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Balancing Social Demands with Technological Challenges
North-South Sustainable Development – What is at Stake?

Appropriate Technologies in a Globalizing World?

Prof. Dr Adrian Atkinson
Institute of Urban and Regional Planning, Technical University Berlin

e-mail: a.atkinson@isr.tu-berlin.de

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The Era of Appropriate Technology

The notion of 'appropriate technology' (AT) is universally seen as emanating from the writing and activities of the economist Fritz Schumacher. In fact, the term that Schumacher himself used was 'intermediate technology' and derived from visits he paid to India and Burma in the late 1950s and early 1960s in his capacity as senior economist to the British National Coal Board, invited to advise these governments. His insights grew from the observation that modern farm technologies lay well beyond the financial capacities and outside the common understanding of the average South Asian peasant. At the same time, he realised that the peasants could be helped to improve their circumstances through relatively simple technological improvements. This led him to the idea that eventually the Indian peasant might become a 'modern' citizen but that he needed to be helped via easy steps of improvement in productivity, supposing, inter alia, stepwise – hence 'intermediate' - improvements in technology. Besides lecturing and writing about this discovery, in 1965 Schumacher founded in the Intermediate Technology Development Group (ITDG) to develop and promote relevant technologies. This became – and even today remains – a key institution in the field.

Across the late 1960s and early 1970s, interest in the notion of AT grew rapidly and became associated with a movement, connecting into a much broader groundswell of radicalism associated with '1968', with its political and lifestyle critique[1]. On the one hand, AT – and related terms of alternative, radical and liberatory technology – became the focus of books, journals and centres in European and North America, critical of contemporary technical developments. On the other hand, along the path forged by Schumacher, attention was turned to the needs of southern countries in the context of development. Centres were founded in numbers of northern and southern countries and significant support began to flow from the full range of international and bilateral development agencies. An international coordination, TRANET, was established following a side event at the United Nations HABITAT conference in 1976 rather than aiming at the establishment of the basis for modern industrial development.

The focus of interest of the southern-oriented centres was mainly, if not overwhelmingly on aspects of rural development in the poorer countries. Thus improvements were developed in agricultural implements, in water pumping and decentralised energy provision and energy-

[1] Schumacher was himself a frequent contributor to the pages of the journal *Resurgence*, founded in 1964 as a voice of the emergent green and 'alternative' movement (North, 1976).

efficient stoves, simple improvements in house construction and sanitation. In so far as processing and production technologies were concerned, these were overwhelmingly aimed at incremental improvement in craft industries[2].

In 1984 the Intermediate Technology Development Group published *A Guide to Appropriate Technology Institutions*[3]. This listed with a brief profile, just under 40 centres and related institutions in 34 countries that had been founded over the previous 10 years to develop and promote AT. In fact an earlier publication of ITDG[4] has estimated that over a thousand institutions around the world were now focusing at least some attention on AT.

A search in the internet today reveals that very few of these institutions have survived or been replaced and those that have either merely maintained themselves at the level achieved by the mid-1980s or have moved substantially into other fields. AT seems to have withered on the vine. The following appeared in the course of an internet exchange in 1996 concerning the idea of AT:

> As a citizen of a developing country (Colombia) and also an admirer of Schumacher's "Small is beautiful" I find the concept of "technology appropriateness" today to be absolute nonsense… The use of all types of technologies has expanded all over the world. The creation of technologies however, is concentrating more and more since developed country corporations have come to dominate our development process. We lost via "appropriateness" this wave of technological change on key technologies. We can't catch up but must just get ready for the next wave to overtake us.[5]

This paper asks why so much effort should have come to so little. In fact, it must be stated at the outset that the paper asserts the importance of the movement that led to the establishment of these institutions and the way in which their demise has been part of deepening misdirection of technological development associated with the triumph of neoliberal ideology and practice and its associated postmodern condition.

Definitions and Debates

The word ‘technology’ is generally understood in the first instance to mean man-made objects and in particular tools and machines. I want to make clear at the outset that the term as used here – and as understood by the AT movement – is seen as a good deal more just such hardware. It is, rather, a particular focus from which to view and understand – and eventually influence - the broad processes of development both in the south *and* the north. It is incipiently in danger of being seen as a ‘technological determinist’ view of development (that development is primarily driven by technology). However, as long as the broader context in which technologies are implemented are adequately incorporated into the concept, then this can be a very useful perspective on what has been happening to our – increasingly global – society over the past century plus.

We should see technology as set within a wider framework on the one side of theory and the other of the praxis which makes technology effective. Thus if we look in the one direction from the concept of technology, we see science. If we look in the other direction we see technique. Today, science is understood as the theoretical basis upon which technologies are developed. Technique is the social and institutional context within which technologies

[2] Whilst a large number of books and pamphlets were produced, illustrating particular projects, see particularly Dunn (1978) for a good overview and selection of projects.
[3] Sinclair (1984)
[4] Whitcome and Carr (1982)
[5] Vicini (1996), edited

are developed and implemented. In this way, technologies can be understood as part of a continuum with no clear borders as these emerge from theoretical and cultural contexts and find their meaning and activity in social and political contexts.

Science

Three points need to be clarified regarding the understanding here of 'science'. The first is to note that there have always been difficulties in defining what science really is. For much of its history it was seen as a methodology for discovering the truth about nature (and, in the social sciences about society) involving a certain kind of mental discipline – 'objectivity' – which sets the observer apart from that which is being observed. It thus involves a deep belief on the one hand in the importance of pursuing the understanding of nature and on the other hand that in the end the basic structure of nature is simple and comprehensible. The former idea stems from the Christian belief that all of life is a progressive process (unlike other religions that believe that life processes are cyclical or adopt a fatalistic stance wherein history is of no importance) and that pursuit of science can contribute to the improvement of human life over time[6].

The second point is that in recent years the totemic idea of science as revealing absolute truth has come under considerable criticism[7]. At a theoretical level it has become apparent that scientific theories can explain the same 'facts' in different ways, via different 'paradigms', each of which has its usefulness. At the practical level it is apparent firstly that different scientific disciplines and niches find very different ways of explaining their subject matter that can be shown to conflict with explanations in other niches but which is effective for the activity to which it relates. And finally, the directions in which scientific enquiry goes depends on political priorities regarding what is wanted to be known for reasons of extending economic or political power. In short, science is socially and politically constructed and, in the final analysis there appears to be no ultimate truth upon which it comes to rest.

The third point is that in spite of the way in which science emerged in the 16th century (viz Francis Bacon and the 'Invisible College') around the idea that it could unlock the secrets of nature such as to make technological development more effective, in practice, it was only in the 19th century that this marriage succeeded, technological development in previous centuries having developed from artisanal inventiveness and skill[8]. Having said this, it remains clear that today the natural sciences do produce structural understanding that is an effective basis for the development of technology. The connection, both through the interconnection of relevant institutions and through the adoption by large private enterprises of research programmes, science has, indeed, become the handmaiden of technological development.

Technology

All that need be noted concerning technology is that it comprises not only the physical means of production – tools and machines and latterly automated production systems – but also artificial materials that have become increasingly important in the world of modern technology and, finally, the increasingly sophisticated consumption technologies with which we surround our daily lives.

[6] Atkinson (1991) Chapter 5
[7] Aronowitz (1988), Chubin and Chu (1989), Knorr-Cetina, Krohn and Whitley (1980), Latour (1987), Pickering (1992)
[8] Braverman (1974) Chapter 7; Derry and Williams (1970)

Technique

Nor does much have to be added to the concept of technique apart from emphasising its importance as the determining context in which technologies – and indeed scientific programmes - are created and effectively put to work. Thus it is on the one hand the ways in which materials are brought into the orbit of technological artefacts and transformed through these. And on the other, the operation, design and administrative arrangements through which technological artefacts are incorporated into ongoing political and social processes and influence the outcome of trajectories.

Appropriate Technology (AT)

The way in which the AT movement came into existence through the insight of Schumacher and his idea of 'intermediate technology' as a stepping stone to development was briefly described above. Although the institution he founded maintained the term 'intermediate', this soon gained a reputation of implying that developing countries could make do with the second best and by this means remain underdeveloped. The term 'appropriate' implied, rather, appropriate to particular situations and was seen less often as being associated with underdevelopment.

The issue then became: 'appropriate for what?' A large literature grew up around the movement offering many attempts at definition. In the first instance it seemed clear that: "An appropriate technology is a technology which is suited to the environment in which it is used[9]." Whilst, put in such a simple way, this could be said to be tautological this nevertheless asserted that technological development is not inevitably along any pre-defined route, but involves choices. Broadly speaking, these choices concern socio-cultural factors: what is appropriate in the context of particular cultural, subsuming social and economic, environments and what is appropriate in particular geographic and physical environments (not damaging to the environment).

Beyond simple definition, however, it becomes clear from the literature that the notion of freedom to choose technologies was associated with the desire to find new routes to technology development where 'technology' was seen as embedded in wider notions of alternative development paths. Many routes emerged and these spawned their own titles for the kinds of technologies these implied: alternative technology, utopian technology, eco-technology, humanized technology, community technology, village technology, liberatory technology, radical technology, soft technology and many others[10]. Before proceeding with the discussion of the issues of technology choice in a broader way, it is deemed useful to catch a glimpse of the more concerted and coherent manifestations of the technology movement(s) in the 1970s and how these tied into the aims and activities of other social movements of the times.

Liberatory Technology

The term 'liberatory technology' was coined by Murray Bookchin in an extended essay published in 1965[11]. Bookchin is an anarchist having broken away from the Marxist

[9] This is how Frances Stewart, one of the best-known analysts and promoters of appropriate technology, opened her introduction a compendium of writing concerning appropriate technology (Carr, 1985). The following sentence reads: "The idea that appropriate technology was often different from the technology actually being adopted was first conceived with reference to the Third World, but more recently it has been argued that in the advanced countries, too, much investment incorporates technologies which are inappropriate to long-term needs of the community."

[10] In the course of his research, Willoughby (1990, 17) discovered 18 such titles.

[11] Bookchin (1965)

movements of the 1950s and is seen as almost one of the founders of the green movement in the United States, having started writing on environmental topics already in the late 1950s. The particular stream of the movement that has grown out of his prolific writing and those of his followers is known as Social Ecology. The emphasis of this movement is its interest in the social and political structures necessary to be able to take environmentally sound decisions. It is therefore focused on decentralised political structures and necessarily also decentralised production processes and consumption patterns that require technologies compatible with these. Liberatory technology is not necessarily 'low tech' as is the case with AT for rural development in the South. But it does lead to radically different kinds of technologies than those which have been being developed in recent years, involving centralised mass production for global markets and the creation of dependencies through the sophistication of tools and machines offered to consumers.

Radical Technology

This term emerged out of debates in the social movements which arose around 1968 which resulted in a split away from orthodox Marxist groups that believed that the main problem of the day was to wrest control of the increasingly globalised capitalist world of production by the global socialist movement and that this would naturally lead to appropriate technologies. For the mainstream Marxist movement the issue was therefore irrelevant, or worse, reactionary (see discussion of Emmanuel below). In breaking away, a more anarchistic-inclined fragment focused attention on lifestyles that would bring control of technology back into local hands and which would be environmentally benign and promote human good-health. The movement was associated with a blossoming of the communes (alternative lifestyles) movement throughout Europe and the North America. In the UK the aspirations of the radical technology movement were best expressed through the journal *Undercurrents* with an anthology published under the title *Radical Technology*[12]. In the United States this was channelled through the publication of the *Whole Earth Catalogue.* In more recent years, in the face of their erstwhile ambitions to build a different world, the protagonists of radical technology became leading lights in the promotion on the one hand of organic agriculture and on the other of the implementation of renewable energy systems.

The Green Movement

As discussed further below, although the green movement which emerged from amongst the radical movements of '1968' did not in general focus on the issue of technology, nevertheless many of its concerns had a technological dimension and implied a critique of technology. In should be noted that major foci of attention in the early years, among others, were issues of appropriate approaches to agriculture and issues surrounding the use of energy. In the first case, the solution to problems of over-use of agricultural chemicals and the pollution this causes by advocating organic agriculture. Concern with energy was focused both on the critique of nuclear energy and its dangers on the one hand and on the use of fossil fuels on the other. Appropriate energy policies thus meant a reduction in the use of energy through conservation measures and ultimately lifestyle changes and through the development of renewable sources of energy. The latter concern was one which was taken up strongly by the AT movement focused on the South.

Debates and action in the context of development in the South

In fact Schumacher was by no means the first or only source of insights concerning the putative need for southern countries to develop their own technologies independent of the general development in technologies amongst the northern countries. Mahatma Ghandi was

[12] Boyle and Harper (1976)

particularly concerned that indigenous technologies be given far more weight in the Indian development process rather than pursing modernity along the lines initiated by the British as colonial masters. In the event a sharply dualised development path emerged in Indian. The government and major business interests pursued the industrialisation of the country to satisfy the needs of the modern sector (the urban middle and upper classes) through huge industrial complexes in Bombay, Kanpur, Singrauli and elsewhere. Meanwhile the development of appropriate technologies took off and has more or less continued to proliferate small organisations and initiatives concerned to develop incremental improvements in rural settings in a situation where the great majority of the population are still peasants in the countryside.

In Brazil, Celso Furtado, an academic economist who created the development agency for the (poor) north east of Brazil (SUDENE) and between 1962 and 1963 served as Minister of Planning prior to the advent of the military regime, in analysing the developmental problems of Brazil saw the unavailability of AT as a significant factor in the underdevelopment of much of the Brazilian economy[13]. Inter alia he wrote:

> In a developed economy, technical progress takes place gradually: an improvement in farm mechanization method may lead to substitution of one tractor by another of more efficient type, cheapening of a certain kind of fertilizer may signify a new use of land previously used for extensive stock breeding, and so on. The whole of these gradual modifications have very little effect of the overall structure of relationships constituting the economic system. In the underdeveloped economy, on the other hand, expansion in sector A induces abrupt change for the whole input structure; the demand for manufactured and semi-manufactured goods increases suddenly. The transport sector offers another good example: the change from animal (including human) haulage to motor traction occurs 'in one fell swoop'. The handicraft produced cart and locally bred draft livestock are shoved aside by the motorized vehicle; a whole sector of highly advanced industrial processes arises whose operation and maintenance call for a complex input setup.

Like India, Brazil, in practice, developed a highly dualised economy. In fact, it was the one Latin American Economy that at various key periods in its development, consistently implemented a policy of modernisation through import substitution. In some periods this policy was successful resulting in the development of such key industries as steel, chemicals, automobiles and (sadly) armaments[14]. Whilst much of this, particularly during the years of military rule, was carried out through successful attraction of foreign direct investment, there were notable cases of pragmatic local development (not always environmentally or even socially benign) such as the development of the ethanol industry and modification of cars to run on ethanol and the encouragement of small-scale pig iron manufacture in conjunction with the mining operations of the massive Grande Carajas mines. However, no significant steps were taken to think through and adopt a technology policy that would be relevant to a form of development that would address the needs of the poorer sections of the society and Brazil has remained the country where, on the one hand, the AT movement has had no purchase and, on the other, with one of the greatest differences between rich and poor of any country in the world.

It is important to focus some attention also on the case of China. Whilst the connection between the AT movement in the North and those who implemented development policies and practice in China across the 1960s and '70s was in no way direct, nevertheless, China was seen by many in the movement as a shining example of the possible[15] whilst it is likely

[13] Furtado (1964)
[14] Evans (1979). Some attempts, such as promotion of the computer industry whilst restricting import of foreign brands was less successful.
[15] Durham (1976), Sandbach (1980, Chap.7)

that ideas generated in the movement did percolate into China. It was understood that Chinese culture had historically and long before Europe developed its own version of sophisticated science and technology (indeed Bacon's advocacy of science at the outset of the 16th century, used examples of what kinds of benefits science could bring, which were all of Chinese origin), together with its own visions of the good society and what its relationship should be with nature[16]. However, the fact that China's development policy since the early 20th century was oriented ultimately to achieving modernisation on the occidental model, with, from the 1960s to 1980s, small-scale local technologies as stepping stones to this end, was almost totally misunderstood or ignored by the AT movement.

The facts of the case are that between the Liberation in 1949 and 1960, Chinese development policy was closely tied to the assistance being given by the Soviet Union and as such oriented strongly to mega-projects ranging from large hydro-electric dams to vast integrated tractor factories. The break with the Soviet Union, largely over growing differences of view with regard to development strategy and tactics and the overbearing attitude of the Soviets, precipitated a radically new direction involving a strong focus on locally-organised self-development not only of improved agriculture but also of rural industrialisation. Whilst this was seen by the alternative movements in the North as embracing their vision of a decentralised development process, in practice there was a greater degree of pragmatism that was – and is still – acknowledged to have lain behind the change in direction. The policy in this first phase of classical Maoist development, termed the 'Great Leap Forward', came under the more general title of 'walking on two legs', indicating that besides the encouragement of localities to develop themselves, the national government would continue to invest in large-scale development projects.

Already in the first stages of development under the communist regime, a system of village health and hygiene was developed under the title of 'bare foot doctors' – in fact trained paramedics who, with basic methods including traditional Chinese medicine, succeeded in greatly improved health conditions relative to the pre-Liberation situation. The Great Leap Forward was an immensely ambitious – and largely disastrous – attempt to educate the vast Chinese peasantry in the basics of modern industry through the building of back-yard iron and steel manufacture, fertilizer manufacture and basic engineering as a basis for improving economic performance across the board.

The rigidities and resulting failures of this campaign were evaluated and a second campaign was launched under the heading of the 'Cultural Revolution' indicating a more focused understanding of the need to make fundamental changes at the level of minds and practices and not just by introducing technologies. This was also more geared to being sensitive to particular local needs and resources but was not far removed in terms of radicality from the earlier campaign. Although this is popularly (including in China) also seen as having been a disastrous failure, evaluations of what was achieved are nevertheless mixed. On the one hand great and permanent improvements were made in the rural economy with a wide range of small-scale and locally-appropriate technologies[17] albeit by no means always with satisfactory environmental results[18]. On the other hand a few local factories grew into large and successful industries[19]

[16] Needham (1976)
[17] Sigurdson (1977)
[18] Smil (1984)
[19] In 1997, when the author was engaged in a training course in 'sustainable development' in the Pearl River Delta in China, he was taken, inter alia, to see the largest refrigerator factory in China – possibly in the world – which had grown out of a small local industry established during the Cultural evolution and which, when he visited it, was still a municipally-owned enterprise, albeit employing 14,000 workers!

The case of energy conversion is illustrative. On the one hand there was a very widespread introduction of small-scale hydro and biogas plants[20] - renewable energy sources - that provided energy which hitherto had been sorely lacking in the countryside. At the same time, encouragement was given to building local coal-fired power stations that were highly inefficient and polluting[21]. Indeed, the crash introduction of many technologies into the rural context with little knowledge or skill of how these might be run in any way in a clean and efficient manner resulted in a vast waste of resources.

The point was, however, in stark contrast to India and Brazil – and indeed most other 'developing' countries - the insistence that all the people should benefit from development. Major efforts were made to eliminate dualism within the economy to the point of destroying the educational system as the basis of urban and middle class superiority. With the death of Chairman Mao, however, this ended and the introduction of 'market-oriented reforms' under the slogan: 'it doesn't matter what colour the cat is as long as it catches the mouse'. China thus joined the world of conventional development strategies including an orientation towards adoption of 'modern' technologies purchased from the already developed countries including welcoming large numbers of foreign concerns to import their factories and employ cheap local labour to manufacture both for export and for growing internal markets.

The AT movement did not go uncriticised even at its height. On the one hand there was self-questioning of a ruminative[22] and of a harsher[23] kind from within the movement. On the other hand the notion of AT was investigated usually in passing but sometimes more seriously by academics concerned with development issues. There were several quite different conclusions reached which, inevitably, grew out of very different approaches to the subject.

At one extreme there appeared a broadside attack on the whole notion of alternative technologies, published by the Greek intellectual Marxist Arghiri Emmanuel[24]. In essence Emmanuel argued that the best route to technological development of southern countries is via the good graces of multinational industries. These have an interest in setting up operations in the South to exploit local markets and in the process bring with them the latest technologies that, in the long run, will 'trickle down' to local industries. This polemic was subjected to widespread discussion amongst academics interested in the topic[25] - though not overtly within the AT movement itself.

Development economists generally, when analysing the concept of AT, were interested in whether it could be seen as a more economically efficient approach to development. The situation faced by local entrepreneurs in the south was generally that low labour costs did not justify investment in more productive technologies. Low productivity did not matter so much if all factors of production are cheap. If for whatever reason labour costs were to rise, then it would become worthwhile to invest in more productive machinery in order to reduce the amount of labour per unit output. 'Appropriate' technology within this line of reasoning, if it is to be attractive to entrepreneurs (including peasants) would have to be technology that raises productivity without raising costs. In principle this was indeed in line with the intentions of the AT movement.

However, economists do not generally consider such factors as local culture and institutional frameworks and hence their insights were not particularly helpful. Arguably the most forceful

[20] Qui et al (1990)
[21] Wirtshafter and Shih (1990)
[22] Willoughby (1990)
[23] Rybczynski (1980)
[24] Emmanuel (1982)
[25] Including Celso Furtado (Emmanuel (1982, 119-125)) and Frances Stewart (Carr (1985, 27-28))

academic analyst on the side of the movement was Francis Stewart[26]. Stewart is an economist who, however, engaged over a long period with developmental issues. This involved coming, on the ground, into contact with and recognising the multifarious cultural, institutional and political problems confronted by development tactics and strategies in general. She saw the necessity to address these if there were to be any success in the development and implementation of technologies that could help provide stepping stones to economic improvement of rural populations and, more generally oil the wheels of the technological dimensions of development. As, in the course of the 1980s, the AT movement ran increasingly into the ground she and others promoting the aims of the movement focused attention on the framework conditions which she – and they – recognised as inhibiting developments:

> "…despite the multiplicity of such interventions and widespread agreement on the need for AT, progress in achieving AT on a significant scale is generally acknowledged to have been disappointing… this comparative failure, despite successes at the micro-level, has been due to obstacles resulting from macro-policies[27].

Since the beginning of the 1980s, the development institutions had come under the sway of the so-called Washington Consensus. Originating in a general agreement of the most powerful international economic institutions – the IMF, the World Bank and behind these the US Treasury - this consensus involves the implementation of a set of economic policies emanating from liberal economic theory. Government regulation of the economy should be reduced and the private sector given broader freedom to decide what they should invest in as a response to market demands.

At the bottom end of local economies in southern countries, even if there were vast populations desiring to purchase the means to improve their lives, if they were poor, then there was no incentive for private investors to risk developing and attempting to sell anything that they did not already have on the market. With national governments in southern countries increasingly forced through neo-liberal 'structural adjustment programmes' of the IMF and World Bank to reduce intervention and encourage markets to satisfy needs, initiatives to be proactive in AT development withered. The poor 80 percent of humanity were left to find their own way out of their traditional lifestyles and the poverty that this has increasingly involved.

Key Issues in Technology Development

There is a loose presumption that we might refer to as 'common sense' that technologies are chosen to fulfil specific functions in order to improve the lives of people. We have seen in the foregoing section that in spite of a very reasonable logic applied to the idea that the poor and 'underdeveloped' can benefit from the development of 'appropriate technologies', somehow the whole aspiration and the movement which it generated came, almost, to nothing. This essay is not dedicated merely to accepting what happened as a kind of fate but rather to analyse what factors underlay the failure. Further it is concerned with studying the continuing failure to apply technology where it is, prima face needed, in an age where technology has run wild and, in principle, could be applied to provide for any reasonable human need. What has to be understood and turned around if the promise of technology is to be fulfilled?

[26] See in particular Stewart (1978, 1987)
[27] Stewart (1987,ix)

Autonomous Technology?

There is a certain extreme opinion that sees technological development as something autonomous to the human ability to control it. The idea arose already in the story of Frankenstein, written in the early years of the 19th century where industrialism was beginning to arise in Britain[28]. The allegory contained in this story, famous as it is and yet never consciously understood for what it says, is that technological development can (and does) run ahead of the realisation of the need to contain it within the life we wish to lead and the environment in which it operates. Technology is out of control and has a life of its own. Only those technologies are developed that conform to the ultimate aims of some God of technology and we humans are merely the tools that serve the needs of this God. AT was not to His liking.

There have been many references in recent years to ours being the age of technocracy or the 'technological age' and this notion implying independence of technical developments has been investigated in depth by numbers of authors. Arguably most influential was Jacques Ellul[29] whose analysis was conducted under the assertion (p.14) that: "Technique has become autonomous; it has fashioned an omnivorous world which obeys its own laws and which has renounced all tradition." Langdon Winner followed this with his ruminative *Autonomous Technology*[30] stating (p.16) that: "The theories I will examine here maintain, in one way or another, that far from being controlled by the desired and rational ends of human beings, technology in a real sense now governs its own course, speed and destination."

There can be no doubt that, in historical terms, our age is one of bewilderingly rapid technological development. It is also clear that many of these developments, as they diffuse into society and the environment run more or less high risks of causing accidents or resulting in other unanticipated negative consequences of catastrophic dimensions. And yet the 'benefits' of these developments remain in many cases extremely ambivalent and in some cases add directly to disbenefits to many who lie outside the charmed circle. Although responsibility for the rapid changes taking place in our society today can in no way be wholly laid at the door of technology – nor, *pace* Ellul, the technique surrounding particular technologies – nevertheless, technologies are in much of this transformation a vital ingredient.

Mass road and air travel presuppose vehicles and control systems; rapid mass-communications presuppose the internet, computers and handphones; the intensive penetration of social images and ideology into every last village presuppose television and the means of transmission; the disappearance of work (and income) for increasing numbers presupposes rising productivity through the introduction into the production systems of ever more sophisticated machines; the lightening of the load in running households presupposes a shower of household machinery, more effective cleaning and decorating materials, pre-prepared foods; and so on, all created with the vital ingredient of technological 'improvements'.

In fact, calling into question the notion of 'autonomous technology', considerable analysis has been carried out in recent years to study the motivations and mechanisms underlying technological change. It is true that at a strategic level, the process is possessed by fashions, fads and beliefs that, one might speculate given the relative absence of rationality at this level, are cunningly motivated by the God of technological development. However,

[28] Written by Mary Shelly (1969 {1818}) at age 20, the novel is subtitled 'The Modern Prometheus' thus consciously relating it back to the Greek myth of technological hubris…
[29] Ellul (1964)
[30] Winner (1977)

these generally only result in finance and effort being invested in so far as they contain the promise of future payback in terms either of raised national prestige and power or company profits. The motivation to open a line of research and development of technology is overwhelmingly structures of competition. On the one hand national governments are concerned with the power and prestige of the nation. On the other – and clearly more important in a world that emphasises the role of the private sector as leading the development process – competition for markets motivates private enterprises to innovate.

Technology Development to 'Improve' Consumer Products

In pursuit of private profit, private enterprises innovate on the one hand to produce goods (technologies) that will sell and, on the other hand, in order to reduce their costs of production. In the case of goods for sale, work on technical improvements is overwhelmingly directed at incremental change to goods (and materials) sold in the past to those who can afford them. Risks may be taken, though cases are relatively rare, in innovating around putative new social desires that might be satisfied by new products. A successful example is the introduction of home computing as a sideways movement out of computers used in business and research. As made clear with respect to the case of AT analysed above, 'effective demand'[31] may cover basic needs of the rich and thence a mass of more vicarious desires of this same group. Indeed, for reasons of an arbitrariness with respect to what can be produced cheaply, a much broader spectrum of consumers stretching down even to the poor may find vicarious desires met within their capacity to pay – such as soft drinks, ice cream and television - whilst basic needs for instance for clean water and sanitation go unmet. This is a topic to which we must return in more detail in the conclusions to this essay.

The Role of Technology in Increasing Productivity[32]

Technological - and more broadly technical - innovation in the production process comes in layers. This includes innovations in agriculture and mining, in transport, in processing, in manufacturing, in storage and distribution, in retailing and in administrating each part of the process. In all of these areas, technologies have changed rapidly in recent years and it is impossible to do this justice in a short paper. What cannot be avoided, however, is to focus some attention on innovation in electronic control systems and their diffusion throughout the production and distribution systems.

The impact of microelectronics over the past thirty years has clearly introduced far-reaching changes to the point of disorientation of our capacity to understand what is happening. 'All that is solid melts into air' wrote Karl Marx of capitalism already in the mid 19th century and by the end of the 20th century the sociologist Zigmunt Bauman could characterise our era as that of 'liquid modernity'[33]. We can see how electronics has transformed the surface of life in telecommunications and entertainment but it is less visible how so much that may be familiar in the past by way of consumer goods has been made more efficient and effective by the use of electronics. However, it is the transformation of the production and distribution process that has been most revolutionised, largely out of sight but leading to widespread changes in the organisation of social life, particularly with regard to employment patterns.

[31] Economists make the distinction between 'demand' as being what people might actually need and 'effective demand' which is what people can afford to buy whether needed or more vicariously desired.
[32] The concept of 'productivity' as used by economists is slippery – potentially to the point of absurdity. If measured solely in money terms: poor people are unproductive simply because they are paid little for what they do even if they work long hours and produce huge satisfaction for others through their services. The term productivity as used in this paper thus focuses on the capability of machines to increase output of goods and not how much the workers are paid for their productivity or the lack of it.
[33] Bauman (2000)

That development and diffusion of microelectronics would have the effect of increasing the productivity of machines – and ultimately virtually eliminating whole sectors of work – was foreseen already by Norbert Wiener, one the of the chief theoreticians of electronic control systems back in the 1940s[34] at which time he attempted in vain to warn the trade unions of what lay ahead for them. It was, however, only towards the end of the 1970s, with the invention and first applications of integrated circuits – the microchip - that the full implications started to become clear and in this context quite suddenly significant attempts were made on the part of national governments in OECD countries to anticipate what the impacts might be in the medium and longer term[35]. These were followed by a proliferation of county and sectoral studies[36] worried about the impacts on national and local societies and groups.

A number of academic institutes dedicated themselves to monitoring the processes of introduction of microelectronics in the workplace and the implications for employment mainly focused on the OECD countries[37]. In spite of early demonstrations that it would be possible to build factories in which sophisticated goods could be produced eliminating almost all manual work (typically from several hundred workers to less than 50)[38] the full possibilities were not immediately realised. This was in part due to inertia – continuing to use or adapt existing processes (adding new control mechanisms to existing machines) particularly in recession conditions. But also the incompatibility of different machines used in the same factory (inability to use faster production machines unless feeders and packing were equally increased). There was also significant resistance on the part of labour which, although overcome incrementally, took – and continues to take - time.

Whilst most of the focus of these studies was inside manufacturing processes, some attention was focused also on how input and administrative processes were also the subject of reorganisation. Along an entirely different dimension, as it were over the heads of these researchers into technological change, liberalisation policies were encouraging manufacturers to restructure their operations altogether with erstwhile ('Fordist') integrated manufacturing processes split into parts and with sections sold off or relocated overseas where labour costs are cheaper. Whilst this was not a process on which any coherent attention was being focused by researchers on technological issues, it nevertheless in practice interacted strongly with the changes taking place in the application of new technologies.

The Role of Governments in Technological Research and Development

What in these changes was the role of governments and international organisations? In principle it might be expected that governments somehow steer the process of technological change with the interests of society in mind. Certainly, communist countries during what the historian Eric Hobsbawn has called 'the short 20th century'[39], between the emergence of the Soviet Union (1917) and the triumph of neo-liberalism as the dominant ideology (1980), did focus attention on technological development as a key component of their development strategies, as was described above with regard to the Chinese example. That the emergence of neo-liberalism changed the focus of government – and international agency -

[34] Wiener (1965)
[35] Nora and Minc (1978), ACARD (1978), Barron and Curnow (1979), Rada (1980)
[36] A selection of such studies from the UK includes: CSS (1981), Kirk (1981), Swann (1986) and Christie et al (1990)
[37] Prominent among these was the Science Policy Research Unit at Sussex University that published a long list of research publications relating to this topic across the 1980s. See, for instance, Marstrand (1984), MacLoad (1986)
[38] Hatvany et al (1985)
[39] Hobsbawm (1994)

intervention in technology development not only in erstwhile communist countries but across the board has already been implied in the abandonment of support for AT. This has not meant, however, the abandonment of government technology policies and initiatives and it is necessary to take a closer look at how these work and the changes that have taken place in their focus in recent years.

Governments in OECD countries and to an extent also elsewhere have come to play two distinct roles in technology development, one to promote technological development and the other to control actual or potential negative effects. On the one hand they promote technology development as a basis for increasing both national power and prestige and assisting national-based private industries ('our team'), in the past to an extent to improve the lives of their own people but today overwhelmingly to compete more effectively internationally. During the 20th century it was not only communist governments that designed and implemented the development process including the development of technology. Key industries such as armaments, energy conversion and even parts of the construction industry, the automobile industry and much more, and including the research facilities aimed at developing relevant technologies, were owned and operated by national governments in many OECD countries and, through their purchasing policies and activities, governments controlled the direction of technology development over a much wider range of ostensibly private industries.

In all countries – that is including communist countries - these interventions took place in a more or less fragmented way with many ministries and agencies developing their own programmes quite independent of overall technology strategies or plans. There were planning ministries and agencies in some countries – most impressively and effectively in the German Federal Republic (Bundeministerium für Forschung und Technologie) and in Japan (Ministry of International Trade and Industry - MITI) and more recently in South Korea – that played a major role at least in encouraging more coordinated efforts of the private sector to develop technologies both for more efficient production and for goods to be sold into international markets. But other aspects of technology development such as armaments, for social purposes and for the improvement of infrastructure remained in the hands of other agencies. Research and development programmes for specific technologies were instigated both through the building up by governments of research and development institutes sometimes - as in the case of national nuclear industries – on a massive scale and sometimes providing funds to the private sector to undertake relevant work[40].

Clearly, with very few exceptions, governments in southern countries are not in a position to finance the kinds of research programmes supported by northern governments. Whilst, however, research into low-tech solutions to burgeoning developmental problems could be pursued with relatively small financial resources, in practice governments in southern countries currently quite generally choose, rather, to support research and development of technologies related to the modern sectors. In many cases this relates to improving the export potential of local produce, such as successful support by the Malaysian government for the means to modernise the rubber processing industry and support by the Chilean government to extend the freshness of fruit for export. A few southern governments have put considerable resources into hi-tech developments including nuclear power (Mexico, Brazil, Iran, the two Koreas) and with the notable case of 'poor' Indonesia creating a major national institution – Agency for the Assessment and Application of Technology (BPPT)[41] – that developed an aircraft industry and successfully promoted the development of a national

[40] Braun (1995, Chapter 3) provides an overview of the technological research programmes of a selection of OECD countries.
[41] www.bppt.go.id

information system that has brought low-cost communication and television into even poor households in the most remote parts of this country of scattered islands.

Given the interest in China on the part of the AT movement in the 1970s and '80s, a brief note on the current state of affairs is in order. With the demise of Maoism, whilst it is an over-simplification to say that China became capitalist, the government nevertheless became strongly oriented to the competitive milieu of a capitalist world. In the countryside, the collectives/communes were dissolved and the peasant family once again became the basis of local development under the heading of reform[42]. Development of agricultural potential also reverted to the conventional in the sense that the Ministry of Science and Technology initiated a major programme to develop and disseminate measures to improve agricultural productivity to be handed down to the villages. However, the main orientation of the Ministry was now towards 'catching up' with a massive programme of hi-tech research (known as programme 863) aimed at this goal[43]. Meanwhile urbanisation is being encouraged with an estimated 30 million or more newly urbanised citizens every year, gradually emptying out the countryside.

By 2003 the Chinese research programme (government and private sector) had become the third largest in the world[44] with a scramble on the part of American, Japanese and European corporations to exploit burgeoning – and cheap - Chinese research talent. Economic development in general became oriented – with great success – to the development of industries using the latest production technologies. This has included the successful transition of state and municipal companies to the new circumstances, joint ventures involving a major influx of 'oversees Chinese' and massive influx also of inward investment from Japan, the US and Europe[45]. Whilst no longer overtly visible, some minor local initiatives continue to pursue ecological projects, often supported by international organisations, not dissimilar to the way in which NGO projects work in other southern countries but with insignificant national promotion[46].

Considerable international support has been given to some research programmes in southern countries. The best known of these is the network of tropical agricultural research centres located around the equator ranging from the Philippines to Kenya and Nigeria, Colombia and Peru. Amongst the achievements of these, arguably the most celebrated was the development of high-yield rice, developed by IRRI in the Philippines and disseminated under the title of the Green Revolution throughout tropical Asia. This, however, became an object lesson in the problems of the kind already highlighted by Furtado in the above quotation where the demand for high-cost inputs with high-yield outputs discriminated strongly against the poor whilst augmenting the incomes of the rich[47]. Whilst these centres were established in a past era when development appeared to be primarily aimed at benefiting the people of the tropics, in the context of neo-liberalism, and specifically the TRIPS agreement, the danger that these centres will produce knowledge that will benefit primarily northern corporations becomes very much greater.

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[42] Croll (1994)
[43] www.most.gov.cn/english/programs/
[44] China Daily, 3rd March, 2003.
[45] These industries are heavily concentrated in a few locations, such as greater Shanghai and the Pearl River Delta. See Yeung (2003) for a recent developments in the latter.
[46] See www.china-biogas.cn/english.htm The author's experience includes working with experts from the China Academy of Sciences on a programme for the city of Yangzhou, designated China's most advanced 'eco-city'. In this context ecological projects are not expected to criticize the general development of the municipality as a centre for chemical and vehicles production (Research Center for Eco-Environmental Sciences. (2001)).
[47] A vehement critique of the impacts of this diffusion programme in India are provided in Shiva (1991)

Control of Technology

Already in the 1960s increased anxiety was arising regarding the evident problematic nature of many emerging technologies. It was clear that military technologies were lethal and already in the 1950s strong northern social movements against nuclear, chemical and biological weapons contributed to the forging of international agreements to set certain limits on the production and deployment of these. However, starting in the 1960s, attention came to focus also on the civil nuclear and chemical industries and major accidents in these spurred on the process of civil concern.

On the one hand this emerged in the political sphere in the form of the environmental movement. On the other, a more low-key focus expressed itself in the form of debates on the control of technology. In principle these two should have interacted more forcefully than they did in practice and it might be speculated that this lack of a strong focus on technology on the part of the environmental movement was the result simply of the complexity of the issues involved and the lack of an adequate conceptual framework to deal with the issues as a whole. Thus the environmental movement came to focus criticism on specific technologies which included at the forefront nuclear power and then pollution from industry and modern agricultural practices.

The specific focus on technology was a more academic debate on the theme of the 'control of technology'[48] and, as with technology development, this remained overwhelmingly fragmented, generating specific approaches to assessment for different technologies (as noted earlier in this paper with respect to microelectronics). One highlight, however, was the establishment of the Office of Technology Assessment (OTA) to advise the US Congress on issues relevant to policy formulation regarding emergent technologies between its founding in 1973 and its dissolution in 1995. Whilst demonstrating the practicability of such an institution, this remained small and, although dealing with numbers of important issues concerning emergent technologies, could in no way be said to have provided a comprehensive control system[49]. Few other governments attempted to establish such an initiative[50] and the attempt to look at the problematic of control of technology has given way to fragmented focus of attention on particular problem areas of which the most prominent in recent years has been genetic engineering and the diffusion of genetically modified organisms (GMOs) into the environment[51].

It must nevertheless be noted that the institutionalisation of environmental impact assessment (EIA) across the globe – albeit with vary varied levels of effectiveness with respect to implementation[52] - and more relevant the implementation of strategic environmental assessment (SEA) across Europe, via EC directive, would seem to cover much of the territory of technology assessment albeit somewhat downstream from the root concept of technologies being assessed from a stage where they remain in prototype or in very early stages of diffusion.

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[48] Hetman (1973), Elliott and Elliott (1976), Collingridge (1980)

[49] Although no longer in existence, a comprehensive archive of the activities and reports of the OTA remains available at the web site www.wws.princeton.edu/~ota/

[50] The European Parliament did, however, establish a programme entitled Scientific and Technological Options Assessment (STOA) through which it examined EC research priorities. The author was involved in one of their projects aimed at assessing the European thermonuclear research programme – absorbing at the time the lion's share of energy research in Europe at that time. The skeptical results of the assessment were enthusiastically embraced by Margaret Thatcher who, at that time, was seeking to criticize the EC's spending priorities. (See: Sweet et al (1988), Atkinson (1989)).

[51] This controversy has generated a large literature in the last few years. See Rifkin (…) and Wield et al (…)

[52] See Wood (2003) for an assessment of the weakness of implementation of EIA systems in southern countries.

It is important to add here that governments are not necessarily the best agents to be responsible for technology assessment. As evidence mounted, through accidents and other indicators, of the dangers of many emerging technologies, it transpired that governments had been at the forefront in promoting and often directly undertaking their development. There was, therefore, a rather clear conflict of interest. Weapons research programmes were necessarily government financed – and the OTA was certainly not expected to shine any critical light on these. Indeed, more than two thirds of US research was at the end of the 1980s, dedicated to 'defence', by far the largest in absolute and percentage terms of any country (Japanese research – the second largest programme, was allocating at the time just 4.4% to military research).

But from the late 1960s, major civilian science and technology research programmes also came into the critical limelight and it has been difficult for governments to separate their roles as promoters and as critics of the same technologies. A major case has been the development of nuclear power which in many countries involved massive government resources and continuing support but where, particularly following the accidents at Three Mile Island and Chernobyl, the risks became increasingly evident. It is of considerable interest that, with the pressure emanating from neo-liberal ideology to privatise national energy industries, private investors have baulked at accepting the financial risks nuclear power[53]. Whilst in OECD countries there has been some concern to ensure that there really is some separation of responsibilities for technology assessment (and by extension EIA and SEA), in most transition and developing countries, this principle is far from being respected and governments regularly suppress information that might be critical of their technological ambitions and those of national industries and dangers attaching to their programmes in some cases extending to the suppression of organisations and individuals outside of government who would voice such criticisms.

Environmental and Social Factors

We now wish to focus a little more attention on the benefits and disbenefits of the current trajectory of technology development and finally sketch a possible framework aimed at overcoming the latter in so far as these are seen as increasingly problematic.

The Achievements of Technology

Firstly it must be clearly stated that the virtuosity of present-day technology development is truly breath-taking. Whilst many of the benefits might seem trivial or, worse, a diversion from serious problems in the world, developments in a host of directions bring clear and, almost unassailable benefits. Medical technologies, for instance, ranging from medicines to diagnostic, surgical and prosthetic technologies have transformed – at least for part of humanity – the capacity to maintain human health and extend life. There are those who maintain that much of formal, 'northern', medical progress is misdirected[54] but is would be crass folly to reject much that has resulted in recent years from technological development in this field. Whilst, as discussed further below, micro-electronics has generated immense problems in changing the very foundations of social life across the globe – and has been far from benign in the environmental and health impacts in the production and disposal of

[53] Governments everywhere are thus 'cheating' in terms of rigorous liberal policy by taking on insurance risks of private nuclear plants for the event of major nuclear accidents.
[54] There can be no doubt that major pharmaceutical corporations have distorted the path of medical 'progress' to suit their own pursuit of profits.

electronic components[55] – nevertheless, it is difficult to imagine that these technologies cannot be directed towards the improvement of the human condition in overcoming the problems which these have sired.

The Environmental Failures of Technology

At the same time, the problems emerging from technology development have become ever more profound. Whilst there is a huge popular literature of engagement in the latest technological developments in air and space travel, automobiles and home electronics, and a host of other things, in the course of the 1980s a stream of books appeared that set out a broad critique of the direction which technology development is taking. Ellul and Winner noted above were precursors of this, but many academics who became involved in the field of technology development and assessment came increasingly to focus on the dangers – with such titles as *The Tragedy of Technology, The God that Limps, Futile Progress* and *High Tech Holocaust*[56]. At one extreme it was asserted that "…we have perhaps no more than five years to make a choice in favour of a cleaner, safer world.[57]" However, most of the contributors took a more circumspect view, whilst nevertheless, deeply questioning the decision-making processes and the lack of adequate safeguards in the way in which technologies were coming into existence and released into the environment and society.

There were, by then, sufficient examples of both sudden and more insidious environmental problems that in turn led to complex procedures to minimise future impacts after the fact, examples which – in no way exhaustive - are given in the following paragraphs. These included the accidents in nuclear facilities and other lethal leakages of radioactive materials that led to the implementation of elaborate systems for organising responses to accidents should these occur again in future[58]. Major fires and explosions of chemical manufacturing plants led at least in OECD countries to the implementation of similar expensive and elaborate accident response systems around chemical plants[59].

Similar measures were not implemented in southern countries despite the dangers of such facilities demonstrated by the Bhopal disaster in 1984 in which some 2,000 people were killed and the health of another 200,000 permanently affected[60]. Indeed, pesticides – for the production of which the Bhopal plant was built – have a long history of negative affects on the environment and human health, leading to the banning of DDT and other products in northern countries – whilst they continue to be used in countries of the South. Currently the use of pesticides with inadequate precautions leads to several thousand deaths and tens of thousands disabled annually in countries of the South[61].

More insidious has been the widespread dissemination in water sources of chemicals emanating not only from agriculture and industry but also innocent-seeming products used in the home. The problem of chemicals released into the atmosphere that are destroying the ozone layer is well-enough known, as is the problematic of global warming, also as a consequence of progressive changes being wrought to the earth's atmosphere. But there

[55] The contamination of domestic water supplies in California's 'Silicon Valley' from disposal of chemicals used in the production of microelectronics components, leading to the birth of deformed babies, is a celebrated – but by no means the only – case of environmental problems emanating from the electronics industry (ref).
[56] Albury and Schwartz (1982), Bellini (1986), Braun (1995), Hill (1988), Norman (1981), Winner (1986), Zerzan and Carnes (1988).
[57] Bellini (1986,2)
[58] Atkinson (??), other refs.
[59] In EC countries this resulted from the so-called Seveso Directive, formulated and implemented following the explosion at the Seveso chemical plant in northern Italy.
[60] Weir (1988) provides an analysis of the actual and potential danger of chemical plants developed and located in the South. The appendix to the book provides a list of major chemical accidents over recent decades.
[61] Ref. ILO report

are a mass of other potential problems from chemicals released into the environment, for instance oestrogen-related chemicals used in many processes and products which, once in the environment, affect the reproductive capacities of animals in the wild and eventually also on humans[62].

Latterly attention has come to focus on the whole thrust of 'genetic engineering' and the production of genetically modified organisms (GMOs) with the fear that, whilst already negative impacts on wider ecosystems can be seen that at some stage a major disaster will result from the release of one or more organisms into the environment[63]. So far the EC and most European governments have advised against their use and consumer pressure has successfully resisted the introduction of foods made from GMOs into Europe. However, the general drift of commercial pressures of this kind from the United States and large European corporations to allow such 'innovations' to be accepted means that in time they are likely to find their way also into Europe.

Attention must also be focused on automobiles. Much research has been carried out and modifications of automobiles have been incorporated over time to lessen the impact of accidents at least to drivers and passengers (but hardly affecting pedestrians hit by vehicles). Furthermore, fatalities and injuries per kilometre travelled have been greatly reduced in recent years at least in northern countries. However, continual increase in kilometres travelled means that the statistics have remained relatively stable at approximately 100,000 road fatalities and 4.5 million road injuries[64] a year across the OECD countries[65]. This information is not widely advertised and yet road accidents clearly amount to a serious problem. The continual increase in the use of automobiles – and indeed the unnecessary size and fuel consumption of a large proportion of these especially in the United States – makes a large and increasing contribution to local pollution and global warming. The obsessive nature of the automobile culture and the unwillingness of our society to confront the environmental problems and personal risks which it creates is a case study of great relevance to this essay that is discussed again in the last section[66].

Organic Agriculture and Renewable Energy: the Opening of a New Era?

On the other side of the equation it should not be asserted that technological development has entirely ignored criticism concerning environmental impacts. Besides the examples noted in the foregoing paragraphs of technological and organisational measures to address some of the problems, it should also be noted that advances have been made to address such issues as the need to reduce the use of agricultural chemicals and the need to shift energy production onto a sustainable footing, backing away from the use of fossil fuels and nuclear energy, replacing these with renewable sources. It is probable that these initiatives are the consequence of the green movement in so far as these were major foci of the movement it its early years and this did make an impact on a significant part of the population of northern countries and a certain impact on some institutions. Thus the demand for organic agricultural produce has significantly risen in Europe in recent years, with support from the EC and national governments, and been responded to by producers. This should not, however, be exaggerated: although over 10% of Austrian agriculture is now organic and organic agriculture in Italy increased eighteen-fold between 1993 and 1998,

[62] Colborn et al (1997)
[63] Refs.
[64] The reference below notes that injuries from road accidents are probably significantly under-reported, indicating that the number is actually well over 4.5 million.
[65] www.bts.gov/publications/journal_of_transportation_statistics/volume_02_number_02/note/tessmer.pdf
[66] Ref. Autogeddon

nevertheless, the overall increase over this period right across the European Union was from just 0.8% to 2.8%[67] of food crops produced.

Similarly, renewable sources of energy have been subsidised and otherwise encouraged in EU countries over the past 30 years, albeit not consistently. Medium and large-scale hydropower has featured since the beginning of electrification in the 1880s as a significant source of electricity, indeed in a few countries, in the middle years of the 20th century, as the dominant source. With the general growth in energy demand, however – particularly from the transport sector – this has dwindled as a percentage of the total. Furthermore it should not be forgotten that eventually reservoirs become silted up such that hydroelectric dams are not actually a renewable source[68]. Today only Sweden boasts as much as 30% of its energy needs being satisfied from renewable sources with most EU countries less than 10%. The UK, for instance, after two decades of specific support for renewables only obtains 1.1% of its energy from these sources[69].

Exploitation of renewable energy sources in the countries of the South has also had mixed support over the years[70]. The demise of support for AT came with a disillusion of the international agencies stemming from the lack of realisation at the outset of the requirement for maintenance (these days referred to as 'a sense of ownership on the part of the recipient'). A renewed interest on the part of development agencies in supporting renewable energy projects came following the UN Conference on Environment and Development (UNCED) in Rio in 1992. This led to the discovery of the collapse of earlier programmes when left in the hands of 'beneficiaries'. In the new policy framework, commercialisation of renewable technologies – and most prominently solar photoelectric cells - has become the goal of some programmes. In fact most people in poor countries obtain their energy from (in principle renewable) biomass.

Renewables programmes, other than traditional sector biomass and medium and large hydroelectric schemes, are still marginal. They amount to no more than a few percent of the total energy use even in the best cases and these remain dwarfed by the continuing growth in use of non-renewable resources and the decline in percentage of energy supplied by biomass. Perhaps a significant move, that could be seen as a potential promise that progress will continue in the future is the way in which recently multinational oil concerns have initiated programmes to promote renewable energy technologies, notably photoelectric and wind technologies[71]. However, not only the radical fringe, but indeed Fortune magazine has seen this as little more than a rhetorical gesture of image improvement[72].

Across the world as a whole, the use of energy from renewable energy sources is increasing around two percent per annum, almost identical to the growth in all forms of energy use. Renewables represent just under 14% of total global energy use of which 80% comes from biomass, mainly as the traditional source of energy in rural areas, a further 17% from hydro (overwhelmingly medium and large scale) and just three percent from all other sources. Although the direct use of solar and wind power has been growing rapidly in annual percentage terms, these are from a minute base, relative to the use and actual growth in

[67] www.organic.aber.ac.uk/library/Public%20support%20for%20organics%20in%20Europe.doc
[68] Where upstream erosion is high – the case in many southern countries – the life of hydroelectric dams as generators of electricity can sometimes be measured only in a few decades.
[69] IEA (2002)
[70] For a recent overview, see Martinot et al (2002)
[71] Shell Corporation: http://www2.shell.com/home/Framework?siteId=rw-br&FC1=&FC2=%2FLeftHandNav%3FLeftNavState%3D0&FC3=%2Frw-br%2Fhtml%2Fiwgen%2Fwelcome.html&FC4=%2Frw-br%2Fhtml%2Fiwgen%2Fimpulse.html&FC5= British Petroleum: http://www.bpenergy.com/products/alternatives.html
[72] See: http://www.fortune.com/fortune/articles/0,15114,373412,00.html

non-renewable resources. The most important point to be made at this stage is that our technological society has been built – and continues to be expanded – on the back of non-renewable energy sources which must be considered as part and parcel of today's technology problematic.

Another Look at Technology Assessment

A central point made at the outset of this essay, that should have become increasingly clear, is that technologies gain their meaning and importance only in the context in which they are operationalised. One automobile, one automated factory, one nuclear power station, one bottle of a nonyl-phenol-based cleaner may be little more than a curio. But all of these, implemented as major components of our lifestyle, produce serious dangers or, directly, problems. It is thus necessary for any assessment of technology to take into consideration what the technology might contribute to our lifestyle both as intended and in terms of possible unintended side effects.

It was noted above that environmental impact assessment (EIA) as a technique and a component of project implementation is designed to assess the intended and unintended impacts of projects. This, however, comes well down the road of technology implementation and it has often been noted that an incremental project-by-project approach does not indicate the full potential impact of a particular technology until after this has revealed itself in practice. Strategic environmental assessment (SEA) possesses more promise in this respect and may be part at least of the technical component of the solution to the 'crisis of technology' we are here in process of discovering.

In recent years, in a sense superseding Technology Assessment – but not generally seen in this light – is risk analysis (RA). This consists of a systematic ('scientific') procedure for identifying hazards, hazard characterisation, exposure assessment and calculation of the likelihood of negative impacts of technologies (including materials). Like EIA, however, it is a method that fragments the decision-making around technologies, rather than looking at these in their wider setting in space, time and magnitude.

However, it is this notion of risk that has produced a more considered assessment of the whole field of rapid technology development and its sources and results in society. This is what Ulrich Beck characterised in terms of our society being a 'risk society'[73] and which has generated a new debate concerning technology and society. The perspective here is that we, as a society, are prepared to take increased risks as we forge progress towards whatever it is that lies at the end of the rainbow of modernity – or latterly post-modernity. We may go into this with our eyes open (scientifically assessed magnitude of the risks) but most people most of the time are taking decisions increasingly well beyond their knowledge of the consequences of their acts and often as not without even consideration of what the risks might be.

We might say that the population at large naïvely believes that someone, somewhere is making sure they are protected against potential dangers. In the language of post-modernism, we are no longer coerced into our lifestyles but rather allow ourselves to be seduced into the unfamiliar[74]. Most obviously this is through advertising and the meaning of things that is conveyed through the media. But it comes with a sense of excitement, of anticipation that stalks the world like a disease in so far as the dangers of the changes taking place escalate and wisdom is thrown to the four winds.

[73] Beck (1992)
[74] Bauman (1988)

Social Causes and Consequences of Technological Development

Those concerned with the impacts of technology development like to think that technologies are developed out of an urge to invent plus an urge to improve the lot of mankind. They then see the need to assess technology as arising over the inadequacy of consideration in these processes of the impacts of technological innovation. Inventiveness and a will to improve the lot of mankind – and beyond this profits - may account in part for technological progress, but in practice it is a good deal more complex than this. Many – including potentially extremely socially useful - things are invented that never go further than paper or prototype. Much more important is to realise what it is that drives the process of invention and, above all, of implementation and dissemination. The following paragraphs look first briefly at the social impacts of developments in consumption technologies and then, at somewhat greater length, on the decision-making process regarding the choice and adoption of technologies in the production process.

The social impacts of consumption technologies

'Consumption technologies' in this context refers to technologies available and used by people in their role as consumers. Of course there is not always a clear distinction between consumption and production technologies, for instance automobiles and aircraft convey both people on business, in their role as producers, and also tourists and others in consuming their incomes. As already noted, the growth in recent years in technology available to consumers – not only the rich but even, albeit it on a much more restricted scale, the very poor – has been breathtaking. These have both greatly eased what was seen as the burden of traditional household activities but, above all, made available pastimes that engage and occupy consumers throughout their non-work waking hours.

We might speculate that the potential revolution that was anticipated in 1968 was effectively defeated by the first wave of mass consumerism: pop culture and a cornucopia of consumer products newly available to the broad masses of northern populations[75]. The coming of neo-liberalism coincided with the emergence of 'the post-modern condition' in which seduction, rather than in the past coercion, became the basis for rendering social critique ineffective[76]. Things don't matter so much any more as we are fully occupied with consuming a constant stream of new diversions. The latest car or motorcycle, the latest handphone, the latest home video apparatus and games and the increasing virtual reality of entertainment including tourism, all crowd out any residual feeling that we should take the structure of our lives seriously. At the same time, any effective machinery that might be used to do something about it, should we start to worry, has been effectively dissolved. We are mentally and physically disempowered, inebriated. This can be said to possess an element of social engineering – pacification or sedation of the population at large – but at this stage essentially the whole world has been overtaken by this process that carries us all forward as on a wave with a fatal lack of an adequate sense of responsibility towards our future.

It might be said that the populations of southern countries do not, and particularly that the poor cannot, participate in this. This is not, however, true. It is extraordinary how consumer culture has insinuated itself into the poorest and most inaccessible communities. In squalid squatter settlements in growing cities everywhere, in remote towns and traditional villages even, television is bringing the images and entertainment of the postmodern world. Although they may not seem much to sophisticated northerners, the coming within economic range of the poorest of soft drinks, ice cream, chewing gum, above all electricity (batteries and flashlights where large- or small-scale grids fail to penetrate), and a host of other products of

[75] This was clearly understood at the time by the Situationists. See Plant (1992).
[76] Harvey (1989)

distant over-productive industries, is transforming lives. It is seducing populations, even at this level, to overlook or at least reduce the impact of poverty and insecurity of the changing world around. There is an irreducible sense of excitement and anticipation in the air even at this level. The role of technology here is obvious but becomes obscured by the nature of the social and individual engagement and the social and political engineering which the technologies facilitate.

The Social Impacts of Technology in Production Processes

A certain line of Marxist analysis has always been interested in 'the labour process'[77]. This refers to the way in which the production processes have been organised at different stages in history (and in different cultures). Necessarily this concerns itself with technology in that technologies of various kinds lie at the centre both of production processes and what of is produced. We see how, in the 19th and early 20th century a working class was created to serve the purpose of mass production industries, first in the cotton industry in Lancashire in England and then spreading to other industries and transferring, with time, to the creation of new industries. This became epitomised in the 20th century in the creation of the automobile industry in what has become known as 'Fordism', resting on a mode of 'scientific' production management known as 'Taylorism'. The driving force in implementing this method of organisation was common across the whole spectrum of modern sector production industry and was adopted and adapted as such. And when this system began radically to change towards the end of the 20th century, the new methods and approaches spread, too, across the whole spectrum of, now overwhelmingly, globalised industry.

There can now be little doubt, as established in historic analysis that industrialisation in Britain was not simply an urge to become more productive and produce profits for entrepreneurs, but was also a *social* policy designed to undermine the organisation of, and to discipline, the lower classes in an age of great social unrest and fear, on the part of the upper classes, of revolution.[78] The invention of steam power, spinning and weaving technologies and in the 20th century technologies associated with the 'production line' (and many other technologies that facilitated the industrialisation process in other spheres) were thus aspects of a project of social engineering put into practice through a particular organisation of the processes of production.

We might then recognise how the whole system turned on its head around the turn of the 20th century with the analysis which Karl Marx built upon the aspirations of earlier socialists (particularly the cotton entrepreneur Robert Owen). Factories might have started as prisons to discipline the workforce but they brought the workers face-to-face in a way that the previous more dispersed production system did not, and facilitated them to see, discuss and organise around their unfortunate predicament as slaves to an inhuman production process. Socialism as an ideological force and trade unionism as a means of organising gave the workers real power which they exerted in the political realm around the turn of the 20th century. Converted into political praxis, this power brought into being social democracy (including liberal democracy) and 'actually existing socialism' that became the predominant political systems in the countries of the North throughout what, above, was characterised as 'the short 20th century'.

Social democracy and in practice also 'actually existing socialism' became methods of containing the more sophisticated ways in which workers organised against their disempowerment as industrial workers: rather than a liberation that would end in their

[77] The classic analysis of recent times is that of Braverman (1974)
[78] See EP Thompson's (1964) classic *The Making of the English Working Class.* But also analyses by Eric Hobsbawm (19…, 19...) of aspects of industrial development in Britain in the 19th century.

freedom, as Marx put it, *"to hunt in the morning, fish in the afternoon, rear cattle in the evening, criticise after dinner",* it gave them the welfare state which continued to deny them any significant degree of determination over what should be produced and how: power, in other words, over the way in which their lives are created. As portrayed by Charlie Chaplin in the film 'Modern Times', Fordist production was at least as monotonous and deskilling - disempowering - as, if less arduous than, the 19th century mode of organising the production system.

The break-up of the Fordist mode of production became possible through the direction in which technology was evolving in the middle years of the 20th century: transport and communications and the automated control of the production processes. In fact the break-up started slightly before the implementation of these technologies, with the emerging system essentially demanding and steering the technological changes. Industrialists decisively broke the mass unions in Japan already in the 1950s, with force on one side and on the other encouraging engagement of the workforce in decisions with regard to the improvement of the production processes. It was in part the nature of Japanese social relations and outlook that allowed the subsequent dismembering of Fordist production units giving way to the system of 'just-in-time' subcontracting that gave workers the freedom to organize themselves in their own units. However, these are fragmented into units producing particular parts of whatever item their erstwhile employer produced, with, in addition, no security against fluctuations in market demand for their work. Introduction of automation completed the task, removing all but a rump of workers from direct contact with the core production processes.

The return of liberalism in the United States and the UK came in the light of these new possibilities to remove categorically the danger that workers might be able to make demands by using their mass power over the production processes. Margaret Thatcher made no secret of her aims in restructuring the British economy. Whilst liberal theory might be a convenient screen for the crudity of the social engineering, enough was said and the actions taken were more than enough to make clear what was intended. The labour unions and the power which these gave the working class had to be broken. Their main strength lay in three industries: the railways, the ports and above all in coal mining[79].

The means to undermine this power lay in two directions: to displace these industries – conveniently in the ownership of the state - altogether and, directly linked to this, to promote technologies that would facilitate this. The precipitate drop in employment in these industries in the UK over the 1980s speaks volumes. Automated mining machinery introduced in new mines whilst closing the old, labour-intensive mines; containerisation and roll-on roll-off shipping; and the reduction of the extent of, and employment in the railways - transferring transport to the roads (individualised vehicles making organisation of the workforce difficult).

The directions in which production technologies develop is certainly not *only* determined in this manner but it is important to see the strategic role that technology has played in these social power struggles and not to be naïve in imagining that it is simply some general competitiveness that drives the process along. Nor should the analysis of the social impacts of technologies be blind to these manoeuvres and imagine that everyone is good-hearted and wants only to do the best for humanity.

[79] In 1973, a strike of the coal miners precipitated the fall of the then Conservative government and it was the vindication of her party, so humiliated by this event, which inspired Mrs Thatcher's strategy to destroy the industry which provided the workers with the basis of their power as well as their employment.

It is necessary in this light to look now in a more focused way at the general problematic in which extreme productivity, made possible by IT and being implemented throughout global industry, is affecting changes in social patterns and relations on a global scale. Earlier it was noted that there had been concern in the 1980s that the spread of IT in production and distribution industries would create unemployment in northern countries. In practice, there has been incipient high but also fluctuating unemployment in these countries. The shift to service employment has, however, been relatively smooth albeit with downward pressure on incomes and widening of income differentials reflecting the increasing concentration of power over economic decisions.

In the countries of the South, however, goods produced by modern processes – whether locally or imported - have systematically undercut goods produced by traditional, less productive means. National and local economies are being hollowed out and craftspeople radically de-skilled with no hope of competing without the kind of investment needed to build modern plant and which has only been forthcoming to a degree in a few Asian countries ('Tigers'). Modern service industries cannot create sufficient employment for those joining the labour force due to declining local productive economies.

At the same time, 'structural adjustment' - more or less forced on the majority of southern governments – has been resulting in these governments also reducing employment (and social welfare programmes) and hence increasing the numbers looking for alternative work. Finally, forces working on the vast numbers who, until recently, were engaged in traditional subsistence farming are encouraging and coercing a process of flight from the land[80]. Arguably the most important force behind this momentous process is the rise in productivity on the land that is reducing the price of commodities and impoverishing small farmers – while enriching large farmers who extend their production as the poor farmers take their leave. It would seem also that influences through television and other sources of information (facilitated by technological change) are also encouraging peasants to abandon their culture. The resulting urbanisation, much of it simply consolidation of rural settlements, is in practice the attempt of these populations to enter into the commercial economy, resulting in a further deluge of those seeking alternative employment.

Essentially IT and the organisational context in which it is being disseminated has brought the global production system to a point where a relatively small percentage of the global workforce can produce and distribute almost everything we need and much more in terms of what we might desire even in the most vicarious way. Whilst, as noted above, Bacon might have enthused about the possibilities for lightening the burden of work by submitting ourselves to the discipline of science (and technological innovation), he failed to envisage how the savings in the need for work might be distributed. If we in any way believe in fairness and that all of humanity should benefit from the fruits of modern technology, then the present world is truly immoral – even bizarre - in terms of the organisation of global and indeed local societies.

Work remains – and under neo-liberalism, with its insistence on the abandonment of welfare systems, has become increasingly – the main source of income and hence livelihood for the vast majority of humanity[81]. But as work, in the sense of creating things, is rapidly declining there is a mad scramble to find the remaining jobs. The International Labour Office (ILO) refers to this as a 'race to the bottom' where whoever offers themselves at the cheapest price and is willing to work long hours, gets the job. Indeed, at this level forced labour - tantamount to slavery – and the employment of children is rapidly on the increase[82]. Over

[80] Bryceson et al (2000)
[81] Beder (2000)
[82] Ref. ILO reports

eighty percent of those seeking employment throughout Africa and Latin America cannot find employment. Without welfare systems they thus join the 'informal economy' where some kind of income might be gained though insecure and vicarious 'work', mostly selling things[83], but also providing transport services, recuperating garbage, prostitution and other low-grade services[84].

At this point it should be further noted that liberalism – the main ideological force behind the current global economic system - has embedded in it, in its original form, a fundamental callousness towards the poor, asserting that "the poor will always be with us" and, in its pure Malthusian form, that welfare for the poor is a waste of resources, or worse, encourages them to reproduce and thus broaden and deepen the pool of poverty[85]. The development agencies proclaim their primary concern today is to reduce poverty. And yet there is a studied refusal to acknowledge the direct and multiple connections between the global economic system and its underlying ideology and the escalation of poverty. Looked at clearly, it is truly absurd to fabricate 'Poverty Reduction Strategies[86]' without analysing how poverty is being created. This can only lead to treating the symptoms and ignoring the disease.

Approaches to Solving the Problems

Enough of the global context has now been sketched that we can take a fresh look at the question of AT, what role it might play and what needs to happen if, next time round, it is to 'take off'. The first thing that must be said is that this essay is not the first or only critique of the neo-liberal framework of development – or as it is being referred to in a rapidly growing literature: the critique of globalisation. However, this so far suffers from a fundamental fragmentation that fails to make the connections between the strategic and the details[87].

Thus we have critiques of the system as a whole ranging from what we might call the neo-Keynesians - prominently Joseph Stiglitz[88] – and more radically to the various members of the International Forum on Globalisation (IFG)[89]. At the detailed level, concerned in particular with the problems arising in rapidly urbanising southern countries, the 'globalisation critique' has involves a vast efflorescence of small and partial initiatives – as presented in the many hundreds of workshops undertaken at the World Social Summit (Porto Alegre).

At the same time, numbers of academics and 'aid-workers' involved with development agencies and NGOs continue to engage with life on the ground as it is, focusing entirely on small-increment amelioration measures[90]. This includes, inter alia, continuing small projects and programmes concerned with appropriate technologies. Concerning the context within which such technologies might be developed, the focus is, on the one hand, on assisting in small business development and on the other a focus on 'sustainable livelihoods'. It is sad to see how much effort is going into small business development, with no analysis of the chances which these have to survive in the larger economic context. The statistics are

[83] ILO (2002)
[84] A current joke in poor taste asks: "what is the biggest source of employment in the cities of the South?" Answer: "the main road junctions."
[85] Atkinson (2004)
[86] 'PRSP', as they are called, are the current mechanisms used by the World Bank and IMF as the bases for decisions on lending to southern countries.
[87] See Starr (2000) for a detailed analysis of the whole range of globalisation critics.
[88] Stiglitz (2000)
[89] IFG (2002)
[90] A thoughtful assessment of the current debates amongst international NGOs is presented in Eade and Ligteringen (2001)

absolutely clear in indicating that the constant extension of global markets, like a tide coming in, are progressively drowning markets for locally-made goods, with the residual being precisely the 'informal economy', growing in size but reducing in opportunities[91].

The 'sustainable livelihoods' view of the job of development assistance is one that may at least acknowledge that:

> "…the situation of poor households is determined not just by their own resources but by the economic, social and political context in which they live: global and local economic forces, social and cultural change, policy and government action. Thus a focus on poor people and their households has to be situated in a wider context.[92]"

However, there is no analysis in this literature that actually attempts to understand in any coherent way what is happening at the contextual level. The focus is simply on small initiatives that might make life easier for people in their immediate environment regardless of the tidal wave of global change that is overtaking them and, indeed, motivating their own actions.

It is unlikely that a new effort to develop appropriate technologies on any scale can go very far without there being a major sea change in the global framework conditions. It must be recognised that neo-liberal rules – euphemistically under the title of 'economic globalisation' – will have to be replaced with rules that give indigenous and local development a chance in the countries of the South. This must emanate from the North – and particularly through a thorough reform of the approach, policies and programmes of the multilateral economic development agencies. This is not the place to go into details on what this might entail beyond stating that local and regional economies have to be protected against the aggressive activities of multinational capital and the way that this is hollowing out the weaker economies. These processes are deskilling and disempowering vast populations that have no gainful activity or access to resources which might allow them to develop such activity.

This implies the emergence of focused and forceful political and social movements that could grow out of the kind of opposition which has been shown in demonstrations and alternative summits[93] in the context of G8, IMF/Wold Bank, WTO, WEF and other such global meetings of 'world leaders'. At a level once removed a new sense of what can only be called a new morality must be formulated, discussed and disseminated. This is not a question of harking back to old religions which devised their moralities in worlds which have little in common of the one we have created over the past century. We speak of a morality that addresses the actual, technical[94] as well as natural and social, conditions in which we live today. The basis of such a morality is taking responsibility for the way in which society works, in itself and in relation to nature and to the technical ways in which we transform nature for our benefit. The core belief of liberalism, that life is a struggle of all against all and that competition is a good thing must be rooted out once and for all and replaced by an deep

[91] For northern countries Harrison (1997) has clearly exploded the myth that small business might be the wave of a decentralized market economy of the future, showing clearly the process of continual consolidation of their hold over all significant economic sectors by large corporations. The author knows of no single text that provides a similar overview for the countries of the South; however, the fact that small (formal) businesses fail as fast as they are created in southern countries is widely acknowledged.

[92] Rakodi (2002, xx)

[93] It is unfortunate that public media make much of global economic summits and recently also of the demonstrations that have been accompanying these but rarely even mention – let alone present the results of – the 'alternative summits' that have been organised alongside the formal summits, presenting an alternative set of proposals for development to those discussed and presented by the 'leaders' involved in the formal summit itself. For the results of the first two attempts at 'alternative summits' accompanying the then G7 meetings, see Ekins (1986).

[94] The nearest we come to this today is in the pursuit of the very vague notion of the 'precautionary principle'!

realisation of our common human destiny – in the first instance local society - and its interconnection with the rest of nature - in the first place the local environment.

Decentralisation of political decision-making – or 'subsidiarity' - that is spoken of so much today must become a reality. However, this must extend to a realisation that it is not just government but also economic activity that needs to be decentralised fundamentally against current trends, as discussed in the central part of this essay. (Re)empowerment is not simply bringing government within reach of people, it is ensuring that they have the resources – physical, technical, organisational and mental – to bring the means of the complete range of their livelihoods back into their grasp.

Further, this implies a radical review of what is done by way of education. People have not only to have a sense of what is right and wrong for them and their immediate social and natural surroundings but also of how these work and could work within a framework of responsible common action. This might sound rather abstract. However, it is not difficult to envisage correct actions as long as such a framework becomes the accepted way of doing things. Without this framework, without a strong awareness of the need and the possibility to bring the means of livelihood within the grasp of ordinary people, the kinds of small actions being undertaken in hundreds of development projects today can achieve nothing of significance. This is in no way to say current efforts should be abandoned: on the contrary, the future has to start by building incrementally on what is already there. The point is to have a clear view of which way the process should be heading and ensuring that this is universally understood, accepted and acted upon.

The best approach to the kinds of educational reform suggested here is to undertake local planning projects and programmes that demonstrate the relationship between the concrete, immediate environment and the larger context in which it operates. Local communication fora at different levels but functionally interconnected must provide a basis for generating plans and programmes through discussion as a social self-education process. These must in some functional way involve everyone and not just those in the community who are active. Such fora have been proliferating in recent years, some localities possessing two or more overlapping and with different remits[95]. Indeed, these are already widespread in both northern and southern localities, albeit under the shadow of formal political structures that continue, as we have seen, to promote 'conventional' ideas of development, handing the lead role to private enterprise.

There has been a proliferation of planning methodologies through which these fora decide what needs to be done by way of new local initiative that will solve problems arising from the emerging situation. In the context of rural development in the South these come under such titles as 'Rapid Rural Appraisal' (RRA) and 'Participatory Action Planning' (PAR). Both in the South and the North, 'Local Agenda 21' (LA21) processes are being undertaken in several thousand localities[96]. There has been a great experimentation with a wide variety of specific ways of working through issues and problems, ranging from stakeholder and problem tree analysis, 'future search', 'planning for real' etc.[97] So far these efforts remain marginal to the general processes in which life is being organised around us. We may think of them as first

[95] The author's experience with these in southern countries included design and implementation, including national legislation, of environmental planning fora in Thai municipalities (Atkinson, 1996). Subsequently also the formulation and implementation of multi-layered fora in the 3.5 million city of Surabaya (Atkinson, 2001) which became the basis also for national legislation encouraging these to be established throughout the country. In the latter case, in the course of formulating and piloting the local fora, something of a competition arose amongst external agencies to implement their own ideas of how these should operate.

[96] www.iclei.org

[97] For a brief description of 21 such methodologies with examples of experiences with particular exercises, see Ref.

steps in realising the possible. The results generally possess little functional authority and as yet they almost always involve self-selected groups from within their respective communities with little inclination to find ways to draw in communities as a whole. Furthermore, those persons, groups and institutions already wielding power and control over resources do not feel it necessary to share this power and hence rather than participating, take decisions on the basis of their power.

This experimentation with procedure needs evaluation and development to a new level of effectiveness that begins to be seen as a possible escape route from the dismal trajectory that we see life taking today as set out in this paper. Concerning content and, to an extent, means to involve complete communities, the Chinese experience of the 1960s and 1970s has much to teach us and is worth recovering and re-evaluating. This may sound odd in view of its having been seen quite generally as a failure. However, it is precisely by evaluating and building on this, the reasons for the failures (and a proper assessment of the successes) can be ascertained and used as valuable lessons[98]. This experience has been by far the most coherent attempt to design and implement a fully participatory social and economic development process of the kind we are exploring here. What is particularly important with respect to lessons for us today is the way in which these experiments incorporated the dimension of appropriate technical development.

Once the moral framework is understood and there is a level of confidence that action within the grasp of local – and we should add sub-regional - populations is secured; once the institutional framework is there in terms of participatory planning fora, then the process can move forward.

- Two activities need to be undertaken in parallel. Firstly a kind of mutual 'detoxification' – a kind of socio-psychoanalysis - regarding the excitement of life in the postmodern world must be introduced. This will be a self-critique of lifestyles and recognition of the unsustainability and crass lack of wisdom in where our world has reached and where it is going. Communities must become aware of the problems at all levels – or bring existing unsaid concerns to the surface - and structure this awareness into effective knowledge concerning the ways in which our world is deskilling and disempowering. This will inevitably result in realisation that people within communities do possess much technical knowledge that could be used at the local level in returning gainful activity and with it power to the community.

  But at the same time it will reveal that much of the technical structure of the world around them is not understood nor is likely ever to be understood at least in a way that it could be brought into use at the local level. The aim is to bring life from the spinning virtual show in which we live today back to the ground. The 'detoxification' process does not take place prior to the planning process. It runs in parallel with it through time, delivering insights that help to steer the planning process and, at the same time, delivering information that should result in a radical restructuring of education systems that now aim, in the first instance, to empower.

- The second activity is the planning process itself. This must produce results. Short-term demonstrations of its efficacy, medium-term changes in infrastructures and long-term changes that bring tangible power over resources – knowledge, land and other primary resources, manufactured artefacts and the means to produce these – systematically

[98] The main lesson can be stated simply: that the rules, handed down from the centre were too inflexible and that as the centre became impatient with the slow progress, the pressures increased, rather then decreased this rigidity (Croll, 1993). The process must be given adequate time and localities allowed to move at their own pace, within a framework of debate between localities and at a more strategic level.

back into the hands of the population as a whole, in their communities and their spaces. Neo-liberalism frowns on planning, as being an infringement on freedoms. In practice, however, ours is a world planned like never before. Corporations plan their assaults on consumers, how they will conquer markets and vanquish the competition. Governments and international agencies plan the macro-systems that facilitate the activities of corporations: the organisation of the airways necessary for increased air travel, cellphone frequencies, motorways and a host of other dimensions of the techno-structures of modern life.

The neo-liberal deprecation of planning is but a smoke screen with the freedom that it purports to support being in practice disempowerment through the removal of knowledge and control over resources. And we can assume that the planning processes under discussion here are unlikely to be welcomed by corporate and other powerful interests. Careful watch will need to be maintained: to draw people out of the frameworks of corporate power and capital and to engage them as citizens in the process of reorganising life in a different paradigm.

Reinventing local planning in the way discussed here is designed to bring control back, incrementally, to people in their communities. As such it follows standard planning procedure in the sense of deciding strategies (aims and objectives) and then concrete programmes and projects on a range of issues, prioritising these, assessing the means to achieve the aims, including the resources required. It then distributes responsibilities for implementation and thence carries out the agreed programmes and projects, providing the resources and monitoring the work to ensure that what was planned is what is actually done. The results are evaluated to determining whether the aims have been achieved and to feed into another round of planning aimed at achieving the next step.

- In the past, local planning was conceived of as a process to design the social and physical infrastructure within which social and economic processes could operate smoothly. Planning technique became over-elaborate (systems-planning and its progeny) more as a means to provide planners with professional status than that this truly improved the end result. But, whilst during the short 20th century local and regional planning interconnected to a degree with the decisions of nationally-owned corporations responsible for certain aspects of physical production, there was never any intention to interfere with the planning of the strategies of private corporations. As these became more powerful and, particularly in the context of neo-liberalism, they have systematically asserted their influence, directly through 'privatisation' but also by more indirect means[99].

  The new approach to planning reverses this process and reacquires not only control of the planning, implementation and operation of infrastructures, but further, plans the processes of consumption and the systems of production that serve these needs. It must be clear that planning involving ordinary people directly needs to be a simpler process than it became in the hands of the planning profession – and this is precisely what has started to happen with the participatory planning experiments discussed above.

This returns us to the start of this paper: the role that AT could – indeed should - play in the future. In the earlier parts of this paper I have endeavoured to show how our world has become increasingly organised around technologies and these have come to play a determining role over life. My concern is how these have become the means to deskill and

[99] Korten (1995) analyses how corporations are influencing priorities in education, health care and indeed in all aspects of what hitherto were realms of public decision-making. Strategically this is completed through control and influence of the media (Herman and Chomsky , 2002)

disempower people in all parts of the globe. This has been true whether they are reasonably affluent and able to afford the full offer of the consumer society or whether poor, able to afford little and, to boot, deprived of the very possibility of work that might earn them the living that would enable them to participate in the consumer society.

AT, broadly interpreted to include the context within which it will be produced and used, will be a core issue of the new planning processes – perhaps unearthing the attempts made in the appropriate technology movement to define ahat, in fact, might be appropriate for a world that works[100]. There is nothing inherently wrong with a world in which technique plays a central role. The issue will be to ensure that it is controllable in terms both of being understandable for the average citizen who is educated to understand it and that the citizenry as a whole is in a position, possessing the skills, to maintain physical control over its production and use. In no way does this mean walking back through the recent processes of technological development. We can certainly benefit greatly from much of what has been invented and implemented in recent years – and indeed build on this in ways which have sometimes been inhibited by corporate goals and strategies (technologies that use less energy and materials, less than profitable medicines and foods, etc.). But it will certainly mean the abandonment of some technologies that are dangerous, unnecessary outside the framework of profit-making and inherently beyond the capacity of local or sub-regional communities to exert control.

It would seem prima facie that local approaches to technology development in the context set out above will produce very different results in different cultural contexts. This was, indeed, the assumption of the AT movement. However, at the time most of the literature assumed that, in the end, everyone will achieve modernity and with it 'benefit' from 'modern' technologies; this was assumed to be just a question of time. The main objection emanating from the 'underdeveloped countries' at the time was, indeed, that technologies that are appropriate for the North are equally appropriate for the South and that so-called 'appropriate technology' was an insult to their development aspirations. That modernity should be a universal aspiration was assumed equally by Schumacher, Furtado and Mao Tse Tung.

It was only the more radical technology movements of the northern countries that started the questioning of where 'development' is leading us, that was followed by a growing critique of 'development' as such[101]. In the context of the path set out above, different cultures, different environments and different ways of life should again produce different technologies. This follows a logic of the past that can still be see today as the way in which vernacular architecture and urbanism produced in different places produced forms that evolved out of particular cultures, environments and lifestyles[102].

Of course the above sketch is merely a proposal. It says that if efforts move in this direction, namely the continued development of the 'alter-globalisation movement' on the one hand and the formation of increasingly effective local planning fora, that a new sense of responsibility for our destiny comes into existence, then there is a chance that the direction the world is taking can be altered. Things can, however, continue along the present route, with southern countries descending more or less to the level of Somalia[103]. Here government barely exists and incipient civil conflict rules, there is virtually no indigenous industry and around eighty percent of the potential workforce is either unemployed or in the informal economy. Most of the male population is almost permanently under the influence of

[100] More thoughtful contributions included: Dickson (1974), Bodington (1978) and Riedijk (1986).
[101] Norgaard (1994), Rist (1997), Sachs (1992), Wolfe (1996)
[102] Oliver (1997)
[103] Atkinson and Couté (2003)

the drug Quat with the well-off ‘enjoying’ life with Land Cruisers and handphones. The country lives almost entirely on a combination of foreign donations and remittances by Somalis working in the North. It is often suggested that the only way that real progress will be made is when the system as a whole receives a major shock – and there can be no doubt that the accident at Chernobyl in 1989 was the kind of shock that was capable of bring to the surface a greater sense of the danger of our development path.

Even if there is a turnaround, sudden or more leisurely, there is a long road to travel. The sooner the direction of the route is changed, however, the surer we might become that the ever more dangerous route down which we are currently travelling will be abandoned. In the end, if we are to master the business of technology control, then it will inevitably be at a relatively local level with each locality living largely within the limits of their own physical resources. But we will have achieved the results hoped for by Bacon and others across the 17th and 18th centuries who initiated the process of scientific and technological discovery with an optimism of the benefits it could bring to humanity. Life *can* be leisurely and sustainable for all. But our fate can no longer be laid at the door of unknown forces of nature or God or a simplistic global development philosophy. Rather it must rest on the achievement of the wisdom and equanimity of a society that consciously regulates its own internal functioning and, above all, its relations with the rest of nature.

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