

9. Capital accumulation, crisis and return to nature?

Dimitrios Patelis

INTRODUCTION

The problem of nature and its relationship with society becomes of great significance in the context of contemporary globalized capitalism, especially under conditions of global, systemic and structural economic and ecological crisis. Can nature be viewed as independent of its historically defined interaction with society, as independent of the transformation of nature through labour, in order to adapt nature to human needs? What is the specific relationship between the capitalist mode of production, capital accumulation and nature? Is there any way out of the crisis through a new technological model of production? Is an ecological growth strategy a way out of the economic and ecological crisis? Is the policy of a 'Green New Deal' able to achieve ideological hegemony in society?

I am convinced that scientific answers on the above questions can be given as a result of theoretical and methodological investigation of these problems, from the point of view of dialectical social philosophy and political economy.

This chapter aims to analyse the concept of nature and natural resources, the theoretical and methodological criteria of periodization and the characteristics of the contemporary stage of capitalism. It also aims to provide a framework for discussing the necessity of technological restructuring of capital, taking into account the crisis and the contradictions of scientific and technological progress in contemporary capitalism.

In this chapter the philosophical concept of nature in relationship with society and the developing interaction between the two is briefly defined. The economic dimension of nature, the function of natural resources and the problem of the lack of natural resources in the production process are highlighted.¹ A theoretical periodization of capitalism (based on the philosophical and methodological approach of the Logic of History, and the Logic of Capital),² the key points of contemporary global capitalism and the inconsistency between capitalism and the use of scientific

and technological progress are pointed out. Particular emphasis is given to the structural crisis of the capitalist system and to the changes to the technological model needed to find a way out of the crisis. This will be achieved through greater realigning and reorientation of production, based on the technologies that make up the third stage of the scientific and technological revolution. Finally, reference is made to the economic, political and ideological importance of 'green development', in light of the urgent need for technological restructuring, in order to invigorate capital accumulation.

NATURE AND SOCIETY. NATURE AS AN ECONOMIC RESOURCE

Nature, in its broadest sense, is the precondition for the emergence and development of society as a whole, and also the necessary condition for social construction and evolution. Society itself, as the natural culmination of a particular evolutionary process and as the basis for another type of development, is essentially a network of interactions between humans and nature, as well as between humans. To a great extent, the interaction between nature and society does not refer to any sub-relation of certain species with their habitats, in the processes of adapting to an ecosystem. The survival strategy of human beings is not simply to satisfy their needs by adjusting to changes in the natural environment, but on the contrary, the satisfaction of human needs is predominantly through the adjustment of the environment to these needs. This adaptation, expressed by human activity upon nature, constitutes the distinctive – socially and technologically – intermediary type of exchange of material and energy (metabolism) between man and nature.

Nature is involved in the productive activity of man, in correlation with the actual level of development of the productive forces and the connection of the latter with the dominant powers of production. When it comes to production, the involvement of nature is distributed among the actual necessary labour, material and natural resources. The latter, in light of the economy (along with material, financial and labour resources) are economic resources, which are key elements of the economic potential, of the entire process of production in its broadest sense.

Natural resources are becoming part of economic resources, only if and to the extent that these are involved in economic activity, on behalf of society. The degree of integration of natural resources into the production process depends on the needs of the latter for energy and materials (technologically and socially intermediary anabolism), and for elimination

of by-products (technologically and socially intermediary catabolism). Therefore, in a more or less developed society, a relationship with nature which is independent of production processes and production relations cannot exist. These resources include land (soil, subsoil minerals), waters (potable, irrigation, marine), flora (forests, grasslands, and so on), fauna, renewable energy resources (solar, wind, tidal, geothermal, and so on), atmosphere, and near space. These are the necessary conditions of production, the physical basis for growth. Private ownership, particularly in its capitalist level, requires the total exploitation (instrumental, predatory and rapacious-destructive) of all resources, based on the exploitation of labour power. Therefore, it is methodologically and practically impossible to isolate the relationship (instrumental, predatory and rapacious-destructive) with nature, under the framework of capitalism, from the essential contradiction between capital and labour.

To the extent that the socialization of production creates a huge scale complex of technological and social means of action towards nature and society (able to give a multiplier breadth, depth, speed, precision and power), it is essential to adopt a rational and planned use of all economic resources, including natural ones. Natural resources are subdivided into inexhaustible and exhaustible (or renewable and non-renewable). A big part of natural resources is non-renewable (for example mineral deposits). Other natural resources demand labour costs and the restoration of natural processes for their renewal (for example soil, waters, forests, and fauna).

Therefore, a scientific basis is required for the assessment of the actual available natural resources, the actual availability and manageability of which has a specific historical character. Any estimates are based on current available technology (production), economy (as a quantitative expression of economic categories) and society. The accurate assessment of natural resources is a condition for their optimal, rational and efficient use.

The elaboration of financial estimations is a key condition for the rational management of natural resources. Under the framework of capitalism, the financial estimation of a resource equals the amount of differential revenue, under the optimal regime of exploitation.

The most complex problems concerning the rational use of natural resources are related to the rational use of all living matter (biota) and of complex and sensitive ecosystems, which require an exploitation scheme that is capable of preserving their sustainability and reproduction for a sufficient period of time.

Of particular importance is reducing the loss of non-renewable resources such as soil, in mining, extraction and transportation. It is also important

to maximize their use through the use of secondary and tertiary products (derivatives) and by-products, thus moving towards minimization of losses, recovery, recycling, treatment and disposal of all the useful elements.

Scientific and technological progress offers new possibilities in substituting exhaustible natural resources with others, as well as with a variety of complex artificial materials (such as plastics, polymers and ceramics instead of metals). This substitution makes it possible to exploit reserves, the management of which has been technically impossible in the past and/or economically unviable at great depths (for example in the bottom of the sea), land (land reclamation, drainage, irrigation, fertilization) and in oceans. There is, therefore, a broadening and deepening of human potential in exploiting natural resources by developing the means of production (automation, automated steering systems) with the help of scientific and technological advance.

Finite economic resources are the result of the correlation between the producing and consuming power of society: production creates and transforms needs, while the satisfaction of these needs, based on the available resources, is limited.

Economic-productive needs are pushing the technical-technological upgrade, which in turn relativizes the finite character of the available resources. The 'absolute' factor in this particular availability has to do with natural resources and demographic processes. However, given the level and the rate of economic growth, the growth of a certain type and of all types of resources is also limited.

Given the level of technological development, any capital investments towards the growth of resource production (*extensive growth*) beyond certain limits decreases rather than increases their use. Therefore, of particular importance (in terms of limited resources) are the *intensive factors of economic growth* (productivity growth of social labour, acceleration of scientific and technological progress, improving the quality of labour and products).

The view of the problem of scarcity of resources, as detached from the thesis stated above, leads to economic interpretations that are based on the detachment of the problem of resource constraints from the specific historical and socio-economic context, and also on apologetic theories concerning crises. A typical common view is the theory of 'marginal utility' of the Neoclassical School, which ignores all the objective production relations towards nature and between individuals (primarily the labour theory of value), seeing society as an unhistorical group of people. The milestone of this theory is the subjective-psychological relationship of the 'rationally acting individual' (whose 'nature' refers to the principle of utility), with

the utilities that he/she needs to acquire (see Bentham, 1931 p. 144). Since the last decades of the twentieth century many fatalistic theories have been stated as to the survival prospects of humanity on the basis of available resources, such as The Club of Rome, zero growth, and 'limited' development (see The Club of Rome; Meadows, 1974, etc).

On this basis, the adequacy/inadequacy of resources is not an absolute physical constant. On the contrary, it is continuously redefined through a controversial process, by which the finiteness of the resources is relativized, within a range of technologically and socially intermediary potentials, moving between catastrophic failures and creative opportunities.

The question of involvement of nature in production takes humanitarian and planetary dimensions in capitalism, with the development of the industry and the conversion of science into a direct productive force. Hence nature is directly correlated to the conditions of capitalistic accumulation, and each combination of development both in depth and range of the capital (*extensive and intensive development*).

PERIODIZATION AND THE NEW STAGE OF CAPITALISM

Capitalist socio-economic formation, according to the Logic of History (see Vazulin, pp. 371-94), is the completion of the formation of human society. It marks the growth of large private property on the basis of produced means of production, (relatively equal to this large private ownership basis), and the dominance of *Commodity-Money Relations*.

The external limit of the extensive development of capitalism is the formation of the world capitalist system (which is limited by the creation of the world socialist system). The internal limit of extensive development is the limit of extension (through concentration-centralization) of the capitalist ownership as an economic form; that is monopoly (see Lenin, 1917).

Despite the fact that capitalism moves towards its intensive growth, even from its maturity stage (capital appreciation due to machines produced by machines), the intensive growth of capitalism is dominant only at the stage of imperialism. The inconsistency between productive forces and productive relations is intensified. However, it cannot be absolute, because absolute inconsistency requires the absolute elimination of living labour from the production process and the complete automation of production (maximizing fixed capital and reducing variable capital to zero). However, this is an extreme limit (of intensive growth of capitalism), the reaching of which pertains to infinity. Reaching this limit would reject the

essence of capitalism, as imposed by the nucleus of the social relations of production, by the position of living labour in the productive interaction between society and nature.

If we tried to give a concise definition of the current stage of capitalist development, of global imperialism, we would say that it is the transnational-monopolistic stage of capitalist subordination of humanity to transnational-multinational monopolistic corporations.

The characteristics of this stage are the concentration and centralization of capital, as well as socialization of production. The high-level development of the latter creates the current internal limit of capital extensive growth: the transnational monopolistic corporations, which play a decisive role in economic life on a global scale.

Another characteristic is the merger of financial and industrial capital, subordination of the second to the first, and the formation of a global financial oligarchy on the basis of this financial capital. We need to stress the importance of instant financial flows, which are getting more and more intermediately related to production. This is accompanied by the corresponding transfer of parts of the production process all around the globe, which has acquired pronounced importance, instead of traditional exports of capital and goods.

According to the second stage of scientific-technological revolution, the creation of a technological basis of globally distributed and inter-networked production is done by transnational monopolistic corporations, in terms of production and not only in terms of export circulation of capital (also see Bakan, 2004). The creation of such a basis, on the one hand leads to the real subordination of global labour to globalized capital (the global distribution of labour turns out to be a technological need), and on the other hand, marks the beginning of the creation of global productive forces, and the technological basis for the unification of humanity.

Given the change of the limit of extensive growth of capital (due to the restoration of capitalism in most countries of early socialism in the twentieth century) as well as of the limit of intensive growth of capital (due to the second stage of the scientific-technological revolution and restructuring of production), the results are:

1. Escalation of the division of the world among the international monopolistic corporations and subordination of society to these corporations.
2. Reconstruction of forces and establishment of poles for the division of land (soil, subsoil, sea, air, space) and power among the biggest and strongest capitalist powers.

Globalized imperialism is a unique development stage of capitalism. During this stage the dominance of multinational monopolistic conglomerates and of financial capital is shaped, instant cash flows are becoming significant, the technological basis for the unification of production is created by conglomerates, the redistribution of wealth among multinational monopolistic groups is increased and the major capitalist countries are struggling for redivision of land, subsoil, sea, air, space and power (see Ziegler, 2002, 2005).

SCIENTIFIC AND TECHNOLOGICAL PROGRESS IN THE CONTEXT OF CAPITALISM

Throughout history, capital, as a social relation of production, has played a major role in the development of productive forces and society as a whole. This active role is performed to the extent that is necessary, in order to connect with production, in a large-scale of social productive forces: artificial systems that facilitate large-scale ways of acting upon nature (machines, technological devices, and so on) and the subject of such an effect, the labour force. In contrast to unhistorical apologetic ideologies, capital does not constitute the only and ultimate form of wealth, since its scope of influence and action is defined by a certain level of socialization of labour, by the activity of abstract labour and by the resulting highly contradictory relations (based on the domination of dead labour over living labour) of abstract sociability. In this particular context, Marx examines capital 'as the condition of the development of the forces of production as long as they require an external spur, which appears at the same time as their bridle. It is a discipline over them, which becomes superfluous and burdensome at a certain level of their development, just like the guilds and so on' (Marx, 1857, p. 422).

A favourable term for the operation and development of capital is not the full and unhindered development of the whole range of possibilities of productive forces, but only of those that are consistent with the self-valorization of capital, through the exploitation of labour power, in the form of surplus-value, as the primary basis for capital accumulation. Therefore, whatever deviates from the plan regarding the development of productive forces (a plan based on profit and made by capital), undermines the main purpose of capital, that is profitability. In this sense, the relationship of capital with the development of the productive activity of man upon nature is ambiguous and contradictory: on the one hand, it is propulsive (to the extent that it contributes to profitability), and on the other hand, it is dissuasive (to the extent that it prevents profitability) (see

Richta, pp. 68–9). Hence, it is crucial to distinguish the actual development of productive forces, the potential of humanity to meet its actual needs, along with the appropriate protection and improvement of the natural and artificial environment (as an intergenerational term of the existence of humanity) through the real development of science and technology, from the current capitalist concept of ‘innovation’ (focused on short-term business competitiveness in the area of profitability, through manipulation of humans and nature, indirectly related to real needs, even through the implementation of notional needs).

This contradictory function of capital is expressed differently in each situation on behalf of different sectors of capital, especially when it comes to monopolistic capital. The latter, in its most recent forms, *has enormous potential to use and abuse the social and natural resources of the planet, as well as the technical and organizational means*. The manipulative power of monopolistic capital, over science and technology, is manifested through the range of disincentives and/or incentives that each case involves.

The capitalistic use of scientific and technological achievements, implies the further exploitation of labour and nature, the consolidation and improvement of the role of the bourgeoisie (including the marketization, commercialization and militarization of science and technology, also see Uzunidis, 2006, pp. 5–15). The exploited part of scientific and technological attainment takes the form of the capital, whereas science becomes, to a great extent, a sector of capitalist production, with profitability being the main criteria of its effectiveness. Newly acquired knowledge, as a new source of profitability (see Chapter 2 by Laperche and Levratto), is converted into an object and instrument of a special form of competition. The *sine qua non* conditions for this competitive conflict to emerge are:

1. an adequate volume of scientific and technical information and the relevant institutional and technological means in order for the research activity to subordinate to the capital, production, systematization, evaluation-certification of this information (based on relevant standards), management of circulation and reproduction of this information, and so on
2. the availability of capital surplus in search of profitable investment fields
3. relative saturation of demand for goods that are produced by traditional and long-established industries.

The conflict today is taking place mainly among large international groups and countries that control scientific research centres. This conflict also attracts the much more flexible and non-bureaucratic creative

potential of small and medium-sized businesses, with the corresponding public and private funding programmes. Through the interweaving of public and private national and supranational institutions, and through a complex network of contracting-supercontracting, outsourcing of works, financing, and so on, a multifaceted struggle is being conducted, a battle between the components of the financial oligarchy and the national-transnational elite of political-administrative bureaucrats, that want to gain access to networks of redistribution of accumulated in budgets surplus value (for example, business support from government programmes). The share in profits is distributed according to the economic and political power of the participating monopolistic conglomerates, and of their allies. The parasitic nature and the decay of the financial capital of our times, is manifested, *inter alia*, by the subordination of science to war research, the inhibition of scientific and technological progress and the deterrence of investments in new fields of production (in order to avoid risk), which is also reflected in the inflation of financial sector and structural crises.

The scientific and technological revolution, and the corresponding relationship with nature, is associated with the transition from extensive to intensive growth in the economy as a whole. This correlation leads to radical transformations in the structure and dynamics of productive forces:

- With respect to the combination of quantitative and qualitative characteristics of products, regarding the needs satisfaction of all members of society (more or equal to the minimum, less or equal to the maximum), and of waste by-products that derive from the productive activity upon nature and society
- With respect to the breadth, depth, strength, inflexibility-flexibility correlation, rate of operation, layout and the interconnection of technological provisions of production means, as determined by the nature, level and degree of integration of scientific knowledge in these
- With respect to the nature, level and degree of combined targeted implementation of laws of nature and society, depending on the degree of conversion of science into a direct productive force, which entails the corresponding expenses of natural and social resources
- With respect to the texture and character of objects, materials and processes of the productive activity upon nature
- With respect to the technical and organizational aspects of distribution of labour
- With respect to the character of labour, the kind of effort that is required from the subject to produce the object (directed to the part

or to the whole, manual and intellectual, continuous-repetitive-monotonous and rotating-changing-creating, executive and performative, and so on)

- With respect to the kind of psychosomatic properties of the subject (human being) of the labour, in terms of structure of this subject, the scale (individual, group, unified humanity) and the relationships between its components
- With respect to the correlation between creative and destructive processes, and so on.

This revolution upgrades the subject of labour in a controversial way, by upgrading the real terms of production. The creation of different levels of automated production systems, dramatically changes the position and role of humans in production as well as the dynamics of the productive forces of society. These changes do not involve quantitative expansion of production processes on a stable-invariable technological basis, but mainly qualitative changes in productive forces, technique, organization (see Chapter 1 by Senge) and training-education of the subject of labour. These are the exact changes that mark the transition towards the intensive type of economic development. The above processes are taking place in a contradictory way. This is not a linear evolutionary process of pure technological character. These processes are associated with the entire complex of human activities and relationships (with the prominent role of relations of production) and require a gradually more active and conscious involvement of the social subject. These processes are unlikely to be thoroughly and effectively interpreted, on behalf of the various technocratic approaches or the methodologically similar anti-technocratic trends.

STRUCTURAL CRISIS AND SHIFTS IN THE TECHNOLOGICAL PARADIGM

Any new technology intersection (paradigm) is not consolidated into large-scale production instantly and effortlessly. At first it appears as an abstract potentiality from the existing range of practice-applied outlets generated by basic research and fundamental scientific knowledge, in a feedback connection with the technological capabilities and the production needs of the time. Thus, it escalates into actual potential, with applied orientation research programmes, in order to move to experimental manufacturing processes, industrial production surveys – in particular patents – until it is made productive, through its technological processing.

The above process is not a linear process of free choices, based on a

series of logical steps. The actual socio-economic conditions (profitability in the case of capitalism) are involved in every step along the way, accelerating or retarding, orienting and disorienting, creating incentives, disincentives, barriers or failures, imposing certain directions over others, and so on. Only a small part of patent rights, held by the monopolistic conglomerates, are used in a productive way. A great part of them remains bound (using the benefits of the patent monopoly and the capacity of patents to block innovations) in order not to be used by competitors, as long as there are chances of profitability or monopolistic excess profit from already invested capitals in other preceding technologies. The last thing the monopolistic conglomerates desire is to provide competitors with a new series of unexpected strategic moves. Typical of this are the institutional changes in higher education and research (the Bologna Process, Common European Research Area [ERA], and so on), changes that suggest the systematic undermining of basic research (physical and social) and clearly support the institutionalization and reproduction of a unilateral mechanism, oriented towards directly applied and technological outlets, rather than the available acquisition of basic research.

In any case, technological reconstructing of production is neither the first nor the most direct or only solution chosen by capital. As a result of the intensity of the quarrel in conditions of crisis (which occurs between the poles of labour and capital at a national, regional and global level, between the monopoly corporations for intrasectional and intersectional domination, between old and new imperialistic poles, between monopolized and non-monopolized capital, and so on) and the resulting changes of global current events, capital has the tendency to resort to the following solutions, or a combination of these:

1. Relocation of production (spatial fix) of the enterprise in countries and areas with the optimal combination of exploitation of labour, energy, natural resources, transfer, anti-pollution legislation elasticity, and so on
2. Technological reconstruction of production (technological fix)
3. Transport to more lucrative, less concentrated, and so on branches of production (product fix)
4. Exodus to the financial sphere (financial fix), through the sale of production units, and the turn to financial or other temporary investments (also see Silver, 2003).

As a rule, the solutions chosen by capital are derived by a series of repeated trial and error, until the choice is the safest way, always depending on the circumstances and the choices of competitors.

During the process of each new technological structure, in the context of modern capitalism, the financial intermediaries have a significant role in the decision-making process, aiming targeted investments in key innovations and thus, in the financing of relevant research and development. The intermediaries of financial capital, as far as they detect the falling rate of profit in production processes that provides credit, begin to search for completely new investment outlets. In these targeted investments the strategic role is assigned to public funds and institutions (both national and international).

In the context of the new technological structure, different types of skills are emerging: the rapid reproduction of appropriate technological applications and the growth of new products, which have to compete with existing ones. As a consequence, the torch of technological development is handed over to production operators, that is, industrial capital. At this introductory stage of the new technological structure, the role of public investments, and funds from research and educational institutions is crucial, as well as mixed financial institutions. The state will have to take the risk, providing opportunities for innovative scientific and technological programmes (under high levels of uncertainty), in a hostile environment of fierce competition for finding alternative technical solutions, especially when the demand for the efficiency of these programmes is highly uncertain and cannot be guaranteed beforehand.

Since the transition to the new technological structure of production is already on its way, the investments in production are limited, based on the hitherto dominant technological structure, releasing financial resources that seek areas of investment. This search creates opportunities for new speculative games, along with the high demand field of innovative businesses, and of companies that rally to produce imitations of key innovations. The excessive growth of the financial sphere is linked to capital flows, which are directed to areas promising rapid growth and high profitability. This observation is associated with a phenomenon, similar to the fetishism of commodities and money, first studied by Marx: the phenomenon of fetishism of technology and its resulting ideologies (technocracy and technophobia). All the above increases the risk of investment in the production of the new technology structure still under formation, creating very favourable conditions for speculative manipulation of resources in the range of possibilities which move between real and fictitious promises of business perspective innovation (see Glazev, 2009).

Under these circumstances, the emergence of a financial bubble operates to a great extent as a mechanism for centralizing investment resources in new technologies (a technology-related financial bubble, see Perez, 2007). The bursting of that bubble, due to crisis, and the consequent depreciation

of capital, leads to recession. The crisis itself and its effects, make the investment climate even worse, which can slow the spread of future innovations. However, because of the special idiosyncrasy of capitalism, financial bankruptcy and its devastating effects on the real economy, and especially on employment, is almost the only peaceful way to redirect investments towards innovations associated with the new technological model.

The way out of recession is associated with the consolidation and expansion of the core of the new technological paradigm. In this case there is some recovery in sectors dominated by the preceding technology. The alternation of models is conditioned by disparity, in a relationship of continuity-discontinuity. Innovations under the new paradigm on the one hand, are put into force with the help of the technological achievements of the preceding paradigm, and on the other hand, they are spread everywhere, opening up opportunities to enhance the production efficiency and product quality of all branches of production.

As far as the technological component of productive forces is concerned, which is the basis of the actual intensive development of capitalism, we need to stress there is some contradictory, deterministic escalation.

In the early twentieth century, the first stage of scientific and technological revolution (the beginning of automation in the level of production, departments, laboratories, single energy-productive units, in series and in sequence production-assembly, mass production via assembly lines, Fordism, Taylorism, and so on) set the ground for the intensive development of imperialism. At this stage, the export of capital over the export of commodities has a vital role, as this is gradually shaping the global system of productive relations, on the basis of financial capital, within the privileged area of circulation. Crises and wars have consolidated the policy of state-monopoly regulation in various forms. The experience of the previous structural crisis of capitalism (1929–33), shows that before the outbreak of the crisis, there is a significant slowdown in the pace of industrialization (Richta, 1967). Since the decade of 1930–1940, during the Second World War and especially during the Cold War, 'monopolies put into circulation a large number of inventions and patents, thus increasing the pressure for innovation. Expenses are spent very quickly on basic and experimental scientific research. The social position of technique is restored and economic growth is remarkably accelerated again' (op. cit.). This recovery is largely associated with the Keynesian policies of state interventionism, public expenditure and state-monopoly regulation, the origins of which are linked with war and military expenses. This recovery is associated with labour struggles and the pressure that is exercised (de facto) by the countries of 'early socialism', which emerged after World War Two.

The second stage of scientific and technological revolution (which coincides with the rapid growth of multinational corporations) began in the late 1970s and 1980s. The key feature at this stage is the transition to another level of intensive development of capitalism, the intensive development of an information technological complex (single automated complexes, production of automated devices by other automated devices, automation of industries, space technology, launch of telematics and networking at the level of a world wide network). This has resulted in restructuring of labour relations and relations of production, stimulated by the strategy of neo-conservatism/liberalism; the latter expresses a different view, opposed to bureaucratic rigidity, which is a typical feature of the state monopoly scheme.

These days are marked by a new turning point in productive forces, a turning point that paves the way for the upcoming third stage of scientific and technological revolution. The range of possibilities of that stage leads to new achievements in basic scientific research. Hence, a wide array of attainments is imminent: intensified promotion of automation and the information technology complex, upgrading of networking, telecommunications, biotechnology, nanotechnology, emergence of new sources of energy with a high rate of return, and new flexible ways of using soft and renewable energy resources, new possibilities of impact on humans and the human psyche, hydrogen energy, and so on. The multinational companies and the countries that control and manage these achievements of scientific and technological progress, hold a hegemonic position in the world.

According to forecasts (see Government of the Russian Federation), creating a coherent core based on new reproductive technologies by some countries and economic groups, is expected to take place unevenly, but significantly, in less than ten years. Taking into consideration existing trends, the key guidelines of the new technological model are: biotechnology (based on the achievements of molecular biology and genetic engineering), nanotechnologies and nanomaterials, new Artificial intelligence (AI) systems and global information networks. The core of this new paradigm, which is still under formation, will embody the development of convergent technologies, based on interdisciplinary principles, of various kinds and levels (possibly: nanoelectronics, molecular technology and nanophotonics, nanomaterials and nanostructured coatings, catalysis and membranes, nano-optics, nanoheterogeneous systems, nanobiotechnology and so on). The latter will be formed by the combination of different achievements in the fields of nanotechnology, biotechnology and information technology, as well as other research and technological fields, apparently unrelated to the basic ingredients of the new system. The sectors that encompass these new technologies will be the following: electronics, nuclear energy,

electrical engineering, information and communications, machine tools, shipbuilding, aeronautical engineering, automobile industry, pharmaceutical industry, solar energy, rocket engineering and space industry, cellular medicine, building and construction, chemical industry, metallurgy, and so on.

These multidisciplinary and/or converging technologies, which are the driving force of the forthcoming technology intersection, will not only lead to the emergence of radically different goods and services, but will also contribute to the production of traditional goods and services, with properties and specifications that were impossible to achieve in the past. This process will cause new antagonisms and imbalances, through recognizing the old-fashioned nature not only of goods and services, but also of manufacturing processes, portions of the labour force, types of needs and consumption patterns, and so on.

The transition to the new technological model will be the new third stage of scientific and technological revolution that will radically enhance the socialization of production. In addition, it will further develop technologies and production processes within a global scale, the nature of labour, and the efficiency of basic strategies of economic development. In other words, it will radically change the characteristics and the composition of the global working class. Under these conditions, new channels of communication between research, technology and production, as well as new requirements of education and training, for labour, will be established.

The processes associated with all the above, in the context of capitalism, can only take place unevenly. Countries, regions and economic groups that achieve faster transition to the reproductive system, based on the new stage of scientific and technological revolution, will also have a comparative advantage in the next phase of global competition. The objective is to extract from the rest of the world the so-called technological rent for as long as they have the exclusive use of these achievements, no matter where the final product will be produced; besides, all the procedures of vital importance are under their control.

What is expected is the emergence of new sectors of economy (such as nano-industry) as well as the transformation of existing industries, via the assimilation of completely new technologies and products, in a process which will lead to the reproductive system of the new technological model.

Consequently, in the near future, a rapid development in three main directions is estimated:

1. Initiation of mass production of radically new products in sectors that will form the core of the new structure: information and communication technologies, nano-industry, bio-industry and the pharmaceutical

- industry, which is accompanied by the stormy growth of the relevant markets, under the control of specific monopoly corporations
2. Initiation of rapid development of completely new convergent technologies, oriented towards the production of goods and services in various sectors of production
 3. A race for the earliest possible introduction and spread of these technologies, in all sectors, which will result in the rapid production of goods and services with new standards that were previously unattainable.

Any precise prediction of the final choices of scientific and technological strategies is considered high risk, but they will become the means for recovering from the crisis, thus creating the new field of capital accumulation. Despite the limits posed by the subordination of science to capital, science makes great progress in establishing more fundamental laws that govern nature, society and psyche, and also broadens and deepens human knowledge. This progress will lead to new principles of description, explanation and prediction regarding the foundations of the structure and development of several fields of reality.

However, there is not any visible intersection in scientific knowledge that can be used by capital as the platform for innovative technology guidelines (breakthrough technology), capable of making a difference, revolutionizing production, or providing the expected recovery through the boost of capital accumulation. Therefore, the most likely solution for the next phase of capital accumulation is a targeted combination of innovative approaches, on the basis of available achievements in basic research, and further optimization and combination in the use-extension of already known technologies, on a wide scale. The promotion of these solutions will not be just a matter of economic, technological and political decisions.

THE NECESSITY OF TECHNOLOGICAL RESTRUCTURING OF CAPITAL AND THE 'GREEN DEVELOPMENT'

In recent years, environmental problems have occupied a central role in shaping public opinion, especially the problem of climate change. Regarding this issue, the Stern report (2006), the drafting of which was assigned to the economist Nicholas Stern by the British government, is typical. The report refers to the consequences of climate change on the global economy and has become the most thorough and popular research of its time (Weitzman, 2007). According to the report, now is the most

economically advantageous time to create a green capitalism, which will face the consequences of climate change. If we wait it will be too late . . . This chapter is not dealing with the debate over the scientific validity of such views.

The massive publicity of this problem at all levels and by all means, its place in the political discourse of the elites in the world, and the impressive joining of forces of resources, institutions, celebrities and movements to promote it, creates a unique dynamic. The technology of renewable energy sources (RES) seems a necessity, much more for public opinion than for researchers. The limited scale of its productive applications so far, the lack of natural resources, the problem of climate change, but more importantly, the agonizing search for a new field of capital accumulation, and the relevant international conflicts, now provide a major boost to RES. The limited availability of fossil hydrocarbons (coal, oil and natural gas), and the highly polluting technologies of their exploitation mark the end of an entire era.

Under the framework of the ongoing global systemic crisis, the moral, aesthetic and the ideological context in general should not be underestimated. The emphasis on the ecological dimension does not seem to be limited to RES, but extends, apparently, (and it will be extended even further) to the whole range of technological innovations, chosen by capital. The systemic promotion, subjection and imposition of the ecological dimension of the forthcoming technological turning point, is a promising strategic choice of the transnational capital, with many targets and multiple recipients. It may dispel the hesitations about the cost of relevant investments and open up a wide investment scope, not just in terms of broad consensus, but also in terms of a mass movement in favour of this change. This change is considered an ideal convergence of private economic interest and social awareness about the fate of the planet and humanity . . .

With the systematic consolidation of the relevant ideologies, what will also be pursued is the massive mobilization of people in favour of these green policies and business decisions, as a substitute for an ideal and vision of a society that is characterized by a general sense of drift and the complete absence of viable alternatives to emerge from crisis. This mobilization is of vital importance for capital, also in terms of response management, given the huge shift of investment costs and the cost of the final product, onto employees and the broader working classes. It paves the way for the promotion of radically new products and services, that will be produced on a huge scale with the introduction of the new technological model, but also of the renewed traditional products and services (because of import-diffusion of new technology). This mobilization, to the extent

it will be achieved, will exonerate consumerism; the act of purchase, as well as consumption itself, will be disguised with the green halo of social sensitivity (as a vote of confidence to the ecological sensitivities of the producer). The promotion of consumption patterns will increasingly focus on these three principles: 'cleaner, greener and smarter' . . . (see Daniel, 2006). Venture success lies in the fact that the technological strategies chosen by capital, for the new era of accumulation, may not be the best in terms of the real needs of humanity and the protection of the environment, but in general, they will be greener than the previous ones.

The Green New Deal, promoted methodically on a global scale, is moving towards this direction: 'The Green Economy initiative has three pillars – valuing and mainstreaming nature's services into national and international accounts; employment generation through green jobs and the laying out the policies; instruments and market signals able to accelerate a transition to a Green Economy' (see UNEP, 2008). According to this set of policy proposals, there are five priority sectors underpinning a global Green New Deal. The five sectors likely to generate the biggest transition in terms of economic returns, environmental sustainability and job creation are:

- clean energy and clean technologies including recycling
- rural energy, including renewables and sustainable biomass
- sustainable agriculture, including organic agriculture
- ecosystem infrastructure
- reduced emissions from deforestation and forest degradation (REDD)
- sustainable cities including planning, transportation and green building (UNEP, 2008).

Hence, the Green New Deal, provides for generous funding from national and international, private and especially public institutions, (the social-ecological ideological justification of the forthcoming redistribution of accumulated surplus value in favour of capital is of great use at this point) and for the transition to new green forms of production. In this way, an ambitious global programme is set up, which will lead to new sources of capital accumulation, in a context in which capital desperately seeks new investment opportunities (such as the new market of exploitation of natural resources, through biodiversity research or genetic technology, through commercial use of medical applications of biotechnology, through technologies of ecological upgrade of production efficiency and energy saving, and so on). We can predict the new investment and speculative opportunities that are being opened up, in search of virgin markets

for evaluation-certification of ecological standards of production and related fuel permits. The massive shift in consumers' habits, and the prevalence of green consumption models, holds similar opportunities for capital. Besides, under the framework of Eco-Capitalism, a plethora of eco-friendly business models and orientations have already been recorded:

- the privatization of eco protection, for example <http://www.sustainablebusiness.com/>
- green business consultancy (Jim Harris, former leader of the Green Party of Canada, see http://en.wikipedia.org/wiki/Jim_Harris_%28politician%29)
- environmental entrepreneurship (Bill Shireman, see <http://www.ecospeakers.com/speakers/shiremanb.html>)
- natural capitalism eco-options; eco-arbitrage; eco-secondary markets (Lovins, see http://en.wikipedia.org/wiki/Natural_Capitalism)
- ecopreneur – 'entrepreneurs using business tools to preserve open space, develop wildlife habitat, save endangered species, and generally improve environmental quality' (Anderson and Leal, 1998)
- Terra Cycle Inc, and so on.

The protection of the environment is overtly commercialized, a fact that drastically reduces the possibilities of resolving the ecological crisis. Therefore, the policy of the Green New Deal, under any circumstances, does not resolve the ecological crisis. On the contrary, it involves the attempt to manage this crisis through development in the context of an aggressive capital accumulation, in combination with the orchestrated manipulation of opposition groups, which seem to be ecologically conscious (see 'The ongoing crisis . . .').

Certain types of ideologists (intellectuals, academics, and so on), voluntarily or involuntarily have contributed to this manipulation, through their abstract moralistic ideologies regarding nature, as a supposed value in its own right. These ideologies lead to the ahistorical and socially neutral (philosophically naive to primitive, metaphysical, irrational and highly theologized) interpretation of the enforced green fashion, preventing a critical and rational attitude and paving the way for a new sophisticated invasion of capital (see for example Larrère). According to many of these ideologies, the ecological crisis is the result of human value disorientation, while the same ideologies resort to moralistic sermons in order to awaken people's ecological consciousness.

Under conditions of exploitative production relations, any relationship between technology and labour intervention in nature (therefore in nature itself) is not and cannot be socially neutral, as long as it determines

the underlying mentality of production, the distribution of labour, the nature of labour, and labour relations. Under the domination of bourgeois ideology, relationships with nature range between two seemingly non-related extremes which in essence, are closely interrelated mentalities; active manipulation and passive contemplation. In the first case, everything (people, nature, and so on) are projected as exploitable and usable, as passive objects and materials, adaptable and available for any kind of transformation, manipulation and exploitation. Nature and society are perceived as a field where the rational or irrational voluntary actions of the subject-manipulator are taking place. At this point, the absolutized activity of the subject is likely to lean towards catastrophic arbitrariness, which, in fact, leads to self-destructive tendencies. In the second case, things are different: the subject holds the role of passive contemplation. Everything around man is perceived as unchanged, a fact that ultimately eliminates the status of the subject, absolutizing the domination of the object. Moreover, it sees people as incapable of transforming the conditions (natural and social) of their own existence in a rational manner, based on the laws that regulate these conditions. These poles co-exist in various forms and contexts. Both poles of this metaphysical dipole are ultimately destructive. This passionate feeling for nature and the adoption of various environmental trends often serves as a value supplement of religious character, covering up the actual domination of the manipulative relationship between man and nature. This fact creates the need for such ideologies, until the next technocratic-manipulative campaign.

The dominant power in these production relations, the capitalists, choose from the current range of opportunities for technological development only those that ensure the continuation and consolidation of their sovereignty and also the optimal exploitation of man and nature through them (profitability), depending on what the dominated accept or permit. The rulers have every reason to present these as options that are made for the sake of society and progress in general, as if they are in charge of some purely technical procedures, that are almost inevitable. Some ecologically-sensitized representatives of leftism, as followers of activism, claim some type of management (but within the boundaries of the system), lacking a scientifically-based strategy. Their vague and abstract ideas of green anthropologism-deontologism, increase capital's chances of success.

The dominated ones, only by their position and role in the labour process, cannot see the options from the current range of opportunities for technological development, no matter how much they are being dominated and exploited. In this perspective, they evaluate these options in terms of limitation of this domination, in terms of upgrading their labour relations, until the elimination of such exploitation, with the radical and

revolutionary transformation of society. In fact, this dominant-dominated relationship often takes the form of an uneven but reciprocal hetero-determination. The initiative moves into the hands of the dominator, as long as the dominated are unable to rally forces, as well as in the theoretical, practical and organizational struggle, as long as they remain defensive.

By upgrading the social character of labour, in the process of this contradictory development outlined above, the lines of the labour camp are enriched with new armies of workers who are not associated with repetitive, monotonous, manual and execution-based jobs, but on the contrary, with renewable-developing, mental, and performance-based jobs (involving creation, installation, configuration, monitoring, control, optimization, and development of automated technological processes of various types and levels). The type of personality and collectivity that these new workers develop, gives them the opportunity to evaluate the scientific and technological potentials of humanity, in a global-scientific scale. This view enables them to exceed the limitations of hetero-determination (and therefore of defensiveness-negativity) between the two poles (labour-capital) and highlight the best potential not only for the needs of a specific class, but of society as a whole and for the inevitable necessity of the unification of humanity. This is a necessity that objectively matures in any subsequent turning point in the development of productive forces, with the main component being man himself as the subject of labour. For the unification of humanity to happen, in the context of another type of development culture, a necessary condition is a harmonious relationship with nature, not as an excuse for some selfish motives, or as fragmented solutions; it is rather an all-round protection, a rehabilitated and consciously creative development of the objective conditions of human existence.

CONCLUSION

As we have seen, nature cannot be viewed as independent of its historically defined interaction with society, on the basis of which it is placed the transformation of nature through labour, in order to adapt nature to human needs. The predatory and exploitative character of capitalism concerns the two main sources of wealth: man and nature. The problem of protection and restoration of nature and the scarcity of natural resources becomes of great significance in the context of contemporary globalized capitalism, especially under conditions of global, systemic and structural crisis. Under conditions of social war against labour, the capitalist system is desperately seeking ways out of the crisis through the exploitation of scientific and

technological progress, and by changing the technological model and the escalating reorientation process of production, based on the technologies that make up the third stage of scientific and technological revolution. The outcome of this search will be largely dependent on whether (and to what extent) labour forces will try to develop their own strategy to come out of the crisis, and on whether global capitalism will be disrupted through the detachment of some of its weakest links. The policy of Green New Deal and similar ideologies are oriented towards this effort. This deal is not acceptable yet by all the segments of capital and its politicians, due to conflicts of interest. The major power of capital is still in the hands of non-green capitalists, but the policy of Green New Deal aims for a strategic consolidation of all the segments of capital, in order to achieve ideological hegemony in society.

The combination of the above solutions for the technological reconstruction of production called the Green New Deal, in the event that will result in qualitative and essential upgrade of intensive development of the material and personal conditions of the production, with the use of science and technological advancements (fact that redefines the terms and the boundaries of extensive development of the capitalism via newer, broader and deeper usage of natural resources and processes) may lead to temporary rescue outlet from the crisis of capitalism, creating a new field of accumulation, more conducive for the safeguard of an ideological consensus and hegemony, preparing the next historical round of the social struggle.

NOTES

1. This chapter is not focused on the academic debate on Marxism, post-Keynesianism, ecology and sustainable development (see Wallis, 2009; Faber, 2006; Courvisanos, 2005, 2009).
2. See The International 'Logic of History' School in Vazulin, 2005a; Vazulin, 2005b; Vazulin, 2011.

REFERENCES

- Anderson T.L. and D. Leal (1998), 'Nature's entrepreneurs. Profit-driven entrepreneurial approaches can protect and produce environmental quality', *The Freeman*, 48 (11), accessed 20 September 2011 at www.thefreemanonline.org/featured/natures-entrepreneurs/.
- Bakan, J. (2004), *The Corporation. The Pathological Pursuit of Profit and Power*, London: Constable.
- Bentham, J. (1931), *The Theory of Legislation*, London: C.K. Ogden.
- Courvisanos, J. (2005), 'A post-Keynesian innovation policy for sustainable

- development', *International Journal of Environment, Workplace and Employment*, 1 (2), 187–202.
- Courvisanos, J. (2009), 'Optimise versus satisfice: two approaches to an investment policy for sustainable development', in R. Holt, S. Pressman and C.L. Spash (eds), *Post Keynesian and Ecological Economics: Confronting Environmental Issues*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 279–300.
- Daniel, C.E. and S.W. Andrew (2006), *Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage*, New Haven, CT: Yale University Press.
- Faber, D. (2006), *The Political Ecology of Global Capitalism*, Sociology G230, accessed 16 September 2011 at www.northeastern.edu/socant/wp-content/uploads/syllabus-for-political-Ecology-of-Global-capitalism.pdf.
- Glazev, S.J. (2009), 'The global economic crisis as a process of changing technological structures', *Вопросы экономики [Economic Problems]*, 3, 26–38.
- Government of the Russian Federation, 'Long-term prognosis for scientific and technological development of the Russian Federation (2025). Potential, and Russia's position in the technology marketplace', [Долгосрочный прогноз научно-технологического развития Российской Федерации (до 2025 года). Потенциал и позиции России на рынках технологий], accessed 16 September 2011 at <http://protown.ru/information/doc/4295.html>.
- Jevons, S. (1866), 'Brief account of a general mathematical theory of political economy', *Journal of the Royal Statistical Society*, XXIX, June, 282–7, read in section F of the British Association, 1862, accessed at <http://socserv2.socsci.mcmaster.ca/~econ/ugcm/3113/index.html>.
- Larrère, C. (1997), *Les philosophies de l'environnement*, Paris: Presses Universitaires de France.
- Lenin, V.I. ([1917] 1963), *Imperialism, the Highest Stage of Capitalism, Lenin's Selected Works*, vol. 1, Moscow: Progress Publishers, 667–766, accessed 16 September 2011 at <http://www.marxists.org/archive/lenin/works/1916/imp-hsc/>.
- Marx, K. (1857–61), *Outlines of the Critique of Political Economy (Grundrisse)* accessed 16 September 2011 at www.marxists.org/archive/marx/works/1857/grundrisse/.
- Marx, K. (1867), *Capital. A Critique of Political Economy*, vol. I. first English edition, trans. S. Moore and E. Aveling, F. Engels (ed.) (1887), *Capital. A Critique of Political Economy*, Moscow: Progress Publishers, accessed 16 September 2011 at www.marxists.org/archive/marx/works/1867-c1/.
- Meadows, D. (1974), *The Limits to Growth*, 2nd edn revised, Signet: Universe Books.
- Perez, C. (2004), 'Finance and technical change: a long-term view', in H. Hanusch and A. Pyka (eds), *The Elgar Companion to Neo-Schumpeterian Economics*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
- Perez, C. (2007), *Great Surges of Development and Alternative Forms of Globalization*, accessed 16 September 2011 at www.carlotaperez.org/papers/GreatSurges_and_Globalization.pdf.
- Richta, R. (ed.) (1967), *Civilization at the Crossroads: Social and Human Implications of the Scientific and Technological Revolution*, Prague: Czechoslovak Academy of Sciences.
- Rubin, I.I. (1972), *Essays on Marx's Theory of Value*, Detroit, MI: Black and Red.

- Silver, B. (2003), *Forces of Labor. Workers' Movements and Globalization since 1870*, Cambridge: Cambridge University Press.
- The Club of Rome, accessed 16 September 2011 at www.clubofrome.org/eng/home/.
- 'The Green New Deal', accessed 16 September 2011 at www.neweconomics.org/projects/green-new-deal.
- 'The International 'Logic of History' School', accessed 16 September 2011 at www.ilhs.tuc.gr/en/index.htm.
- 'The ongoing crisis of financial capitalism – a test for the left' [*Кризис капитализма финансовых рынков – испытание для левых*], accessed 16 September 2011 at http://scepsis.ru/library/id_2431.html.
- UNEP (2008), '*Global Green New Deal*' – *Environmentally-Focused Investment Historic Opportunity for 21st Century Prosperity and Job Generation*, London/Nairobi, accessed 22 October 2008 at www.unep.org/documents.multilingual/default.asp?documentid=548&articleid=5957&l=en.
- Uzunidis, D. (2006), 'Science and technology in today's economy. The fourth stage in the organisation of production', Laboratoire de Recherche sur l'Industrie et l'Innovation. ULCO/Research Unit on Industry and Innovation working papers 125.
- Vazjulin, V.A. (2005b), *Die Logik des 'Kapitals' von Karl Marx*, Nordesstedt, Germany: Books on Demand GmbH.
- Vazjulin, V.A. (2011), *Die Logik der Geschichte*, Übersetzung aus dem Russischen von Gudrun Havemann, Herstellung und Verlag, Nordesstedt, Germany: Books on Demand GmbH.
- Vazulin, V.A. (2005a), *The Logic of History. Questions of Theory and Methodology*, Moscow: Moscow Humanitarian University Press, accessed 16 September 2011 at www.ilhs.tuc.gr/ru/istorioglav.htm.
- Wallis, V. (2009), 'Beyond "Green Capitalism"', *Monthly Review*, 61 (9), February, 32–48.
- Wayt, G.W. (2009), 'Plan B for energy: 8 revolutionary energy sources', *Features*, accessed 16 September 2011 at www.scientificamerican.com/article.cfm?id=plan-b-for-energy-8-ideas.
- Weitzman, M.L. (2007), 'The Stern review on the economics of climate change', *Book review for JEL, Journal of Economic Literature*, 45 (3), 703–24, accessed 16 September 2011 at www.economics.harvard.edu/faculty/weitzman/files/JELSternReport.pdf.
- Ziegler, J. (2002), *Les nouveaux maîtres du monde et ceux qui leur résistent* [*The New Rulers of the World and Those Who Resist Them*], Paris: Fayard.
- Ziegler, J. (2005), *L'empire de la honte* [*The Empire of Shame*], Paris: Fayard.