quickly dispose with the latter. MMI applies to situations where at least two incompatible models of the same phenomenon (or a kind of phenomenon) are proposed, each of which has its advantages and is applied for specific purposes. In contrast, Marx's goal in *Capital* was to put forward a single unified theory of the capitalist mode of production that would at the same time serve as a critique of political economy.

According to Weisberg, Galilean idealization (GI) "is the practice of introducing distortions into theories with the goal of simplifying theories in order to make them computationally tractable" [Weisberg, 2007, p. 640]. Typically, GI would be used in the quantitative investigation of phenomena to disregard complicating factors. The motivations of GI are "largely pragmatic" [Weisberg, 2007, p. 642]. The simplifying assumptions introduced by GI could *in principle* be removed, but this is undesirable for practical reasons or not possible due to a lack of computational power. In the future, they may be eliminated – indeed, scientists should be looking for ways of removing them – and a more accurate representation proposed, but until then, the simplified account of phenomena provided by GI will have to do as an approximation.

Our example of Marxian idealization from the beginning of Section 2 does not seem to be an application of GI, though. First of all, the reason why Marx excludes the value of constant capital is *not* because it would introduce computational complications. Any given value of constant capital is irrelevant the ratio of surplus labor to necessary labor. Hence, leaving out constant capital by assuming its value is zero does not lead to *approximation* in any sense: it simply gets what does not matter out of the way.

Let us look at some other examples of Marx's idealizations in Volume I of *Capital*:

> We […] simplify our analysis, by the assumption, that the labour of the workman employed by the capitalist is unskilled average labour [Marx; Engels, 1996, p. 209].

> It will, therefore, be useful […] to assume provisionally, that the possessor of labour-power, on the occasion of each sale, immediately receives the price stipulated to be paid for it [Marx; Engels, 1996, p. 185].

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[5] Note that Weisberg does *not* distinguish between omission of properties and their misrepresentation. Hence, Weisberg's kinds of "idealization" may also include what we have called "abstraction" above. I shall come back to this point shortly.

> […] the simple fundamental form of the process of accumulation is obscured by the incident of the circulation which brings it about, and by the splitting up of surplus-value. An exact analysis of the process, therefore, demands that we should, for a time, disregard all phenomena that hide the play of its inner mechanism [Marx; Engels, 1996, p. 565].

All of these assumptions are counterfactual and simplifying. According to Marx, the first prevents a "superfluous operation" [ibid., p. 209], i. e., the introduction into his numerical examples of coefficients for the reduction of skilled to simple labor. Involving such a reduction would add more realism and detail to the analysis, but it would not alter the general conclusions. The second example concerns the functions of money in the exchange between the capitalist and the worker. Marx counterfactually assumes that money is not used here as "means of payment". Again, eliminating this assumption would make the analysis more realistic, and it could even help explain some real-world phenomena like wage theft by employers. But it would in no way affect the production of surplus value, which, at this point, is Marx's sole concern. Finally, the third passage serves to justify Marx's explicit disregarding of phenomena that obscure the process of accumulation. These are complications arising out of circulation (e.g. the inability to sell) and out of the distribution of surplus value in the forms of industrial and commercial profit, interest, and rent. Again, Marx argues that in the investigation of capital accumulation, both factors are irrelevant: insofar as accumulation takes place at all, circulation must have been successful, and the division of surplus value cannot not alter the "nature" of accumulation [ibid., p. 565].

While these examples cannot be classified as cases of Galilean idealization, they fit the third kind of idealization, which Weisberg calls minimalist (MI). He characterizes it as "the practice of constructing and studying theoretical models that include only the core causal factors which give rise to a phenomenon" [Weisberg, 2007, p. 642]. The exclusion of causally irrelevant factors may take the form of omission (as in Jones's abstraction) or of counterfactual ascription of properties (as in Jones's idealization). MI neatly corresponds not only with Marx's insistence, in the three passages above, that the disregarded aspects of the target system are irrelevant to the mechanism at hand, but also with his broader concern with the capitalist mode of production "in its ideal average". As regards the passages quoted earlier on, which I have identified as cases of Jonesian abstraction, similar considerations apply. At a given stage of exposition, Marx limits his focus to aspects which either make a difference to the mechanism being investigated or allow the introduction of new aspects – thereby omitting all other aspects.

Weisberg also distinguishes five "representational ideals" or "goals governing the construction, analysis, and evaluation of theoretical models", each of which consists of two components: *inclusion rules* and *fidelity*

rules [Weisberg, 2007, p. 648]. The former serve to identify the kinds of properties of the target system must be included in its representation, while the latter provide criteria for assessing the precision and accuracy of the resulting model. Without going into too much detail, the five ideals are *completeness* ("include everything, maximize precision and accuracy"), *simplicity* ("include only what is necessary for a qualitative match between the representation and the target system"), *1-causal* ("include primary causal factors only"), *maxout* ("maximize predictive power"), and *p-general* ("maximize the number of possible target systems represented").

Weisberg's three kinds of idealization (GI, MI, and MMI) can be associated with corresponding representational ideals. Since GI seeks the elimination of all idealizing assumptions, its ultimate goal is completeness. In contrast, minimalist idealization focuses on what is causally relevant, and hence tends to favor the 1-causal ideal. Insofar as MI is successful, the adding of details that had previously been left out will not substantially improve the model, but may "allow a more thorough characterization of a highly specific event" [Weisberg, 2007, p. 648].

We have characterized Marx as a proponent of minimalist idealization in Weisberg's sense, and of both abstraction and idealization in Jones's sense. Based on this, it seems that two representative ideals were especially pertinent to his practice: 1-causal and p-general. Marx's version of the former ideal entails inclusion rules which postulate that unobservable causes and mechanisms ("essences") of phenomena cannot be left out. We have identified this rule in Section 3.2 above. His approach to the latter ideal dictates the inclusion of historically specific aspects which characterize all forms of capitalist production and distinguish them from other modes of production. This was discussed in Section 3.1.

By way of conclusion, let me point out an avenue of further research that this assessment could motivate. If the above analysis is correct and Marx was *not* a proponent of Galilean idealization, then his use of abstraction and idealization is incompatible with the idea of a series of "successive approximations" in *Capital*. The latter approach was elaborated in considerable detail in the works of L. Nowak (e.g. [Nowak, 1980]). It comes with clear fidelity rules: the idealizing assumptions in Marx's law of value can be eliminated through a series of steps until an empirically testable version is obtained. Based on the degree of approximation of this law to observed phenomena, one can judge the accuracy and precision of Marx's theory. But if Marx's "abstraction" is more akin to Weisberg's minimalist idealization, then what are its fidelity rules, and how do they translate into the language of traditional philosophy of science?

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