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Towards a Democratic Conception of Science and Technology

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Abstract: *The view prevailing in the West since the eighteenth–century Enlightenment that science and technology permit human beings to control nature in a never ending process of Progress and emancipation has been seriously challenged in the last 30 years or so. Not only have science's objectivity and neutrality been disputed but also technology's autonomy has been questioned. However, an even more important issue that has been raised concerns the democratic character of today's science and technology, what we may call the 'technoscience'. The issue arises not just because of the attacks mounted today by irrationalists of all sorts against science but also because of the criticisms raised against the supposedly inherent undemocratic characteristics of modern technology as such. The aim of this article is to examine, from a democratic viewpoint, the claims and counter–claims on the neutral, autonomous and democratic character of technoscience and end up with some thoughts concerning the desired characteristics of a democratic science and technology.*

Introduction

The crisis of technoscience surfaced about 30 years ago when, on the one hand, the scientific process of creating 'objective' truths was challenged[1] and, on the other, the adverse social as well as the ecological implications of today's technology were stressed.[2] The crisis of science had particularly devastating consequences with respect

to the truth value of the interpretations concerning social and economic phenomena, as the subsequent rise of the post-modernist movement showed.

Science plays a double role with respect to the reproduction of the *growth economy*, defined as the system of economic organisation which is geared either 'objectively' (capitalist market economy) or deliberately ('socialist' planned economy) towards economic growth.[3] Science has played an important ideological role in 'objectively' justifying the growth economy — a role that has been put under severe strain by the credibility crisis of science. And, just as religion played an important part in justifying feudal hierarchy, so has science, particularly social 'science', played a crucial role in justifying the modern hierarchical society. In fact, from the moment science replaced religion as the dominant worldview, it had 'objectively' justified the growth economy, both in its capitalist and 'socialist' forms.

However, science and, in particular, applied science and its technological applications, plays an equally important functional role in the material reproduction of the growth economy through its decisive contribution to the effort to dominate the natural world and maximise growth. The realisation of the effects of economic growth upon Nature and, subsequently, upon the quality of life, called into question the functional role of science in advancing Progress. When, on top of this, the credibility of scientific truths themselves was challenged, whether those truths originated in orthodox social 'science'[4] or in the alternative 'science' of socialism, Marxism,[5] the moment of truth for the growth ideology had come. Today, the central imaginary signification of the growth economy, that is, the identification of Progress with growth and the implied idea of human domination over Nature, is, for the first time after the Enlightenment, under massive fire.

The collapse of 'socialist' statism and the rise of neoliberalism had the side-effect that the radical critique of 'scientific' socialism, statism, and authoritarian politics, which had started earlier, did not function as a catalyst for further development of the non-authoritarian left thinking. Instead, the critique of scientism was taken over by post-modernist theoreticians and developed into a general relativism, which inevitably led to the abandonment of any effective critique of the status quo and to the theorisation of conformism.[6]

Still, it is not science itself and rationalism in general that have to be blamed for the present multi–dimensional crisis, as irrationalists of various types usually assert. Thus, as Paul Heelas, reader in religion and modernity at Lancaster University and author of *The New Age*, states:

> We no longer believe in reason and science to be the engines of human progress, the promise of the Enlightenment (...) there is no sense of optimism or enthusiasm about the future. [The] spiritual movements are the exception; they are optimistic but on a very personal individualistic level, as they seek their own self–perfection. Up to 50 per cent of my students are into neo–paganism, Wicca or shamanism; they are more concerned with exploring themselves than changing the world.[7]

However, as it will be stressed below, applied science, like technology, is not 'neutral' to the logic and dynamic of the market economy. Still, science belongs to the autonomy tradition given the methods used to derive its truths and, sometimes, even from the point of view of its content (e.g., the demystification of religious beliefs). Therefore, as I tried to show elsewhere,[8] what is needed today is not to jettison science, let alone rationalism altogether, in the interpretation of social phenomena, but to transcend 'objective' rationalism (i.e., the rationalism which is grounded on 'objective laws' of natural or social evolution) and develop a new kind of democratic rationalism.

Is Technoscience Neutral?

The thesis proposed in this paper is that modern technoscience is neither 'neutral' in the sense that it is merely a 'means' which can be used for the attainment of whatever end, nor autonomous in the sense that it is the sole or the most important factor determining social structures, relations and values. Instead, it is argued that technoscience is conditioned by the power relations implied by the specific set of social, political and economic institutions characterising the growth economy and the *dominant social paradigm,* that is, the system of beliefs, ideas and the corresponding values that are associated with these institutions.[9]

A crucial element of the presently dominant social paradigm is the *growth ideology,* which may simply be defined as the ideology founded on the social imaginary signification that "the unlimited growth of production and of the productive forces is *in fact* the central objective of human existence."[10] The growth ideology has been established for over 200 years, following the industrial revolution and the 'grow–or–die' dynamic that was set in motion by the market economy. Thus, from Adam Smith[11] to Karl Marx,[12] the fundamental problem was how humankind could, with the help of science and its technological applications, maximise growth. In fact, Marx was even more emphatic about the importance of rapid growth. As a recent Marxist study put it:

> The Marxist critique of capitalism has often appealed from one economic rationality to another, from a crisis–ridden growth process to one which would be

> crisis-free ***and therefore more rapid***, from an inefficient and wasteful allocation of productive resources to one which would rest on more accurate and comprehensive forms of calculation. (emphasis added)[13]

No wonder, therefore, that the socialist movement that emerged in nineteenth-century Europe and, of course, the Marxist movement, constituted the material manifestations of a socialist statist view, according to which the aim of the socialist movement should be the conquest of state power by legal or revolutionary means as the necessary condition to bring about radical social change, that is, as the precondition for employing our knowledge about nature and society in order to shape the natural environment and the course of social evolution. This view involved a course of linear (or dialectic) Progress into the future. Politics could be grounded on science, on an effective knowledge, regardless of any collective, creative or self-instituting activity on the part of social individuals. The socialist statist view mainly flourished in the quarter of a century following the end of World War II, as a result of the vast geographic expansion of the "socialist" growth economy in East Europe and the take-over of power by social-democratic parties in West Europe.

The socialist statist view, implicitly or explicitly, adopted the thesis of the neutrality of technoscience, according to which technoscience is a 'means' which can be used for the attainment of capitalist or socialist development of productive forces. Within the Marxist movement, it was only the Critical Theory School which denied the neutrality of technology thesis, arguing that while technology serves generic aims, such as increasing the power of human over nature, its design and application serves the domination of human by human, and, in this sense, the means (technology) are not truly 'value free' but include within their very structure the end of furthering a particular organisation of society (Georg Lucaks, Adorno, Marcuse et al.).

Therefore, it was hardly surprising that 'existing socialism' fully adopted the Western industrial technostructure (same factories, production systems, etc.). Lenin, as early as 1918, had introduced Taylorism, Stalin talked about the 'scientific-technological revolution', whereas Trotsky stressed that "Marxism sets out from the development of technique as the fundamental spring of progress, and constructs the communist program upon the dynamic of the productive forces."[14] Thus, the principle of economic efficiency had always been the standard for assessing success with respect to the aim of developing the forces of production in the 'socialist' growth economy. The objective in designing technology and organising production was, on the one hand, to maximise efficiency and, on the other, to ensure the maintenance and reproduction of hierarchical structures. This is the reason why a modern Soviet factory, even in Lenin's times (with

his encouragement), in no way differed — in terms of internal functioning, hierarchical organisation of production, etcetera — from an equivalent capitalist one. This, of course, simply reflected the socialist-statist belief in the 'neutrality' of technology. Thus, in exactly the same way as technology was considered by socialist-statists as a neutral *means* that could be used by *any* social system to achieve a specific aim, efficiency was, also, held as a neutral means in achieving the growth objective.

The growth ideology has therefore complemented the *liberal* ideology of the capitalist growth economy and the *socialist* ideology of the 'socialist' growth economy. In this sense, the growth ideology has been the ultimate ideological foundation for both the capitalist and the 'socialist' growth economy, despite the different ways in which the hierarchical patterns of power concentration are structured in the two types of growth economy. Furthermore, the growth ideology has, in a sense, functioned as the `ideology in the last instance' since it has determined which ideology will be dominant at the end. This is why the economic failure of the 'socialist' growth economy (namely, the failure to create a Western-type consumer society) was the main reason leading to the collapse of this type of growth economy and to the present predominance of the capitalist growth economy and its own ideology (liberalism).

Moreover, the fact that the 'socialist' growth economy adopted the same definition for economic efficiency as the capitalist growth economy (that is, a definition based upon narrow techno-economic criteria which did not include the ecological cost of growth) can also account for the fact that both types of growth economy share a similar environmental degradation. Thus, despite the fact that in the 'socialist' growth economy the growth process was not combined with the marketization of the economy, as in the West, it still resulted in significant ecological damage (in fact, greater than in the West due to the lower level of technology in the East). Therefore, to the extent that the present concentration of power cannot be simply reduced to capitalist production relations, as Marxists contend, to a similar extent the ecological crisis itself cannot be merely reduced to capitalist relations and conditions of production as eco-Marxists maintain.[15] It is, anyway, evident that an analysis of the ecological crisis on the basis of capitalist production relations fails to explain the presence of an even more serious ecological crisis in the countries of 'actually existing socialism', despite the absence of capitalist production relations, in the sense of means of production being privately owned. Thus, just as it would be wrong to attribute the ecological crisis merely to the growth ideology as the environmentalists and various '*realos*' within the Green movement do, disregarding the institutional framework of the market economy and the consequent power relations, it would be equally wrong to impute the crisis mainly to capitalist

production conditions (as eco-Marxists are trying to do), disregarding the significance of the growth ideology on the theory and practice of socialist statism.

In this context, the differentiated institutional framework of the two types of growth economy (capitalist and 'socialist') and the common ideological framework (growth ideology) will be equally important in the analysis of the objectives of the élites controlling the growth economy and the implications of those objectives with respect to the ecological repercussions of growth. Thus:

- In the case of the capitalist growth economy, those controlling the means of production (capital, labour and 'land') have to aim, in the context of the marketization process, at the minimisation of social controls on the respective markets — either these controls are designed to protect labour or the environment.
- In the case of the 'socialist' growth economy, central planners were able, in theory, to take ecological factors into account when making their planning decisions; in practice, however, this would have implied that growth and efficiency would not be maximised, resulting in further lagging behind the capitalist growth economy.

It is therefore obvious that in both versions of the growth economy the built-in logic of the system, which emanates from the fundamental objective to maximise growth and the intermediate objective to increase economic efficiency, leads to either leaving the environment out of the calculations of the costs of growth, or to a straightforward attempt to use Nature as an instrument in the pursuit of the above object.

Technology has never been 'neutral' with respect to the logic and the dynamics of the market economy. Still, not only socialist statists but environmentalists as well, explicitly, or usually implicitly, assume that technology is socially neutral and that we only have to use it for the right purposes in order to solve not just the ecological problems but the social problems as well. It is obvious that this approach ignores the social institutioning of science and technology and the fact that the design and particularly the implementation of new techniques is directly related to the social organisation in general and the organisation of production in particular.[16] In a *market society*, as in any society, technology embodies concrete relations of production, its hierarchical organisation and, of course, its primary aim, which, in the case of a market economy, refers to the maximisation of economic growth and efficiency for profit purposes. So, technology is always designed (or at least those designs are adopted) in a way that best serves the objectives of the market/growth economy.

Still, some eco-feminist authors, like Carolyn Merchant, attempt to explain the present ecological crisis in terms of "the new mechanical philosophy of the mid–seventeenth century (which) achieved a reunification of the cosmos, society, and the self in terms of a new metaphor — the machine (...) rational control over nature, society and the self was achieved by redefining reality through the new machine metaphor."[17] However, the fact that this view of History cannot assimilate is that the 'mechanistic view of Nature' was nothing else but the by-product of the emergence, some 400 years ago, of a process of separation of the economy from society,[18] culminating in the rise of the market economy, two centuries ago, and of the present growth economy. In other words, the flourishing of the mechanistic view of Nature was simply an integral part of the new social paradigm that became dominant in the last two centuries and, in particular, of the growth ideology which idealised the dynamics of the market economy. So, it is not technology as such that should be blamed for the present ecological crisis, as deep ecologists usually assert. Similarly, it is not industrialism in general and its theoretical idealisation that created the present eco-damaging form of economic organisation but the specific type of industrial society that developed in the last two centuries in the framework of the market/growth economy. Therefore, the ultimate causes of the ecological crisis are the market economy and its offspring, the growth economy, and not its symptoms, namely, the present type of technology and industrial society.

In general, the type of technoscience that developed in the past two centuries is not an autonomous cultural phenomenon but a by-product of the power relations and the dominant social paradigm which emerged in association with the rise of the market economy. As I have attempted to show elsewhere,[19] it was not just the introduction of mechanised production and the adoption of a 'mechanistic view of Nature' that led to the present type of technoscience. Instead, it was the fact that mechanised production was introduced under conditions of private ownership and control of the means of production which, on the one hand, led to *marketization*, and on the other to *economic growth*. The former was the outcome of the effort of those controlling the market economy to minimise social controls on the markets. The latter was the outcome of a process which, at the micro-economic level, involves the pursuit of profit through the continuous improvement of efficiency (by means of investments into new techniques, methods of production, products, etc.) and the sales figures. Both orthodox and Marxist economic theory could be used to show that the maximisation of economic growth and efficiency crucially depend on the further division of labour, specialisation and the expansion of the size of the market. This is why modern technology has always been designed to maximise economic efficiency (in the sense defined above), implying further expansion of the division of labour and the degree of specialisation, irrespective of the broader economic and social implications as a result of the inevitable departure from the principle of self-reliance:

unemployment, poverty, economic crises in the market economy and economic irrationalism in the 'socialist' growth economy, disintegration of social ties and values, environmental implications and so on.

It is therefore nonsensical to adopt the practice of deep ecologists and their sympathisers and describe the present socio-economic system as 'industrialism' rather than as a market economy or capitalism. Roy Morrison, for instance, argues that industrialism "is not simply" capitalism. Instead, industrialism is defined as "a system for maximising production and consumption, but it is also something more: industrialism is a civilisation."[20] Further on, we are informed that industrialism is characterised everywhere "by two central imperatives: to maximise production and consumption, and to maximise profit and/or power. (...) hierarchy, progress and technique, linked to form the steel triangle of industrialism."[21]

The above definition makes immediately clear that the author is not in effect talking about the institutional framework of the market economy and the consequent growth economy but about a "civilisation," in other words, a cultural phenomenon rather than a socio-economic system and its associated value system and ideology. No wonder that Morrison sees maximisation of production and consumption, as well as maximisation of profit, as two central imperatives characterising industrial civilisation and not as imperatives implied by the dynamics of the market economy and capitalist property relations respectively. Furthermore, by confusing the growth economy with growth ideology, he puts in the same bag of 'industrialism' market economies as well as the defunct regimes of 'actually existing socialism', although power structures in the latter took very different forms from those in the former. His description of hierarchy confirms the suspicion that the author is not talking about a socio-economic system but about a civilisation.[22] Thus, hierarchy is described as "the basic industrial ordering principle. Industrial hierarchies rest not on caste or class, but on success in fulfilling industrial imperatives."[23] So, the fact that industrial hierarchies, which control the means of production, pursue basically the same objectives as the élites owning the means of production is ignored by the author, who seems to adopt the myth (presently almost defunct) of the divorce of ownership from control in industry.

Still, this problematique is not original at all. It seems that deep ecologists are presently reaching the logical conclusions of their approach, which has always emphasised in its interpretation of the ecological crisis the importance of value systems rather than of institutions and of science and technology rather than of the market system. It is not therefore surprising that they now assume away the market economy itself. Thus, as Janet Biehl points out in a review of a recent book on the Industrial Revolution,

"Kirkpatrick Sale explicitly defines industrialism as 'the ethos encapsulating the values and technologies of Western civilisation'. This subjectivization of 'industrialism' as an 'ethos' precludes a capitalistic component in Sale's industrialism."[24]

It is clear that deep ecologists and Morrison, using a simplistic 'historical' analysis, which cannot distinguish between basic concepts like capitalist property relations, the market economy and the growth economy, on the one hand, and the growth ideology on the other, end up by mixing everything up under the rubric of 'industrialism', which is supposed to be the cause of all our ills! Therefore, the fact that the industrial revolution happened in a society where the means of production were under private ownership and control is simply ignored by this approach. Equally ignored is the fact that the defunct regimes of actually existing socialism, in fact, had the option of not adopting a growth economy but simply did not pursue it — not because they aimed at becoming industrial societies and therefore had to adopt the comprehensive system of social relations shaped by industrial reality, as Morrison seems to argue, not even because of the 'objective' factors which obviously necessitated a certain amount of economic development to meet the needs of their peoples. Although these factors did play a role, the main reason they did so was a 'subjective' factor, that is, the fact that the identification of Progress with economic growth was an essential part of their ideology.[25]

Of course, today, few still believe in any identification of Progress with economic growth, or even in the idea of Progress itself. For instance, not many people would argue today, particularly after the experience of this century, that there is some sort of correlation between Progress in technoscience and the degree of autonomy achieved in society at the political and economic levels. Furthermore, several writers have noted the increasing vulnerability of the human species because of the world-wide reliance on the same technology and the fact that increasing technological complexity is accompanied by an increasing lack of flexibility and adaptive capacity.[26] Still, if one accepts the non-neutrality thesis of technology, one may counter-argue here that the homogenisation of technology is not an 'independent variable' but just the inevitable outcome of the marketization of the economy.

Today, the non–neutrality of technoscience has become even more obvious than in the past. Thus, as regards technology first, as Ian Reinecke argues with respect to electronic technology:

> The values inherent in many electronic systems extend beyond offices and factories to reflect the society in which they exist. The systems emphasise the primacy of control and production geared to profit. They serve the interest of those

> who produce technology, those they sell it to, and those who benefit from it. The test of technology's supposed neutrality is whether its design is unaffected by the society around it (...) the neutrality of a technology resides not in its theoretical possibility for good or evil but in how it is designed to be used. If in practice it is used only as a threat, as an instrument of control, as means of subjugation of many by few, its claim to neutrality is spurious.[27]

Also, as regards today's science, its non-neutral character has become more obvious than ever before following the 'privatisation' of scientific research as a result of scaling down the state sector in general and state spending in particular within the context of the neoliberal phase of the marketization of the economy.[28] As Stephanie Pain, an associate editor of New Scientist (not exactly a radical journal) stresses, science and big business have developed ever closer links lately:

> Where research was once mostly neutral, it now has an array of paymasters to please. In place of impartiality, research results are being discreetly managed and massaged, or even locked away if they don't serve the right interests. Patronage rarely comes without strings attached.[29]

In fact, as the same author argues, even more pernicious is the scientists' slide into self-censorship in an attempt to ensure that contracts keep coming — an effort which is vital for their survival after the institutionalisation of the formerly informal links between business and science introduced by neoliberals. In Britain, for instance, a 1993 Government's white paper on science stressed the need to concentrate on research that would help 'the economy' whereas industry was asked to pick out the areas of science that were likely to create wealth in the future. As a result of the formal and informal links between business and science, today, not only is it not possible to talk about the neutrality or 'objectivity' of social sciences — as has always been the case[30]— but it is becoming increasingly meaningless to even talk about the neutrality of the natural sciences.

I will mention two examples which clearly show the common objectives of, and the links between, on the one hand, those controlling industry in today's internationalised market economy and, on the other, those controlling scientific research. The first example concerns agro-industry research and the second refers to the greenhouse effect.

As regards agro-industry research, *The Ecologist* reported a few years ago:

> Through the strategic placing of grants, industry can direct public funds into research that best serves its own long–term agenda. The process has gained its

> own momentum and universities are embracing their own corporatist, profit maximising vision. In the US, public universities allocate scarce resources to research which it is hoped will yield patentable processes and products to form part of the universities 'future endowments'; biotech research thus receives considerable funds, while research on the environmental and social impact of industrial agriculture is neglected or eliminated.[31]

The second example concerns the critical problem of the greenhouse effect and the fossil fuel industry's attempts to wreck negotiations for a climate treaty aimed at preventing global warming. As Stephanie Pain, again, reports, scientists for many years have tried to establish a link between climatic change and burning fossil fuels. Finally, in 1995, more than 2,500 climate scientists reached consensus that the world had definitely begun to feel the effects of global warming as a result of human activities, that is, burning fossil fuels and the consequent generation of greenhouse gases which are responsible for the world's rising temperature. Still, fighting the consensus every step of the way has been a powerful group of industry lobbyists, aided by a handful of scientists, "who argued that global warming is a confidence trick to frighten governments into awarding large research grants (...) [and] who have helped drag out the negotiations to win the fossil fuel lobby a reprieve of almost a decade."[32] This, at the moment when it is estimated that for every year of that reprieve, another 6 billion tonnes of Earth–warming carbon dioxide was pumped into the atmosphere. Needless to add, "a web of financial links exists between US university research scientists, fossil fuel lobby groups (whose members include Shell, Exxon, Texaco and Ford) and industry paymasters including British Coal and the Kuwaiti government."[33]

Is Technology Autonomous?

It is not uncommon that the issue of the non-neutrality of technoscience is confused with the issue of its autonomy. David Watson, for instance, argues that "the idea that technology is not neutral logically implies not only that our concepts shape and determine technology but that the technological relations and requirements imposed by our technology also shape our concepts and social relations."[34]

However, this implication can only be derived if we assume that technology is not only non–neutral but also autonomous, which it is not. An autonomous technology means that it has the ability to determine the institutional framework as well as the dominant social paradigm, either as the sole or the most important factor. But such an approach immediately raises questions like: how do we explain that, historically, similar, if not identical, technologies rested on very different political and social structures, from

democratic Athens and oligarchic Sparta up to a "fairly democratic federation such as the Iroquois and a highly despotic empire such as the Inca?"[35]

Others explicitly adopt an 'autonomy-of-technology' thesis. Thus, Michael Shallis, quoting Marshall McLuhan's phrase "the medium is the message," argues in favour of technology's autonomy, an autonomy which, as he points out, is usually ignored when we ignore the medium and only see the content. Shallis refers to the clock technology and stresses that the clock transformed society and subjected people to the rule of time and at the same time made the abstraction of time from human experience possible. Similarly, referring to the computer technology, the same author argues that what matters is not how we use the computer but the fact that "the anonymity of a computer, its faceless[ness], symbolises man's own loss of face and faith, his own anonymity in a world of machines."[36]

However, one may counterargue here that the question is not whether the clock or the computer have transformed society. Of course they have done so. The real issue is whether the adoption of these technologies was reflecting important, newly-emerged needs of the socio-economic system (i.e., those of the ruling élite controlling it), in which case technology can hardly be characterised as autonomous. From this viewpoint, it is not accidental that although the first mechanical public clock was made and erected in Milan in 1335 and the first watches appeared shortly after 1500, still, it was not until the end of the eighteenth century that watch technology was advanced to such an extent that the expansion of its use became perfectly compatible with the parallel expansion of the factory system. In other words, it was not the invention of the clock that subjected people to the rule of time but the emergence of the market economy which made it necessary. Similarly, it was not the arrival of the computer that brought about "man's own loss of face and faith, his own anonymity in a world of machines," but the emergence of the huge urban centres in today's post–industrial society (where almost half of the world population is concentrated[37]) and the consequent decline of communities. The information technology simply reflected the needs of the newly-emerged internationalised market economy for faster processing of data and speedier communication.

From this viewpoint, following Frances Stewart,[38] we shall make the important distinction between the *available technology* and the *actual technology in use*. Thus, starting with a broad definition of technology as extending to all the "skills, knowledge and procedures for making, using and doing useful things", we may describe technology as a set of techniques, each technique being associated with a set of characteristics. The available technology may be defined as the set of all those techniques which have

evolved historically and are known to the world, whereas the actual technology in use is just a subset, that is, a (small) part of the former, which, at any moment of time, is determined by the nature of the available technology and the choice made among those available. Given this distinction, as Stewart points out, the development of techniques is a historical process. The state of scientific and technological knowledge sets the scene or provides the starting point for new developments in which one technique with one set of characteristics replaces another in the light of the historical and economic conditions of the time.

As regards, first, historical conditions, the characteristics of the techniques adopted at any moment of time depend on the historic circumstances of the place where they were introduced. Thus, because of the fact that most technological development, since the emergence of the market economy during the industrial revolution, has occurred in the advanced capitalist countries, the available technology today relies on the characteristics of the techniques developed in these countries, which, in turn, depend on the historic/economic circumstances of the advanced capitalist countries during this period (factory system, high degree of division of labour and specialisation, high levels of productivity and income, etc.).

Second, as regards economic conditions, as Stewart stresses, "techniques are only developed and introduced if they are believed to be viable in the economy in which they are introduced."[39] In other words, which particular subset out of the set of all available techniques will be chosen at any moment of time depends on the economic organisation of society and the built-in selection mechanisms. So, the choice actually made depends on the nature of the decision makers and their objectives, the economic circumstances in the economy concerned and the characteristics associated with different techniques.[40] It is therefore obvious that to explain the introduction of, say, the clock or computer technology it is not enough just to refer to the relevant inventions as autonomous, techno-scientific developments, but to the entire socio-economic structure of society and its values. This is particularly so if we take into account the following facts: first, that associated with each technique is a particular distribution of benefits; second, that individual techniques are designed for a particular economic/technical environment and are 'efficient' only within the context of that environment; and, third, that "the selection mechanisms are themselves part of the technology system, so that the system becomes self–justifying, generating selection mechanisms which are consistent with it."[41] This can explain the 'paradox' mentioned by Bookchin that "while capitalism has turned to technology with a fervour unknown to any previous society and dressed in the mystifying garb of an 'industrial society', capitalists have notoriously neglected very important

technologies and chosen to develop precisely those techniques that benefit its unique imperative for growth and its inflated appetite for profit."[42]

In conclusion, although technical inventions may reflect a significant degree of autonomy, particularly in earlier times when scientific and technological research was not carried out, as today, in the framework of huge and expensive research institutions, technology itself, in the sense of actual technology adopted by those controlling the production process, has always been an integral part of the power relations implied by the dominant socio–economic institutions and the values which were compatible with the dominant social paradigm.

Therefore, contrary to Castoriadis' view ("genuine choice would require the establishment of *criteria* and *priorities;* what criteria, what priorities and upon what basis? (...) And these choices, were they to exist, would be choices by *whom*")[43] one may argue that choices *are* being made on the basis of specific criteria. But, neither the choices nor the criteria are determined by society at large, let alone the scientists themselves. In this sense, technoscience is not autonomous as Castoriadis, following Jaques Ellul, argues.[44] But, if technology is not considered to be autonomous, the question that arises is how we can explain the present situation when it is obvious that its development contradicts the very aims of the market economy system, notably because of the on-going destruction of the environment. In fact, it is exactly this characteristic of today's technology that has led Castoriadis to argue that technology is at present uncontrollable, directionless and aimless.[45]

However, to my mind, this may be true only if we take a long-term view of technology. In the short to medium-term, technology is very much controlled by the institutions funded by the system of the market/growth economy and guided by the values imbued in this system. If, therefore, in the longer term, technology appears to be directionless and even contradicting the very aims of the system, this is because it is outside the logic of the market economy for those controlling it to think about the long-term implications of their choices. So, although the technological choices seem irrational, they are very much compatible with the values and aims of those controlling the market economy and, as such, rational. Furthermore, to the extent that new 'green' technologies satisfy the long–term needs of the system in terms of their ecological implications, and, at the same time, are compatible with the objectives of maximising efficiency, growth and profits, such techniques are being adopted. It is exactly the partial adoption of such green technologies (e.g., 'green' fridges) which feeds the environmentalists' mythology that a 'green capitalism' is in the cards.

Murray Bookchin also rejects the autonomy-of-technology thesis. This is made explicit in statements like the following one:

> The notion that science and technology are 'autonomous' of society, that they themselves are controlling factors in guiding society is perhaps one of the most insidious illusions of our time. That science and technics conduct lines of research and open visions toward new developments is certainly true, but these developments are rigorously guided by the prevailing market society rather than the other way round (...) technology is a heteronomous or dependent phenomenon (...) ecomysticism tends to emphasise its autonomy from society and the mystique of a 'technological imperative', crudely obscuring the profoundly social factors that promote or inhibit technological innovation.[46]

However, although Bookchin refers not just to the non-autonomous but also to the non-neutral character of technology, at the same time he seems to accept the division between ends and means with respect to the uses of technology, which, in effect, negates the non-neutrality thesis: "In class societies the use of technologies to displace labour by machines, to deforest vast areas of the planet, to exploit low-wage populations in the Third World — all raise precisely the social issue of the *ways* in which technology is used."[47]

To my mind, the non-neutrality of technoscience arises neither out of some imaginary autonomy of technoscience, nor out of a supposed division between ends and means and the implied truth that technoscience is a good tool that has fallen into bad hands. The idea of the autonomy of technoscience leads to crude forms of determinism according to which the state of technology (of productive forces) determines at any moment of time the form of social organisation by conditioning directly production relations and indirectly the organisation of the economy and the superstructure. On the other hand, the idea that technology has fallen into bad hands, because bad people divert it from its true ends leads to an illusion that the 'ends' can be separated from the 'means'. But, ends and means are integral parts of the dominant social paradigm which determines choices, criteria and priorities. It is in this sense that technoscience is neither neutral nor autonomous. It is also because of the heteronomous character of technoscience in the above sense that we may hope that in an inclusive democracy the dominant social paradigm would contain a radically different set of values which will prescribe a correspondingly different, democratic science and technology.

Therefore, a democratic conception of technoscience has to avoid both types of determinism: *technological* determinism as well as *social* determinism. According to the

former, which is usually adopted in rather crude versions of Marxism, technology determines society. On the other hand, according to the latter, society determines technology; this is the type of determinism under which, as David Pepper points out, "technologies as disparate as the Davy miners' lamp, green revolution agriculture and Information Technology were developed by capitalist business and industry specifically to serve the interests of capital accumulation, as if they would not have developed in a non–capitalist society."[48] I think that the only way to avoid these two types of determinism is, as I attempted to show above, to view technology as an integral part of a totality consisting of the power relations implied by the concrete socio–economic institutions and the dominant social paradigm. However, the dominant social paradigm should not be seen as determined narrowly by ownership and the corresponding control of economic institutions, as Marxists usually do. The system of values that characterise the dominant social paradigm of a growth economy, either of the capitalist or the 'socialist' type, is very similar, despite the differences in economic and social institutions involved and the consequent differences in power structures.

In conclusion, the non–neutral and heteronomous character of technoscience today arises out of the fundamental organisational principles that characterise the growth economy and the values implied by the dominant social paradigm which is associated with it.

The Non–Democratic Nature of Technoscience

To talk about the democratic or oligarchic character of technoscience we have to examine the degree of control that citizens exert over its content. If we accept the hypothesis made above that technoscience is neither neutral nor autonomous and that its nature is crucially conditioned by the power relations implied by the existing institutional framework and the dominant social paradigm associated with it, then we may assume that technoscience is not democratic. The high degree of concentration of power characterising today's society implies an oligarchic control over technoscience that is manifested in its content, which, in turn, expresses the existing power relations and the dominant social paradigm.

The concentration of economic power in the hands of the élites that control the economic process in a market economy has been the inevitable consequence of the pursuit of profit through maximising efficiency and the size of the market. It can be shown, as it has been confirmed by a recent study, that "there is a robust positive relationship between industry profitability and market concentration."[49] This is an indication that the pursuit of profit by those controlling the market economy does lead to concentration. At an early

stage of marketization, the concentration of economic power was the outcome of the 'massification' of production, namely, the concentration of the production process in big production units that secured 'economies of scale' and economic efficiency. Today, capitalist companies, to survive competition in the internationalised market economy, have to "produce small quantities of high quality, semi–customised goods tailored to niche markets, thereby displacing economies of scale as the central dynamic of competition."[50] Thus, nowadays, the concentration of economic power coincides with a parallel process of 'de–massification' of production and diversification, which is consistent with the requirements of the post–industrial society and modern technology. However, this 'de–massification' of production, although it may influence the size of production unit, certainly does not affect the degree of concentration of economic power at the company level. This is indicated, for instance, by the fact that the top 500 trans–national corporations (TNCs) control today two–thirds of world trade (40 percent of it carried out *within* TNCs) and that, excepting South Korea, all of them are headquartered in the North.[51]

Thus, contrary to the view held by classical, as well as some contemporary, anarchists,[52] in their effort to show that there are *natural* tendencies leading to a decentralised anarchist society (a similar claim is made today with respect to bio-regionalism by its advocates), it can be shown that there is a long-term market trend leading to the continual concentration of economic power even when this trend is accompanied by a simultaneous physical decentralisation of the production process, as is the case today. This increasing concentration can be shown at both the inter-country, macro-economic level and at the inter-company, micro-economic level.[53]

Concentration of economic power does not, of course, constitute a new phenomenon. In all hierarchical societies, some concentration of wealth has always accompanied the concentration of political and military power in the hands of the various élites — a fact usually 'justified' through a system of social rules based upon religion. The new element in the growth economy is the fact that the reproduction of the social system itself, as well as of the power of the élite controlling it, crucially depends on the realisation of the growth objective, which, in turn, is `justified' through its identification with Progress. So, economic growth functions not just as a fundamental social and economic goal, but also as a basic means to reproduce the structures of unequal distribution of economic and political power which characterise the modern hierarchical society, as well as a central element of the ideology that supports it. Therefore, the hierarchical society took a new form with the rise of the market economy in the West and of the planned economy in the East. In this new form, the élite draws its power not only (as in the past) from the concentration of political, military, or, in general, social power, but, primarily, from the concentration of

economic power, whether this concentration is brought about by the market mechanism, or through central planning.

It must be stressed, however, that concentration and ecological disintegration do not simply constitute *consequences* of the establishment of the growth economy, but also *fundamental pre-conditions* for its reproduction. Contrary to the under-consumptionist 'civil societarians', who hope that the élites of the Triad (NAFTA, European Union, Far East), facing the threat of an inadequate demand because of growing inequality, will be induced to introduce a world mixed economy,[54] it in fact seems that the opposite is the case. The growth economy in the North, far from being threatened by the growing inequality of the present internationalised market economy, it, instead, depends on it. Thus, just as the production of the growth economy is not possible without the plundering of nature, its physical reproduction is equally impossible without the further concentration of economic power.

It is therefore obvious that the present concentration of economic, political and social power in the hands of the élites that control the growth economy is not simply a cultural phenomenon that can be accounted for by the values established by the industrial revolution, as significant currents within the ecological movement naively believe. So, the realisation of ecological balance is not just a matter of changes in value-systems (abandonment of the growth logic and consumerism), which would then lead to an eco-friendly way of living. In fact, the concentration of power constitutes the inevitable outcome of a historical process that started with the establishment of hierarchical social structures and the implied ideology of domination of human over human and nature[55] and culminated in the last two centuries with the development of the market economy and its by-product the growth economy.

The market/growth economy and concentration of economic power are opposite sides of the same coin. This means that neither the concentration of economic power nor the ecological implications of the growth economy are avoidable within the present institutional framework of the internationalised market/growth economy. But, on the other hand, the increase in the concentration of economic power leads to the realisation that Progress, in the sense of improvements in welfare through growth, has a necessarily *non-universal* character.

So, given the oligarchic control over technoscience that inevitably follows the concentration of power implied by the market/growth economy, the question is whether there are any inherent characteristics in science and technology which influence their democratic or oligarchic nature. As regards, first, science, one may argue that from the

democratic viewpoint, the essence of science lies not in its content, although of course natural sciences, by fostering a secular approach to reality, played a significant liberatory role in subverting religious and metaphysical beliefs. Thus, it may be argued that the essence of science lies in the constant questioning of truths, that is, in the procedures it uses to derive its truths. Therefore, science, although from the point of view of its content (as well as its technological applications) may enhance either autonomy or heteronomy (mainly the latter, given the usual heteronomous institution of society which conditions the development of science), from the point of view of the procedures used, it has historically been an expression of autonomy. In other words, the very fact that science constantly searches for new truths to replace old ones and does not accept any permanent truths is an indication of its democratic character. This is because of the crucial difference regarding the procedures used by scientists in deriving scientific 'truths', versus the methods used by prophets, church fathers and gurus of various sorts to create beliefs, dogmas, mystical 'truths', etcetera. The very fact that the scientific procedures of finding and assessing 'truths' have so drastically changed over time is a clear indication of the democratic nature of the scientific method. Scientific 'truths', as well as the procedures used to derive them, unlike mystical, intuitional, and irrational 'truths' and procedures in general, are subject to constant questioning and critical assessment.

By the same token, the fact that autonomy is not an 'individual' affair and it is "decisively conditioned by the institution of society"[56] implies that the project of autonomy can only be realised through the autonomous activity of the people within a process of creating social institutions that make autonomous thinking possible, and not through some kind of spiritual process of 'self–realisation', as deep ecologists,[57] for instance, suggest. In fact, such a process of self–realisation could only enhance privacy and the withdrawal from the social process that institutes society. A hierarchical society based on the domination of human over human could perfectly survive the self-transformation (usually of its middle classes) in the form of Mahayana Buddhism's enlightenment or reborn Christianism. It is not accidental, anyway, that the self-transformation of millions of Americans and West Europeans along these lines in the past decade was fully compatible with one of the most vicious economic attacks by the ruling élites in the form of neoliberal policies (Reaganomics, Thatcherism, etc.).

However, despite the fact that scientific search, by itself, is democratic, it is obvious that a democratic science, from the point of view of content and control over it, is impossible in the context of the power relations and the social paradigm which is dominant in today's oligarchic society. The non–neutral and overall heteronomous nature of today's science precludes a truly democratic science.

But, let us turn now to the question of how democratic today's technology is. The first question that arises here is how we should define a democratic technology. From what was said above about science it is obvious that the criterion suggested here to classify a set of techniques as democratic is who controls the process that determines not the available technology, which as we have seen above is an uncontrollable process, but the actual technology in use. There is little doubt, in the light of the above analysis, that the process which determines the actual technology in use is crucially conditioned by the power structures implied by the existing institutional framework and the corresponding dominant social paradigm. Therefore, given the present concentration of power, the actual technology in use is decisively controlled by the élites controlling the market economy and, as such, it is not democratic.

The criterion introduced above in defining democratic technology is different from the usual criteria used for this purpose. Lewis Mumford, for instance, distinguishes between authoritarian and democratic technics as follows:

> From late Neolithic times in the Near East, right down to our own day, two technologies have recurrently existed side by side: one authoritarian, the other democratic, the first system–centred, immensely powerful, but inherently unstable, the other man–centred, relatively weak but resourceful and durable (...) what I would call democratic technics is the small scale method of production, resting mainly on human skill and animal energy but always, even when employing machines, remaining under the active direction of the craftsman or the farmer.[58]

He then argues that authoritarian technics is a much more recent phenomenon which emerges around the fourth millennium. The new centralised technics was resting on ruthless physical coercion, forced labour and slavery and created complex human machines —the work army, the military army, the bureaucracy. Authoritarian technics has come back today, according to Mumford, in an immensely magnified and adroitly perfected form where "the inventors of nuclear bombs, space rockets, and computers are the pyramid builders of our own age (...) through mechanisation, automation, cybernetic direction, this authoritarian technics has at last successfully overcome its most serious weakness: its original dependence upon resistant, sometimes actively disobedient servo–mechanisms.[59]

It is therefore obvious that, for Mumford, the main characteristic which differentiates between democratic and authoritarian techniques is scale. But, although it is true that small scale is inherent in historical forms of democratic technics (and vice versa as regards the historical forms of authoritarian technics), still, scale should not be the criterion of distinguishing between the two types of technology. If craftsmen in ancient or feudal times were relatively independent and at the same time were able, in the context of small scale production, to control the production process and their own product, this was not the result of a democratic form of social organisation, either at the political or the economic level, but of the fact that the production process in pre–market economy systems did not require mass–scale production and the factory system. The two main characteristics of a market economy, marketization and growth, were missing in those systems and made democratic technics 'objectively' possible. Whether at any moment of time the objectively possible democratic technology was discarded in favour of authoritarian techniques, this was usually determined by either such objective, but non–economic, factors as climate, geology and so on, or by 'subjective' factors like the aims of the élite monopolising power (pyramid building, etc.).

It was in fact, the introduction of the factory system during the Industrial Revolution that marked the transition to a situation that made authoritarian technics 'objectively' possible in the sense that the reproduction of the market/growth economy that emerged at the same time was no longer compatible with democratic techniques. However, it was not the change in values, as it is argued by deep ecologists and others, that was to blame for the introduction of the factory system, the mass–scale production, the factory system, etcetera. It was the 'nationalisation' of the market and the 'marketization' of labour and land through state action, as I tried to show elsewhere,[60] which made the factory system, mass scale production, and authoritarian technology both feasible and desirable. In this context, the merchants' drive to efficiency was bound to lead them, as Sidney Pollard points out, "to seek new ways of production, imposing their own managerial achievements and practices in the productive sector," making the introduction of the factory system a matter of discipline "so that workers could be effectively controlled under the supervision of foremen."[61] So, marketization and growth and their effects in the agricultural sector (enclosures) and the industrial sector (factories) led to a situation where as Christopher Hill observed, "what was lost by factories and enclosures was the independence, variety and freedom which small producers had enjoyed."[62]

If the above analysis is valid, then, we do not have to abolish medium– or even large–scale production in a future inclusive democracy —a move that would, for instance, imply the abandoning of today's medical technology. Despite the shortcomings of modern medicine, with its non–holistic approach and neglect for preventive methods,

few would deny the significance of, for instance, modern techniques in restoring the sight for millions of people, not to mention orthopaedic microsurgery, etcetera.

The emphasis on the scale of production in defining democratic technology focuses the discussion on technical and organisational aspects of production rather than on the power relations and structures on which technology is really based. Not surprisingly, Schumaher's thesis in favour of small–scale technology[63] also lacks any significant social content by not focusing on the relation of technology to domination, exploitation, bureaucratic control, racism, sexism and militarism. As some well–known eco–Marxists rightly argue, "Schumacher's focus is on the technical consequences of production with little attention to the social and economic conditions which mandate the introduction and deployment of technology."[64]

The marginalization of the 'alternative technology' movement, which also focuses on the technical and organisational aspects of production, is another illustration of why social movements, which do not see technology embedded in the power relations and structures implied by the institutional framework and the dominant social paradigm, are bound to fail. Thus, ecocentrics, who see humankind as part of a global ecosystem subject to ecological laws, are in favour of 'alternative' technologies, that is, decentralised, small–scale technologies using renewable energy. Furthermore, it is interesting to note that their thesis in favour of alternative technologies is based not just on environmental considerations but also on 'democratic' ones. They therefore advocate alternative technologies "because they are potentially democratic (in the sense) that they can be owned, understood, maintained and used by individuals and groups with little economic or political power, unlike high technology."[65] However, it is obvious that their argument ignores the fact that democracy is not just a procedure but a way of social, economic and political organisation,[66] and that therefore technology cannot be separated from the dominant social paradigm implied by the concrete organisation of society.

So, the encouragement of alternative technologies within the existing socio–economic structure not only is not going to make it more democratic, let alone bring about an ecological society, but, as the experience of the alternative technology movement has already shown, it is more likely to lead to the marginalisation of such techniques. This is particularly so with respect to alternative technologies that are incompatible with the logic and the dynamic of the internationalised market economy. On the other hand, as regards those alternative technologies which are compatible with the market economy, they simply tend to complement rather than challenge existing technologies and social relations, as David Pepper rightly stresses:

> Today, the Intermediate Technology Development Group, founded by Schumacher in 1966, may well be realising the worst fears of some ecocentrics (...) it often operates mainly in a context where this kind of development merely complements rather than replaces, large–scale, capital–intensive development funded from outside and subject to Western influence and control (...) the intermediate technology component, then, is not part of radically different communitarian social relations, but mostly provides the seed bed for complementary small–scale capitalism, from which large–scale capitalism tends to grow: part of the problem rather than the cure. [67]

In conclusion, the democratic, or alternatively, authoritarian nature of tecnology is not the outcome of some inherent characteristics of technology but of the power relations implied by the existing socio–economic framework and the associated social dominant paradigm.

Science and Technology in an Inclusive Democracy

I would like to close this article with a few thoughts about the significance and nature of science and technology in an inclusive democracy. The danger, even to the present type of 'democracy', because of the spreading of authoritarian technics, were clearly stressed by Lewis Mumford:

> The danger to democracy does not spring from any specific scientific discoveries (...) the danger springs from the fact that since Francis Bacon and Galileo (...) our great physical transformations have been effected by a system that deliberately eliminates the whole human personality (...) overplays the role of the abstract intelligence and makes control over physical nature, ultimately control over man himself the chief purpose of existence. (...) Once our authoritarian technics consolidates its powers, with the aid of its new forms of mass controls, its panoply of tranquillisers and sedatives and aphrodisiacs, could democracy in any form survive?[68]

However, Mumford was talking about the inherent characteristics of technology in relation to the technical and organisational aspects of production and not about the general nature and direction of technology which, as we have seen, is crucially conditioned by the power relations and structures in society and the dominant social paradigm. But, it is the general direction and nature of technology that determines the technical and organisational characteristics of production and not vice versa. Therefore, what is needed in an inclusive democracy is the reconstitution of both our science and technology in a way that puts at the centre of every stage in the process, in every single

technique, human personality and its needs rather than, as at present, the values and needs of those controlling the market/growth economy. This presupposes a new form of socio–economic organisation in which citizens, both as producers and as consumers, do control effectively the types of technologies adopted, expressing the general rather than, as at present, the partial interest.

An important implication of democratisation of the technoscience in the above sense is that such a process has nothing to do with the currently fashionable 'access to information' that the modern information technology supposedly secures. As Herbert Schiller[69] points out, "historically and currently, the free flow of information is a myth. Selectors and controllers continue, as they always have, to sift and shape the messages that circulate in society. It is always a matter of who the selectors are and whom they represent. And this is an area in which social class is in control." Also, as Langdon Winner stresses,[70] current empirical studies, far from confirming the hypothesis that power is spread through the proliferation of information technology, lead to the opposite conclusion: information technology leads to an increase in power by those who already have a great deal of power, an enhanced centralisation of control by those already in control, and an augmentation of wealth by the already wealthy.

The conclusions of Schiller and Winner are not of course unexpected. Although citizens' access to information is an important element of an inclusive democracy, this requirement refers to information relating to political and economic decision–taking and not just to the endless manipulation of, at best, "enormous quantities of data manipulated by electronic media, used to facilitate the transactions of large, complex organisations,"[71] or, at worst, the manipulation of frequently irrelevant and useless data. In other words, there is no automatic link between knowledge, particularly the 'knowledge' manipulated by information technology, and power in a social or political sense.

Similarly, the democratisation of science and technology should not be related to a utopian abolition of division of labour and specialisation as, for instance, Thomas Simon suggests. For Simon, democratising technology means abolishing professionals and experts: "the extent to which a professional/expert is no longer needed is partially the extent to which a process has become democratised. It is the extent to which we are able to make the professional terrain a deliberative assembly."[72] But, although it is true that the present extreme specialisation and division of labour has been necessitated by the needs of 'efficiency' which are imposed by the dynamics of the growth economy, still, there are certain definite limits on the degree of reduction in specialisation which is feasible and desirable if we do not wish to see the re–emergence of problems that have

been solved long ago (medical problems, problems of sanitation, etc.). This leads to the question of which parts of existing technology (if any) should remain in an inclusive democracy and to the related issue of choice.

Choice is a necessary element of an inclusive democracy in general and of an economic democracy in particular. In fact, an inclusive democracy should restore the possibility of technological choice. As Jacques Ellul argues:

> The existence of choice appears to have been one of the most important historical factors governing technical evolution and revolution. Evolution was not, then, a logic of discovery or an inevitable progression of techniques. It was an interaction of technical effectiveness and effective human decision (...) (today) technique has become objective and is transmitted like a physical thing; it leads thereby to a unity of civilisation, regardless of the environment of the country in which it operates. We are faced with the exact opposite of the traits previously in force.[73]

I have outlined elsewhere[74] a model of economic democracy which aims at meeting the basic needs of all citizens and securing freedom of choice in a marketless, moneyless and stateless 'scarcity society'. In an inclusive democracy there would be real choice of technology based on the decisions of citizens' assemblies and not just what Ellul describes as 'technical automatism'. It is obvious that the change in the aims of the economic system, which would be brought about by the introduction of economic democracy, would be embodied in the technologies that would be adopted by the community and workplace. This does not exclude the possibility that the technologies adopted by citizens' assemblies might contain parts of the existing technology, provided that they are compatible with the primary aims of a confederal inclusive democracy.

Thus, as regards agricultural techniques, one may argue that the 'green revolution' technology should not be part of the technology that an inclusive democracy will adopt. Not only because the green revolution technology has been associated with intensive agriculture and all that it implies, that is, destruction of the environment, damage to human and animal health and so on. But, also, because, as George Bradford stresses, the green revolution destroyed subsistence as well as culture:

> The green revolution, which was to revolutionise agriculture in the 'backward' countries and produce greater crop yields, has only been a miracle for the banks, corporations and military dictatorships who defend them. The influx of fertilisers, technology, insecticides and bureaucratic administration exploded millennia–old rural economies based on subsistence farming, creating a class of wealthier farmers dependent upon western technologies to produce cash crops such as

> coffee, cotton and wheat for export, while the vast majority of farming communities were destroyed by capitalist market competition and sent like refugees into the growing cities.[75]

Similarly, as regards industrial techniques, all those techniques that are detrimental to the environment and life, including all those techniques that are alienating their users, should not be adopted by an inclusive democracy, even if they are 'efficient' according to the usual definitions of economic efficiency given by technocrats. Still, it is not industry per se that has to go, as some naive greens argue, but the present type of industry which, as we have seen above, is an integral part of the growth economy (capitalist or 'socialist'). Therefore, the choice involved here is not just a choice of culture, as deep ecologists and others suggest, but a choice of socio–economic systems, as well as of culture: an oligarchic and hierarchical society based on a capitalist or 'socialist' growth economy and the associated social paradigm versus a democratic society grounded on an inclusive democracy and a democratic paradigm.

In a dynamic, economic democracy, investment in technological innovations, as well as on research and technological development in general, should constitute a main part of the deliberations of the confederated community assemblies. The advice of workplace assemblies, as well as that of consumers' associations, would obviously play a crucial role in the decision–taking process. Therefore, far from leading to stagnation, the democratisation of technology would have the opposite effect. As Ellul stresses, whenever effective human decision was lacking, the inevitable result was social and human stagnation. This was the case in the defunct 'socialist' growth economy of the East, where bureaucracy and central planning stifled any spontaneity and personal creativity and eventually led to a technological backwardness which precipitated the collapse of this type of growth economy.[76] But, it is also the case in the capitalist growth economy, which, although characterised by a higher degree of flexibility than its 'socialist' counterpart, it is still "incapable of absorbing technical progress; the replacement of machines at the tempo of technical invention is completely impossible for capitalist enterprise because there is no time to amortise one machine before new ones appear (...) the reaction of capitalism is well known: the patents of new machines are acquired and the machines are never put into operation."[77]

An important by–product of democratising technology would be the restoration of its non–homogeneous character, that is, its differentiation according to the local environment. This would be a very significant step not only in reintegrating man and nature but also in allowing local cultures (as well as the respective communities) to

flourish at a moment when they are being phased out under the heavy hand of ubiquitous, homogenised technology.

However, it should be made clear that the nature of the technology to be adopted by a democratic society does not just depend on who owns it, or even on who controls it. Not only, as History has shown, it is perfectly possible that 'socialist' bureaucrats may adopt techniques which are as environmentally destructive and life–damaging (if not more) as those adopted by their capitalist counterparts, but also the possibility can not be ruled out that citizens' assemblies may adopt similar techniques. So, the abolition of oligarchic ownership and control over technology, which would come about in a marketless, moneyless, stateless economy based on an inclusive democracy, is only the necessary institutional condition for an alternative pro–life and pro–nature technology. The sufficient condition depends, as always, on the value system that a democratic society would develop and the level of consciousness of its citizens. One therefore can only hope that the change in the institutional framework together with a democratic *Paedeia* (which is not just education but character development and a well rounded education in knowledge and skills, i.e. the education of the individual as citizen) would play a crucial role in the formation of this new system of values and the raising of the level of consciousness. However, at the end, as Castoriadis points out, the question of the direction of science remains unresolved: "a truly democratic society, rid of all economic, political and other sorts of oligarchies, would still collide into this question just as hard [since] (...) in greco–western history, the creation of freedom is indissociable from the emergence of questioning and rational research." [78]

Finally, a democratic (or liberatory) technology does not presuppose a post–scarcity economy as dialecticians, from Marx to Bookchin, believe. There is no 'objective quantitative basis' for a liberatory society or any material preconditions for freedom.[79] Marx believed that humanity would pass from the realm of necessity to the realm of freedom by way of the rational, socially responsible application of the advanced technology created by capitalism. But, technology as such does not have an inherent potentiality toward a liberatory society in the sense that it drastically reduces toil, leading from the realm of necessity to the realm of freedom. The essence of a liberatory technology is not its 'objective' character but the subjective meaning assigned to it by a democratic society.

In fact, the advancement of technology has not reduced the workload. Where labour markets have been 'freed', people (those who can find work) work more! In the United States and the United Kingdom, flexible markets mean today longer hours than 15 years ago,[80] indicating that it is not technology itself that reduces or increases toil but the

socio–economic organisation. High technology as such can be as liberatory as oppressive, and it is not just who uses it that determines its nature but the power relations implied by the socio–economic institutions and the corresponding social dominant paradigm which do so. A liberatory, democratic technology would be the by–product of a new liberatory project, and such a project does not presuppose a post–scarcity society. The view that a liberatory technology could only be founded on a post–scarcity society presupposes an idea of Progress which is inconsistent both with the democratic principle that there are no 'laws' (social or natural) which 'in the last instance' determine social change, as well as with historical evidence. From a democratic viewpoint, the distinction between one technology for the realm of necessity (a scarcity society) and one for the realm of freedom (a post–scarcity society) not only does not make any sense but also, in effect, rules out the possibility of a liberatory technology itself, since a post–scarcity society is simply a myth, particularly if we take into account the ecological constraints of economic growth.

To sum it up, a democratic science and technology presupposes:

first, a political democracy, so that effective citizen control on scientific research and technological innovation can be established;

- second, economic democracy, so that the general economic interest of the confederated communities, rather than the partial interests of economic élites, could be effectively expressed in research and technological development;
- third, ecological democracy, so that the environmental implications of science and technology are really taken into account in scientific research and technological development; and last, but not least,
- democracy in the social realm, that is, equal sharing in the decision–taking process at the factory, the office, the household, the laboratory and so on, so that the abolition of hierarchical structures in production, research and technological development would secure not only the democratic content of science and technology but also democratic procedures in scientific and technological development and collective control by scientists and technologists.

In other words, a democratic science and technology presupposes an inclusive democracy.

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[1] *See*, e.g., Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1970); Imre Lakatos, *Criticism and the Growth of Knowledge* (Cambridge: Cambridge University Press,

1970); Paul Feyerabend, *Against Method* (London: Verso, 1975); and Derek Phillips, *Abandoning Method* (London: Jossey–Bass, 1973).
[2] *See,* for instance, Herbert Marcuse, *One Dimensional Man* (London: Sphere books, 1968); and Murray Bookchin, *Post–Scarcity Anarchism* (London: Wildwood House, 1974).
[3] Takis Fotopoulos, *Towards an Inclusive Democracy* (London & New York: Cassell, 1997), Ch. 2.
[4] On the crisis in economic methodology in particular, *see*, e.g., Daniel Bell & Irving Kristol, *The Crisis in Economic Theory* (New York: Basic Books, 1981); Ken Kole et al., *Why Economists Disagree* (London & New York: Longman, 1983); Homa Katouzian, *Ideology and Method in Economics* (London: Macmillan, 1980); and T. W. Hutchinson, *Knowledge and Ignorance in Economics* (Oxford: Blackwell, 1977).
[5] For an extensive bibliography on this subject, *see* Takis Fotopoulos, *Towards an Inclusive Democracy,* Ch. 8.
[6] Cornelius Castoriadis, "The Era of Generalised Conformism," lecture given at Boston University on 19 June 1989 in a symposium under the general title "A Metaphor for Our Times."
[7] Madeleine Bunting, "Shopping for God," *The Guardian* (16 Dec. 1996). In fact, some ex–leftists exploit the New Age boom to establish lucrative tourist businesses, as for example New Age UK magazine *Eye to Eye* whose editor, Yannis Andrikopoulos, has set up a profitable New Age business combining the teaching of 'alternative life–styles' with tourism in the islands of Greece and the Caribbean where people like film director Ken Russell and the writers Marina Warner, Sue Townsend, Alison Lurie and others teach relevant courses.
[8] Takis Fotopoulos, *Towards an Inclusive Democracy,* Chapt. 8.
[9] In fact, one may argue that historically this has always been the case. As regards, for instance, classical Greece, Murray Bookchin argues that "Hellenic thought, which appropriately linked craft and art under the rubric of *techne*, also linked both with the value systems and institutions of society (...) techne was conceived holistically, in the sense that we today describe an ecosystem. Skills, devices, and raw materials were interlinked in various degrees with the rational, ethical and institutional ensemble that underpins a society; insofar as techne was concerned, all were regarded as an integrated whole"; Murray Bookchin, *The Ecology of Freedom* (Montreal: Black Rose Books, 1991), p. 223.
[10] Cornelius Castoriadis, *Philosophy, Politics, Autonomy* (Oxford: Oxford University Press, 1991), p. 184.
[11] Adam Smith, *The Wealth of Nations* (London: Harmondsworth, 1970), p. 104.
[12] As Sean Sayers observes, drawing from Marx's *Capital*, Vol. 3, and *Grundrisse*, "Marx regards the immense expansion of production to which capitalism has led as its progressive and 'civilising' aspect"; Sean Sayers, "Moral Values and Progress," *New Left Review*, No. 204 (Mar.–Apr. 1994), pp. 67–85.
[13] John Grahl in the *New Left Review,* No. 214 (Nov.–Dec. 1995), p. 155, referring to the study by Elman Altvater*, The Future of the Market* (London: Verso, 1993).
[14] Leon Trotsky, *The Revolution Betrayed* (New York: Merit, 1965), p. 45.
[15] *See* James O'Connor, "Capitalism, Nature, Socialism," *Society and Nature*, Vol. 1, No. 2, (1992), pp. 174–202.
[16] For a critique of the neutrality of the technology thesis, *see* Cornelius Castoriadis, *Philosophy, Politics, Autonomy*, p. 192. See also Frances Stewart's study, which shows that the way in which technological choices are made in practice is anything but 'neutral'; Frances Stewart, *Technology and Underdevelopment* (London: Macmillan, 1978), Ch. 1.
[17] Carolyn Merchant, in *Questioning Technology: Tool, Toy or Tyrant?* John Zerzan & Alice Carnes, eds. (Philadelphia, Pennsylvania: New Society Publishers, 1991), p. 36.
[18] Henry Teune, *Growth* (London: Sage, 1988), p. 13.
[19] Takis Fotopoulos, *Towards an Inclusive Democracy,* pp. 7–14.

[20] Roy Morrison, *Ecological Democracy* (Boston: South End Press, 1995), p. 25.
[21] Roy Morrison, *Ecological Democracy*, pp. 8–9.
[22] Roy Morrison, *Ecological Democracy,* p. 25.
[23] Roy Morrison, *Ecological Democracy*, p. 9.
[24] *See* Janet Biehl's book review in *Green Perspectives*, No. 36 (Feb. 1996), p. 8, of Kirkpatrick Sale, *Rebels Against the Future: The Luddites and Their War on the Industrial Revolution: Lessons for the Computer Age* (Reading, Massachusetts: Addison–Wesley, 1995).
[25] Takis Fotopoulos, *Towards an Inclusive Democracy,* Chapt. 2.
[26] *See*, for instance, John M. Gowdy, "Progress and Environmental Sustainability," *Environmental Ethics,* Vol. 16, No. 1 (Spring 1994).
[27] Ian Reinecke, in *Questioning Technology,* John Zerzan & Alice Carnes, eds., pp. 214–15.
[28] Takis Fotopoulos, *Towards an Inclusive Democracy,* pp. 33–46.
[29] Stephanie Pain, "When the Price Is Wrong," *The Guardian* (27 Feb. 1997).
[30] Takis Fotopoulos, *Towards an Inclusive Democracy*, pp. 340–42.
[31] *The Ecologist*, Vol. 22, No. 4 (July–August 1992), pp. 157–58.
[32] Stephanie Pain, "When the Price Is Wrong."
[33] Polly Ghazi, *The Observer* (10 March 1997).
[34] David Watson, *Beyond Bookchin* (New York: Fifth Estate, 1996), p. 119–20.
[35] Murray Bookchin, *The Ecology of Freedom*, p. 246.
[36] Michael Shallis, in *Questioning Technology,* p. 31.
[37] According to World Bank data, in 1994, urban population constituted 45 percent of the world population. But, in 'middle income economies' urban population was 61 percent of the total and in 'high income economies' it was 77 percent! World Bank, *World Development Report 1996* (Oxford University Press), table 9.
[38] Frances Stewart, *Technology and Underdevelopment*, p. 3.
[39] Frances Stewart, *Technology and Underdevelopment,* p. 3.
[40] Frances Stewart, *Technology and Underdevelopment,* p. 22.
[41] Frances Stewart, *Technology and Underdevelopment,* p. 87.
[42] Murray Bookchin, *Re–Enchanting Humanity,* p. 155.
[43] Cornelius Castoriadis, *Philosophy, Politics, Autonomy*, pp. 250–51 & 255.
[44] Cornelius Castoriadis, *Philosophy, Politics, Autonomy,* p. 271.
[45] Cornelius Castoriadis, *Philosophy, Politics, Autonomy*, Chapt. 10.
[46] Murray Bookchin, *Re–Enchanting Humanity* (London: Cassell, 1995), pp. 154–56.
[47] Murray Bookchin, *Re–Enchanting Humanity,* p. 157.
[48] David Pepper, *Modern Environmentalism* (London: Routledge, 1996), p. 93.
[49] Martin J. Conyon, "Industry Profit Margins and Concentration: Evidence from UK Manufacturing," *International Review of Applied Economics,* Vol. 9, No. 3 (1995), p. 288.
[50] P. Nolan and K. O'Donnell "Restructuring and the Politics of Industrial Renewal: The Limits of Flexible Specialisation," in *Farewell to Flexibility?*, A. Pollert. ed. (Oxford: Blackwell, 1991), p. 161.
[51] Tim Lang and Colin Hines, *The New Protectionism: Protecting the Future Against Free Trade* (London: Earthscan, 1993), p. 34.
[52] *See,* e.g., Petr Kropotkin, *Fields, Factories and Workshops Tomorrow* (London: Hutchinson, 1899) and the additional data and comments by Colin Ward in the 1974 edition of the book (London: Allen & Unwin). *See* also Petr Kropotkin, *The Conquest of Bread* (London: Penguin, 1972), Chapt. 16.
[53] Takis Fotopoulos, *Towards an Inclusive Democracy,* pp. 67–73.

[54] Paul Hirst and Grahame Thompson, *Globalisation in Question* (Cambridge: Polity Press, 1996), p. 163.
[55] S*ee,* for instance, the work of Murray Bookchin and, in particular, his works *Remaking Society* (Montréal: Black Rose, 1990*), The Ecology of Freedom*, and *From Urbanization to Cities* (London: Cassell, 1992 & 1995).
[56] Cornelius Castoriadis, "The Crisis of Marxism and the Crisis of Politics," *Society and Nature*, Vol. 1, No. 2 (1992), p. 209.
[57] According to Naess, the father of deep ecology, "the higher the Self–realisation attained by anyone the broader and deeper the identification with others"; Arne Naess, *Ecology, Community and Lifestyle* (Massachusetts: Cambridge University Press, 1989), p. 196.
[58] Lewis Mumford, in *Questioning Technology*, pp. 14–15.
[59] Lewis Mumford, "Authoritarian and Democratic Technics," in *Questioning Technology,* p. 17.
[60] Takis Fotopoulos, *Towards an Inclusive Democracy*, pp. 10–14.
[61] John and Paula Zerzan quoting the historian N. S. B. Gras in *Questioning Technology*, p. 202.
[62] John and Paula Zerzan quoting Christopher Hill in *Questioning Technology*, p. 207.
[63] E. F. Schumacher, *Small Is Beautiful: Economics As If People Mattered* (London: Sphere Books, 1973).
[64] M. Goldman, James O'Connor et al., "Ideologies of Environmental Crisis: Technology and Its Discontents," *Capitalism, Nature, Socialism*, No. 1 (Fall 1988), p. 96.
[65] David Pepper, *Eco–Socialism* (London: Routledge, 1993), p. 33.
[66] *See* Cornelius Castoriadis, "La democratie comme procedure et comme regime," in *La Montee de l'insignificance, Les Carrefours du Labyrinthe IV* (Paris: Seuil, 1996), pp. 221–41.
[67] David Pepper, *Modern Environmentalism*, p. 97.
[68] Lewis Mumford, "Authoritarian and Democratic Technics," in *Questioning Technology,* pp. 18–19.
[69] Herbert I. Schiller, in *Questioning Technology*, p. 174.
[70] Langdon Winner, "Mythinformation," *Whole Earth Review* (Jan. 1985), in *Questioning Technology*, p. 165.
[71] Langdon Winner, "Mythinformation," pp. 166–67.
[72] Thomas W. Simon, "Beyond Technological Things," in *Renewing the Earth,* John Clark, ed. (London: Greenprint, 1990), p. 112.
[73] Jacques Ellul, in *Questioning Technology*, pp. 41–42.
[74] *See* Takis Fotopoulos, "Outline of an Economic Model for an Inclusive Democracy," *Democracy and Nature*, Vol. 3, No. 3 (1997), pp. 21–56; *see* also Takis Fotopoulos, *Towards an Inclusive Democracy*, Chapt. 6.
[75] George Bradford, in *Questioning Technology*, p. 48.
[76] Takis Fotopoulos, *Towards an Inclusive Democracy,* pp. 73–85.
[77] Jacques Ellul, in *Questioning Technology*, p. 45.
[78] Cornelius Castoriadis, *Philosophy, Politics, Autonomy*, pp. 245–46.
[79] Takis Fotopoulos, *Towards an Inclusive Democracy,* pp. 197–99.
[80] *See*, for instance, S. Milne, *The Guardian*, 24 Jan. 1995 and D. Brindle, *The Guardian*, 4 Nov. 1996.