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4 **ON THE PRODUCTION**
5
6 **OF KNOWLEDGE**
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9
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12
13 **ABSTRACT**
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15 *This article aims at contributing to the development of a Marxist theory of the*
16 *production of knowledge, and in particular of natural sciences and techniques*
17 *(NST), under capitalism. It rejects the double critique that the labor theory*
18 *of value has become obsolete under modern capitalism and that Marx's*
19 *theoretical structure cannot accommodate mental production. The paper*
20 *starts with two preliminary sections. First, some relevant aspects of dialectics*
21 *as a tool of social research are submitted. Then, notions such as Information*
22 *Society or Service Society are debunked. On this basis, the production of*
23 *individual and of social knowledge is inquired into and the conditions for*
24 *knowledge production to be production of (surplus) value are analyzed. Next,*
25 *the question is tackled as to why and how this knowledge (and in particular*
26 *NST) is functional for the interests of the capitalist class, even though in*
27 *a contradictory way. Several examples are provided. Particular attention is*
28 *paid to the computer and to biotechnology and genetic engineering. The most*
29 *common objections against the thesis of the class determination of knowledge*
30 *are dealt with. It is argued that class determination of knowledge can explain*
31 *why the science and techniques developed in one society and by one class*
32 *can be used in other societies and by other classes. Examples are provided of*
33 *trans-class and trans-epochal elements of knowledge. Finally, the last section*
34 *submits that a radically different type of NST can originate only from a*
35

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1 radically different type of society, based on radically different production
 2 relations.
 3

4 1. INTRODUCTION

6
 7 There is nowadays a widespread awareness that in contemporary capitalism a
 8 specific type of knowledge, natural sciences and techniques (from now on, NST),
 9 has become increasingly important for economic purposes.¹ Yet, the theorization
 10 of the production of NST both in general and in particular under capitalism, has
 11 been impaired by the acceptance of two epistemological dogmas, i.e. that the mind
 12 (knowledge production) is somewhat independent of the body as well as of society
 13 (Ferretti, 2004). Marxist theory provides a framework within which to theorize
 14 three interrelated aspect, i.e.: (a) the production of NST both as an individual
 15 and as a social process; (b) the production of NST under capitalism as an aspect
 16 of the production of value and surplus value; and (c) the social, ideological, and
 17 moral impact of the specific type of NST being produced nowadays. Yet, most Left
 18 theorizations have disregarded these possible avenues of research – by overlooking,
 19 to begin with, Marx’s scarce, but key, epistemological hints – and have relied,
 20 consciously or not, on the two above mentioned dogmas. Not surprisingly, then,
 21 the Left (both Marxist and not) has been caught unprepared by the explosion of what
 22 has been called the Information Society and the digitalization of the labor process
 23 (which are seen basically as purely technological, rather than class determined,
 24 processes) and by certain developments in biotechnology and genetic engineering
 25 (like animal – and, since short, human – cloning). It can be safely stated that at
 26 present this is one of Marxism’s black holes. This article aims at contributing to the
 27 development of a Marxist theory of knowledge production *under capitalism*, and
 28 in particular of NST, adequate to the 21st century. But, given Marxism’s condition
 29 of theoretical backwardness in this field, what follows cannot but be partial and
 30 incomplete.
 31

32 2. ON TEMPORAL DIALECTICS

35 The present approach is based on dialectics as a tool of research of the social world
 36 (including the social production of NST) rather than as a law of development
 37 immanent in nature. On the basis of the observation that social reality is
 38 continuously changing, it submits a notion of dialectics explaining this changing
 39 reality in a way consonant with Marx’s theory.² Here, only a brief summary of
 40 some relevant aspects will be submitted.

1 Social reality is perceived as a *dialectical relation* among its component parts,
2 or instances, in the sense that each instance is either determinant or determined
3 and either realized or potential. The determinant instance is such because it is a
4 condition of existence of the determined one while at the same time transferring to
5 the latter its social content (to be defined in a moment). The determined instance's
6 social content reacts upon and modifies the determinant instance's social content
7 so that the determined instance becomes a condition of further reproduction,
8 supersession or destruction of the determinant one.³

9 An instance is either determinant or determined only analytically, i.e. according
10 to the level of abstraction considered. For example, at a level, distribution
11 determines consumption but at another level distribution is itself determined by
12 production. But in reality, all instances are both determinant and determined. It is
13 in this sense that all instances are mutually and existentially interrelated. Given
14 this mutual interrelation, each instance is not only a conditions of existence but
15 also of reproduction, supersession, or termination of all other instances and thus
16 (possibly in a very indirect way) of society. This is the *social content*, both what
17 is transferred and what reacts upon after having been transferred.

18 The analysis of the relation between the realized instances explains the dynamics
19 of the world in its actual manifestations (the *form* taken by that social content).
20 But, at the same time, all realized instances (both determinant and determined) are
21 also determinant of the world of potentials because they contain within themselves,
22 and thus are the conditions of existence of, and give their social content to, those
23 potentials. The analysis of the relation between realizations and potentials gives
24 the coordinates for an analysis of possible future developments of the actually
25 realized world. All of this in a temporal dimension, i.e. the potentials can become
26 actual conditions of reproduction, supersession, or destruction of their determinant
27 instance only after the moment of realization of their determinant instance.⁴ Or,
28 while the realized world is the *present* condition of existence of the potential
29 world (it encompasses the realm of potentials into itself), the potential world is the
30 condition for the *future* reproduction, or supersession or destruction of the present
31 realized world. Within a temporal setting, a determined instance can never precede
32 temporally its own determinant instance, it exists either simultaneously with it (if
33 it is realized) or as a future possibility (if it is still a potential).

34 We can now tackle the question as to the origin of the social instances' social
35 content. The thesis is that it derives from the capitalist production relations. Let
36 us first dwell on the notion of relations. A relation is an interaction between two
37 or more people. A process is an activity and therefore a transformation. Relations
38 determine processes because every relation contains in itself a transformation,
39 be it of the relation itself (relational transformation), or of material reality
40 (material transformation), or of the persons engaging in that relation (personal

1 transformation), or of knowledge (mental transformation).⁵ Then, relations transfer
2 their social content to processes and the processes' social content react upon that
3 of the relation thus becoming a condition for the reproduction, or supersession, or
4 destruction of that relation and thus of society. Relations and the processes they
5 determine are the ever changing, existentially interdependent, building stones of
6 society.⁶

7 The thesis that all relations and processes get ultimately their social content
8 from the capitalist production relations rests on the notion that, under capitalism,
9 the owners of the means of production (and thus of the laborers' labor power)
10 can determine what to produce (surplus value), how to produce it (through the
11 control and surveillance of the laborers by the capitalists and their agents), and for
12 whom (the capitalists themselves). Since production is prior to distribution and
13 consumption and thus to all other aspects of society, the ownership of the means
14 of production determines all other social relations and processes by not only being
15 their condition of existence but also by transferring to them its own social content
16 (functionality for the reproduction, supersession, or destruction of those relation
17 and processes and thus of society).⁷

18 This social content is inherently contradictory. To see this, we must briefly
19 tackle the notion of human nature. This is our biological make-up, and thus some
20 permanent traits, capacities, needs and powers which are characteristic of each and
21 all human beings and which set apart human beings from other living creatures –
22 e.g. the capacity to create their means of production (Marx & Engels, 1970, p. 42)
23 or of creating, and communicating through, languages (Geras, 1983, p. 48). But it
24 is also the necessarily social form through which these traits, capacities, needs and
25 powers must manifest themselves. Thus, *human nature is the ensemble of specific*
26 *human potentialities which must realize themselves as historically specific and*
27 *socially determined human features*. It is thus neither a pure social construct nor
28 a biologically immutable given. Rather, it is the interpenetration of both. Society
29 molds those very potentialities, it not only gives them a historically specific form
30 but penetrates them and adapts them to itself. It is within these socially given
31 boundaries that humans, if let free, tend to develop those potentialities to the
32 utmost.

33 Under capitalism, this need is double and contradictory. On the one hand, the
34 capitalists need to deal with the producers (the non-owners) as *abstract* individuals,
35 as carriers of the capitalist production relations, as producers of surplus value
36 (i.e. as the source of the maximum feasible quantity of unpaid labor) rather than
37 as *concrete* individuals (individuals considered in their uniqueness, as specific
38 individuals) for whom the production process should be the means for a full and
39 all round development of their potentialities. On the other hand, the producers
40 have an equally objective need, but of an opposite nature. Their objective need,

1 which they have in common with all humans, is their free and full development,
2 the realization of their human nature, of their specific potentialities, in that specific
3 social setting. Within the capitalist context, the non-owners' objective need is that
4 of resisting their alienation not only from their own products (which they must
5 alienate to the owners of the means of production) but also from themselves. If
6 *classes* are defined as groups of people carrying certain production relations, the
7 basic classes under capitalism are the capitalists and the laborers.

8 The contradictory social content of the capitalist production relations, then,
9 is both a class's objective need to exploit another class and the objective need
10 the latter class has to resist that exploitation, *both the need to thwart human*
11 *development and the need to expand it to the maximum*. The satisfaction of the
12 former need (by the class of the owners of the means of production) is functional
13 for the reproduction of the capitalist system, the satisfaction of the latter need
14 (by the class of the non-owners of the means of production) is functional for
15 the radical change of that system. It is this contradictory social content which is
16 transferred to the rest of society. But, while this basic intrinsic contradictoriness
17 constitutes each social phenomenon's *ultimate* social content, each specific social
18 phenomenon is functional for the reproduction, supersession, or destruction of
19 other social phenomena and of society in its own specific way. The capitalist
20 production relations, thus, are both determinant and determined. But they are
21 *ultimately* determinant because it is their own social content which pervades the
22 rest of society.

23 Finally, if this social content is contradictory, social phenomena are not
24 only contradictory to each other but also inherently contradictory. Thus, those
25 phenomena which are conditions of reproduction actually both foster and at the
26 same time hinder that reproduction. They are conditions of reproduction because
27 this is their *dominant*, rather than being their only, function at each particular
28 time and under each specific historical conjuncture. The same holds for those
29 phenomena which are conditions of radical change or of termination. It is because
30 of this that an instance can change from a condition of reproduction to a condition
31 of radical change or termination and vice versa.⁸

34 **3. INFORMATION SOCIETY, SERVICE SOCIETY** 35 **OR CAPITALIST SOCIETY?**

36
37 One more preliminary step is needed. This article aims at the development of
38 a theory of knowledge both in general and, above all, under capitalism. But it is
39 fashionable nowadays to hold that capitalism has been replaced by the Information
40 Society or by the Service Society, i.e. by a world system in which, supposedly,

1 the developed countries are not dependent any longer on material production.
2 Rather, allegedly, their main activity has become the provision of services which
3 – confusedly – are made to include the production of NST as well. The production
4 of wealth (value, in Marxist terms), then, is ascribed principally to the service and
5 NST sectors in these countries. Concomitantly, these two sectors are seen as either
6 the new working class or the new middle class. These theses catch some elements
7 of novelty but are nevertheless erroneous and highly ideological.

8 *First*, capitalism is still capitalism. Its essence, the ownership of the means of
9 material production by the capitalists, and thus the division between capital and
10 labor, is unchanged even though the forms of appearance of the capitalist ownership
11 relations, and thus of the two basic classes, have indeed undergone dramatic
12 changes. If anything, the owners/non-owners divide is growing, as indicated by
13 capital's unprecedented freedom to roam the world and to subject labor to old and
14 new forms of domination (e.g. displacement by automation, de-skilled, flexible,
15 temporary, casual, off the books, and on call jobs), by capital's penetration of
16 realms of activities previously not subjected to capitalist (ownership) relations (e.g.
17 the commodification of previously free activities and the taking over of activities
18 previously performed by the state), and by the growing sector of mental labor
19 (to be defined later on) employed by capital. Contrary to notions such as the
20 "New Economy" and the "Information Society," which are based on a supposedly
21 generalized "empowering" and creative mental work, most mental laborers are not
22 self-employed but subjected to the rule of capital and thus to the just-mentioned old
23 and new forms of domination to which all labor is subjected. For example, mental
24 labor, just as material labor, is subjected to continuous waves of technological
25 innovations and restructuring that, tendentially, de-qualify positions.⁹ This is far
26 cry from self-fulfillment through work. The so-called Information Society, or better
27 said this new stage of capitalism, is far from having made class relations redundant.

28 *Second*, while it is true that the production of NST is highly concentrated in
29 the imperialist world, material production has not become less important. It has
30 only been partly shifted to the dependent countries. The developers as well as
31 the beneficiaries of this shift are mainly the capitalists in the advanced capitalist
32 countries: "At present, only 1% of patents are owned by persons or companies in
33 the Third World and, of those, 84% are owned by foreigners and less than 5% are
34 actually used for production in the Third World" (Mihevc, 1995, p. 172). Contrary
35 to the apologetic version of the international relocation of productive activities, the
36 shift of some material production to the dependent countries is a new and crucial
37 aspect of the continuing domination of those countries by the imperialist ones
38 through the retention by these latter of the production of advanced NST.

39 This affects mental labor in the imperialist countries as well. Its less
40 qualified sectors are threatened by international relocation and thus by increased

1 exploitation.¹⁰ Moreover, given the high concentration of unproductive, financial,
2 and speculative activities in the service sector of the developed countries and
3 given the appropriation of value from the dependent countries by the imperialist
4 ones, the Information Society thesis reduces both the value produced by the
5 dominated countries and inflates the value produced by the dominant ones. It
6 is thus a rationalization of capitalism and imperialism. Finally, as May (2000)
7 has pointed out, certain tasks, which used to be carried out within processes of
8 material production, such as security and advertising, are now undertaken by firms
9 specializing in those activities. Statistically, what used to be categorized as an
10 industrial activity is now defined as a service. But this is a statistical change, not
11 a real, economic, one.

12 *Third*, the Information Society thesis rests on an impairing confusion between
13 knowledge (NST) and services. They are usually lumped together not only because
14 they, allegedly, are both immaterial (supposedly, they lack physicality) but also
15 because, especially after the recent spate of privatizations of public services, they
16 both are said to be “produced” as commodities. But, first, by collapsing mental
17 production into the service sector and by considering the former as a highly skilled
18 and “empowering” activity, the “still Taylorised ranks of the service class” are
19 swept under the rug (May, 2000). Second, both mental labor and the provision
20 of services are considered to be (immaterial) production and these two branches
21 of activity are ascribed a productive role simply because they are “production.”
22 But they are productive (of value) only under specific circumstances. Thus, the
23 productive nature of the “new economy” is highly inflated and the ideological grip
24 of this new form of capitalism is strengthened.

25 *Fourth*, the category “services” is both spurious and highly ideological.
26 Supposedly, the capitalists provide a service to the workers, by supplying them
27 with the means of production, and the workers provide a service to the capitalists
28 by making available to these latter their labor power. The exchange of services
29 replaces exploitation. This is why Marx says “A service is nothing other than the
30 useful effect of a use value, be it that of commodity, or that of labor. But we are
31 here dealing with exchange value” (Capital I, pp. 300, 301). As for its spurious
32 nature, it encompasses activities with radically different economic nature. Let us
33 review them, keeping in mind that we refer here to the provision of services by
34 *private capital*.

35
36 (A) Public utilities. There are two categories.

37 (A1) The labor used for the provision of water, electricity, gas, etc. Let us
38 recall that for Marx labor is productive of (surplus) value if employed
39 by capital and if it transforms use values into new use values. Given
40 that a labor process is split in a number of sub-labor processes, the same

1 criterion applies to all those sub-processes that are sub-elements of the
 2 transformation of use values. It is for this reason that the transportation
 3 of material goods is productive labor. For the same reason, the use value
 4 of water, etc. is not ready for consumption, i.e. it has not been finished
 5 yet, until it has been delivered to the place of consumption. This is then
 6 an example of *material production*. Without this final step, it could not
 7 be used and would not be a use value. The labor needed for the provision
 8 of material public utilities is thus productive of value.

9 (A2) The labor used for the provision of postal services, telephone and
 10 telegraph, etc. on the other hand is an example of the transmission of
 11 knowledge. It too is similar to the transportation of material products.
 12 But this is *mental production* (see below). That knowledge has to
 13 be transmitted if it has to realize its use value. The labor needed to
 14 transmit this knowledge (not to be confused with the knowledge being
 15 transmitted) results in the production of value because this is the last in
 16 the transformation of knowledge under capitalist production relations.

17 (B) The labor used for social services, i.e. for the provision of social insurance,
 18 health care (e.g. hospitals, family help, etc.), entertainment, old age pensions,
 19 etc. This labor participates in material production for the same reason as
 20 that adduced by Marx in discussing the maintenance of machinery, etc.
 21 Maintenance prevents the deterioration of use values and thus is equivalent
 22 to their production. The difference here is that the use value preserved is the
 23 collective laborer's labor power.

24 (C) The labor used for financial services, mainly those provided by banks and other
 25 financial institutions. They are often referred to as immaterial production.
 26 However, they pertain to the realm of exchange, i.e. to the redistribution of
 27 value. This, for Marx, is unproductive labor.

28 (D) The army (e.g. mercenaries) engages in the destruction of use values. Thus,
 29 its labor can be neither productive nor unproductive of (surplus) value, it is
 30 an example of what has been called elsewhere "labor destroying value" (see
 31 [Carchedi, 1991](#)).

32 (E) The police and more generally the "services" provided by repressive
 33 apparatuses are examples on a societal level of what Marx calls "non-labor"
 34 i.e. the work of control and surveillance within the production process.
 35 Since their function is that of extracting (surplus) value, they cannot create
 36 (surplus) value. However, the police is productive of value inasmuch as it helps
 37 preventing the destruction of use values (which is similar to transformation
 38 of use values).

39 (F) Tax collection too is an example of non-labor, the extortion of (surplus) value
 40 from the working class as a whole after surplus value has been produced and

1 realized. It should not to be confused with the subsequent redistribution of the
2 taxed (surplus) value which, being a redistributive activity, is unproductive
3 labor, rather than non-labor.

4 (G) Finally, knowledge. Marx mentions only two possible cases of knowledge
5 production, the production of books, works of art, etc. and teaching (and
6 thus by extension modern educational services). Thus, for him, immaterial
7 production and production of knowledge resulting into the production of value
8 are the same (1976, pp. 1047, 1048).

9
10 Thus, services comprise a whole range of economic processes under capitalism,
11 i.e.:

- 12 (1) processes of production of (surplus) value based on the transportation of
13 material goods (case A1), or on the transportation of knowledge (case A2), or
14 on the preservation of labor power (case B);
- 15 (2) processes of redistribution of (surplus) value, i.e. unproductive processes (case
16 C);
- 17 (3) processes of destruction of (surplus) value based on the destruction of material
18 use values (case D);
- 19 (4) processes of extraction of surplus value (cases E and F);
- 20 (5) processes of production of knowledge which, as the next section will argue,
21 can be production, redistribution, extraction, and destruction of value.
22

23 Given this heterogeneity, the category services hinders analysis and should be
24 banned from value theory.¹¹

25 To end this section, a few words on value theory's supposed inadequateness
26 to deal with NST production. Four arguments can be made. The first is based on
27 the assumption that the production of NST relies increasingly on free information
28 (which has no value). But then, first, how can an input that has no value create
29 value (NST as a commodity)? And, second, given that "free social knowledge is
30 appropriated and turned into a source of private profit" . . . "direct exploitation is
31 becoming less important as a source of profit" (Morris-Suzuki, 1997b, p. 64). On
32 both accounts "we have moved away from Marx's picture of classical capitalism"
33 (ibid.). These objections can be challenged on three accounts.

34 To begin with, suppose that the mental laborers' knowledge were increasingly
35 acquired for free. In this case the value of their labor power would decrease
36 proportionally. If, for sake of argument, all of the workers' knowledge were to
37 be acquired for free, the value of their labor power would be determined only by
38 the value of their socially determined means of reproduction, except knowledge.
39 The workers would still be exploited. There would be a tendential disappearance
40 of exploitation only if all means of reproduction lost their value, in which case the

1 capitalists would not have to pay wages any longer. But then the (mental) laborers
2 would have to live on thin air.¹²

3 Moreover, it is not true that the production of information (NST as an output)
4 relies increasingly on free knowledge (as an input). If anything, the movement
5 seems to go in the opposite direction. Suffice it to think of the privatization
6 of education, from kindergartens to universities, not to speak of the increasing
7 use of intellectual property rights. More precisely, the production of information,
8 nowadays as well as in Marx's times, relies on a dialectical process of deskilling
9 and reskilling of (the mental laborers') labor power within an increasing level of
10 knowledge for labor power as a whole. This too is one of the centerpieces of Marx's
11 analysis of the labor process.

12 Finally, Marx's "classical picture" *does* take into account the free appropriation
13 of knowledge (e.g. the appropriation of the knowledge imparted by parents to their
14 children when, later on, these latter will sell their labor power; or the assimilation
15 by workers of cultural and traditional elements, two cases Marx does not deal with
16 explicitly) just as it takes into account the free appropriation of natural resources
17 (something he does deal with explicitly). Both types of appropriation are a free gift
18 for the capitalists, they increase their laborers' productivity, the production of *use*
19 *values* per unit of capital invested, but they do that without increasing the value
20 produced. Similarly to the case of improved techniques, this increased physical
21 productivity makes possible a greater appropriation of value by some capitalists
22 (those who benefit from these gifts) from some other capitalists.

23 The second argument is advanced by [Hardt and Negri \(2000\)](#). As they submit,
24 "As labor moves outside the factory walls, it is increasingly difficult to maintain the
25 fiction of any measure of the working day and thus separate the time of production
26 from the time of reproduction, or work time from leisure time" (pp. 402, 403).
27 Consequently, "The object of exploitation and domination tend not to be specific
28 productive activities but the universal capacity to produce, that is, abstract social
29 activity and its comprehensive power" (p. 209). But, first, the thesis that labor
30 moves increasingly outside the factory walls is, just as so many of these authors'
31 assertions, empirically unfounded. If anything, the opposite is true. Second, as
32 pointed out by [Callinicos \(2001\)](#), they simply confuse exploitation in the Marxian
33 sense with different forms of domination in different spheres of society, all of
34 which can be shown to be ultimately determined by exploitation proper.¹³

35 The third argument focuses on the supposed impossibility to measure value
36 under modern circumstances. It stresses that while it is possible to measure the
37 value of (a unit of) material product, it is impossible to measure the value of (a
38 unit of) knowledge because of this latter's immaterial nature. Let us disregard for
39 the present purposes that the value of a commodity is given also by the means of
40 production and let us focus only on the new labor expended. In material production

1 the value of the whole product is given by the labor expended within the productive
 2 unit, considering the intensity of labor and the level of skills (see below). This
 3 value can be subdivided into units of output, so that the unit value is the value of
 4 the total output divided by the total output. The same applies to the production
 5 of knowledge, whose value is given by the hours of labor needed to produce it
 6 within a certain enterprise. Given that knowledge is always contained in a material
 7 shell (be it a book, a computer, or simply a piece of paper), the unit value is
 8 the value produced divided by the quantity of the material shells in which it is
 9 contained.

10 While these three arguments focus on the supposed obsolescence of the labor
 11 theory of value under modern capitalism, a broader critique holds that Marx's
 12 theoretical structure cannot accommodate mental production. The remaining of
 13 this article counters this critique by submitting a (value) theory of knowledge
 14 production focused on NST, both in general and under modern capitalism. This
 15 theory is based on the bearing walls, while being at the same time a development,
 16 of Marx's own (value) theory.

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4. INDIVIDUAL KNOWLEDGE

21 The notion of temporal dialectics submitted in Section II above will now be
 22 applied to knowledge. This section will examine how concrete individuals, either
 23 in isolation or together, produce knowledge, i.e. individual knowledge.

24 The notion of abstract and concrete individuals has been submitted above. Let us
 25 elaborate on it, keeping in mind that the distinction between concrete and abstract
 26 individuals is only analytical because in reality individuals are always both concrete
 27 and abstract.¹⁴ *Individual relations* are forms of interaction among *concrete*
 28 *individuals*, i.e. individuals considered in their uniqueness, as specific individuals.
 29 An individual relation depends for its inception, continuation, transformation, or
 30 termination only on the uniqueness of those individuals and on their capacity
 31 and will to engage (either freely or not) in that relation. An *individual process*
 32 is then a process determined by individual relations and at the same time the
 33 specific form of that relation. Individual relations and processes will be called
 34 *individual phenomena*. Given the uniqueness of concrete individuals, they are
 35 not replaceable in individual phenomena. *Social relations*, on the other hand, are
 36 forms of interaction among *abstract individuals*, i.e. individuals considered as
 37 possessing some socially significant common features (for example, they are all
 38 catholic), irrespective of the specific, individual, forms taken by those common
 39 features (e.g. my specific way to be a catholic). It is because of these common
 40 features that these individuals are considered to be members of a certain group.

1 *Social processes* are then processes determined by social relations and at the same
 2 time the form of existence of those relations. Social relations and processes are
 3 called *social phenomena*. Given the common features defining abstract individuals,
 4 abstract individuals are replaceable in social phenomena.

5 This general scheme can now be applied to the production of knowledge.
 6 *Individual knowledge* is the view of reality from the perspective of concrete
 7 individuals. It is different for each one of them. *Social knowledge* is the view
 8 of reality from the perspective of abstract individuals, i.e. of social groups, and is
 9 common to the abstract individuals belonging to a social group. This section will
 10 tackle the production of individual knowledge. To begin with, characterizations
 11 such as “intellectual labor” versus “manual labor” are inadequate and theoretically
 12 unfounded, given that any labor is both manual, i.e. the result of physical activities,
 13 and intellectual, the result of conception. To avoid this impasse, we must change
 14 perspective and introduce the notion of *transformations*. Material transformations
 15 (MAT) are the outcome of the combination of the material means of transformation
 16 (MMT), of the material objects of transformation (MOT), and of labor power (LP).
 17 Mental transformations (MET) are the outcome of the combination of existing
 18 knowledge, i.e. knowledge as an input (K), and of LP.¹⁵ If + indicates combination
 19 and if = indicates the outcome of that combination

$$20 \qquad \qquad \qquad \text{MAT} = \text{MMT} + \text{MOT} + \text{LP} \qquad (1)$$

$$21 \qquad \qquad \qquad \text{MET} = K + \text{LP} \qquad (2)$$

22
 23
 24 Since knowledge is part of labor power, in Eq. (2) K refers to the knowledge existing
 25 outside the agents of mental transformation (books, etc.). This K is incorporated
 26 by the agents of MET who will transform it. But this is not the only input in
 27 (2). The other input is their LP and thus the knowledge they already have. The
 28 knowledge contained in LP thus transforms itself by incorporating K . It becomes
 29 thus clear how mistaken is the dogma, mentioned in the introduction, that the mind,
 30 i.e. knowledge, is independent of the body. Knowledge is the result of the activity
 31 of labor power and not only of the mind, brains.

32 The separation between MAT and MET is only analytical: *labor, and thus a*
 33 *labor process, is always the combination of both types of transformations*. That
 34 is to say, these two types of transformations cannot exist independently and can
 35 realize themselves, as a labor process, only conjointly and contemporaneously. A
 36 labor process, then, is either material (MAL) or mental (MEL), i.e. it produces
 37 a material product or knowledge, depending upon which type of transformation
 38 is determinant. Given that it is not possible to observe which of the two types of
 39 transformations is dominant during the labor process, we can trace back the nature
 40 of this process only by considering the outcome. Usually the dominant aspect of a

1 product is empirically given. Thus, in the production of a car it is the material aspect
 2 which is empirically given (and on this basis we know that the production process
 3 has been a material one) and in the production of a concert it is the mental aspect
 4 which is empirically apparent (so that we can deduce that it is the mental aspect
 5 which has been determinant). However, this rule is not always accurate. *What*
 6 *decides the material or mental nature of a labor process is the social validation*
 7 *of the outcome.*¹⁶ This social validation occurs at the moment of exchange. Thus,
 8 for example, a book is produced and exchanged primarily because of its mental
 9 content and its materiality (it must be clearly printed, graphically attractive, with
 10 as few printing mistakes as possible, etc.) is necessary but subordinate to the
 11 mental content carried by the book. In symbols, if the bold type denotes the
 12 determinant aspect, if P indicates the material aspect of the output, and K^* indicates
 13 the knowledge aspect of the output,

14
$$\text{MAL} = \mathbf{MAT} + \text{MET} = \mathbf{P} + K^* \tag{3}$$

15
$$\text{MEL} = \text{MET} + \mathbf{MAT} = K^* + P \tag{4}$$

16
 17
 18 Notice that the product of a labor process has always a double aspect, the physical
 19 and the mental one, irrespective of whether that product is the output of a MAL
 20 or of a MEL. K^* is the *dominant* aspect of the output of a MEL (because in a
 21 MEL the MET are *determinant*) and the *secondary* aspect of the output of a MAL
 22 (because in a MAL the MET are *determined*). Similarly, P is the dominant aspect
 23 of a MAL's output and the secondary aspect of a MEL's output. As a short-cut we
 24 can say that the outcome of a MAL is a physical object, a material product (P),
 25 and that the outcome of a MEL is knowledge (K^*). But we should be aware that
 26 these are the dominant, and not the only, aspects of that outcome.

27
 28

29 **5. SOCIAL KNOWLEDGE**

30

31 We must now inquire into how concrete individuals, who produce individual
 32 knowledge, can originate social knowledge. Individual knowledge has also a
 33 social dimension in spite of its being produced by (concrete) individuals. As Marx
 34 puts it:

35
 36
 37
 38
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 40

when I am active *scientifically*, etc. – when I am engaged in activity which I can seldom perform
 in direct community with others – then I am *social*, because I am active as a *man*. Not only is
 the material of my activity given to me as a social product (as is even the language in which
 the thinker is active): *my own existence is social activity*, and therefore that which I make of
 myself, I make of myself for society and with the consciousness of myself as a social being
 (Marx, 1971, p. 137.)

1 The production of knowledge, then, even if it is the result of a concrete individual's
2 activity, is never disassociated from society because the inputs material of that
3 activity are socially given and because the concrete individual has been formed
4 through a process of socialization. Let us elaborate on Marx's hint.

5 Individuals undergo, from the first moment of, and throughout, their life, a
6 process of socialization. This is a personal transformation (see [Section 2](#)), it is
7 the internalization, for the whole span of a person's life and for each individual
8 in his or her own specific way, of social phenomena, individual phenomena, and
9 chance occurrences. It is in this way that social phenomena become elements
10 of the concrete individuals' consciousness and individuality and that their social
11 content is reduced to a potential state, i.e. that concrete individuals' functionality
12 to be agents for the reproduction, or for the radical change, or for the cessation
13 of society is only potentially present in them. It follows that not only abstract
14 individuals but concrete individuals as well possess a social nature: the former
15 are the actual carriers of social relations and agents of social processes, the latter
16 are so only potentially. Having thus received their potential social content through
17 socialization, concrete individuals can transfer it back, in its realized but modified
18 form and possibly content, to social phenomena either by generating (participating
19 in) new social phenomena or by transforming existing ones (whether they are
20 aware of it or not). By so doing, through their purposefulness and volition, concrete
21 individuals contribute to the reproduction, or the radical change, or the termination
22 of society.¹⁷ To sum up, the logical chain goes from the realized social content of
23 social phenomena to socialized concrete individuals (socialization), to the potential
24 social content of individual phenomena, to the realization of the potential social
25 content.

26 Some aspects should be highlighted. First, social groups contribute to the
27 reproduction, radical change, or termination of society, whether they know it or not,
28 by pursuing their economic, political, and ideological interests. This means that
29 the production of social knowledge is at the same time the transformation of those
30 interests into that view of reality. There is no ideologically neutral knowledge.

31 Second, not all members belonging objectively to a group share necessarily
32 that group's knowledge. Since the different groups' interests and needs are
33 contradictory, the formation of social knowledge is at the same time an ongoing
34 attempt by each group to impose its own view upon that of other groups. Thus,
35 the knowledge produced by a group's intellectual representatives can incorporate
36 elements of different social knowledges (representing the interests of other groups)
37 up to the point where the social content of their mental production undergoes
38 a radical change. In this case, that social knowledge becomes the theoretical
39 expression of a different group's or class's interests (false consciousness, in the
40 case of the collective labourere).

1 Third, social knowledge is produced by concrete individuals but from the
 2 perspective of the group they belong to, i.e. as abstract individuals. They give the
 3 view of reality of a group their own personal features and in so doing they become
 4 that group's ideological, or intellectual, representatives. In class divided societies
 5 only some concrete individuals have the possibility to become the intellectual
 6 representatives of some groups, whose specific (and often paid) function is that of
 7 being an intellectual representative. This function often requires a special system
 8 of rewards so that they develop vested interests in this specific function.

9 Fourth, an individual knowledge becomes social knowledge only if it is accepted
 10 by a number of persons sufficiently great to transform it into a social phenomenon,
 11 i.e. if that knowledge can continue to exist without its original producer (given
 12 his or her replaceability as an abstract individual) and if it can affect other social
 13 phenomena (but see next paragraph).

14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

6. KNOWLEDGE AND VALUE

We can now inquire into the conditions for knowledge production to be productive
 of (surplus) value. This applies to mental producers employed by capital,
 irrespective of whether their knowledge becomes a social phenomenon or not.¹⁸

Let us recall that for Marx a material capitalist process is the combination of a
 material labor process and of a surplus value producing process (the performance
 of the work of control and surveillance). This process is productive of (surplus)
 value only if, as a labor process, it transforms material use values. If we apply this
 concept to the production of knowledge:

Pl. check 'o' in
 line no. 20 & 23

- (a) the production of K^* produces (surplus) value if it is the outcome of a
 MEL conceptualizing the transformation of material use values or if it is the
 secondary aspect of a capitalist MAL transforming material use values into
 new material use values;
- (b) the production of K^* redistributes or destroys (surplus) value if it is the
 secondary outcome of a MAL redistributing or destroying material use values
 or if it is the outcome of a MEL conceptualizing the redistribution or destruction
 of material use values;
- (c) the production of K^* extracts surplus value if it is the secondary outcome of
 that part of a capitalist MAL which extracts surplus value from the laborers or
 if it is the outcome of a MEL conceptualizing the extraction of surplus value
 (e.g. management techniques).

But there is a fourth type of knowledge production. This can be called *open-ended
 knowledge* because it does not conceptualize any of the three above-mentioned
 cases. Consider teaching on a secondary school, for example. Inasmuch as it is

1 imparted within a capitalist setting, it produces (surplus) value. In fact, similarly
2 to material production, the object of mental labor (the pupils' labor power) and
3 the means of mental production (the teacher's knowledge, buildings, books) are
4 transformed in the pupils' different labor power. The value of the pupils' labor
5 power is increased by the amount of the constant capital (buildings, books), plus
6 the variable capital (the teacher's labor power), plus the surplus value (the surplus
7 labor provided by the teacher).

8 The production of knowledge, then, can result in the production of (surplus)
9 value, in its distribution, in its destruction or in its extraction. This knowledge
10 can be subsequently applied to a further production but also to the distribution,
11 extraction, or destruction of value.¹⁹ But this concerns the following period, not
12 this one. It is thus possible that, say, the knowledge developed in the process of
13 destruction of value can be subsequently applied to the production of value and
14 vice versa. The time dimension is essential.

15 A few differences and similarities between MAL and MEL follow. First,
16 knowledge as an output enters immediately the mental laborer's labor power.
17 Thus, knowledge is both absorbed into the mental laborers' labor power and,
18 upon its incorporation in a material shell, appropriated by the capitalist. Physical
19 commodities, on the other hand, are either appropriated by the capitalists or are
20 consumed by the laborers.

21 Second, knowledge, just as material commodities, is produced by the laborers
22 and appropriated by the capitalists. But, as submitted in the previous point, the
23 same knowledge is also incorporated in the laborers' labor power, i.e. the individual
24 mental laborers are not deprived of their knowledge. However, due to the technical
25 division of labor, the vast majority of mental laborers does not have a general view
26 of the knowledge they have collectively produced. It is then the collective laborer
27 who is deprived of the knowledge produced. Capital's ideologists turn this upside
28 down. For them, the employees' minds "are repositories of knowledge accumulated
29 over untold hours of listening and talking while not delivering any goods or services
30 to paying customers . . . [they, G. C.] carry a share of the company's knowledge
31 capital" (Strassmann, 1999).

32 Third, due to its immateriality and thus contrary to material commodities, K^* ,
33 to be a capitalist commodity, needs a material shell, be it the material product in
34 which it is incorporated as the secondary aspect of the output or a material shell
35 incorporating it as the dominant aspect of the output (e.g. a piece of paper or
36 a magnetic tape). It is through this material shell that K^* , similarly for material
37 commodities, can become an input of the next production period. However, the
38 difference is that knowledge, as the output of a production period, cannot become
39 the input of a subsequent production period without being incorporated in the
40 laborers' labor power.

1 Fourth, it is not necessarily true that mental laborers (those who engage in a
2 MEL) produce more value than material laborers (those who engage in a MAL).
3 It all depends on the value of their labor power. If the value of a mental laborer's
4 labor power is less than that of a material laborer, the value created by the former
5 is less than that created by the latter, *ceteris paribus*.
6
7

8 7. ALIEN KNOWLEDGE 9

10 Let us now apply the above to the case of NST. Since the capitalists own the *material*
11 *means of mental production* (libraries, schools, research institutes, computers,
12 etc.)²⁰ and can purchase the mental laborers' labor power (which incorporates
13 their knowledge). This means that they own also knowledge as the *mental means*
14 *of mental production*, i.e. that they can decide, or let decide, *which knowledge*
15 *should be produced, how it should be produced, and for whom*. They have the
16 power to (let) define and solve problems to their own advantage (irrespective of
17 whether the capitalists themselves are able to do this or delegate the formulation
18 and solution of these problems to others, scientists and technicians). It is for this
19 reason that this knowledge is functional for the interests of the capitalist class,
20 even though in a contradictory way.

21 There are three ways this result is achieved, according to the position of natural
22 scientists and technicians in the capitalist process of mental production. The *first*
23 *category* is that of natural scientists working for a capitalist enterprise. They
24 define and solve problem of specific interest for the capitalist who employs them.
25 This mental production is either carried out by business as "in-house" research
26 or as a business in itself. Universities too increasingly adopt a more commercial
27 approach to their research by seeking research contracts with industry, by patenting
28 inventions, by licensing technologies, by forming joint-ventures with the business
29 world and by offering training courses for industry. Governments too shift funds
30 to research of more strategic value to business. These are so many ways in which
31 the production of knowledge is influenced and steered by business.

32 It is important that natural scientists internalize norms, values, etc. which lead
33 "naturally" to a certain type of knowledge rather than to another. This is the
34 case of medical science, which for obvious economic reasons on the part of
35 the pharmaceutical industry, de-emphasizes prevention and alternative techniques.
36 Genetic engineering is another example. As we shall see, it aims at preventing, or
37 curing illnesses before they manifest themselves but the research is based on the
38 belief that the scientific approach mandates that life should be decomposed into
39 its essential particles which must then be recomposed into medicines or even life
40 forms whose sale must be a source of profit. More generally, the mental laborers are

1 spurred and directed in their research by the notion of efficiency which they have
2 internalized and which they build into techniques and material instruments. This is
3 of course capitalist efficiency. Given that labor's control is by definition not efficient
4 for capital, any technique which seriously and effectively weakens capital's control
5 over labor will be perceived by the researcher as a non-starter. Whenever more
6 techniques and material instruments can achieve the same purpose (e.g. increased
7 productivity), the choice will fall on that which increases capital's control more
8 than the others. The separation between material and mental labor, the application
9 of the capitalist technical division of labor to the production of knowledge, and
10 the recomposition of the different segments into a body of knowledge is the way
11 the individual laborers can produce a class determined knowledge.

12 Noble (1978) has provided a classic example of the social determination
13 of numerically controlled machines. This author has shown that the choice of
14 numerically controlled machines, instead of the alternative technique of record
15 playback, was due not to some ineluctable technological imperative but to two
16 orders of motives. First of all, it favored large firms rather than small ones. In
17 fact, since the market for this technique was initially created by the Air Force, the
18 builders of numerically controlled machines had no incentive to develop a type
19 of less expensive machine which could be acquired by smaller firms. Moreover,
20 since the Air Force favored a certain type of program (APT) needed to run the
21 machines, and since this program required expensive computers and experienced
22 programmers, those who could not afford this program (basically, smaller firms)
23 were deprived of government (Air Force) commissions.

24 Secondly, numerical control was chosen instead of record playback because in
25 this latter method the machine repeated the notions of the machinist which were
26 recorded on a magnetic tape. The preparation of the magnetic tape thus implied
27 that the machinist retained control over the machine and thus over production.
28 Numerical control, on the other hand, did allow a far greater management, as
29 opposed to workers', control, by transferring the knowledge needed to operate
30 the machines from the shop floor to production engineers and managers. This was
31 achieved by translating the specification needed to make a part into a mathematical
32 representation of that part, then into a mathematical description of the path of the
33 cutting tool, and finally in a large number of instructions which could be read by
34 the machine. This type of knowledge was outside the reach of the machinist and
35 became the prerogative of the planning office.

36 The *second category* is that of those natural scientists engaging in capital-
37 financed or state-financed "applied science" programs (e.g. space programs). As
38 concrete individuals, these mental laborers internalize the interests of capital as a
39 whole and thus produce the knowledge needed for the reproduction and further
40 development of the capitalist economy as a whole. They represent these interests

1 by posing and solving problems which they perceive as obstacles on the road
2 towards progress, rather than on the course of capitalist expansion and domination.
3 Since the development of capitalism is identified with the course of progress,
4 any new theory or technique which makes possible the further development of
5 capitalism is perceived as a further step in scientific progress, and this might
6 just as well be the basic motive and satisfaction behind natural scientists mental
7 production. The motivation for natural scientists as concrete individuals may be
8 their personal “dreams” but these latter arise from a culture which at the same
9 time also draws the limits (of which the scientists are mostly aware) of what is
10 achievable.

11 In these first two cases, the natural scientists employed by capital need not be
12 aware of the social content of, and of the social interests served by, the knowledge
13 they produce. This lack of awareness is imposed through first the separation of
14 mental labor from material labor within the social labor process; second, through
15 the subjugation of mental labor to specific forms of the work of control and
16 surveillance; and third through the technical division of labor within the process of
17 production of knowledge, so that most mental laborers have only a limited, partial,
18 and isolated exposure to the collective process of the production of knowledge.
19 The recomposition of these partial elements of knowledge into a vaster body of
20 knowledge can then be functional both for the mental laborers’ domination by the
21 capitalists and for the formers’ production of value for the latter. This casts a light
22 on the question of Intellectual Property Rights different from what capital would
23 have us believe. Intellectual property is actually the capitalist’s appropriation of
24 the outcome of other people’s mental labor rather than being the product of the
25 capitalists themselves. The capitalists can not only decide which knowledge should
26 be produced, how it should be produced, and for whom. They can also make a profit
27 out of it.

28 Finally, the *third category* is given by those mental laborers engaging in “pure
29 science” without being employed by capital. The social content of their production
30 is accounted for in the same way as for the previous category. As an example, I
31 shall mention the social determination and social content of Newton’s theory, as set
32 forth by Hessen’s classic study.²¹ As I argue in my 1983 work, based on Hessen’s
33 work (1931): “It is Hessen’s merit to have shown, in his classical study of Newton’s
34 ‘Principia’, that both the new technological needs and the non-teleological view
35 of science . . . were functional for (determined by) the rise and development of
36 capitalism. Hessen shows very clearly how Newton’s work addresses itself to
37 solving those technical problems whose solution was a necessary condition for
38 the development of manufacture and merchant capital, and that the solution to
39 those problems (Hessen analyses the three areas of communication, industry, and
40 war) required a new type of science, a science based on the knowledge of causes,

1 i.e. a science able to reproduce phenomena experimentally and thus industrially”
 2 (Carchedi, 1983, pp.65–65????).

Pl. provide
 missing matter
 denoted by “????”

3 Moreover, “since most of these problems were of a mathematical nature,
 4 the image used by Newtonian science was that of our planetary system as a
 5 huge mechanism. Often the basic features of the determinant instance impress
 6 themselves on the determined one (in this case the new natural sciences) translated,
 7 as it were, in the language of the latter, i.e. in this case as mechanicism. But, as
 8 Hessen stresses, the interpretative scheme in the ‘Principia’ is both mechanicist
 9 and religious and these two aspects are inseparable: a mechanism can be set in
 10 motion only by external forces, i.e. by God. Newton embodies the philosophical
 11 view of the English bourgeoisie of his time which waged ideological class struggle
 12 in the form of religion” (ibid.). “The social effects of Newton’s theory consists thus
 13 in reinforcing the capitalist production relations not only on the economic level,
 14 because it fostered a tremendous growth in the capitalist productive forces, but also
 15 on the ideological level because – aside from the legitimation of those relations
 16 through the growth of these forces – belief in the existence of God, a belief which
 17 is condition of class domination also under capitalism, seemed now to be grounded
 18 in the most advanced form of science” (op. cit., pp.66, 67).

19 In all three above mentioned cases, a whole system of institutions
 20 providing status, monetary and other rewards (or threatening disciplinary
 21 measures, as unemployment), research facilities, the prerogatives associated with
 22 professionalization, technical education, and the ideology of technical “progress”
 23 are needed to stimulate the production by individuals of a type of knowledge which
 24 is ultimately consonant with the social nature of the capitalist production relations.

25 Particularly relevant are the specific features of the social content of new
 26 technologies. If by old technologies we mean those technologies developed before
 27 the rise of the “computer society” and by new technologies those developed after
 28 it, are there qualitative differences between them? The thesis submitted here is that
 29 there are, but not as in the commonly accepted views. Let us review some of them.

- 30
- 31 (1) “Knowledge has become a commodity.” But this has always been the case
 32 under capitalism, starting from the production and popularization of the printed
 33 book. The difference is only quantitative, even though extremely significant.
 - 34 (2) “New technologies require the separation of software from hardware.” But this
 35 is also the case for old technologies, in the form of manuals for the operation
 36 and maintenance of machines, etc. Again the difference is only quantitative,
 37 even though of major importance.
 - 38 (3) “Software,” as opposed to material output, “can never wear out,” since the
 39 value of the labor embodied in the software becomes subdivided between a
 40 potentially infinite number of products (Morris-Suzuki, 1997a, p. 18). There

- 1 might not be physical wear out, given that knowledge is immaterial. But the
2 material shell in which knowledge is embedded does wear out. Moreover,
3 knowledge is subjected to technological obsolescence. Actually, in this phase
4 of capitalism, knowledge loses value due to obsolescence more than in previous
5 stages of capitalism or modes of production.
- 6 (4) “Information, unlike material goods, needs to be produced only once and
7 can then be copied and transferred.” But information too has costs associated
8 with its reproduction. The difference between the reproduction of a physical
9 commodity and of knowledge is that, given a certain technology, the former
10 needs the same inputs (means of production and labor power) each time again;
11 the latter needs a cheaper sets of inputs because it costs less to produce
12 that knowledge for the first time than to reproduce it afterwards. This is a
13 quantitative, rather than a qualitatively decisive, difference.
- 14 (5) “Knowledge can realize its value only if its owner has a monopoly of it.” But
15 this is common to all commodities, including the physical ones, whose owner
16 must be their exclusive owner in order to realize their value.
- 17 (6) “New technologies represent the ‘absolute limit’ of capitalism” (Mandel,
18 1978, pp.207, 208) or mark the “end of labor.” Such opposite views disregard
19 the cyclical pattern of capitalist development, i.e.: (a) that today’s new
20 technologies will be obsolete tomorrow; (b) and that the replacement of
21 people by machines is only a tendency, one of its counter-tendencies being
22 the development of new products and the opening up of new, low organic
23 composition of capital, branches.²²
- 24 (7) “It is the knowledge embedded in a commodity that creates its value.”
25 Knowledge does not create value. Rather, it is labor that creates value and
26 it is the value of the laborers’ labor power, which is partly determined by their
27 knowledge, which determines the quantity of value created.
- 28 (8) “The production of knowledge relies on a constant improvement of the
29 intellectual capabilities of workers and technicians.” This disregards the
30 constant dialectical process of tendential dequalification and of counter-
31 tendential requalification of mental labor.
- 32 (9) “Knowledge is the product of capitalism’s productive powers.” This is
33 capitalist self-deception, masterly spread among all social classes. In reality,
34 as always under capitalism, knowledge is the product of labor’s productive
35 powers. It is the social, economic and ideological content of knowledge that
36 bears the imprint of capital even though knowledge itself is the product of
37 labor.

38
39 These notions reveal a perception that key new developments have altered and
40 continue to alter the configuration of the countries of the imperialist centre.

1 Nevertheless, they do not catch the essence of these new developments and
2 technologies. Let us first consider the computer.

3 The computer shares with all other machines the feature of increasing labor's
4 productivity (either immediately, if applied to material transformations, or in the
5 future, if applied to mental transformations when will they will be incorporated
6 into computers applied to material transformations). At the same time, it "reduces
7 operating costs," i.e. causes unemployment and furthers both de-skilling and the
8 control over labor. The computer shares also two further features with other
9 machines, but in its own specific way. First, it incorporates knowledge (as books
10 do), but it does this in an interactive way. Second, direct personal relations between
11 concrete individuals are increasingly substituted by relations between concrete
12 individuals and a machine through its language. It has been argued that the
13 increasing role played by the computer in the early formative years may allow
14 the acquisition of new skills and forms of knowledge but at the same time it
15 may imperil the development of the child's social skills (Baran, 1995). This
16 contributes to the formation of a collective worker whose individual components,
17 as concrete individuals, lose those social skills which are necessary for them to
18 acquire consciousness of their social position and function. All these features
19 emerge in the computer's specific applications.

20 Consider telecommuting. When people work from their homes on their
21 computers, great savings are realized not only on fixed capital (lower costs for
22 office buildings) but also on variable capital (no medical benefits and no vacation
23 allowances, higher labor "flexibility," etc.). At the same time, telecommuting
24 increases the extension of communication, but also the separation, between
25 workers. Another example is virtual reality. Here, it is the computer which perceives
26 for and with us. The perception of reality is both extended and restricted to
27 only what can be processed through a computer. Virtual reality might be the
28 first step towards the fusion between humans and machines. Another step in the
29 same direction is given by thought-controlled devices, i.e. devices which can be
30 controlled by brain waves. "The brain produces electrical signals which are known
31 as electroencephalograms. In the 1960s, it was shown that subjects could modify
32 one type of brain waves known as the alpha rhythm by closing their eyes and
33 relaxing. This is the basis of biofeedback. Electrodes are attached to the subject's
34 scalp and by using relaxation techniques they can be taught to move an on-screen
35 cursor or activate a buzzer" (Cole, 1995). This is the beginning of a line of research
36 into "certain types of electronic equipment [which, G. C.] seem to be susceptible
37 to mental intervention" (ibid.). Researchers hope that in 20 to 50 years it will be
38 possible to use these techniques to move, for example, artificial limbs. But the
39 possibility to control human brains through these techniques are the other side of
40 the coins.

1 These and other similar techniques separate the workers from each other, thus
2 bringing the process of isolation and seclusion one step further. They also promote
3 the fusion of people and machines, thus creating a positive image of Robocop-like
4 “humans.” Further, they extend the reach of communication, while at the same
5 time restricting both the content of that communication and creating the “digital
6 divide.” And finally they promise an easy and equal access for everybody to an
7 increasing quantity of information while they foster the increasing concentration
8 of the mass media and of information technology in a few hands. All this, it could
9 be argued, concerns the capitalist use of these machines and techniques and it could
10 be avoided if the computer were to be used in a different way. This is true. The
11 social content of these machines and techniques, of the “Information Society,” is
12 another.

13 The real, qualitative difference between old and new technologies can be
14 more easily grasped if we focus on the precursor of the computer, Turing’s
15 machine, first theorized by Turing in 1936. It “can replicate the behavior of any
16 human ‘worker’ who is following (consciously or not) any fixed, definite decision
17 procedure, whether it involves manipulating numbers, discrete physical objects
18 or well-defined, publically identifiable environmental conditions” (Caffentzis,
19 1997, p. 51). In short, it is “capable of computing any function a human . . . can
20 compute” (op. cit., p. 49). This machines, then, mimics the working of the human
21 brain, it mechanizes thinking through programming, a new feature and itself a
22 commodity.²³

23 Thus, while old technologies force human functions to adapt to the motion of
24 machines (think of the conveyor belt), new technologies replicate human functions
25 in a machine-like fashion (i.e. only insofar as they are moved by fixed decision
26 procedures) and thus replicate in a machine-like fashion both bodily movements
27 and the production of knowledge, including the self-reflexivity of thought (think
28 of robots). Ultimately, they mechanize creativity and human life itself. This
29 *mechanization of human thought and of human creativity* makes possible the
30 substitution of humans not only by machines (as in previous techniques) but also
31 by *human-like machines*. This is the economic aspect of their social content. At
32 the same time, on the one hand, these machines propagate a view of humans as
33 highly skilled machines. This view, as Morris-Suzuki has aptly put it, “catches
34 only fragments of the original cosmos of meaning” (1997b, p. 69). On the other,
35 they elevate the machine-like mimicking of human functions to the ideal and most
36 complete form of these functions. Since these machines can perform computational
37 tasks that are impossible for humans, they propagate the notion that machines are
38 the most perfect form that can be reached by humans. This notion, that *a perfect*
39 *human is a machine-like human, is the ideological aspect of the social content*
40 of this type of NST. It is this social content in its double aspect that sketches

1 most vividly the new contours of modern capitalism in its developed, imperialist
2 centre.

3 Nowadays, as in previous phases of its development, capitalist development is
4 undermined by its constant attempt to substitute people with machines while only
5 people can create value and surplus value. It is as if nowadays capital thinks it
6 can solve this contradiction by creating human-like machines and machines-like
7 humans.

8 If the perfect human is a machine, nature itself is a machine too and thus subject
9 to mechanical reproduction. The mechanical reproduction of human life achieves
10 its greatest success with biotechnology and genetic engineering (agribusiness,
11 pharmaceutical chemical, medical business, animal and human cloning, etc.). The
12 reason is two-fold. First, as Yoxen aptly puts it, biotechnology views “nature as
13 programmed matter” (quoted in Schiller, 1997, p. 114), i.e. nature becomes a Turing
14 machine. Second, mechanization means standardization of procedures and thus of
15 products. In biotechnology, it means the standardization (through the replication)
16 of biological make-ups.

17 The concrete form taken by biotechnology and genetic engineering under
18 capitalism is many-shaped. It can be human cloning for profit (the first of which
19 seems to have already taken place), i.e. the standardization and patenting of human
20 biological make-ups, the creation of parts of the human body for sale, etc. Or, it can
21 be the genetically engineered manipulation of our biological make-up to produce
22 humans moved by fixed and programmable decision procedures (imparted, of
23 course by capital), who (which?) can then be substituted for real humans. Or, it
24 can be some sort of a productivity-enhancing fusion of machines and human life.²⁴
25 Or, it can be some sort of mixed form of life, both human and non human.²⁵ These
26 (and other similar) techniques might never become actualized. But this is irrelevant
27 within this context. What counts is that capital, through their scientists, is seriously
28 considering them, i.e. that they have become part of capital’s dream. Its dream is
29 the standardized and the mechanization of human life and thought. It is the Turing
30 machine brought to its perfection; it is, in short, the perfect monstrosity. The social
31 content of this standardization and mechanization of human life is that it makes
32 possible the perfect subjugation of life to capital.

33 Nowhere is this clearer than in the transhuman and posthuman movement. They
34 posit that, through the development and use of techniques such as biotechnology,
35 cybernetics, robotics, nanotechnology, etc., human beings are in a state of transition
36 towards a posthuman condition where our physical and biological limits (and
37 perhaps even death, through cyber-immortality) will be overcome. Humans will
38 be able to “upgrade” themselves and their offspring by choosing sex, skin color, and
39 more generally by consciously and freely redefining and redesigning themselves
40 (Rikowski, 2003). The social content of these and similar possible developments

1 is that, as Rikowski rightly points out, they abstract from the social conditions
 2 within which these techniques have developed and thus from the social content
 3 of these technologies. If the posthuman society is a prolongation of capitalism,
 4 something which seems to be taken for granted by these movements, if it is
 5 a different technological world based upon the same production relations, only
 6 those with sufficient financial and other means will be able to “profit” from them.
 7 Secondly, only those forms (techniques) of self-expansion will be allowed that will
 8 be functional for capitalism. Individual will be able to choose among *those and*
 9 *only those* form.

10 And thirdly, just as the organization of production based on the capitalist
 11 technical division of labor first fragments the labor process in its constituent
 12 elements and then recomposes them in order to produce identical and cheaper
 13 products and thus, through the production of relative surplus value, cheaper
 14 labor power, similarly capitals’ need to generate profits implies that genetic
 15 engineering seeks the basic elements of life so that they might be recomposed
 16 in life forms which are amenable to be reproduced in identical and cheaper
 17 copies (clones). In short, these forms of life would have a built-in biological
 18 impoverishment (“specialization”). This would bring the capitalist technical
 19 division of labor into life itself thus impeding the free and full development of
 20 those life forms. This impossibility would be built into those life forms themselves.
 21 True, biotechnology has therapeutic advantages. But never as nowadays these
 22 therapeutic qualities have become inextricably intertwined with de-humanizing
 23 potentials.²⁶

8. TRANS-EPOCHAL AND TRANS-CLASS KNOWLEDGE

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 28
 29 The most common objection against the thesis submitted here is that it supposedly
 30 cannot explain why the science and techniques developed in one society and by
 31 one class can be used in other societies (the trans-epochal elements of knowledge)
 32 and by other classes (the trans-class elements of knowledge). These issues are dealt
 33 with in detail elsewhere (Carchedi, 1977, 1983, 1991). Only a few remarks will
 34 be submitted here. Consider first the *trans-epochal elements of knowledge*. The
 35 reason why certain elements of knowledge can be passed over from one society to
 36 another is that they can be functional for the furtherance of the interests of other
 37 classes and social groups in other types of societies. However, these elements of
 38 knowledge are applicable to other societies because they are immersed in a different
 39 context of meaning ultimately determined by different production relations: these
 40 different context and relations *change both their cognitive and their social content*.

1 The trans-epochal nature of these elements of knowledge is explained not in spite
2 of, but thanks to, their social determination. Take, for example, the notion on the
3 number “one.”²⁷

4 For the ancient Greeks, “one” was not a number. Since “one” generates both
5 odd and even number, they argued, it must stand above this dichotomy and thus
6 cannot be a number. But it can also be argued, as it is indeed argued nowadays,
7 that just because “one” generates both odd and even numbers it must itself be a
8 number. As Bloor remarks, both lines of argument are internally coherent. For the
9 ancient Greeks, the world was a well-ordered arrangement of things. The order of
10 numbers, then, was a succession of discrete entities. It was then natural to conceive
11 of numbers as *numbers of some things*, as discrete numbers which could be ordered
12 and counted. Given their discrete nature, numbers could be represented as dots and
13 thus ordered in triangular, square, etc. shapes. Accordingly, the Greeks developed
14 the notion of triangular, etc. numbers. Numbers had “visible and tangible bodies.”
15 Moreover, since numbers could be ordered, their position revealed their being
16 and nature, things had arithmetical properties and these properties concerned the
17 being of things. The classification of numbers was then a means to grasp the true
18 meaning of life. In this view, a number’s relation to its prior or posterior concerned
19 not only its being but also the order of its being. Within this context, an abstract
20 idea of numbers was incompatible with the ancient Greeks’ ontology (Bloor, 1976,
21 p. 106).²⁸

22 The modern interpretation of “one” arises in the sixteenth century, the birth of
23 capitalism, through the work of Simon Stevin, the Dutch mathematician. With
24 the advent of capitalism, numbers came to perform a new function by indicating
25 the properties of moving, active processes of change. For example, number and
26 measurement became “central to an intellectual grasp of ballistic, navigation and
27 the use of machinery” (Bloor, 1976, p. 104). The point is not only that Stevin
28 was an engineer and that he was interested in applied mathematics and in the
29 solution of practical problems. His theoretical preoccupations were also those
30 upon which the development of capitalism depended. But this required the search
31 for general relations, which in turn required that numbers become abstract number,
32 separated from the things they measure. This implies that number be likened to
33 a continuous straight line of homogeneous entities, rather than to a succession of
34 discontinuous and heterogeneous dots. If the whole is homogeneous, its constituent
35 parts (numbers) must all have the same nature and one must also be a number.
36 There is thus a connection between the development of capitalism, of sixteenth-
37 century technology, of symbolic algebra, and of the notion that one is a number.
38 Capitalism required a new notion of the number “one.” Or, this notion, as well as
39 that of numbers, survived the advent of capitalism only at the cost of changing
40 their cognitive and social content.

1 Consider now the *trans-class elements of knowledge*, i.e. those elements of
2 science and techniques that can be used both for capitalist domination and to
3 resist that domination. This too can be explained in terms of class determination
4 rather than in terms of class neutrality. Recall from Section II that, given that the
5 social content of social phenomena is internally contradictory, those phenomena
6 not only can either further or resist capitalist domination but also that it is
7 their dominant content that does that, in spite of their contrary secondary, anti-
8 reproductive, content. Applied to science and technology, this means that they
9 are never pure forms of domination of the capitalist class over other classes.
10 Their functionality for capitalist domination is their dominant aspect while their
11 possibility to use those sciences and techniques to resist capitalist domination
12 is their secondary function. *The use of their anti-reproductive aspect does not*
13 *cancel their dominant, reproductive, aspect.* Rather, the reproductive aspect (the
14 functionality for the reproduction of capitalism) keeps affecting society even if
15 that element of knowledge is used to limit and resist that functionality. This
16 implies neither that the trans-class elements of knowledge should not be used (an
17 impossibility) nor that their dominant aspect neutralizes whatever emancipatory
18 effect their alternative use might have.

19 As an example of a trans-class element of knowledge consider the notion of
20 time.²⁹

21 Our perception of time is strictly determined by the type of society in which we
22 live. Previous societies' concept of time was cyclical – i.e. tied to nature's cycles,
23 as the succession of days, seasons, and years – and concrete, or qualitative, i.e. tied
24 to the specific tasks pertaining to the different parts of the day, of the week, of the
25 month, of the season, and of the year. Whether hunters or land tillers, those societies
26 were strictly tied to these and other recurrent and specific events. While hunting so-
27 cieties were regulated by biological events, agricultural societies found in the con-
28 stellation of planets and stars their reference points to compute time. If the notion
29 of clock had existed, nature would have been their clock (Rifkin, 1989, pp. 64, 65).

30 Under capitalism, on the other hand, time has become linear – i.e. proceeding
31 from past through the present to a future which is not a repetition of the past, as if
32 flowing along a straight line – and abstract, i.e. quantitative, because time periods
33 are no longer associated with specific activities: any activity can be performed
34 during any fraction of time.³⁰ Time is thus dividable into increasingly small parts.
35 It is only within this notion of time that the concept of progress, unthinkable within
36 traditional religions and world views stressing the cyclical repetition of history,
37 could arise. The future is not any longer pre-fixed and a repetition of the past but
38 is open ended.

39 Of fundamental importance for the emergence of this new perception of time
40 was the clock. The clock splits time into hours, minutes, seconds and fractions

1 of seconds. The mechanical clock was introduced by the Benedictine order in the
2 seventh century after Christ. The Benedictines differed from other religious orders
3 in that they were expected to pray and pursue religious activities every moment
4 of the day. Time was scarce and could not be wasted. There was a time to pray, a
5 time to eat, a time to bath, a time to work and a time to sleep. The Benedictines
6 re-introduced the hour as a unit of time (as a unit of time the hour was little used
7 in medieval society). Every activity was tied to a specific hour. For example, the
8 first four hours of the day were reserved for the necessary activities. The following
9 two hours were devoted to reading, etc. This could be interpreted as if the modern
10 notion of time already existed in the Benedictine monasteries. But these hours
11 were still hours of concrete time: each hour was to be used only for a specific task.
12 Under capitalism it has become irrelevant which specific activities are carried out
13 in which specific hours: time has become abstract.

14 It is within this context that the clock was found out. It is because it introduced
15 a mechanical rhythm in daily life that the clock could be used later on under
16 capitalism, when the rhythm of the machines began informing people's daily work
17 and life. Marx's notion of abstract labor, an idea which emerges in the capitalist
18 system, i.e. the expenditure of human energy irrespective of the specific labor
19 carried out, finds its correspondent in the notion of abstract time. It is not by
20 chance that the clock reached regularity of movement and precision only after
21 Galileo discovered the pendular motion in 1649, whose practical applications to
22 the clock were perfected by Huygens in 1656. Minutes and seconds become part
23 of daily experience when they appeared on the dial of the mechanical clock.

24 The social content of this notion of time and thus of the clock, i.e. their
25 functionality for the reproduction of the capitalist economy and society, can now
26 be discerned. The increasingly complex commercial and industrial activities could
27 now be profitably organized thanks to a restructuring of the day in abstract time
28 units so that each activity, no matter which, could be squeezed in increasingly
29 smaller units of time, just like money. Actually, time became money. The economy
30 had become an economy of time too. People's lives, and to begin with the working
31 people's lives, began to be ruled by the rhythm of the mechanical clock first and then
32 of the machines, whose rhythm was as regular as that of the clock. The biological
33 and cosmic notions of time had been replaced by the formal and empty ticking of
34 the clock.

35 But this notion of time at least refers to periods which can still be experienced.
36 The computer introduces units of time which cannot be experienced any longer,
37 nanoseconds, i.e. billionths of a second. This notion of time is unrelated to human
38 experience and can be "perceived" and counted only by machines (nanoseconds).
39 As submitted above, the social content of this notion is that it introduces a new
40 ideal of perfection, a machine-like human or a human-like machine able to perceive

1 time just as a computer can. Whatever remains of human life is standardized,
2 impoverished, suitable to manipulation through genetic engineering and ultimately
3 completely and irrevocably subjected to capital.

4 Even the last residue of the cyclical notion of time, the dial in which the two
5 hands make a recurrent complete revolution every 12 hours, has been replaced by
6 digital clocks and watches indicating only the present time which can be read as
7 numbers. Any reference to the past and to the future is erased in the digital watch.
8 Only the present exists. At the same time, the ticking of the mechanical clock is now
9 being replaced by the pulse of the electronic watch. As Rifkin rightly remarks, the
10 digital clock is a fitting metaphor for a society in which the past and the future exist
11 only functionally to the present: the past is a collection of information which can be
12 retrieved from data banks and the future is any of the many possible combinations
13 of those bits of information. The universe is not seen any more as an immense
14 clock, as in the Newtonian tradition, but is now perceived by many scientists as a
15 sort of immense self-developing information system, a sort of gigantic computer.
16 Life itself is now perceived as a code of billions of information bits which can
17 be re-arranged at will to produce new life forms. These are the cultural roots of
18 genetic engineering.

19 Thus, the original social content of the modern notion of time was its
20 functionality for the emergence of capitalism and its consonance with the interest
21 of capitalism. This is still the case. Nevertheless, due too the inner contradictoriness
22 of social phenomena, this notion is incorporated in conceptualizations which
23 are functional both for capitalist domination and for resisting that domination.
24 But even in this latter case, resistance against that domination spreads also a
25 notion (that of time) functional for the continuation of that domination. The
26 reproductive function of the notion of time can be lessened through not only
27 its anti-reproductive use, through its incorporation in anti-reproductive strategies
28 and tactics, but also by exposing the dominant aspect of this notion's social
29 content. More generally, counterhegemonic knowledge production arises (can
30 arise) because of knowledge's innerly contradictory nature rather than in areas
31 which are (wrongly considered to be) outside the domain of capitalist domination
32 (e.g. concrete individuals working with personal computers). This is why it is
33 capitalism which generates its own supersession, communism.

34 Disregard of the contradictory nature of the social content of NST opens the
35 way to the myth of the social (class) neutrality of NST. It follows that it is thought
36 that the "rational" aspects of science and techniques can be separated from their
37 "capitalist" or "anti-capitalist" use. Supposedly, then, an alternative society can
38 then be built upon these NST.³¹ The thesis submitted here, on the other hand, rejects
39 this possibility without rejecting the opportunity to use the trans-class elements
40 of knowledge to fight this system, not because these elements are class neutral

1 but just because they are class determined. A different system will have to build
 2 its own natural sciences and techniques (and more generally, knowledge), just as
 3 capitalism generated its own natural sciences and techniques.
 4

5 6 **9. KNOWLEDGE AND EGALITARIANISM** 7

8 The above has argued that a radically different type of natural sciences
 9 and techniques can originate only from a radically different type of society, based
 10 on different production relations. Following a suggestion by Marx, these would
 11 be egalitarian production relations in the sense that each and everybody would
 12 have the same chances to realize their potentialities to the fullest.³² This implies
 13 co-operation, because competition generates inequality, and self-management,
 14 because this is the only real basis for freedom. Egalitarianism, co-operation,
 15 and self-management are the conditions for a free association of producers who
 16 themselves decide what to produce, for whom, why and how. It implies the abolition
 17 of the production for profit and its replacement by an economy based on the
 18 production of use values for the satisfaction of human needs as defined by the
 19 producers themselves. This society implies also a different concept of human
 20 nature. While the notion fostered by capitalism pushes “specialization” to its
 21 extreme and makes of people caricatures of themselves, the alternative, egalitarian,
 22 notion stands for the largest possible feasible development of the individual, for
 23 the unfolding of all the facets of the individual’s personality together with, rather
 24 than at the cost of, everybody else. This thesis has been challenged on a variety of
 25 grounds. Here I shall briefly mention only four of them.³³

26 First, there is the question of the presumed impossibility to achieve a different,
 27 egalitarian, division of labor. This objection rests on a carefully cultivated and
 28 endlessly repeated misunderstanding: the impossibility, it is said, for everybody
 29 to be able to do everything.³⁴ But the question is not the abolition of any form of
 30 technical division of labor. Rather, the question is how to restructure the division of
 31 labor in such a way that all positions (jobs) are “balanced” in the specific sense that
 32 they all, while requiring different tasks, offer roughly the same possibility for self-
 33 realization (including a balanced “mix” between material and mental labor).³⁵ This
 34 new structure of positions should be complemented by their flexible nature (the
 35 internal composition of positions should be changed whenever the exigencies of
 36 the individuals so require) and by the possibility for individuals to move from
 37 one position to another (again, whenever the exigencies of the individuals so
 38 require). Maximum feasible balancing within positions, flexibility of positions,
 39 and rotation among positions should be the *three basic principles of an egalitarian*
 40 *technical division of labor*. This implies constant re-qualification of labor. It is

1 on this basis that first new techniques and then new natural sciences can be
2 developed.

3 Second, it is argued that if “specialization” enhances “productivity,” less
4 specialization also implies less production and productivity. The question
5 then would become one of a trade-off between production, productivity and
6 specialization on the one hand and human self-realization on the other. But the
7 opposite is true. Productivity will increase if the producers will really be in charge of
8 their own lives rather than having to be either forced or convinced to do unrewarding
9 and alienating jobs. Moreover, as far as production is concerned, an egalitarian
10 society would do away with the gigantic waste inherent in the capitalist mode of
11 production, e.g. in advertisement, in the production of weapons, in economic crises
12 and unemployment, in the public and private institutions of repression, etc. This
13 would free sufficient labor power and time for the production of a quantity of use
14 values adequate for all to satisfy their socially determined needs.

15 Third, it is also argued that specialization enhances the possibilities for
16 human self-realization. For example, Taylor, the father of ‘scientific management,
17 submitted that:

18

19 The frontiersman had to be not only a surgeon, but also an architect, house-builder, lumberman,
20 farmer, soldier, and doctor, and he had to settle his law cases with a gun. You would hardly
21 say that the life of the modern surgeon is any more narrowing, or that he is more of a wooden
22 man than the frontiersman. The many problems to be met and solved by the surgeon are just as
23 intricate and difficult and as developing and broadening in their way as those of the frontiersman
24 (1985, pp. 125, 126).

24

25 In this example, the task of the surgeon has indeed replaced all other activities
26 but at the same time it has been greatly expanded, not narrowed. The Tayloristic
27 division of labor, on the other hand, implies that the surgeon would be reduced
28 to, say, manning a machine which has incorporated the surgeon’s qualities so that
29 the surgeon would have been reduced to an unskilled laborer performing a de-
30 qualified, repetitive, etc., task. Moreover, there is absolutely no reason why in an
31 egalitarian society the surgeon could not perform also (some of) these other duties,
32 with the exclusion of course of settling his law cases with a gun. More generally,
33 under capitalism, as opposed to an egalitarian society, specialization is time saving
34 but, aside from counter-tendencies, the extra free time is used neither to reduce the
35 working day nor to increase the possibilities for self-realization of those operating
36 those machines.³⁶

37

38 Fourth, the critics submit, undesired tasks will always exist, also in an egalitarian
39 society. Thus, it will always be necessary to force somebody to perform those tasks,
40 even if on a rotation basis. The answer resides not only in the above principles of
balanced positions and flexibility of positions. Only on this basis can rotation be

1 meaningful for an egalitarian society. It resides also on a type of social interaction,
 2 to begin with at the level of production, based on altruism, as opposed to the egoism
 3 inherent in the capitalist production relations.

4 In short, it is possible to argue that for Marx “another world” is a socio-economic
 5 system based on co-operation (solidarity), egalitarianism, and self-management in
 6 planning, allocation, production, distribution, and consumption in harmony with
 7 nature. The specific forms of this radically alternative systems cannot be forecast.
 8 They will emerge from each country’s specific history, including the history of
 9 its struggle to move from a capitalist society to an egalitarian one. However, just
 10 as there are general principles of capitalism which apply to all specific capitalist
 11 countries, so there are general principles which should apply to all egalitarian
 12 countries. If labor does not use this compass, it will never achieve its liberation
 13 from capital. Faced with these questions, the Left needs answers; it needs them
 14 badly and it needs them sooner rather than later. But to get the right answers it
 15 must ask the right questions. To this end, it would do well to revert to Marx’s
 16 epistemology and value theory and develop them rather than denying them in a
 17 constant but vain pursuance of ever new fads.

18 NOTES

19
 20
 21
 22 1. In what follows, the term knowledge will refer to all types of knowledge, including
 23 NST, unless differently specified.

24 2. Even if Marx did not deal explicitly with this question, he thought it would and
 25 should be possible to “make accessible to the ordinary human intelligence, in two or three
 26 printer’s sheets, what is *rational* in the method which Hegel discovered and at the same
 27 time mystified” (Marx to Engels, 14 January, 1858, quoted in [Bhaskar, 1983](#)). What follows
 28 is based on [Carchedi, 1983](#) (ch. 4), 1987 (ch. 3), and 1991 (ch. 2), to which the reader is
 29 referred for a more detailed analysis.

30 3. Supersession, differently from destruction, means that something continues to exist
 31 but in a transfigured form and radically changed content.

32 4. For example, once one accepts that, given a production process P1, the price of its
 33 outputs becomes the potential value of the same commodities as inputs of the following
 34 production process, P2, (potential because the value of those inputs of P2 can realize itself
 35 or not as part of the output of P2, depending upon whether the output of P2 will be sold or
 36 not, at what price, etc.), the so-called “transformation problem” disappears. This requires
 37 that a distinction is made between potentials and realizations and that their interrelation is
 38 spelt out.

39 5. Critics could submit that we must first postulate individuals before we can postulate
 40 any relation between them. But individuals are carriers of social relations because they
 have been formed within society. Even when individuals are temporarily isolated from
 social relations and processes, even when they are isolated from society, they still carry
 suspended relations and thus can re-engage in relations and processes at a later date. The

1 tale of Robinson Crusoe, the folkloristic foundation on which orthodox economics is based,
2 is useless as a starting point for an inquiry into society. Robinson Crusoe did not lose his
3 social nature together with most of his material belongings when he shipwrecked on a desert
4 island. Before that unfortunate event, he had been socialized in a class society, a fact which
5 surfaces forcefully as soon as first Friday and then Fridays' father and "a spaniard" join
6 him. On that occasion Robinson Crusoe observes "First of all, the whole country [the island,
7 G. C.] was my own meer property; so that I had an undoubted right of dominion. 2ndly, my
8 people were perfectly subjected: I was absolute lord and lawgiver" (240, 241). And, to make
9 matters perfectly clear, in a second book, *The Farther Adventures of Robinson Crusoe*, our
10 hero goes back to his island, only this time as a colonist.

6. Given that we can observe a relation only by observing what people do when they
engage in a process, a process is also the specific, empirically observable, form taken by
that relation.

7. It could be held that distribution and consumption can precede production. But,
within a temporal approach, given a certain time period, production is always prior to
distribution and consumption. The latter can precede the former only if a succession of
periods is considered, so that distribution and consumption at the end of one period can
precede production at the beginning of the *following* period. It could also be held that
the social relations of production are preceded by a-historical needs, like the biological
ones, which seem to be impervious to social determination. But a-historical needs cannot
determine the socially and historically specific way to satisfy them. As Marx illustrates,
"Hunger is hunger, but the hunger gratified by cooked meat eaten with a knife and fork
is a different hunger from that which bolts down raw meat with the aid of hand, nail
and tooth" (Marx, 1973, p. 92). Finally, it could be held that it is consumption which
is ultimately determinant because people realize their potentialities through consumption
rather than through production (Holton, p.174). But this does not hold given that
consumers are also, at a different level, producers and given that production precedes
consumption.

8. What submitted here, thus, is neither a theory of simple mutual interrelation (given
the ultimately determining factor) nor a deterministic theory of determination (given the
variety of different and contradictory potentials contained in the actualized world and their
actualization through the interrelation of the already realized factors). Differently from
this view, Resnick and Wolff (1987) stress the "mutual constitutivity among entities" and
reject "essentialism" i.e. the notion that economic phenomena "are the essential cause of
historical change" (p. 3). Laclau takes a different view. This author submits that social
phenomena (he considers explicitly ideological elements), "taken in isolation have no
necessary class connotation . . . this connotation is the result of the articulation of those
elements in a concrete ideological discourse" (1977, p. 99). But the problem is here simply
shifted one step back. Where does the class content of the "articulating principle," of the
"ideological discourse," come from? Certainly not from (any of) the articulated elements,
if they get that content from that principle.

9. This is a tendential movement. While existing positions are dequalified (the tendency),
new and qualified positions might be created (the counter-tendency). The former, tendential,
process continues until the skills are incorporated into the machines, while the new,
qualified positions will sooner or later be subjected to dequalification. A new wave of
technological innovations will repeat the process. The debate on the labor process that
followed the publication of Braverman's *Labor and Monopoly Capital* suffered from the

1 sterile opposition between the dequalification and the requalification thesis. In fact both
2 theses are part of the dialectical view highlighted here (see [Carchedi, 1977](#)). The same
3 negative feature affects present-day debates on the spatial distribution of skills following
4 the shift of some material production to the dependent countries.

5 10. This does not exclude that some dependent countries might achieve, in some
6 branches, levels of production of knowledge and technological development comparable
7 to those of the imperialist countries. But this, in and of itself, is not sufficient for those
8 countries to break free of their condition of dependency.

9 11. In the 1960s and 1970s “services” were basically provided by public institutions. The
10 question, thus, was whether state institutions could produce value and surplus value. On this
11 point see [Carchedi, 1977](#), ch. 2. Nowadays, “services” are being or have been privatized.
12 The point is thus under which conditions they are productive when provided by private
13 capital.

14 12. Also [Davis and Stack \(1997\)](#) reach the erroneous conclusion that “With replacement
15 of human labor by digitally rendered productive knowledge comes the beginning of the end
16 of the distribution of the social wealth on the basis of time worked” (p. 137).

17 13. See [Carchedi \(2003\)](#) and [Panitch and Giddins \(2002\)](#) for a critique of Hardt and
18 Negri.

19 14. The notion of concrete and abstract individuals is modeled upon Marx’s distinction
20 between individual and social value.

21 15. Marx distinguishes two steps in mental transformations. The first is *observation*, the
22 socially filtered sensory perception of the real concrete. The result of observation is the
23 *imagined concrete*, a “chaotic conception of reality” ([Marx, 1973](#), p. 100). The second step
24 is *conception*. Once observation has given reality (the real concrete, in Marx’s terminology)
25 a mental shape, this imagined concrete is transformed by the conscious application of the
26 previous knowledge of reality. The outcome is the *concrete-in-thought*, which, compared to
27 the imagined concrete, is a more structured view of reality. The distinction is analytical. A
28 mental transformation is always both observation and conception, i.e. it is the transformation
29 of the socially filtered sensory perception of the real concrete and of the already existing
30 knowledge of the real concrete.

31 16. just as what decides the worth of a material product for society is not its value
32 contained but the value it realizes.

33 17. Socialization is no homogenization. At each moment of our life, we internalizes,
34 in our unique way, a unique combination of social phenomena, individual phenomena and
35 chance occurrences.

36 18. The object of this paper is knowledge under capitalist production relations. Topics
37 such as “tacit knowledge,” knowledge that cannot be formalized, written down or
38 consciously communicated, are not dealt with, given that these types of knowledge are
39 a type of individual knowledge, produced by concrete individuals, outside the sphere of
40 those relations. They too are important but only as potential forms of social knowledge and
inasmuch as they can be incorporated in some material shell. The knowledge produced for
capitalists must be saleable and thus cannot be tacit.

19. A capitalist process is not based necessarily on wage labor in all segments of the
labor process. [Schiller \(1997, p. 111\)](#) submits that it is sufficient that wage labor is the
norm. But the point is that the capitalists can buy the produce of small independent farmers,
or of artisans, as inputs of their production process (see [Carchedi, 1991](#)). When this takes
place, the labor produced outside the capitalist production relations counts as if it had been

1 performed under those relations. Similarly, in a publishing company, the writer need not be
2 a wage laborer.

3 20. Nowadays, the ownership of these material means of mental production is extremely
4 important in the field of the mass media.

5 21. For another example, that of the social determination of the development of physics
6 and chemistry at the turn of the nineteenth century, the reader is referred to the work of
7 Baracca (in Carchedi, 1983, Appendix to Chapter 1).

8 22. A fully automated economy cannot be a capitalist one by definition. The Sraffian
9 argument that privately owned machines could both produce the surplus and reproduce
10 themselves, i.e. that a capitalist economy could exist without wage labor (Steedman, 1985),
11 is based on this view's fundamental weakness, its theorization of capitalism as an economic
12 system producing *use values*. A fully automated economy based on the private ownership
13 of the means of production would be a specific form of simple commodity production. See
14 Carchedi, 1991, pp. 259–261.

15 23. Kenney (1997, p. 90) remarks that, in Marx's time, workers were called machine
16 minders, something that implied that machines had no mind. This changes with the Turing
17 machine which has a mind, even though a mechanized one.

18 24. As King puts it, "As our understanding of biochemical processes increases, organisms
19 will be used to produce molecular machines as sophisticated as electronic components . . . In
20 the longer run, these developments will end the separation between the self-replicated, self-
21 assembled products of organisms, and the mechanical, electronic, and plastic products of
22 human manufacture" (1997, p. 48). A first step has already been made by the development
23 of protein-based computer chips (Davis & Stack, 1997, p. 138).

24 25. In 2000, patent EP 380646 has been granted by the EU Patent Office to the Australian
25 enterprise Amstrad for the creation of "chimaeric animals," i.e. beings made up of human
26 and animal cells. In that patent "The following are claimed: (A) a method for the isolation
27 of embryotic stem (ES) cells from animal embryos in vitro which comprises deriving and
28 maintaing the embryos in a culture medium contg. A leukaemia inhibitory factor (LIF) for
29 the development of the ES cells; (B) a method for maintaining animal ES cells in vitro while
30 retaining their pluripotential phenotype which comprises culturing the cells in a culture
31 medium contg. LIF to maintainm the cells; (C) ES cells derived from animal ambryos in
32 vitro isolated by deriving and maintaining the embryos in culture medium contg. LIF for
33 development of the ES cells; (D) a chimaeric animal or transgenic progeny of it generated
34 using ES cells which have been isolated as in (A) or maintained in vitro as in (B)."

35 26. The feminist critique submits, correctly, that inherent in this project there is the
36 possibility to expropriate women of their reproductive power by creating, for example,
37 artificial wombs (see Heymann, 1995). Artificial wombs would be strikingly apt to be
38 produced industrially and could produce life also industrially, possibly for profit.

39 27. What follows has been taken from Carchedi, 1983, pp. 16–20, which in its turn
40 relies on Bloor (1976) and Klein (1968). That work provides also the example of the class
determination of the notion of inertia (pp. 27 and ff).

28. The unknown solution to a specific problem was a specific number to be determined,
not a variable.

29. Much of what follows on this point is taken from Rifkin (1987).

30. It has been argued that the notion of concrete time is abstract too, because it is the
result of human abstraction. This is obviously true. But concrete vs. abstract here refers to
time to be spent for specific activities versus time which can be spent for any activity.

1 31. There is a great affinity between the thesis of the neutrality of knowledge, that of the
 2 neutrality of the productive forces, of which knowledge is a fundamental element, and that
 3 of the neutrality of the organization of the labor process. Both Lenin and Gramsci subscribed
 4 to the neutrality thesis. This made it possible for the former to theorizing the socialist use of
 5 Taylorism (Lenin, No. 18, pp. 594–559; Nr. 20, 152–154; No. 27, pp. 235–277; and No. 42,
 6 pp. 68–84) and for the latter to theorize the use of coercion into the labor process (1971,
 7 p. 301), i.e. the extension of the proletarian condition to the whole society rather than the
 8 supersession of that condition (1975, p. 412). For a well-balanced assessment of Taylorism,
 9 see Linhart (1976).

10 32. In the 1970s, the radical science movements in many countries engaged in the
 11 critique of existing science and technology and provided assistance to a variety of social
 12 movements. See Werskey (1975). This period lasted long enough to offer a preview of some
 13 radically different, but it never got the chance to produce even a distant view of a radically
 14 different type of *science*. The opposition between bourgeois science and proletarian science
 15 subscribed to by many groups and movements in the 1970s was flawed at its core, given
 16 that the USSR – which supposedly had to generate this new type of science – was anything
 17 but an egalitarian society.

18 33. For a refutation of other partly similar objections see Mobasser (1987).

19 34. In observing that nearly a decade after the fall of ‘Communism’ no ‘Western
 20 style’ capitalism has been created in the former ‘Communist’ countries, A. Greenspan,
 21 the Chairman of the FED, discovered that “much of what we took for granted in our free
 22 market system and assumed to be human nature was not nature at all, but culture” (Hoagland,
 23 1997). What for a first year Sociology student is a plain fact, becomes for the neo-classical
 24 economist a revelation.

25 35. See Albert and Hahnel (1981, 1991a, b).

26 36. In considering whether the working day has been shortened or not, it is the collective
 27 laborer on a global scale (with situations in the Third World reminiscent of the English
 28 Industrial Revolution) which should be considered, rather than only the laborers of the
 29 developed capitalist countries.

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