STRATEGIES FOR ALTERNATIVE TECHNOLOGY ASSESSMENT
IN THE INFORMATION SOCIETY

by

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ABSTRACT

Conventional technology assessment strategies are based on the premises that

1) the tools of scientific technology can reveal potentially undesirable effects of individual technologies, and

2) the collected findings of such studies will constitute an adequate check on technology qua technology.

The effect of the former is to deny the ability of ordinary people to decide about technology; the effect of the latter is to render technological growth uncontrollable.

A review of the literature of both dystopian and utopian critics of technology reveals a false dichotomy and suggests the need for a third position. To address that third position, the thesis employs Ivan Illich's concept of convivial technology which holds that technologies may be socially functional up to a critical threshold, beyond which dysfunction sets in.

However, since Illich fails to provide a concrete strategy for locating such thresholds, an alternative model of technology assessment is developed, employing the concepts and practices of appropriate technology. From that model, four specific tests are derived. The model suggests both an analytical framework for testing technologies for conviviality and a process that returns the right to the community to accept or reject them.

It is argued that an alternative technology assessment tool should be useful for post-industrial applications. Accordingly, the efficacy of the derived model is tested on the emerging information technology -- videotex/Telidon. The preliminary test strongly suggests that videotex/Telidon significantly exceeds the threshold of information technologies.

The study concludes that an alternative strategy for technology assessment is practical and suggests areas of contingent concerns for future research.
DEDICATION

For

DONNA MOFFATT

and the memory of

KAJ OLSEN
Many years ago, the good burghers of Warsaw discovered a special clay out of which they could mould a man-like servant whom they called the Golem. After fashioning the Golem, they would write 'emeth' (truth) on its forehead, thus bringing it to life. Every day it grew larger and every day it could perform even greater tasks given to it by its master, for the Golem was completely under the control of whoever made it.

When it became too large, the master would reach up and erase the letter 'e' from its forehead to rend the word 'meth' (death), and the Golem would collapse into a lifeless heap of clay at the master's feet. It was then a simple task to fashion a new one.

One day, a careless master let his Golem grow too tall for him to reach its forehead. As it continued to grow, it threatened injury and damage to the master's property and might even have killed him -- not because the Golem was evil, but because it was out of scale for the master's world.

In desperation, the master ordered the Golem to bend down and tie his shoe laces. When the Golem complied, the master quickly erased the 'e' from its forehead and the Golem collapsed on the master, crushing him to death.

Anon.
As with all who enter late into academic studies, I owe much to many unnamed friends who encouraged, criticized, tolerated my efforts and patiently outwaited my conceits.

Congratulations are also due to those of my teachers who triumphed over educational technology to actually help me to learn.

Finally, my special thanks to fellow students who gathered around at a mid-thesis crisis in conceptualization and hoisted me over the barrier.
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INTRODUCTION

There is a pervasive sense at large that the industrial era is being displaced by one characterized by the prominence of information based on electronic technology: an information society.

The literature suggests that the transition will be at least as radical as that which marked the rise of industrial society from the agricultural era it displaced.

In each of these transitions, pivotal technologies emerged as the engines of change. Moreover, it is technological changes in the old order that give rise to the possibility of the new. For example, it has been persuasively shown that agricultural technologies such as the chisel plough, crop rotation and fencing of the commons produced sufficient food surpluses to permit the rise of labour-intensive industrial technologies. They in turn yielded even more efficient agricultural tools. In the current transition it can be shown that solid-state and micro-circuitry industrial techniques are necessary minimum technologies for the emergence of an information dominated technology. It too renders industrial processes more efficient.

The popular notion of the difference between the two shifts is that modern citizens are more conscious of the role of technology in shaping their lives. While the actions of the Luddites question that perception, what can be seen as substantially different is the degree of complexity of the issue arising from the extent to which technology pervades the social milieu and thus alters consciousness about itself.

Out of this consciousness comes an awareness of either the impact of technology or the opportunities it offers. While one segment of critical society sees technology as a threat to human autonomy, another sees it as potentially liberating mankind from toil and want.
The dystopians, like Rousseau, seem to see humans as essentially free, spontaneous and "real" until they are overwhelmed by the trappings of society. The utopians tend to start from Hobbe's view that the apparatus of state can remove mankind from savage competition, lengthen life and reduce scarcity. The literature of the dystopians concentrates on analyses of the relationship between technological developments and restrictions on human autonomy, while that of the utopians searches for the promise of greater human strength through technology.

What they share in common is the belief that technology is at least a major, and for some the exclusive, determinant of the human condition.

Accordingly, both sides wish to be able to make rational purposive decisions about the directions technology should take. Both persuasions can therefore be said to favour some process by which technologies can be assessed for the possible impacts or the opportunities they present.

Even in the midst of this agreement, disagreement occurs. Consistent with their belief in autonomous mankind, dystopians search for human control of the assessment process; utopians tend to rely on social technologies to carry out that process.

This thesis holds that there is a third position that borrows a bit from the positions of both protagonists.

Essentially, the third position states that technology offers liberation from toil and want -- up to a critical threshold point, beyond which technology begins to restrict human autonomy. In short, once the threshold is breached, previously functional technology becomes dysfunctional.
Thus, the task of technology assessment becomes one of locating the threshold and rejecting all technologies that exceed it.

However, technological mankind already exists. Technology has shaped the habits and expectations of all people to the extent that judgments about where to place the threshold are not free of technocratic influences.

What is needed is a decision-making mechanism that can incrementally de-technologize human perceptions, a technology assessment strategy that can invade the collective consciousness. To fail to do so will be to shift from autonomous humanity to autonomous technology.

To unfold the case, this thesis will examine the literature of both dystopia and utopia before setting out the third position. A tentative assessment model can then be derived which will be tested against an emerging information technology. The contingent questions that emerge and which are beyond the scope of this treatment can then be identified for future studies.
CHAPTER I

The changeover to free industry, based not on tools and craft processes alone, but greatly aided by labour-freeing machines, began around the tenth century, and was first marked by a steady increase in the number of watermills in Europe. As early as 1066, when William the Conqueror seized England, there were 8,000 watermills, serving less than one million people. At the very modest estimate of 2.5 horsepower per mill, this was twice the energy that was available through the assemblage of the 100,000 men who built the Great Pyramid, and probably more than twenty times in relation to the population of their respective countries.

Lewis Mumford, The Myth of the Machine

The Dystopians:

The basic premise underpinning the dystopian viewpoint is that technology is in some way self-perpetuating, that it alters human awareness of what is possible. In its most radical form, the dystopian position holds that technology has a life of its own and is therefore nearly completely autonomous.

Without a doubt, Jacque Ellul presents the most radical and unequivocal statement of the dystopian view. Not only is technology operating free of the control of mankind, but we are becoming its subjects.

Let no one say that man is the agent of technical progress ... and that it is he who chooses among possible techniques ... He is a device for recording effects and results obtained by various techniques ... He can decide only in favour of the technique that gives the maximum efficiency. (1)
This state of affairs does not arrive because technology has fallen under the heavy hand of a dictator or a ruling elite. It arises because human consciousness is formed by technology, in the interest of technological progress.

Furthermore, the process is largely irreversible. Ellul allows only three possible events that might reverse the trend:

1) If a general war breaks out, and if there are any survivors, the destruction will be so enormous, and the conditions of survival so different, that a technological society will no longer exist.

2) If an increasing number of people become fully aware of the threat the technological world poses to man's personal and spiritual life, and if they determine to assert their freedom by upsetting the course of this evolution, my forecast will be invalidated.

3) If God decides to intervene, man's freedom may be saved by a change in the direction of history or in the nature of man. (2)

Such a radical analysis requires a careful reading of his line of reasoning.

First of all, it is imperative in understanding Ellul to separate the machine from technique. Technique is the systematic organization of the entire human environment into rational, purposive methods and ends. It is the sum of all individual techniques which have been used to secure any chosen ends. It is conscious, flexible, efficient, numerical. Technique has become an end in itself with mankind but a component of its autonomous force. It is global, universal, monolithic.

It takes what was previously tentative, unconscious and spontaneous and brings it into the realm of clear, voluntary and reasoned concepts. (3)
In Ellul's view, the machine itself is not the problem, however much it may contribute to the process. What technique does is to heighten the problems brought about by the machine, but it does not descend from or depend on the machine for its existence. To rely on refinements of organizational technique in an effort to control the abuses of the machine, such as might be proposed by environmentalists to control the machine, is to employ the methods that created the problem in the first place.

*This is the age-old procedure of digging a new hole to fill up an old one.* (4)

He divides technique into four branches:
1) Mechanical technique is the familiar machine, which he says confuses by its very visibility our understanding of technique.
2) Economic technique is the practices of production, ranging from labour organization to long range economic forecasting.
3) Organizational technique arranges and records the 'things' that make up the built environment, such as information, people, resources, structures and so on.
4) Human technique is employed in medicine, propaganda, education and all realms of activity that make man himself the object.

Although he doesn't make the case explicitly, implicitly what renders technique problematical today is the rise to dominance of the latter three branches, particularly human technique.

Ellul provides a useful framework for analysis by developing a schema that points to the confluence of five critical factors that account for the quantum leap of technique that resulted in the birth of technological society.

*I feel that this transformation of civilization can be explained by the conjunction in time of five phenomena: the fruition of a long technical experience; population expansion; the suitability of the economic environment; the plasticity of the social milieu and the appearance of a clear technical intention.* (5)
Each of these historical factors has been centrally treated by classical social critics such as Marx, Weber, Malthus and Tonnies. Ellul's thesis is that they needed to occur together in order to give birth to technological society.

The obvious question that follows is what generated the rise to prominence of each of the five factors? Ellul professes not to know.

Of course, it might well be said that the first phenomenon -- accumulated technical capability -- may account for all of the others. For instance, it has been claimed by James Burke (6) that the invention of the modern plough and related agricultural techniques was an essential step in creating sufficient food surpluses to permit the freeing of agricultural workers for industrialization as well as allowing population to increase. In turn, the invention of the more modern moldboard plough had to await the development of suitable materials for which high temperature energy technologies were needed for fabrication.

Nevertheless, his requirement for confluence of several critical factors does answer the question about why early inventions such as steam power, gunpowder or submarines, all attributed to pre-industrial inventors, did not immediately result in practical applications.

According to Ellul, one of the powerful agents of the growth of technique was the rise of the state and its inevitable adoption of organization technique. He characterizes the rise of this phenomenon with the example of Napoleon's government.

This systemization, unification and clarification was applied to everything -- it resulted not only in the establishment of budgetary rules and in fiscal organization, but in the systemization of weights and measures and the planning of roads. All this represented technique at work. (7)
Here we see a clear example of the importance of organization technique and a concrete example of Ellul's assertion that technique has to be distinguished from simple machine technology. (Critically, it must be pointed out that a similar degree of state use of technique was found 2,500 years earlier when the Egyptian kings mobilized a vast army of workers, supervisors, craftsmen, farmers, scribes and soldiers to erect their great architectural works long before the technological society can be said to have emerged.) (8)

The rise of what Ellul calls social plasticity -- the most decisive of his five congruent phenomena -- has been thoroughly documented by Tonnies and Weber. Essentially, the thesis is that an organic, integrated, land based, normative ethic gave way to one characterized by dissociation, individualism, flexibility and mobility. Not only does such a value shift engender tolerance for organization technique, it even demands it. Seen in the light of Hegelian dialectics, it is easy to see how technique begins to insert itself at every social intersection.

What role did population growth play? Did it generate the need for the machine, or did the machine permit population growth? Ellul does not say. It is only necessary that population pressure be present at the same time as the other phenomena. Its function is to put pressure on continuing technological growth.

Much less easily demonstrated is his requirement for the rise of technical intention, by which he means,

... the will to attain certain ends, application in all areas and adherence of the whole of society to a conscious technical objective. (9)

Certainly, plasticity of the social milieu is a necessary condition. Is it also sufficient? Not according to Ellul.
He has earlier identified the other four conditions that must be present before technique begins to characterize society to the extent that it may be said to be essentially technological in nature. If we turn this over-all argument around, it becomes clear that the absence of technical intention would render technique and technology amenable to change by such simple expedients as statutes or public education programs which would not have to encounter entrenched values and expectations.

The problem as Ellul sees it is that a bent towards technique has become ingrained in the values and ways of thinking of the masses to such an extent that it is unthinkable for people to adopt any other mode of behaviour. It is this characteristic of technique that makes it practically irreversible.

The last piece that weaves technique firmly into the fabric of society is the marriage of science and technology which occurred in the twentieth century. As a result of all of these forces,

Technique has penetrated the deepest recesses of the human being. The machine tends not only to create a new human environment but also to modify man's very essence ... He must adapt himself ... to a universe for which he was not created. (10)

Technical intention, then, becomes assimilated into the very being of man. As a result, he begins to become amenable to the last frontier of technique -- human technique.

For Ellul, human technique is nothing less than the invasion of an alien force into the spontaneous, natural, sensate being to render it rational and subject to mediation and therapeutic re-construction. For human technique to become universal, a body of rational explanations for human behaviour becomes necessary. Sciences of mankind's motivation, aspirations, delusions, habits and deviations begin to emerge.
Eventually there arises a body of behavioural theory -- endorsed by scientific credibility borrowed from the already proven physical sciences -- which becomes accepted as truth, as the only truth, by its very subjects. The technical language of Freud, Pavlov, Durkheim and Darwin becomes ordinary language. Parents begin to raise children not according to normative rules inherited from their own roots but by scientifically proven techniques.

If these scientific descriptions of human behaviour are to have predictability, people must be transformed to fit the model: mass man comes into being through the instrument of technique -- at a great price:

But to become mass man entails a tremendous effort of psychic mutation. The purpose of the techniques which have man as their object, the so-called human techniques, is to assist them in this mutation, to help to find the quickest way, to calm his fears and re-shape his heart and brain. (11)

What makes the inexorable advance of human technique disturbing is not that it is the tool of some malevolent human agency, some dictatorship, but that it is willingly entered into by its subjects in pursuit of happiness and well-being without awareness that the process is essentially irreversible and that it entails the risk of maladaptation.

In attempting to understand Ellul on technology it is essential to understand that last point. His Catholic biases do not overwhelm his critical faculties; he is not simply saying that a wilful evil force is threatening to overwhelm mankind from outside of himself. What he fears is that technology has developed at the hand of people and that the process is not only irreversible but also benign. Only the end result is destructive.
With the final integration of the instinctive and the spiritual by means of these human techniques, the edifice of the technical society will be completed. It will not be a universal concentration camp for it will be guilty of no atrocity. It will not seem insane, for everything will be ordered, and the stains of human passion will be lost amid the chromium gleam. We shall have nothing more to lose, and nothing to win. Our deepest instincts and our most secret passions will be analysed, published and exploited. We shall be rewarded with everything our hearts ever desired. (12)

While perhaps holding the most radical dystopian perspective, Ellul is by no means alone.

Herbert Marcuse, for example, working from a somewhat less metaphysical outlook, arrives at an equally dystopian position. He also sees technology as having captured mankind and his institutions, but is less inclined to see it as inherently corrupting. Nevertheless, it has given rise to a neurotic form of humanity that he calls one dimensional which, in turn, tends to produce a totalitarian society. The prospect of society breaking away from this voluntary submission to the machine is not hopeful.

How can the administered individuals -- who have made their mutilations into their own liberties and satisfactions, and thus reproduce it on an enlarged scale -- liberate themselves from themselves as well as from their masters? How is it even thinkable that the vicious circle can be broken? (13)

Like Ellul, Marcuse sees the hegemony of technology as sufficiently entrenched to resist fundamental change; all that is likely is that technology can tinker with its subordinate institutions to diminish the will to dissent.

Nothing indicates that it will be a good end. The economic and technical capabilities of the established societies are sufficiently vast to allow for adjustments and concessions to the underdog, and their armed forces sufficiently trained and equipped to take care of emergency situations. (14)
Theodore Roszak also repeats the theme of self-denial of humanity through the instrument of technology:

It is not easy to question the thoroughly well intentioned, but nevertheless reductive humanism with which the technocracy surrounds itself without seeming to speak a dead and discredited language. Especially so if one admits -- as I do -- that it may well be within the capability of the technocracy to utilize its industrial prowess, its social engineering, its sheer affluence and its well developed diversionary tactics to reduce, in ways that most people will find perfectly acceptable, all the tensions born of disorganization, privation and injustice which currently unsettle our lives. (15)

Unlike the others, Roszak sees the prospect of a popular uprising of human consciousness, such as Ellul mentioned as his second contingent variable, and predicates his study of the counterculture on the possibility that it has started.

The fact that he may have staked too much on a seemingly transitory phenomenon should not discredit his thesis that a revolutionary consciousness can arise as a contradiction of the prevailing ethos of technocracy. The question begs an answer: whether that is a logical proposition or even an empirically demonstrable one remains for history to comment on.

To sum up: The dystopians have adequately made their case that, to the extent that any era can be characterized, at least the northern people of the world presently live in a technological society. Whether it is capitalist, socialist, industrial or cybernetic, it is above all technocratic. They have also effectively argued that technology is more than just the ubiquitous machine. This is so because the essence of technology is its base in a rational system that makes the universe largely predictable. The root of this rationality is the so-called scientific method. Because of that foundation, technology attempts to master the natural world, to control it for mankind.
Because technology dominates all of the environment, it also dominates mankind. This assertion is supported by evidence that people adapt their behaviour to the rational systems that they rely on to make life more orderly and comfortable: the clock, bureaucratic rules, the machine and so on. To the extent that such adaptations limit human freedom, technology oppresses people.

A more contentious assertion is that, because it requires us to adapt ourselves to the machine, technology alters our essential character, requires us to be re-made to suit the machine. Out of that re-making comes a set of values and behaviours that is unique to technological society. It even becomes acceptable to employ human technique to ensure the fit between mankind and the machine. In that very special sense, technology becomes autonomous, reducing the opportunities for humans to escape the vicious circle.

The Utopians:

The radical utopian position is not to be found in the inclusive theoretical form that Ellul provides for the dystopians. Nevertheless, the utopian position is clear and the assumptions underlying it are not difficult to extract.

Briefly stated, utopians hold that technology has begun the process of freeing humanity from want and its attendant conflict. While transitional difficulties are unavoidable and even dangerous, in the end technology offers the real and imminent hope of salvation of mankind. There is no sense among utopians that technology is inherently dangerous in itself; only humans are, and technology can reduce that danger.

The case is put most concisely by Herman Kahn. He says the world is presently at about the mid-point of a "Great Transition" which began about 1775 and will be completed by about 2175. (16)
He bases that observation on what he sees as an essential characteristic of history.

We tend to emphasize continuities more than discontinuities because we believe that history is relatively continuous, that institutions and other social constructs are grown rather than created overnight, and that almost every aspect of tomorrow's society will have historical roots. (17)

He also reveals in his writings a characteristic that is frequently found among empiricists: the notion that his studies are somehow value-free and free therefore of the alleged corruptions of politics.

All our conclusions -- optimistic or otherwise -- are the results of our studies and considered judgments, and not of wishful thinking, political ideology or an attempt to provide an inspirational message. (18)

The message is clear then. The world is unfolding in a continuous fashion which is technologically progressive. Critics who hold other views are relying more on faith or ideology than on careful analysis of the facts and speak in a "dead and discredited language." While there is surely evidence that technology can do harm, it is not inherent in its character, only the result of bad luck or inadequate management of technique.

However, there is a hint that the process by which technology unfolds is in some way inexorable. Putting the best face on that inevitability, there is every reason to believe that it will work for mankind.

Humanity should go ahead and take its chances because the prospects are so exciting, because it is still probably safer to go ahead than to try to stop prematurely the growth process, and because it is impractical to do anything else. (19)
What is the nature of the utopian society after the Great Transition? Kahn's analysis is essentially economic. He says the world will enjoy an increase of real income of something like ten times the current levels: the Advanced Capitalist Nations like the United States will enjoy even higher levels of income. Indeed, the level of affluence will be such that the principal problems of consumption will not be of choices among scarcities but choices of abundance: want will be eliminated.

Like Ellul at the other end of the continuum, Kahn sees the rise of services and activities that bring man himself into the realm of technology. The difference, of course, is in the way in which each describes the relationship between man and technology.

Kahn describes his "quaternary" economic system, which is destined to follow the service or tertiary system, as freeing people from onerous work but giving rise to occupational roles that service people's social and emotional needs.

Such high level personal service roles as teacher, psychiatrist, doctor, author, priest and public entertainer will increase. (20)

He does not ask what might be the effect of the use of human technique or what role technology plays in making such services necessary. Nevertheless, he does seem to agree that technology will alter the nature of mankind, mostly by relieving economic imperatives. Here we see the notion that conflict and meanness are the result of competition for scarce resources and will disappear with the advent of abundance.

The keystone that supports Kahn's whole case lies in his readers' ability to accept a number of assumptions which he says are both commonsensical and widely accepted. These assumptions
hold that technology is inevitable, risky, amenable to some degree of intervention (contradicting its inevitability?) and therefore demands universal commitment. Finally,

It is simply untrue that there is no possibility of having an attractive, human, high quality, affluent technological society. (21)

Being commonsensical, these assumptions are not supported by evidence. What is revealing about the list, and Kahn's sense that people generally agree with it, is the fundamental value that holds that technology is at least benign, if not absolutely beneficial; that its growth is nothing more than the increasing progressive development of mankind.

To summarize Kahn's essentially economic argument, two core theses can be derived:

1) A rational, logical analysis of the evidence indicates that technology is on the march and there is no good reason to expect it will be interrupted.

2) There is no reason why it cannot be shaped to serve human ends and provide for an egalitarian, free and wealthy society.

The second assertion is made in spite of his earlier judgment that the so-called Advanced Capitalist Nations will be many times richer than the rest of the world. Presumably, since abundance will prevail, disparities of income will be unimportant.

For a more mechanistic case of the extreme utopian position, we turn to Arthur C. Clarke. Clarke's interests are only technical: he undertakes no analysis of the impact future technologies may have on society. Nevertheless, he too is operating with some assumptions, the most obvious of which is that there is no human limit to technological innovation. In fact,
Anything that is theoretically possible will be achieved in practice, no matter what the technical difficulties, if it is desired greatly enough. (22)

The absolute elimination of want and suffering his forecasts seem to promise cannot possibly leave any doubt about how greatly they are to be desired.

From the perspective of a scientist and a futurist, Clarke presents a solid, if speculative, case for an unprecedented rise in technological innovation between now and the year 2100, nearly perfectly matching Kahn's Great Transition period. In short, his evidence offers a reasonable prospect, based on the rise of technology over a 300-year period beginning in 1800, of universal liberation from the constraints of the natural world. (23) If the technocrats can resolve the energy demands of such technologies and if their use for destructive purposes can be prevented, utopia becomes tantalizingly possible.

Given such a vision, it is little wonder the utopians grow impatient with the Cassandran doubts of the dystopians. Nevertheless, it is perfectly legitimate for the dystopians to ask what happens to people in this Elysian march.

Since utopians seem to agree with their critics that human technique will be increasingly important, it will be instructive to see how a utopian deals with the ethical questions it raises.

At least one of them has attempted to address those questions. As B.F. Skinner sees the future, man in his present form is a hindrance to his own prospects, perhaps even a danger.

*In short, we need to make vast changes in human behaviour.* (24)
The popular conception of man as being free and having dignity -- autonomous man -- arises from ignorance and failure to see ourselves from the perspective of the scientific method.

Autonomous man is a device used to explain what we cannot explain in any other way. He has been constructed from our ignorance, and as our understanding increases, the very stuff of which he is composed vanishes. Science does not dehumanize man, it de-humanculizes him, and it must do so if it is to prevent the abolition of the human species. (25)

We have failed to apply the scientific method to the study of man. As a result, our advances in technology raise the risk of man destroying himself with his tools.

What we need is a technology of human behaviour. (26)

Autonomous man is still an important and dangerous figure in politics, law, economics, religion and a host of other domains that are critical to the future of mankind.

For Skinner, control of human behaviour is a scientific fact and not a bogeyman to be exorcized. The question is not whether control over people is being practiced, but by whom and to what ends.

There exists a large body of literature and myth that has taught people to believe in their own autonomy: their ability and right to be free. Yet no one is free of behavioural constraints and the belief that freedom is possible is dangerously misleading. What is more, it prevents us from developing rational and effective countercontrol methods.

A preference for methods which make control inconspicuous or allow it to be disguised has condemned those who are in a position to exert constructive countercontrol to the use of weak measures. This could be a lethal cultural mutation. (27)
It is theoretically possible, he says, to engineer a society that avoids destructive behaviours and rewards those that advance society. While it is not possible now to design anything like a perfect society, we have enough tools in the technology of human behaviour to begin in a piecemeal fashion. Like Clarke, he sees a clear theoretical framework for proceeding, secure in the faith that the means will thereby be found. Because we have the key tools to begin the process, the end result must be sanguine.

*Our culture has produced the science and technology it needs to save itself.* (28)

To the charge that such engineering, if successful, would forever stop growth and change, Skinner answers that it is possible to design for variety. Furthermore, variety in the past has been a byproduct of an otherwise destructive accidental process on which we cannot afford to continue to depend. Of course, such engineering might be employed for corrupt purposes. That is not sufficient reason for remaining ignorant since such controlling has always been practiced and we have lacked the knowledge to raise effective countercontrols.

The literature of freedom and dignity has taught us to fear or despise the cultural manipulator as if he were interfering with some innate or natural quality of the human condition.

*The designer of a culture is not an interloper or meddler. He does not step in to disturb a natural process; he is part of a natural process.* (29)

The natural process has led mankind to the secret of the scientific technique and it is only natural we use it on ourselves.

As for the complexities of the distinctively human mental processes, they are nothing more than a finely tuned set of contingencies of reinforcement.
The processes of discrimination, generalization, abstraction, memory and association which we call cognition are conceptual constructs derived from observable responses to environmental contingencies. Since we did not understand their internal workings, we adopted labels or language codes to explain them. Man is entirely made of his environment, including his own physiology. In the end, the increasingly sophisticated tools of human technology will permit society to control all of his behaviours. After all,

*Man is a machine in the sense that he is a complex system behaving in lawful ways* ... (30)

To his critics, distressed by this formula, Skinner offers the prospect of becoming whatever we wish to be.

*Man himself may be (is) controlled by his environment, but it is an environment which is almost wholly of his own making.* (31)

Inevitably, the question arises: what values will determine what we ought to become? In Skinner's formula, value is the code word for a set of behaviours that a society adopts which seem to ensure continued survival. Such behaviours become organized in some kind of code or norms for transmission to the society's newer members and usually carry sanctions for non-conformity. Historically, such codes -- often carried in myths or other irrational vehicles -- have been based on ignorance. With the prospect of the systematic application of the scientific method, rational bases can now begin to displace the irrational.

Unlike many other utopians, Skinner has carefully and systematically dealt with the values that inform his theory. Indeed, such explicitness has led to much of the abuse he has taken for his theories.
Skinner's position is easily summed up. If we don't engage in a scientific study of man and develop from it a body of human technique, we can make no use of our full technological potential and may even employ machine technology to destroy ourselves.

To sum up: The utopians agree with the dystopians that we live in a technological society. They also agree that the essence of technology is its roots in a rational system that makes the universe predictable and the future promises more of the same. They further agree that it is possible for mankind to dominate the natural environment. Here the two positions diverge.

For the utopians, it is not only possible but also desirable to do so, towards the very feasible goal of ending scarcity. It is only fair to point out that utopians are not simplistically putting blind faith in technology to solve all problems without giving rise to others. In fact, most are quick to recognize the possibility that technology may be abused by mankind, resulting in a possible catastrophe. For the true utopian, that risk merely points up the need to get on with better management of human technique.

To analyze the evidence in support of their otherwise optimistic position the utopians employ the very method they say characterizes the technological world: science. Those who rely on other means are relying on pre-scientific reasoning and are therefore bound to reach the wrong conclusions: they do not see the objective proofs that surround them.

While there is no significant disagreement about the tendency of technology to shape human relations and values, the utopians see this as an opportunity to improve people rather than as a threat to oppress them.
The Synthesis:

The key to understanding the debate between dystopians and utopians is the question of autonomy, either of man or of machine. Since both sides agree about the pervasiveness of technology in human life, a judgment of the dispute will depend on whether we accept that either mankind or machine is or can be autonomous.

Skinner's carefully articulated argument against autonomous mankind is difficult to turn aside unless, of course, one rejects out of hand his mechanistic view of human behaviour.

The answer to that dilemma lies in the vastly philosophical domain of the Nature of Man debate and is far beyond the scope of this thesis and subject to intensely personal judgment.

If that question must remain unanswerable, the question about the autonomy of technology does not. The theme of 'technology out of control' -- so clearly developed by Ellul and others such as Marcuse, McLuhan, Galbraith, Goodman, etc. -- seems on the surface to be attributing to technology nearly animistic qualities and thus discredits the idea of autonomous technology.

But there is another sense in which technology can be autonomous.

For most ordinary people, the life supports that sustain them are so vastly complex and often so distant from them both physically and politically that they simply cannot comprehend the network. Koestler describes the relationship between the citizen and the network this way:
His relationship to the objects of his daily use, the tap which supplies his bath, the pipes which keep him warm, the switch which turns on the light -- in a word, to the environment in which he lives, is impersonal and possessive ... Modern man lives isolated in his artificial environment, not because the environment is evil as such, but because of his lack of comprehension of the forces which make it work -- of the principles which relate his gadgets to the forces of nature, to the universal order. (32)

In fact, much of our current technology, including human technique, is deliberately designed to permit ordinary people access without having to understand its inner workings.

The common telephone is a ready example. Telephone technicians, aware of the vastly complex central office machinery that makes up the system, are tolerantly amused by the subscriber who, experiencing trouble with the telephone, demands someone come and check out the elementary black machine that accesses the system from home or office.

In information theory, this masking of the technological complexity is termed "transperancy" and is often called for in designing telematics systems.

Given the vast complexity of modern technology, it is readily apparent that no single human can hope to master all technologies. Winner is able to conclude from that reality the existence of a kind of technological autonomy.

The gap between the realities of the world and the pictures individuals have of that world grows ever greater. For this reason, the possibility of directing technological systems toward clearly perceived, consciously chosen, widely shared aims becomes an increasingly dubious matter ... What one finds therefore are highly developed systems of control, which are themselves beyond intelligence, beyond control ... (33)
If the foregoing is accepted, the conclusion that must be reached is that technology is already autonomous.

Yet the radical dystopian argument seems to leave mankind with no option but to reject all technologies; to go back to Eden. Aside from the possibility that there may be no means of getting there or even that there is no such place, the call ignores the possibility that it is not technology per se that is the problem, but that certain kinds of technology may be the problem.

In other words, the issue may not be that posed by the debate between the dystopians and the utopians. There may be a third position.
CHAPTER II

Since I began work in futures research, in 1967, it has seemed clearer and clearer to me that industrialized society in particular and the world in general are headed for a climacteric which may well be one of the most fateful in the history of civilization.

Willis Harman,
An Incomplete Guide to the Future

The Third Position Theory:

The third position holds that technology has both the power to reduce want and hardship and the power to overwhelm humanity. What is needed to achieve the delicate balance between optimum human use of technology and oppression by the machine is a technology that is benign and subordinate to human control.

One model that approaches that status is Ivan Illich's theory of a convivial technology which he has developed through several of his published works.

An analysis of Illich's major works reveals a consistent theme and an over-all structure that places Tools for Conviviality (34) at the centre. Working within that theoretical framework, his other major works can be seen to be explications of the central theme, beginning with education, followed by treatments of energy, transportation, medicine, professionalism, politics and social institutions.

The central concept of conviviality is worth summarizing. In his introduction, Illich postulates a possible modern, post-industrial society characterized by freedom from domination by industry and functioning within natural scales and limits. He defines a convivial society as one,

... in which modern technologies serve politically related individuals rather than managers. (35)
While acknowledging the potentially frivolous meanings associated with the term 'convivial' in the English language, he chooses its more careful roots in Spanish and French and associates it with a concept of joyful austerity. The literature of the American appropriate technology movement often employs the term 'frugality,' which also has negative connotations.

More important than its linguistic roots are the characteristics that define the idea of convivial technology:

- the citizen has free access to tools;
- he can control those tools and use them for his own purposes;
- such tools employ his personal energy;
- they enrich his environment;
- the collected technology gives him autonomy and ensures justice.

Illich does not directly state that a society which employs convivial technology will necessarily be a convivial society, but he has such a deterministic relationship in mind. Given the broad meaning he assigns to the word 'tool,' such a relationship is plausible. In his meaning, tools include, besides small hardware and machinery, 

... productive institutions such as factories ... and productive systems for intangible commodities such as those which produce 'education,' 'health,' 'knowledge' or 'decisions.' I use this term because it allows me to subsume into one category all rationally designed devices, be they artifacts or rules, codes or operators ... (36)

In short, exactly the definition Ellul employs for technology.

A literal interpretation of his list of characteristics of convivial technology would be relatively simple and simplistic, revealing a society operating with only those kinds of tools in use in pre-industrial society. However, Illich elsewhere moderates these absolute characteristics in two ways.

First, he uses a number of adjectival modifiers in citing examples, such as "most," "least," "beyond a certain point" and "to the extent that ..." Clearly he sees his absolute criteria as some sort
of scale against which to assess technology for conviviality. Second, he sees a convivial society being able to employ in some special cases non-convivial or industrial tools.

What is fundamental to a convivial society is not the total absence of manipulative institutions and addictive goods and services, but the balance between those tools which create the specific demands they are specialized to satisfy and those complementary, enabling tools which foster self-realization. (37)

Here we see the first of a number of occasions in which Illich, in attempting to offset the mistaken idea that he is advocating some sort of life of the noble savage, fails to set out a formula for mixing the two kinds of technology. In attempting to describe the mix, he resorts to sometimes overly convenient but reasonable terms such as:

... a convivial society does not exclude all schools. It does exclude a school system which has been perverted into a compulsory tool ... A convivial society does not exclude some high speed inter-city transport, as long as its layout does not in fact impose equally high speeds on all other routes. Not even television must be ruled out ... as long as the over-all structure of society does not favour the degradation of everyone into a compulsory voyeur. The criteria of conviviality are to be considered as guidelines to the continuous process by which a society's members defend their liberty, and not as a set of prescriptions which can be mechanically applied. (38)

Elsewhere, however, Illich re-asserts some sort of absolute standard by rejecting high profile manipulative technologies.

Networks of multi-lane highways, long range, wide band width transmitters, strip mines or compulsory school systems are (destructive) tools. (They) must inevitably increase regimentation, dependence, exploitation or impotence, and rob not only the rich but also the poor of conviviality. (39)
At this theoretical level, the boundary between convivial and manipulatory tools is broad for Illich, but is made somewhat more precise as he explores the specific areas of contention in his later work.

It is readily apparent that he disagrees with the socialists who argue that industrial technology is manipulative only because of its capitalistic ownership and control.

>Certain tools are destructive no matter who owns them, whether it be the Mafia, stockholders, a foreign company, the state, or even a workers' commune. (40)

As a result, Illich does not see the promise of a socialist revolution as offering salvation. In fact, such a revolution, launched from the foundation of a manipulatory society, may even lead to greater manipulation in the name of proletarian dictatorship unless it is imbued with a convivial consciousness. (Here Illich is more of an anarchist than a socialist.)

If the problem of industrial technology cannot be laid at the door of the bourgeois revolution, where did it come from? Illich says that some time early in this century industrial technology reached a first watershed where it began to function more effectively and more ubiquitously than the various folkways it dispossessed. Roughly, just before World War I,

>... a patient began to have more than a fifty-fifty chance that a graduate of a medical school would provide him with a specifically effective treatment. (41)

He has not so precisely fixed the transitional periods for other technologies but he has shown the transition in education and transportation. For example, it is obvious that such a watershed must have occurred in North America some time during the second or third decade with the rise of highway networks and service facilities for motor transport.
By the mid-fifties, he says, it had become obvious that a second watershed had been reached, this one marked by the rise in medicine, for example, of doctor-induced diseases and the full professionalization of health care. In fact, health has become the monopoly of health professionals to the exclusion of all other practitioners, including the patient. In transportation, a network of high speed highways has virtually become the definition of surface transportation.

These transitions mark the rise of "radical monopolies" in which the function becomes defined by mainly one means of its expression. A number of technologies are approaching or have reached this second watershed, thereby setting up the impending crisis.

As technology begins to create more problems than it solves, people will rebel against it, demanding more freedom of choice and more meaningful communities. Presumably, although Illich doesn't extend the metaphor, at that point a third watershed will have been reached: the transition to a convivial society when industrial technology collapses of its own weight.

Exactly how this will happen, Illich does not claim to know.

*I can only conjecture on how the breakdown of industrial society will ultimately become a critical issue.* (42)

He is certain, however, that it will be a failure "of" industrial society, and not "in" it, as was the case in the great depressions of the 19th and 20th centuries. Nearly instantly, people will lose confidence in the conventional institutions as several technologies simultaneously collapse. There is no guarantee, however, that such a collapse will inevitably lead to the creation of a convivial society.
Illich offers only two possible outcomes: managerial fascism marked by Skinnerian controls or a convivial, hence frugal, participatory and de-centralized society. He suggests there are three obstacles to recovery from manipulatory technology.

The first of these, the idolatry of science, prevents the functioning of responsible political community because specialists, not the people, are seen to have the correct answers to societal problems.

The second obstacle is the corruption of everyday language to make it represent the industrial mode of value; the fruits of creative work are made synonymous with industrial output. The result

... reflects a transformation in the idea of ownership
... Fully industrialized man calls his own principally what has been made for him. (43)

His third obstacle is caused by the loss of "legal procedure." To Illich, the political process has become perverted from tradition and community decision-making,

... to the ideology that corporations ought to produce more. (44)

Ideology precludes collective examination of the commonwealth when such political processes endanger industrial productivity. Like Ellul, Illich sees the existence of a dominant mode of thought and behaviour which is "technicized" by virtue of the universal hegemony of technique.

The removal of these obstacles requires the emergence, rather the re-emergence, of what he calls the "critical use of ordinary language" and groups of people who, through "counterfoil research," will be prepared to use that "ordinary language" to reveal the convivial way at the Apocalypse.
The same general crisis that could easily lead to one-man rule, expert government and ideological orthodoxy is also the great opportunity to reconstruct a political process in which all participate. (45)

What does not emerge from the foregoing brief summary is the root value of universal equity which shapes Illich's concerns.

Central to his thesis is the notion that equity is not possible when technology develops beyond use-value to exchange-value. When it advances still farther, radical monopoly emerges, eliminating more frugal options and leading to counterproductive industrial practices.

The cure for such destructive and mindless pursuit of technology is for society to recognize the value and practicality of voluntary frugality; to choose what Illich thinks are natural limits to technological development. Moreover, neither equity nor frugality should be achieved at the expense of autonomy. Free people should be able to function without coercion or control from remote forces.

Understanding these underlying values is crucial to following the case developed by Illich. Equally essential to his theory of convivial technology are the key concepts of radical monopoly and technological thresholds.

Radical monopoly occurs when a particular tool subordinates or even displaces all other means for achieving a desired end (for example, the automobile for surface transportation). In the technical sense, monopoly means absolute ownership or control; in the popular sense, it refers to dominance which, while it doesn't exclude the possibility of alternatives, renders them impractical. It is in this latter sense that Illich employs the term. It arises because the dominant technology offers mechanical efficiency and/or utility at an unacceptable cost in terms of frugality, equity or autonomy.
The concept of a threshold suggests the existence of a point where rising utility of a given technology tips over to become a dis-utility. This occurs because the negative effects of the technology outweigh the marginal increases in utility. An example of how this might occur is the case where improvements in mechanical function (for example, automatic transmissions) result in loss of autonomy (simply the ability to effect owner repairs). As the thresholds of a number of technologies are passed, technology as a whole begins to oppress people.

As will be shown later, as valuable as this concept is, it is often difficult to concretize a specific threshold. In such cases, the sister concept of radical monopoly may resolve the ambiguity by revealing symptoms of loss of autonomy or equity.

In order to see the full development of Illich's argument, it is useful to examine its more explicit development in other works which descend from the theoretical framework of *Tools for Conviviality*.

It will also be revealing to look at some of the critical areas of technology not examined by Illich. It will become apparent that his theories find their most concrete application in what Ellul called mechanical technique. Nevertheless, in spite of the lack of concreteness, they are revealing also for the socio-political environment.

Illich's published studies of conviviality in the physical environment have dealt effectively with transportation and health; less effectively with energy and human settlements; not at all with agriculture or resource utilization. In the case of the first two examples of technologies he has been able to demonstrate relatively concrete thresholds beyond which the technologies begin to lose use-value and, with further advances, eventually acquire dis-utilities: the second watershed.
Applications: TRANSPORTATION

His studies of transportation unfortunately exclude the movement of goods or messages, which he says would necessitate a different, albeit parallel, line of reasoning. (46) Nevertheless, his analysis of the thresholds of human transportation yields an explicit figure.

...free people must travel the road to productive social relations at the speed of a bicycle. (47)

Illich clearly demonstrates the costs of high speed automobile transportation. A North American car owner devotes an average of 1,600 hours a year to her car in order to travel 7,500 miles; an average speed of less than five miles per hour. (48) As all forms of transportation accelerate to current speeds, up to 28 percent of the citizen's time is devoted to transportation.

Transportation thus becomes an industry (acquiring exchange-value) and the citizen becomes an habitual passenger; travel time becomes scarce by definition, resulting in a loss of life-time (i.e. time not determined by exchange-value).

While it is clear from this line of reasoning that accelerating speed arrives at some point where inequities and dis-utilities become unavoidable, it is less clear why 15 miles per hour should be that point. The answer to that question is critical to understanding why some advances in technology are beneficial while still further advances become dysfunctional. If this point cannot be resolved, then Ellul's contention that all technology is corrupting leaves us with an irresolvable dilemma.

By implication, there is an equation here that should show at least a marginal increment in utility as mechanically assisted speed increases to an optimum, followed by a growing dis-utility as the optimum speed is exceeded. (It must be understood that utility and
dis-utility as used here are not restricted to their merely quantifiable dimensions; therefore a literal mathematical equation is not intended.)

The key for Illich is the concept of a radical monopoly.

_Beyond some point, compulsory schooling destroys the environment for learning, medical delivery systems dry up the non-therapeutic sources of health, and transportation smothers traffic._ (49)

In spite of the fact that he has earlier declared an absolute threshold of speed for traffic, Illich now offers an additional criterion for setting such a point.

_The fact that it is possible theoretically to determine the range of speed within which transportation develops a radical monopoly over traffic does not mean that it is possible theoretically to determine just how much of such a monopoly any given society will tolerate ... Only recourse to juridical and, above all, to political process can lead to the specific, though provisional measures by which speed or compulsory education will actually be limited in a given society._ (50)

The physical threshold then is not all that precise. The bicycle seems to represent a near optimal technology, not so much because its speed is limited to under 15 miles per hour but because it does not displace other autonomous alternatives, as do the automobile and the jet plane.

Notwithstanding the necessity for political judgment, there does exist a need for research into the threshold-determining process -- counterfoil research, in Illich's terms -- if the political process is to have correct information on which to operate.

_Because it is technicized, current traffic engineering wisdom is not able to see the low energy, low speed alternatives since it defines all traffic problems in terms of an industrialized speed-
distance equation. Research data available now demonstrate, both in numerical and social terms, a distinct increase in utility of the bicycle over walking. The bicycle can achieve about four times the speed of the pedestrian at about one-fifth the energy output without displacing the ability of all people to walk over the same route and distance. Furthermore, it can be shown that it can travel up to three times as fast as the personal automobile in terms of total support and operating time. In the face of that incontrovertible evidence, no modern traffic engineer has suggested taking cars off city streets.

What is not anticipated by existing knowledge is the effect of as yet uninvented transportation technologies which may be so close to a theoretical threshold as to challenge the capacity of a convivial society to accommodate change.

Also left out of the equation is the role of motor power. There are clearly advantages in motorizing at least some forms of transportation (for example, to carry the sick or the physically handicapped). Illich suggests that such motorized vehicles should be made subordinate to autonomous transport, implying also that their speed should likewise be limited.

Without anticipating the discussion to come later about the socio-political environment for convivial technology, it is apparent that some kind of research schema would be useful in determining at least the questions that must be asked of the political process.

Applications: HEALTH

There is no tidy equivalent to the bicycle in the health field. Nevertheless, Illich claims there is such a thing as primary medical care. It consists of a combination of preventive practices and basic therapy for the most common disorders and for birthing care.
The key to setting the level of such primary care is once again equity.

*Insofar as medicine is a public utility ... no person is to receive services so extensive that his treatment deprives others of an opportunity for considerably less costly care per capita.* (51)

That leaves untouched the question of a health technology so complex as to require advanced expertise to manage it. It will become clear as this study develops that equity is often best assured by complex, mass produced technology -- but at a cost to autonomy and sometimes frugality.

Just as clearly as in transportation, radical monopoly operates in the health field, but in the form of professionalization of all therapies. (We will return to that discussion in the section on socio-political environment.)

The dysfunctional manifestation in medicine takes the form of iatrogenic diseases. As with other technologies, medicine reaches the point where it begins to create problems which, within the industrial mind-set, demand ever more technology as their solution. As highway networks create distances that can only be bridged by better cars, so the damage done by excessive reliance on X-rays for diagnosis can only be repaired by resort to exotic cobalt technology.

In the face of technology-created problems, organized medicine attempts to eliminate "the last vestiges of empiricism" (52) from medical practice in favour of scientific methods which are beyond the comprehension of the patient. The result is that the patient has less control of her own health; health care acquires exchange-value and it too becomes scarce.
Here is a case where it is difficult to establish a measurable threshold. Instead, it is necessary to rely on the evidence of an emerging radical monopoly, in this case taking the form of professionalization of the health industry.

However, there may be a major impediment to adopting frugal practices in health care, even if citizens become aware of their loss of control. Whatever inconveniences that may come from the adoption of limits to technology in other fields, limits in medicine strike people literally where they live and breathe. Moreover, humans have the unique capacity to anticipate those limits.

"(Mankind) is the sole being who can and must resign himself to limits when he becomes aware of them. (53)

In the face of mortality and pain, the desire to postpone fate is strong enough to overcome even the most incontrovertible evidence in favour of convivial technology. Faustian bargains are nowhere more apt to be struck than in the face of the menace of aging or the hope of relief from pain and fear.

Illich seems to recognize the weight of this argument when he once again accepts the need for a mix of convivial and industrial technologies.

*Autonomous production can, of course, be supplemented by industrial outputs that will have to be designed and often manufactured beyond direct community control.* (54)

As he has already pointed out, the means of determining the nature of that mix of technologies is to rely on the political process, i.e. the collective judgment of ordinary people. Even acknowledging the corruption of current political processes, it can be readily demonstrated that people already adopt a mix of technologies they find suitable and it is overwhelmingly industrial, as Illich will quickly acknowledge.
While it seems plausible to imagine a widespread rejection of industrial technologies if and when the collapse occurs, it seems less likely that the loss of life-preserving therapies -- however inequitable -- will be easily accepted.

Of course, effective counterfoil research may be able to demonstrate the long term benefits of convivial health technology, such as,

... sanitation, innoculation, and vector control, well distributed health education, healthy architecture, and safe machinery, general competence in first aid, equally distributed access to dental and primary medical care, as well as judiciously selected complex services ... (in) a truly modern culture that fostered self-care and autonomy. (55)

But in situations demanding therapeutic treatments, no doubt the alternatives will be as radical as those of the Hiroshima dilemma. Will the circumstances be as critical? At any rate, it was the doctors of Hiroshima, not the victims, who resolved the dilemma.

Apparently much depends on the timetable of the collapse of industrial technology. If it is sufficiently protracted for people to come to understand the contribution made by iatrogenises, it may be easier for many to accept the necessity of altering their health expectations. One suspects Illich's Catholic training may also have provided him with a more sanguine appreciation of the place of death in life.

At any rate, counterfoil research into health alternatives will be at least necessary if the health care threshold is to be established and adopted by citizens.

Elsewhere, Illich asserts,

Iatrogenesis (is) but one instance of that paradoxical counterproductivity which is now surfacing in all major industrial sectors. (56)
Nowhere is this phenomenon more evident than in agriculture. Un- 
happily, Illich has not undertaken a critique of the subject in any way 
equivalent to those he provides for transportation and medicine. It 
will serve the objectives of this paper to take a moment to look at 
agriculture from the perspective of convivial technology.

Applications: AGRICULTURE

Until about the mid 1950s in North America, the majority of the 
food production came from the family farm. As the farm population 
declined, the number of farms fell, their average size increased and 
the total acreage committed to agriculture rose gradually. With in- 
creasing urban growth, the total productive acreage is now falling, 
putting even greater demands on technology to improve productivity. 
(57) Furthermore, until multiple dwelling residential development 
emerged in the seventies, many non-farm urban and suburban households 
produced at least part of their annual fresh vegetable and fruit 
needs in backyard plots. (58)

In the early seventies, similar shifts began appearing in 
Third World agriculture with the introduction of the high technology 
based "green revolution." Within this coming decade over half of the 
world's people will be living in urban environments, increasingly 
removed from food producing capabilities.

In order to maintain productivity, the demographic shift from 
agrarian to urban forms necessarily had to be accompanied by capital 
intensive industrial technology. (59) As with transportation and 
medicine, the shift was accompanied by loss of autonomy.

In many ways, the counterproductive consequence of industrialized 
agriculture has more profound implications for human survival than 
even medicine and certainly transportation. The reason the risk is so
high is because of widespread, sometimes irreversible damage to, and even loss of, soil associated with industrial techniques in agriculture. The agricultural equivalents to iatrogenesis are soil erosion, additive toxicity and salination of both ground and surface water. (60) There is also, of course, a direct link to industrialized medicine in the form of industrial and environmental diseases directly derived from modern agricultural practices.

Here again the transition to convivial agriculture technology will necessitate both a radical shift in deep-seated attitudes and some kind of remedial strategy to address the accumulated stress of decades of industrial technology. As Murray Bookchin points out,

Radical agriculture ... implies not merely new techniques in food cultivation, but a new non-promethean sensibility toward land and society as a whole. (61)

It seems likely that the threshold for convivial agriculture will be found around the concept of sustained yield. There is reason to believe that dysfunction sets in when agricultural inputs exceed output.

Whereas traditional Chinese wet rice culture -- employing only re-cycled nutrients and solar energy -- will return about 53.5 BTU of energy for each BTU of human and mechanical energy invested in farming it, in the 1970s industrial agriculture consumed about 4 BTU for every one returned.

That equation demonstrates perhaps the most fundamental critique that can be made about industrial technology. Regrettably, Illich gave the subject of energy only superficial attention.
In Energy and Equity, Illich employs an introductory chapter on energy to underpin his main treatment of the special case of transportation energy. According to him the energy crisis is an industrial crisis, not one of survival.

*The energy crisis focuses concern on the scarcity of fodder for (energy) slaves. I prefer to ask whether free men need them.* (62)

In an industrial mode of thinking the energy crisis leads to concern about high efficiency of energy transformation rather than the more basic question of how much mechanical energy society actually needs to achieve a convivial way of living.

Again there is a threshold, beyond which extra energy erodes equity and eventually results in dis-utilities. In attempting to establish that threshold, Illich resorts to a potentially misleading analogy.

*The per capita wattage that is critical for social well-being lies within an order of magnitude which is far above the horsepower known to four-fifths of humanity and far below the power commanded by any Volkswagen driver.* (63)

While the image is compelling, an attempt to use it to establish the threshold range immediately reveals that it implies an upper level of power about three times greater than industrial man actually uses. (The error derives from the fact that power-in-use must be measured over time.)

A more useful base can be derived from a comparison of daily human energy needs and capabilities against actual per capita energy consumption in industrial society.
A human working steadily over eight hours can deliver about 500 K-cals of work per day. Since he requires an energy intake of about 2,600 K-cals per day just to maintain his metabolism, he works at an average efficiency of 20 percent in industrial terms.

The actual per capita consumption in industrial society is something like 230,000 K-cals per day, at an average net efficiency of four percent, for a theoretical yield of about 9,200 K-cals of work; about 19 times the capability of human metabolic energy. (64)

Current convention says that we each have, therefore, 18 energy "slaves" available to us through the "gift" of technology. That establishes an absolute range somewhere between basic survival and current industrial society consumption.

The resulting equation is far short of useful; a more useful formula is needed. What Illich seems to be suggesting as a way to avoid having to undertake that daunting task is to examine the energy quotient of a number of components of convivial technology -- as he has attempted for transportation -- and then add them up to arrive at a total convivial energy threshold.

The problem with that formula is that it implies a loss of autonomy for individuals and communities to choose for themselves how they will employ limited energy.

There appears to be no theoretical reason why a convivial energy threshold couldn't be derived: in fact, others have done so. In pursuit of that goal, it is necessary to summarize the basic energy question.
In simple terms, the energy problem has two doorways: supply and demand. As Illich points out, much of the activity aroused by the energy crisis is evidently on the supply side. Given the present and projected consumption levels plus the vast and unmistakable global inequity, there is clearly a shortfall in supply.

Technocratic solutions to that problem take two forms, sometimes pursued separately, more often in combination. The blatantly optimistic technocrats alternately look for additional conventional supplies -- new fossil fuels -- and promise nearly unbounded new technologies such as fusion reactors. The more responsible "conservationists" devote their attention to significantly improving that dismal four percent conversion efficiency figure.

Either way or in combination, the solutions demand an inescapable commitment to advanced technology with, if Illich is correct, increasing inequity, entrenching radical monopoly and encouraging greater dis-utilities, possibly of a catastrophic nature. At the very least, high technology supply-side solutions tend to centralize energy conversion, leading to a very concrete inequity. As Lovins explains it,

*Centralized energy systems are inequitable in principle because they separate the energy output from its side effects, allocating them to different people at opposite ends of the transmission line.*  

The demand side can, of course, also be the route to the conservationist solution. If people can be induced through education, moral persuasion or pricing policy to reduce their needs through careful and efficient use of resources, the employment of better conversion technologies will be made more effective.

A more radical, or counterfoil, exploration would be to find Illich's threshold in terms of total units of energy.
The upper limit of that energy range cannot be greater than the level of sustained yield or renewable supply. To do otherwise would be to steal fossil fuel and other one-time resources from future generations. An upper limit set by this means will yield a substantially more precise figure than Illich has been able to derive.

The earth's thermal load capability has been estimated to be about one-fifth of the present industrialized per capita consumption. (66) To turn that formula around, we can say that, if everyone in the world consumed energy at the rate of industrial society, the thermal load would be too great for the globe to handle.

It follows that the upper limit of the threshold must be less than 45,000 K-cals per capita, per day, or about 17 times more than is needed for basic survival.

If the conversion efficiency could be improved through more appropriate uses of energy and by reducing the average 40 percent transmission losses caused by long distance movement of energy, that should leave substantially more energy per capita than is needed, say by about 10 or 12 energy slaves.

Eventually, that calculation arrives at about the same point as that reached by the techno-conservationists such as Amory Lovins. All we have to do to achieve that kind of balance is to switch from the hard path to the soft path and forego utopian visions of unlimited future growth: CS2 in the language of the Gamma study. (67)

Illich would not allow that such a shift was a significant move toward conviviality. He points out that a car running on solar energy is no less a radical monopoly for being operated on renewable energy. A large biomass plantation serving a metropolis with all of
its electrical energy needs would still compel its subscribers to buy energy from it, just as they would from a similar sized nuclear fission plant.

At the extreme other end of the range -- absolute autonomy -- one might imagine for the sake of discussion a single family having immediate control of sufficient resources to meet all of their own needs for food, shelter, procreation and health in isolation from everyone else.

From that could be derived a shopping list of minimum needs for a given bioregion. Assuming a basic technology for survival in a temperate zone, a basic per capita energy need of 10,000 K-cals per day of energy could be arbitrarily allocated, a level slightly lower than that which prevails in China.

To summarize so far, we have an upper limit of 45,000 K-cals and a lower one of 10,000 K-cals.

Illich's thesis, of course, is that there is a positive relationship between energy and equity right up to the threshold. Thus the range of 35,000 K-cals between the lower and upper limits may conceal a substantial capability of increasing the number of energy slaves without breaching the threshold: more accuracy is needed.

Furthermore, a convivial life style couldn't countenance a highly individualistic social form. Some portion of the energy budget must therefore be allocated to human settlements, traffic, recreation and socializing. At least another 5,000 K-cals might be needed to meet those activities. Even with these crude estimates, the range between the limits is still large at a spread of 30,000 K-cals.
The characteristics of technology that cause loss of equity, rise of radical monopoly and dysfunction are still not determined for energy. As yet, we have for energy nothing like his 15 mile per hour upper speed limit for transportation.

The foregoing survey of four important components of the physical technology environment has identified a less than concrete basis for developing strategies for convivial technology.

While at least a provisional limit has been advanced for transportation, there are still no clear guidelines for the adoption of supplementary motor power. The outstanding problem in health is that of demonstrating the need for voluntary limitations of immortality. The questions pertinent to food technology are barely even identified, while the upper and lower limits of total per capita energy are too wide to be of concrete value.

It needs to be acknowledged here also that there are other components of technology that have not even been approached. For example, how could a utilization formula for non-renewable resources be worked out to take into account equity for uncountable future generations?

Before attempting to work up some answers to these questions, it will be desirable to examine the less concrete but no less important socio-political aspects of technology.

Remembering that Illich defined tools as being "all rationally designed devices," it is evident that the non-material aspects of technology are critically important to convivial society. It might even be argued they are actually more critical than mechanical tools in that they often form the very institutions that address the technological environment.
A clear example of that condition is that of education. Not only is it an institutional forum for dealing with technology, it is a powerful shaper of values, attitudes and habitual behaviour.

Applications: EDUCATION

Published before Tools for Conviviality, Deschooling Society (68) lacks the careful analytical structure and the consistent theme found in the other works that followed.

Furthermore, Illich attempted in the education essay to set forth concrete actions appropriate to his analysis which were widely adopted by education practitioners in a brief but unproductive flurry of enthusiasm that gave rise to such innovative but shortlived experiments as the Parkway Project, the Free Universities and the Learning Networks.

What is missing in the early work is the tightly organized theoretical framework that followed later, even though its emergence was foreshadowed in Deschooling Society. It may be instructive to adopt the later theoretical framework to analyze his early efforts.

As schooling takes on institutional characteristics, it begins to supplant informal learning, even though the most significant human learning period -- early childhood -- takes place mostly outside of the school. The learner surrenders her autonomy to schooling as the schools acquire the right to certify process and achievement. When schooling becomes compulsory, radical monopoly begins to set in and schools become increasingly inefficient as schools become scarce. Dysfunction follows. In the face of modernized poverty, school creates demands it cannot fill and the system necessarily becomes financially non-viable in a fruitless pursuit of equity.
In this process, schools represent both a model for other socializing tools and a pervasive carrier of the universal ideology of the value of progress.

*I have chosen the school as my paradigm ... (for) the consumer family, the party, the army, the church, the media.* (69)

As a paradigm, schooling might reveal some principles that could be employed for analysis of the other socializing institutions. Instead of following that course, Illich attempts to set out some practical strategies.

The first of these is a formula by which the state can support learning without violating Illich's variation of the U.S. Constitution's First Amendment:

*The State shall make no law with respect to the establishment of education.* (70)

Prohibitions against a school system need not result in an illiterate population, he says. Equity could be assured by issuing a kind of "edu-credit card" which would establish an equal educational credit for every citizen at birth, to be applied when and where she or her guardians wish. Illich even anticipated head-start problems caused by the differences between middle class and poor households by suggesting the individual's credit balance could accumulate interest to compensate late starters.

The other major concrete proposal was to suggest the use of computers to build learning networks, or webs as he called them. Such a mechanism would allow people to contact others having similar interests and to identify skill resources without having to rely on the school curricula.
Two significant inconsistencies emerge. First, Illich seems not to have looked for a threshold for schooling as he has for other tools he has examined. It would seem reasonable to argue, as he has for other tools, that schools can contribute to conviviality up to some yet to be determined optimum level, at which point they would begin to become dysfunctional.

If that were so, the counterfoil research task would be to establish the critical elements of education to determine what factors should be assessed. It could be that basic literacy might be the educational equivalent to the 15 mile per hour speed limit in traffic; it could be that the authority to certify may be the culprit. Indeed, he suggests at one point that a human rights code could prohibit the taking of educational histories as it now does for race, religion or sex. It may be also that professional certification marks the beginning of the dysfunctional turnaround. More likely it will be found as a combination of these and other factors.

The second inconsistency is more in the order of a strategic slip. In his attempt to illustrate how a learning web might work, he beards the lion in its den by using New York City as his example.

Perhaps because of the distortions of his theories that have plagued Illich for at least 12 years, a number of attempts at learning networks have failed for a variety of reasons. Basic to all of the well researched failures is the fact that learning webs are an attempt to establish a convivial tool in an anti-convivial environment.

Illich has indirectly acknowledged this in his later works where he asserts that the whole structure of industrial society will collapse when the third watershed has been reached by several technologies more or less simultaneously. One of the least convivial tools that must surely be radically altered at
that time must be the modern metropolis, such as New York City. Attempting to build human networks in such an environment must be as futile as trying to build self-help health care institutions in the face of the radical monopolv of industrial medicine.

Applications: HUMAN SETTLEMENTS

In fact, the structure and substance of human settlements may have to be the most radically altered of all technologies. Unhappily, this matter also has not yet received Illich's attention.

Since Illich is so obviously forecasting not a piecemeal modification of technology but a total re-orientation of society, it is clear that the new society must come to terms with the built environment. In light of what he has said about thresholds of, for example, transportation, health care and energy consumption, the modern metropolis cannot function as it now exists.

In the face of a speed limit of 15 miles per hour, all of the world's major cities are too large to be conveniently encompassed; the function of large, highly centralized hospitals will be useless to a health care system that relies on local community and patient resources; with transportation alone demanding close to half of all currently available energy, an energy budget reduced to one-fifth its present level will demand less redundancy than the modern city can accommodate.

Yet, as fast as industrial technology allows, the earth's people are moving into ever larger urban conglomerations. According to the United Nations, during the 25 years between 1950 and 1975, the world's urban population grew from 2.5 to 4 billion people while the rural population grew from 1.8 to 2.5 billion. (71) By the year 2000, the cities of Bombay, New Delhi and Calcutta are expected to hold 100 million people between them.
While such concentrations of population may not be necessarily the inevitable consequence of advancing technology, the history of urbanization from the beginning of the industrial era reveals a geometrically accelerating growth rate as yet undiminished.

In fact, one can argue that, in a variety of ways, the kind of settlements we have slipped into in the nineteenth and twentieth centuries, in this first tentative fumbling phase in man's use of high science and high technology are ... exactly the kind of 'habitat' which a sane, stable and conserving society ought to reform. (72)

Clearly, the size of human settlements -- at least in spatial terms -- is a critical determinant in establishing threshold simply because there is a limit to the ability of convivial technology to service it. Population size would also appear to be important, both because it constrains the spatial dimensions -- either by limiting the perimeter or by forcing high density, high technology building construction -- and because the political unit demands bureaucratization beyond the likely threshold.

Experience with settlement size is both limited and lacking in theoretical foundations. Much of the contemporary literature agrees on the figure of 50,000 as a base-unit population of settlements. Often, smaller districts or neighbourhoods are postulated as sub-units.

For example, in an all-inclusive typology of human settlements, Doxiadis defines a neighbourhood as having a population of about 1,500 people and the "poli" or city as having 75,000 people. (73) During the years between the revolution and World War II, the Russian town planners systematically built over 900 new settlements under a rigid formula based on the idea of a microdistrict of 8-12,000 people organized in blocks of 25-50,000 people. (74)
The concept around which these numbers are derived is that certain activities are most efficiently served in a central place around which residences are clustered. The activities -- work, education, recreation, health services and shopping -- are assumed to take place in a conventional industrial mode. Furthermore, planners adopting this approach rely on raw empirical behavioural data rather than on principles of human satisfaction. In short, conviviality is not a determinant.

Of course, a strategy in pursuit of convivial human settlements would have to take into account Illich's value criteria: frugality, equity and autonomy. While the central place concept appears at least to begin to address the criterion of frugality, it says nothing about equity or autonomy.

At the very least, a convivial human settlement would have to ensure the opportunity for a family to construct its own shelter out of materials equally available to all and in a configuration that assures equal access to amenities. These criteria suggest an upper limit set by the unique characteristics of each settlement site and by the physical limitations of related technologies such as transportation, material resources, construction techniques and tools.

Again, however, the exact threshold cannot yet be determined since it must take into account the ability of the settlement to function effectively as a democratic political unit. Here Illich has provided some leads.

Applications: CONTROL

For Illich, the bottom line of technology is its effect on the democratic political process.
What I do want to call attention to is ... the fact that rising productivity and supply of services results in the irrecoverable loss of conviviality. (75)

The loss occurs because the growth ethic of technological society inexorably leads citizens to surrender their right to define and act to people specially selected, trained and certified to do so: the "disabling professions." The professionals have acquired

... the sapiential authority to advise, instruct and direct; the moral authority that makes its acceptance not just useful but obligatory; and charismatic authority that allows the professional to appeal to some supreme interest of his client that not only outranks conscience but sometimes the raison d'etat. (76)

Matters once clearly in the political domain are transferred to the professional until eventually the political process can only choose between competing professional-industrial alternatives.

According to Illich, there are five illusions widely held in industrial society that encourage that transfer:

1) Use-value is discounted in favour of exchange-value with the rise of consumerism.

2) Technological progress is seen to be unavoidably associated with rising complexity, which in turn requires specially trained operators.

3) Tools must be certified for use by experts.

4) Confusion about rights versus liberties. (Liberties protect use-values as rights protect access to commodities.) (77) As technocrats certify tools, a demand for equal rights of access to them clouds the loss of freedom not to use them at all.

5) In its most modern form -- professional "radical chic" -- even self-help becomes professionalized. Native solutions are analyzed by experts and fed back to the people with the stamp of professional approval and, eventually, control.
Here Illich leaves us with very little direction towards a concrete mechanism for effective citizen control of technology policy. Having persuasively demonstrated the loss of community control through the rise of expertise, he offers no means for dissolving the five illusions.

It is clear that the roots of the illusions are all buried in the distortion of science to make it serve technology. So long as it is seen to do so, it may even be that a convivial society will not trust science to pursue its own means and ends and may demand, instead, that it become subordinate to the will of the people.

Heilbroner anticipated that possibility:

... might not the people of ... a threatened society look upon the 'self-indulgence' of unfettered intellectual expression with much the same mixed feelings that we hold with respect to the ways of the vanished aristocracy -- a way of life no doubt agreeable to the few who benefited from it, but of no concern, or even of actual disservice, to the vast majority? (78)

What science has not done but is capable of doing is to replace human slavery with mechanical slaves without at the same time enslaving people to the machine. To Illich,

... this is not the fault of scientific input in itself. It is rather the result of the intent with which science is applied. Science could be equally well used to increase the tool kit available to every man, endowing individuals and transient gatherings of associates to constantly recreate their environment with undreamt of freedom and formerly unthinkable self-expression. (79)

Holding that view, Illich cannot be a full-fledged dystopian or a simplistic neo-Luddite. However, his problem of finding a threshold is found in its most perplexing form in the domain of science.
Science is not a physical entity or a tangible quantity of activity that can be measured like speed or per capita energy. Moreover, there is no logical level of scientific activity that can be set that will avoid the discovery of new techniques which may turn out to be non-convivial. If past scientific discoveries have disclosed techniques and tools that prevent disease, increase food yields and improve shelter, surely there may still be other discoveries that might benefit people in the future yet still fall below the threshold at which damage begins to occur.

Unquestionably, the mechanism by which the spirit of inquiry can co-exist with limits to application is the universal adoption of full democracy in an ethos shaped by convivial technology and characterized by a deep commitment to equity, frugality and autonomy: no less than a new science, a new science that is informed by a commitment to equity and finds its intrinsic rewards in the elegance of frugality and simplicity.

Such a vision invokes a Jeffersonian image of an enlightened citizenry, albeit unschooled; a kind of scientifically disposed, but not possessed, Renaissance people, sufficiently free of the burden of toil to permit all to participate fully in the direction society will go. They cannot surrender their responsibility to specialists of any kind, particularly those who would govern the community on their behalf: the politicians and bureaucrats.

However grand the reach is to that image, it is unattainable unless the total and individual thresholds of convivial technology can yield something substantially more than mere subsistence for people. Unless it can be shown that sufficient well-being can be achieved equally by all, the prospect of securing a voluntary commitment to frugality is remote; without that commitment, technology
can only be limited by near-absolute resource depletion or environmental collapse. Illich is saying there is at least a theoretical possibility of defining a "tool kit" that would provide only enough technology to reach the threshold, and no more.

In addition to requiring the right kind of democratic environment to enact limits to technology, there must also be a practical framework for determining the threshold of each tool in the tool kit and a comprehensible, ordinary language rationale for rejecting outright those tools that breach the threshold.

Furthermore, that framework -- itself a tool -- must fit the hands, minds and experiences of ordinary people.
CHAPTER III

Insofar as more spheres of decision-making are construed as 'technical problems' requiring information and instrumental strategies produced by technical experts, they are progressively removed from political debate.

Trent Schroyer, Marx and Habermas

The Theoretical Problem:

There are two problems that descend from Illich's statement of the problem, neither of which seems to be in his grasp.

First, ordinary people need to regain the right and ability to make choices about the technology they want to live with, without having to rely on the judgment of technophilic specialists. That problem will be put aside temporarily.

The second problem is that an analytical tool is required that is capable of detecting the threshold which Illich claims lies within each technology and which the previous chapter has suggested can be discovered, albeit with difficulty in many cases. Moreover, the citizen of a convivial society will need to acquire and sustain a meta-technical perspective of the entire tool kit.

What is being asked for is a new kind of technology assessment strategy which for convenience will be designated here as Alternative Technology Assessment (ATA).

Within the past 20 or so years, rising public concern about the unintended or unwanted effects of technology (Illich's second watershed), largely in the areas of environment and health, has led to a
widespread political conviction that technology can and should be controlled. To do so requires some means of assessing emerging technologies for all of their possible consequences. In a belief system that embraces "idolatry of science," it is not surprising that scientific specialists are asked by society to develop countermeasures to address the task. The commitment to technology remains; it is only asked of scientists that they eliminate its negative effects. The outcome is the process usually referred to as Technology Assessment (TA).

**Technology Assessment:**

The body of practices that makes up TA consists of a host of tools and strategies already in the armory of the physical and social sciences. What is distinctive to TA are the purpose, scope and outcomes of the activity.

First, there is an assumption that close and thorough examination of individual technologies will reduce the negative consequences of technology as a whole. Second, the practitioners of TA must assume that they can eventually acquire a useful degree of accuracy in forecasting environmental, economic and social events: there is an assumption of consistent and predictable causality. Finally, TA has a distinctive commitment to a rational political decision-making process.

All three of these assumptions merit closer attention. However, before doing so, a basic model of TA should be set out.

The ideal TA sets out to bound the assessment domain in a sufficiently concrete and inclusive way to ensure that all of the relevant elements can be examined in some measurable form. Reasonable alternative projections are developed which then form the basis for the assessment of likely impacts or consequences, followed by examination of the policy alternatives.
Ideally, the whole process is run through several times by a multi-disciplinary team until some kind of consensus is reached, often expressed in a set of "if-then" alternative action options for consideration by the political decision makers.

A progressive TA, acknowledging the critical influence of public opinion and behaviour, seeks the input and even the participation of non-expert stakeholders such as relevant entrepreneurs, watchdog agencies, citizen organizations, policing agencies and so on.

A 'state of the art' model is set out in Figure 3:1 below.

Fig. 3:1 (80)
The TA activity has become increasingly institutionalized, beginning with the passage of the U.S. Technology Assessment Act in 1972 and later to the implementation of major and on-going studies by Congress, the OECD, the Commission of European Communities, and the Science Council of Canada. (81) The Canadian bureaucracy now includes an office of technology assessment within the Ministry of State for Science and Technology. Most other industrial countries have similar bodies.

To complete this brief description of TA, it should be pointed out that a lively dialogue continues to examine the methodological premises underlying TA. In particular, there is an unresolved question about the scope and feasibility of any individual TA. Some critics point out that governments operate within "real world" constraints that do not permit them the luxury of forthright acceptance or rejection of technologies because of the activities of special interest pressure groups on governments. That condition results in the adoption for practical reasons of a decision-making process termed "disjointed incrementalism." (82)

In this mode, a TA cannot hope to encompass such vast and long term or abstract elements as "societal futures" or "societal values" as suggested in Figure 3:1. Furthermore, the practical range of alternative projections and policy options is narrow and the impact analysis restricted to the immediate and most obvious. In essence, disjointed incrementalist TAs are only able to respond to problems as they emerge and cannot anticipate the future.

... incremental decision making is described as remediably geared, as it is more to the alleviation of present concrete social imperfections than to the promotion of future goals. (83)

Current TA practice seems to lie somewhere between the ideal and the inherently conservative disjointed incrementalism in a
compromise termed "mixed scanning" which integrates higher order goals with the more modest incremental processes. Typically, Canadian government policy has adopted this compromise position. (84)

Finally, there are two other characteristics associated with conventional TA which are seldom discussed in the literature and which will be only introduced here for later discussion.

In all jurisdictions currently carrying out TAs, the agencies involved are a mixture of governmental, extra-governmental and private institutions or firms. Since their active members are elites, they maintain close contact with each other and are largely self-recruited. Credentials for entering into the activity are both organizational and academic: ordinary people do not do TA.

The decision about which technologies merit some form of TA is also informally determined. For example, the rise to political prominence of virtually all environmental and energy issues frequently results in some form of assessment as the technologies develop. Thus, major pipelines, new processing techniques such as tar sands oil extraction, or rising public concerns like acid rain bring to the surface concrete concerns that can readily be phrased in the language of TA.

Other technologies, having less immediately obvious consequences or of a technical configuration that permits incremental development -- such as computers -- may escape formal assessment in their early development stages, at least until concrete effects like unemployment begin to emerge into public consciousness. Low profile technologies such as micro-biology receive little attention. Most often, the technologies that quickly catch public attention are in the category that Winner calls "apparatus" rather than organizational or human techniques. Combinations of apparatus that constitute essentially new organizational technologies, such as telematics, seldom attract public attention until they are in place.
In essence, there is no formal process for determining which technologies merit assessment.

Having completed the outline of the basic TA model, it will be useful to return to the three assumptions mentioned earlier.

First of these is the idea that a close examination of a number of apparently significant technologies will provide a check on technology as a whole. In the first place, concern about technology logically cannot be addressed by examination of individual technologies. That is so simply because meta-technology is not merely the sum of individual technologies: it also includes the attitudes, beliefs and habits of the complex fabric of society — the ways in which the various actors respond to technology. Whatever social control over technologies may be theoretically possible, the cumulative force of meta-technology continues to press society, giving rise to concerns about autonomous technology.

Aside from the probability that individual TAs will fail from time to time to correctly predict consequences, there is the larger question of sheer complexity of the whole technological picture. As Winner asserts,

... members of the technological society actually know less and less about the fundamental structures and processes sustaining them ... the possibility of directing technological systems toward clearly perceived, consciously chosen, widely shared aims becomes an increasingly dubious matter ... With the overload of information so monumental, possibilities ... are neutralized. Active participation is replaced by haphazard monitoring. (85)

What TA does in this situation is to further technologize the problem in an effort to manage the overwhelming complexity of the problem. In short, in its conventional scientistic mode, TA cannot see the forest for the trees.
The second assumption is that TA practitioners can, or at least expect to be able someday, to accurately forecast future events. If decision-making about technology is ever to become anything more than remedial incrementalism, the ability to forecast consequences is essential. The need to do so becomes acutely apparent in scientific speculation about possible global impacts such as atmospheric buildup of carbon dioxide or disposal of radioactive energy by-products, both bearing essentially irreversible consequences. In these mega-impact technologies, incrementalism cannot even close the barn door, let alone bring back the horse.

In recognition of this situation, TA practitioners are experimenting with a host of strategies which seem to offer some degree of accuracy. At least 24 techniques have been identified as forecasting tools (86), all of which can be subsumed under two broad headings: extrapolation and modelling, or a combination of both.

The tools most often associated with extrapolation are trend analysis and consulting expert opinion by various techniques, notably the Delphi. The basic premise here is that futures are more or less continuous with the past — a view commonly held by utopians such as Daniel Bell or Herman Kahn.

The techniques have some evident limitations. Current knowledge in the physical sciences reveals a number of natural phenomena where radical dysjunction occurs (for example, the behaviour of electrons in low versus high frequency configurations). The biological and social sciences exhibit similar radical turnover points where future behaviour cannot be predicated on past behaviour.

The potential of extrapolation to mislead is in proportion to the extent to which it relies on quantification. The danger inherent
in any attempt to quantify is that the numbers imply a degree of objectivity and order they may not be entitled to claim. Thus, for example, economists' attempts to locate substitution curves may employ a simple quadratic equation, when a radical shift may in fact occur at some critical point.

The other family of strategies -- modelling -- is being increasingly employed with the rise in sophistication of low cost computing facilities. Modelling offers the freedom to state any desired situation without having to demonstrate how it might come into being. Mathematical or analogous models of any chosen condition are formulated and set in motion, allowing the modellers to examine impacts in a laboratory setting. War game scenarios are probably the most familiar example of modelling as a predicting tool.

The obvious limitation on this tool is the ability of the model designer to incorporate all of the pertinent elements in the model, some of which are inherently resistant to quantification. A further, and exquisitely crucial, limitation is the programmer's ability to predict human responses to future events. Finally, models are powerful purveyors of whatever bias is built into them. They are more works of art than of scholarship.

The important thing to note in both strategies is the apparent necessity for scientific expertise and escalating reliance on the very tools that form the subject of study. There is something circular about the practice of employing technology to study technology: the subject-object relationship becomes blurred or even contradictory.

The final assumption to be dealt with is that of rationality in decision making. A recent OECD study states,

*TA is a decision making tool which means that it is best conceived as yielding systematic inputs into the larger political and economic system.* (87)
Unmistakably, the value underlying that statement is the notion that the best decisions are those informed, even dictated, by facts. What gives TA its potential power is that society as a whole, not just scientists and bureaucrats, assigns high value to rationality -- at least at the conscious level.

Habermas has defined the emergence of that ethic as "scientization" (88) and notes that it leads to an integration of the roles of expert and bureaucrat/politician. More potently, the political system becomes technicized with the result that key decisions increasingly are made outside of the public realm.

We are no longer able to distinguish between practical and technical power. (89)

A consistent rationale underlies each of the three limitations dealt with here: the idea that science and its offspring, technology, are neutral. Wherever failure occurs, the cause is ultimately human: computers don't make mistakes, humans do. When undesirable side-effects occur,

... the designer was short-sighted, we conclude, or perhaps he is excused since, after all, the design was 'state of the art' for its time. The corrective involves more technology -- for every technological dysfunction there is a corresponding 'tech fix. (90)

In this view, the goal of science is absolute rationality. While the goal may be beyond reach at this moment, each advance in knowledge diminishes society's reliance on irrational causes and moves us closer to the absolute truth. Universal phenomena can and must be reduced to their discrete elements and brought under human control. The social sciences, struggling for credibility in that milieu, attempt to extend the apparent certainty of the hard sciences to the study of human organization and behaviour.
While that simple view of reductionist science has long since been rejected by serious philosophers of science, it continues to be the implicit model of design and engineering practitioners. More importantly, it is manifest in the collective ethos of industrial societies.

In schoolrooms, literature and the electronic media, "pop" science presents explanation as equivalent to understanding; ordinary language begins to describe the world in reductionist terms and public expectations rise to a constantly receding horizon of limitations. Paradoxically, as the horizon expands, the universe becomes less knowable, giving rise to an equally expanding need for experts to keep control of the human-built universe. It is this formulation of the problem that leads Illich to identify the "three obstacles to recovery" mentioned in the preceding chapter.

Operating in that context, conventional TA can only hope to monitor individual technologies as if they were discrete parts of a functioning whole. TA is as reductionist as the worldview it derives from; in that fact lies its two major flaws.

The first flaw -- already introduced -- derives from the 'piece by piece' nature of TA which gives to technology a life of its own. To say so is not to imbue technology with either a mind of its own or even Ellul's technological determinism. It is simply to say that preoccupation with individual technologies fails to ask critical questions of meta-technology which advances largely without effect by individual TAs.

The second flaw derives from the assumption that human behaviour can be made part of the reductionist model of science. It attempts to predict human behaviour because it is an obvious determinant of the various outcomes of a given technology and therefore legitimately is part of any purposeful assessment.
Practitioners of futures studies are bound to concede that this element of their craft is unrefined and continues to seriously limit their accuracy.

The reductionist solution to that problem is to further refine human techniques until the uncertainty is largely or even totally removed. That is precisely the preoccupation of Skinner. Such a perspective shifts the definition of the problem from the practical to the technical realm.

Thus, while conventional TA presents itself as a monitor of technology's effects on society, in fact at best it can only try to assess individual technologies and cannot even do that well if human responses in any way are a factor in the outcome.

Nevertheless, the basic ethos that underpins TA continues to operate. Indeed, this argument contends that the roots of conventional TA lie in that ethos which, re-inforced by the rise of an apparently neutral technology, perpetuates the "idolatry of science." The "corruption of everyday language" continues to define the problem in discrete unconnected terms and perpetuates the belief that the proper realm of whatever remedial action may be required is the technical, not the practical: Illich's "loss of legal procedure."

In summary, conventional TA suffers from a reductionist methodology and is unable to forecast human responses to technology, at least until substantial and potentially dangerous advances in human technique are achieved. Given the problem set out at the beginning of this chapter and the immediately foregoing analysis, a contradiction seems evident: there is a need for individual TAs to reveal the turnaround point where technology ceases to be useful and begins to become dysfunctional while avoiding the reductionist tendencies of scientific TAs, meanwhile preserving a meta-technological perspective.
Appropriate Technology and TA:

A current phenomenon that has the potential to resolve that contradiction is the concept of alternative or appropriate technology. For all practical purposes, alternative, appropriate and convivial are essentially equivalent modifiers to describe a kind of technology that operates at sub-threshold levels (although Illich may object to being put in that company). A shorthand term for such technology, one commonly employed, is AT.

Dickson describes AT this way:

*This technology would embrace tools, machines and techniques necessary to reflect and maintain nonoppressive and non-manipulatory modes of social production, and a non-exploitative relationship to the natural environment.* (91)

AT proponents claim that scale is an important dimension of technology, arguing that so-called economies of scale are often dis-economies when analyzed by life-cycle accounting practices and, at any rate, large scale enterprises are incompatible with democratic work practices. Furthermore, the labour-saving rationale for advancing technology is based on a distorted and anti-human view of work. As Carpenter says,

*Whereas the conventional wisdom accompanying modern industrial practice holds leisure time, filled with material consumption, as the reward for stultifying and unfulfilling labour, AT emphasizes that ethical work is, to a substantial degree, its own reward.* (92)

AT people also maintain that, while industrial technology favours mono-cultural activities in the name of efficiency, AT works from the premise -- borrowed from the ecology movement -- that diversity protects survivability. That translates into concepts such as decentralization of production and control,
integration of life-sustaining activities into regionally appropriate patterns, and reliance on a variety of locally generated, renewable energy sources.

The political values underlying the AT perspective are easily extracted but seldom made explicit. In shorthand form, they are those identified by Illich as frugality, equity and autonomy. In practice, the values are seldom expressed in a coherent and systematic form, as will be demonstrated shortly. AT values serve as little more than handy touchstones to test the appropriateness of specific technologies to the vaguely held image of what is acceptable.

In the meantime, it is appropriate to note that failure to articulate a political framework renders AT almost as prone to reductionism as the industrial technology it wishes to supplant. AT publications frequently, vaguely and briefly address their value bases in general terms before getting on to a more detailed examination of apparatus, sometimes even to the extent of dealing with only one specific kind of apparatus, such as wind systems, photovoltaics or ecological agriculture, just as industrial technology experts do. That claim can easily be demonstrated.

Undoubtedly, the AT success story of Canada is the growth and stability of the journal, Canadian Renewable Energy News (CREN). (93) Table 3:1 shows the results of a summary content analysis of several recent issues of that journal, revealing a heavy hardware bias.

<table>
<thead>
<tr>
<th>Issue/Year</th>
<th>A (Apparatus)</th>
<th>B (Govt. Policy)</th>
<th>C (Organization)</th>
<th>D (Political)</th>
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<tr>
<td>4: 8/81</td>
<td>1,347</td>
<td>141</td>
<td>572</td>
<td>518</td>
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<tr>
<td>4: 11/82</td>
<td>2,147</td>
<td>291</td>
<td>322</td>
<td>236</td>
</tr>
<tr>
<td>5: 1/82</td>
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<td>167</td>
<td>288</td>
<td>209</td>
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<tr>
<td>Average:</td>
<td>1,637</td>
<td>200</td>
<td>394</td>
<td>321</td>
</tr>
</tbody>
</table>

Table 3:1 (94)
Even the movement's guru, Fritz Schumacher, moved very quickly away from values and into tangible expressions of AT's superiority in such matters as job creation, economies and environmental protection. (To his credit, he later attempted to deal with the human component in *A Guide for the Perplexed*, Harper & Row, 1977.)

With few exceptions, the discussions, correspondence and meetings of AT practitioners are dominated by questions of hardware: improved efficiencies of wind machines or insulation, reducing the unit costs of photovoltaics, the labour-cost ratio of biological pest controls, and so on. On the surface, the practices of AT appear to be as narrow as, if less massive in impact than, those of industrial technology. While the criticism is legitimate, the differences are nevertheless substantial; they lie in the values that underpin each of them.

Criticism of the roots of industrial technology are legion; there is a widespread recognition of the part played by the classical liberal traditions of individualism, competition, utility and positivism in shaping modern institutions, beliefs and practices. What is needed is an equally clear understanding of the emerging value bases of AT. While a detailed examination is beyond the scope of this essay, a brief summary would be appropriate.

Given the historical roots of socialism in a science of societies, it is to be expected that it will be as prone to scientism as its liberal democratic counterpart is. As a political theory there is no doubt about that. In fact, Marx contended that the rise of the machine in the industrial revolution was a necessary pre-condition of the proletarian revolution to follow. What capitalism has done is to turn technology into a weapon against the working class.
The contradictions and antagonisms inseparable from the capitalist employment of machinery do not exist (in a free society) ... They do not arise out of machinery, as such, but out of its capitalist employment. (95)

Here is as clear a statement as can be found of the notion of neutral technology. Contemporary socialists retain that belief. (96) However, Gendron tries to make the case that only socialists have a political theory that has the possibility of addressing the social problems of technology, even though they have not yet done so.

Socialists ... claim that socialism, unlike capitalism, will make use of technology in a basically humane and emancipatory way. (97)

That is so, presumably, because of their commitment to universal liberation. He goes on to show that they have not yet proved their claim. Indeed, a look at established socialist economies -- other than China, perhaps -- reveals an obvious technophilic tendency.

Elsewhere on the left there are some striking correlations between stated AT values and the social theories of anarchism that suggest a closer analysis.

However, anarchist theory is also rooted in the 19th century faith in rationality. Both Bakunin and Kropotkin saw the potential of science and technology to free people. Kropotkin in particular devoted a good deal of effort to demonstrate anarchism's basis in science:

(Anarchism's) method of investigation is that of the exact natural sciences, by which every scientific conclusion must be verified. (98)

He too was not a Luddite. Even more striking in this respect are the ideas of the contemporary American anarchist, Murray Bookchin, who goes so far as to assert that the high technology capabilities of
the emerging post-industrial era are exactly those needed to stimulate the final revolution.

*Capitalism's capacity for abundance -- the soporific it employs for domination -- stirs up strange images in the dream world of its victims ... the vision of freedom ... if abundance were used for human ends.* (99)

He is suggesting that the very ease of living in a technological world reveals the possibility of living free of the political and economic domination of capitalism. In fact, only in the latter half of this century has this possibility become imminent.

What appears to be common between the theories of anarchism and the praxis of the AT movement are such ideas as "small is beautiful," de-centralized decision making, local autonomy, social equality and rejection of the dominance of the notion of economic man.

Certainly, many of the social critics adopted as the movement's thinkers have had anarchistic tendencies: Paul Goodman, Lewis Mumford, Theodore Rozsak, Ivan Illich, Barry Commoner. However, just as many others descend from the liberal tradition: Fritz Schumacher, Amory Lovins, Hazel Henderson, Ernest Callenback, George McRobie.

It is nevertheless clear that AT is given at least a general sense of direction from a set of reasonably well articulated values, even if they lack a coherent political theory framework. Phrases like "the end of economics" and "economics as if people mattered" signify a belief that profit feeds the unrestrained search for higher and more technology; in that sense, the movement is of the left. The language of the movement assumes some capacity on the part of ordinary people to intelligently exercise local autonomy and at least a latent desire to live in harmony with nature; in that sense, it is anarchistic.
AT proponents have not embraced any political system. Yet without some kind of political theory, they cannot come to terms with the means for bringing about a re-direction of technology to make it conform to the AT critique. Lacking a coherent political theory to explain how change may come about, AT advocates are left with a series of normative statements and the conviction that people will grow to understand the advantages of AT as knowledge of AT becomes disseminated among the people. In that sense, the AT movement is rationalistic, and somewhat naive.

In the absence of a coherent political theory, the alternative for attracting widespread support is to co-opt public opinion in support of AT through some means of invading the consciousness of that technically illiterate public. The ability to do so may redeem AT from its legalistic/technologistic tendencies and provide it with a political base: a meta-technically literate movement of ordinary people.

Invariably, attempts to explain AT to uninformed people encounter two conceptual barriers. Since the term 'appropriate' is relative, the obvious first question is, appropriate to what?

In the early days of the movement, the answer was, simply, the environment. Lately, it has become apparent to AT practitioners that it is at least as important for technology to be socially appropriate, with all of the implied ramifications, not the least of which is the question of societal futures.

The process of describing environmental and social appropriateness reveals that the scale of technology is critical. The second question, then, is, how big, how much? Current answers to that question are at best imprecise: "small is beautiful" and "intermediate" being two fundamental ideas.
Alternative TA:

Since there is no coherent political theory, some pragmatic means are needed to render the sense of limits more precise. It is the thesis of this study that an interim means of answering these questions is the adoption of an Alternative Technology Assessment (ATA) strategy designed to probe the limits to technology. In time, a workable political theory may surface dialectically.

Some principles of ATA can be set forth at this point. There are two elements of an ATA that will significantly alter conventional TA: the removal of specialists from the core function of the process and the framing of the assessments entirely around the threshold question.

It was argued earlier that the rationale for giving specialists the core function in TA is the adoption of the ethos of scientism by essentially the whole of society. The ethic assumes that the whole is made up of discrete parts, each of which can be made the subject of close and exclusive study. As a consequence, public consciousness about technology is shaped in that mold and the people accordingly look to specialists for answers. As the technological dilemma continues to spiral ever deeper into the technological fix, the only evident means of changing the pattern is to alter public awareness of the problematique.

The pragmatic solution is to confront the issue by inserting non-specialists into the TA core function.

Simply employing ordinary people as part of the TA team has not brought about that change. In the U.S. TA program, citizen participation in otherwise conventional TAs has done little more than strengthen the political power of organized groups like the National
It can be argued that most citizen participation models are based on the assumption that the political process is made up of competing pressure groups, representative of a pluralistic society, in which organized special interest groups only need help to counter the weight of establishment groups. Such models do not propose to alter the structure of society, only to attempt to balance the countervailing forces.

Essentially, the model has to change. In its current practice, TA takes the configuration of Figure 3:2.

If an ATA were designed to address the problem of lack of public consciousness about the meta-technology problematique, it would have to address at least Elements B and C of the schematic and would likely look something like Figure 3:3.
In the ATA configuration of Figure 3:3, the effect of changing the relationship between the "disabling professional" and citizens would be to assign expertise an advisory role. Of course, experts already claim to be doing only that, but, as Illich points out, in the scientific ethos the experts' opinions are often equated with fact. Perhaps more critically, the experts are made visibly subordinate to the citizens, making the actual roles conform to the perceived roles.

Concretely, a direct consequence of the change would be that the experts could not hope to influence the outcome of the decision-making process unless they made sure that the citizens fully understand what was being said. They would need to acquire the ability to phrase their technical expressions in ordinary language. Equally important is the need for the findings of the citizens' body to result in concrete action. While a public body's opinions may have some ability to influence public opinion, unless specific mechanisms exist for direct action, professional groups will continue to use their professional prestige to influence the outcomes.
(It should be noted that this schema does not address the critical question of how technologies come to the ATA process. It is simply beyond the scope of this study to do so. Nevertheless, it should be pointed out that, if an ATA process were created which was under the absolute control of a citizen body, there is some likelihood that technological innovators would attempt to by-pass the process. A study of how technologies enter the TA domain might yield some interesting insights into political power management vis a vis technology.)

The foregoing organizational amendments do not address the more substantive part of the ATA process. In short, the 'how' does not encompass the 'what.' For that it is necessary to return to Illich's concept of the technological threshold.

In keeping with the ethos of objective science, conventional TAs ask questions about the possible outcomes of an emerging technology, not their desirable outcomes. It is thought necessary to expel normative considerations from the forecasts, at least to the greatest possible extent. Researcher bias is deemed a pollutant.

One result is that little attention is given to 'ought to' questions until they emerge under the heading of 'societal expectations,' where they are made the subject of expert attention by social scientists -- retaining the logic of objective science. The difference between 'can we' and 'should we' is that the former is progressive while the latter is conserving. (Conservative would be the term of choice if it were not associated with a body of political theory.)

Inherent in the idea of thresholds is the recognition of the inevitability of limits. A convivial society must re-acquire a sense of the finiteness of technological capability: logically, it must have a conserving value base.
Accordingly, the questions that need to be asked of any new technology are going to be defined by that sense.

Before looking at an ATA paradigm for dealing with thresholds, it may be fruitful to briefly re-state the root principles of convivial technology. The appropriate questions are going to be formed by the value triad: frugality, equity and autonomy.

Given what has just been said about the logic of thresholds, the importance of the value frugality is self-evident. Clearly, if there are finite limits to technology, it makes sense to husband available resources and capital. If so, there is an inherent logic to such a value.

A rationale for a society-wide commitment to equity is less evident. Aside from its universal presence as a value in liberal, socialist and anarchist traditions, a logical basis for seeking equity might be that reduction of conflict must surely also reduce profligacy in a finite world.

Finally, the case for autonomy needs to be made. Unfortunately, Illich was careless in his definition of that term. In the liberal tradition, autonomy is the ability of the individual to order life and opportunity without having to depend on other individuals. Not only is that a theoretical assumption, it is also the very essence of the capitalist ethic. What Illich fails to do is to explicitly define autonomy in communitarian terms.

In co-existence with equity and frugality, autonomy can only be defined as community autonomy. While that still leaves the large question of what constitutes a community, at least it dispenses with the liberal idea of personal autonomy and makes a great deal of sense for its technological implications.
(It also dispenses with those AT proponents -- drawn from the liberal-democratic tradition -- who define the alternatives as household windmills, composting toilets and "five Acres and Independence.")

In fact, autonomy is best represented in an hierarchical model which demonstrates the extensive connectedness of the biosphere and its component parts, with the unit being the local community -- however that is defined -- rather than the individual. Ecology already provides a powerful analytical tool based on that model. There is no such thing as an ecosystem of the individual.

Even a preliminary working up of these three root values reveals some interesting inter-relationships that will emerge later on. For the moment, it is enough to note that frugality is often best served by surrendering autonomy, equity also may best be achieved at cost of autonomy, while equity and frugality are not necessarily achieved by the same mechanism. For a technology to pass the test of appropriateness, it must bear all three qualities.

**ATA Framework:**

It is now timely to draft a tentative framework for the substance of an ATA enquiry.

Since the key to ATA is the notion of thresholds, all questions asked of a subject technology should be designed to assess the technology in relation to that turnaround point. Obviously, the first task is to find that point, at least provisionally.

As Chapter II has suggested, the means for doing that is to organize technology into a set of inclusive families of technologies, albeit somewhat arbitrarily. The purpose in doing so is to begin to establish thresholds against which an individual subject technology may be assessed.
The alternative would be to derive an unacceptably long and multi-levelled list of apparatus-specific thresholds which would defeat the objective of raising public consciousness about meta-technology. The divisions within the set need to be as distinctive as possible without resorting to pointless reductionism. Moreover, they should make sense to ordinary people rather than to some scientistic logic.

A provisional list of families of technology is provided in Table 3:2.

TECHNOLOGY FAMILIES:

- food/agriculture
- shelter
- energy
- resource extraction
- transportation
- human settlements
- manufacturing

- education
- health
- recreation/entertainment
- communications/information
- security
- political organization
- justice

Table 3:2

A public dialogue might order these differently, or add or delete families. For example, it might be argued that energy is a component of all of the other families and therefore becomes a sub-element. Nevertheless, the list is adequate for the moment.

On examination of the list it is immediately apparent that there is some unavoidable overlapping as well as a complex inter-relationship between the technology families which promises some very dynamic shifts around and across several families as changes occur in others. This chain reaction-like effect, well known to development consultants as "circular causation," (102) demands an on-going analysis as technological changes occur within individual families.
Thus, for example, a transportation threshold of 15 miles per hour must set limits on human settlement patterns, shelter design, manufacturing, recreation and political organization. When circular causality is at work, such limits must reflect back on transportation, perhaps in alterations of vehicle manufacturing modes or in some other way.

Clearly, it is asking too much of an individual assessment to address all such inter-relationships directly. However, assessments based on threshold analysis should bring them to the attention of the larger political process if for no other reason, because of rising technological literacy among the general population, some of whom will be required to carry out the assessments.

What an individual ATA can be expected to do is to test the subject technology within its appropriate family. The first question to be asked is what effect will the subject apparatus or technique have on the known threshold? If the answer is that it will not push the family beyond the threshold, the subject technology can then be submitted to a number of subordinate questions which will be discussed shortly.

The assumption here, of course, is that the family threshold is known, which on the evidence would appear not yet to be so in most cases. Nevertheless, the threshold-oriented analysis of a number of related technologies should in time at least suggest the approximate locus of the threshold.

As has been pointed out earlier, there are technologies for which a concrete, quantifiable threshold may not be easily or ever made discernible. In such cases, clear evidence that
the threshold has been exceeded will take the form of emerging radical monopoly. Unhappily, radical monopoly is likely to be visible some considerable way beyond the threshold. Rather than rely on such remote secondary evidence, it may be necessary to search out other, earlier signs of dysfunction. For that evidence, the test criteria adopted by AT practitioners are useful.

ATA Tests:

The first test, and one already familiar to the TA process, is the test for environmental impact. The commitment to frugality and equity demands that the technology should do no critical damage to the natural environment. This aspect needs no further discussion here.

The second test, deriving from the search for community autonomy, is to ask where political/economic control of the technology will be exercised. The simple answer is that ideally it will reside within the community that will employ the technology. In practical terms, the ideal is seldom realizable because of the inter-connectedness of all systems within the biosphere. In fact, dis-connectedness probably is not even desirable, let alone possible.

Furthermore, the definition of a user community may be inter-communitarian in nature. Distance transportation, communications and security technologies are all examples of this kind of community of communities interest.

That is not to argue that certain technologies can only be controlled in national or trans-national forums. Every community must have the right to withdraw from whatever technologies it finds oppressive. Just as the State of Oregon led in banning freon aerosol containers before the nation responded to the threat, any local community may take action unilaterally, often for no other purpose than to persuade others to follow.
Of course, control of apparatus can best be assured if it is locally manufactured from local materials by local people, under local control. An assessment judgment could meet that objective by building into its approval of the technology conditions for such decentralization of control, processing and distribution, much as is now done by 'cartel busting' legislation.

A third test, often overlooked even by AT proponents, is the test for vulnerability. The idea of diversity addresses this concern. The fewer sources of supply of goods and services, the greater the risk in the event of disruption. If, in addition, the source lies outside of the community-locale-region, the risk of disruption is compounded by political risk.

Industrial technology profoundly exhibits this characteristic. Studies of industrial technology risk (103) acknowledge its importance but resort to supposedly fail safe, add on technologies in an effort to reduce the risk. The multiple stacking of safety devices in nuclear power plants affords a dramatic example of that strategy.

An ATA would examine ways of decentralizing and dispersing the error or conflict elements to minimize the consequences of failure, rather than try to eliminate it. For example, an ATA approach to energy supply would be to develop several sources, preferably all within the physical and political control of the community of users.

No present day industrial energy utility meets those conditions. The vulnerability of B.C. Hydro to natural disaster or political/economic disruption is in direct proportion to the length of its ground link to the Peace River generating site or its reliance on foreign bond markets for funding.
Finally, there is the test of the relationship between human and mechanical power that might be termed the labour/energy ratio. Other than the energy limits suggested in Chapter II, there is no readily apparent absolute number that can be derived for this relationship. Nevertheless, an imbalance towards the mechanical energy side of the fraction can be empirically shown to result in reduced autonomy and increased vulnerability. The larger the denominator, the less effect the numerator can have.

AT practitioners discuss the ratio in terms of autonomy and equity. Those who have access to large units of mechanical energy are more vulnerable and also make inequitable demands on a finite resource.

An even more concrete analysis, appropriate to ATA, would be to examine the ratio in terms of its effect on the work force. In the presence of a finite resource (energy) and a theoretical work load, scarce mechanical energy resources should be devoted mainly to those tasks most harmful to humans or least responsive to human skill and ingenuity. An example of the former might be asbestos mining, while the latter might be micro-technology such as that employed in making printed circuits.

Perhaps the most difficult assessment task of all will be to avoid the temptation to make trade-offs between frugality, equity and autonomy. There is no reason to assign higher or lower values to one element in relation to the others.

An argument can easily be made for surrendering local autonomy in favour of equity in the case, for instance, of centralized mass production of a tool meant for popular use. If such a trade-off is the only way in which the tool can be made useful — an obvious example being private television — then the tool is not convivial and should not be developed in a convivial society.
Finally, wherever a specific threshold can be located, it must not be allowed to become fixed in society's expectations. The need is to make maximum use of technology to liberate people short of it becoming dysfunctional. It is quite conceivable that changes in related technologies may have the effect of allowing for a rise in threshold level. The point of an effective ATA process is not to limit surface transport forever to 15 miles per hour, but to avoid having a technology that oppresses people.

With the foregoing preliminary model in mind, it will be instructive now to test it against a real-life emerging technology to see if it can stand the test of conviviality.
CHAPTER IV

At the outset, the development of all technologies reflects the highest attributes of human intelligence, inventiveness and concern. But beyond a certain point, the point at which the efficacy of the technology becomes evident, these qualities begin to have less and less influence upon the final outcome; intelligence, inventiveness and concern effectively cease to have any real impact on the ways in which technology shapes the world.

Langdon Winner, *Autonomous Technology*

A Case Study: Videotex

In selecting a technology to test the ATA model against, there is a natural temptation to choose one from among a number of industrial technologies that can clearly be shown to be anti-convivial; in effect, to build a straw man. A more critical test demands the selection of one of the lighter post-industrial technologies. The case selected here is that of videotex.

Videotex technology also affords a critical test case in that it is a technology that clearly belongs in Winner's "organization" category, and thus presents a degree of complexity that is representative of emerging post-industrial technology.

As Winner describes it,

*A technical organization is an assemblage of human beings and apparatus in structured relationships designed to produce certain specified results.* (104)

A description of a concrete videotex system will quickly demonstrate the fit.
Telidon is the form of videotex most actively being promoted in Canada at this time. While the final configuration of the system has yet to be adopted, historical developments and competition between the communications industry giants indicates the likely outcome will be a shotgun wedding between cable and telco operators, officiated by government regulatory bodies. Godfrey et al represent the likely outcome in Figure 4:1 below.

![Diagram of Hybrid Cable/Telephone Distribution System](image)

It is readily apparent that Telidon technology is made up of a number of pieces of apparatus, all but one -- the interface box -- already being in widespread use: existing electronic hardware, a number of institutional bodies and a software protocol. Essentially,
the only piece of patentable apparatus dedicated to the system is the small piece of hardware that interfaces the system.

What makes the whole system a technology is the over-all systemic architecture that is created to achieve a specific objective. The desired core functions are to store and retrieve information. (Information here is used in its broadest meaning, including the spectrum from high utility hard data to entertainment.) Obviously, the technology is not designed to provide any new functions, although its most utopian advocates insist it will lead to as yet unknown opportunities.

Information exchange is an on-going function which belongs to the communications family of technologies. Therefore it should theoretically be possible -- and probably difficult -- to locate its threshold and therefore to assess the impact of Telidon on that threshold.

Before doing so, a parenthetical point should be made. The probable systemic architecture described in Figure 4:1 is not the only possible outcome. Indeed, to the extent that diversity may be tolerated or even encouraged, a number of different configurations could exist side by side. (Because of the protocol, however, they may not easily be inter-connected.)

What makes the configuration of Figure 4:1 likely is that it affords within the foreseeable future the maximum possible utilization of the technology. It will be shown later that promotion of the Telidon system is based on this maximization principle.

A number of critics have rejected that objective in favour of a decentralized model that appears to afford a greater degree of conviviality. They recognize that all of the basic functions of
Telidon can be achieved by a less sophisticated and less inherently centralist technology. Both the digital data function and a slow-scan visual function can be provided on a voice quality narrow band facility. Furthermore, switching can be achieved through a system of ad hoc temporary inter-connections, as and when they are needed.

It is theoretically possible to design such a system to make it localized in character. Some form of community control could be mandated by statute. Similarly, the data bases could be mainly indigenous and equal access may be assured by statute. Communities of users could associate on a voluntary basis, ensuring user autonomy and reducing vulnerability.

What it may not be able to deliver is equity, because such mini-systems will not achieve economies of scale inherent in mass media.

Advocates of the diffuse model of videotex seem to be saying that its adoption will in some way pre-empt the field, thus preventing the rise of a less convivial centralist model.

Assuming for the moment they are correct in that analysis (the history of telephone technology would seem to question the analysis), they seem to be facing heavy odds. Since the telephone and cable industries have already taken on a centralist, non-convivial form, and since they have the economic and infra-structural resources to move independently and quickly -- as they are already doing -- it seems inevitable that videotex will shape its form to the existing organizational skeletons of the parent industries. The European experience would seem to bear that out. (106)

The history of communications technology everywhere suggests the centralist tendencies are exceptionally strong, perhaps even irresistible.
A more critical judgment of the diffuse model -- *caeteris paribus* -- would be to challenge it on grounds of lack of equity. While some token moves towards the diffuse model are still possible (even likely, since the centralist model can easily accommodate non-competitive innovations), over time the centralist model will develop a radical monopoly through the rise of the so-called electronic highway and development of attractive amenities through economies of scale (for example, colour video display units). In these circumstances the diffuse model will be reduced to the status of a middle income hobby activity, the electronic equivalent to the ten-speed bicycle in an automobile dominated transportation system.

The conclusion to be drawn from the foregoing diversion from the main argument is that the videotex technology will take some variation of the Telidon configuration. Accordingly, that is the technology that warrants assessment. Before testing it against the ATA model, the actual assessment history of Telidon will be reviewed.

The origin of Telidon lies within the bureaucracy of the federal Department of Communications. The rising currency of theoretical dialogue about videotex, followed by early experiments in Europe, led people in the department to believe that a strong international market could be captured if an effective technology could be assembled at Canadian government and corporate initiatives.

*There were a number of precursors to (Telidon), most notably in Great Britain. However, the Telidon system was the first one to incorporate advanced computer graphics techniques into either a videotex or a teletext system. It is widely believed that it will provide the general model on which future videotex and teletext systems will develop, a situation which puts Canada, at least temporarily, in a position of technical leadership.* (107)

The same argument was advanced 30 years ago to justify the development of CANDU.
Telidon was developed by the Communications Research Centre of the Department of Communications over the period 1969 to 1978. Patents for the interface hardware were secured and manufacturing licenses issued by 1976. (108)

By 1978, Telidon was formally launched and several government programs were initiated to stimulate private industry to respond to the opportunities represented in the new technology. The larger corporate conglomerates moved quickly to take control of the technology; in B.C., the telephone company has seized control through several of its subordinate firms: B.C. Tel, AEL Microtel, Microtel Pacific Research, Viscount Industries, Dominion Directory. At a cost of $10 to $50 a page, a full data base could cost as much as $1 million, effectively relegating to a subordinate position the small scale information providers like the Greater Vancouver Information Referral Service.

For the purposes of this study it will be necessary to determine how and to what extent videotex-Telidon has been assessed.

According to the Ministry's Director of Applications Development,

... assessment of the technology is a continuous process in all DOC programs which have a significant R&D content. (109)

While he has not detailed the methodologies employed, the response is consistent with the orientation of federal government assessment policy as stated by the General Director, Technology Assessment Division of Science and Technology Canada, who stated at a recent conference,

... it is more important to have an effective Technology Assessment capability within the executive branch than it is to have an independent office of Technology Assessment. (110)
Thus, the DOC's preference for conducting in-house and therefore effectively in-camera assessments has the blessing of official policy.

More significantly, none of the quasi-governmental or private bodies that normally carry out independent assessments has yet undertaken an assessment of Telidon, although elements of the technology have been assessed in their independent configurations (for example: microcomputers, micro-electronics, EFT, information revolution, data processing, information society, etc.).

There is, however, one potential assessment body operating under the instructions of the DOC -- the Canadian Videotex Consultative Committee (CVCC). Made up of industry, government and public agencies, the CVCC has a primary responsibility to advise the Minister on program developments, as the title suggests.

But one of several sub-committees of the parent CVCC appears in name at least to have been given some kind of mandate to carry out public assessment of videotex generally, if not Telidon specifically: the "Social Impacts" sub-committee (formerly named the "Effect of Videotex on Individuals and Society"). Their terms of reference quite clearly give them the authority to carry out a public enquiry which could constitute a full-blown assessment, if they should choose to take that course. The terms are suitably inclusive and are worth setting out in full.

In view of the fact that the use of Videotex systems may in time become as commonplace as telephone usage, the Subcommittee on the Effects of Videotex on Individuals and Society (our former name) seeks to anticipate the impact of this developing technology on Canadians. Specifically, our concerns are broadly based to include social, cultural, political, economic and other factors.

The Subcommittee will seek to identify as they emerge philosophical and moral issues fundamental to the development of this technology and encourage an integrative approach to the solution of problems which are identified, for the benefit of all Canadians.
In particular, the Subcommittee anticipates that among others the following issues will require its consideration:

1) The need to facilitate and be responsive to public comment on developing issues in order to ensure that the introduction of videotex proceeds in a manner which is both acceptable and desirable to the public.

2) The development of videotex systems which have the capacity to be truly interactive and can provide an opportunity for participation by Canadians in all walks of life. To do otherwise could increase the widespread alienation already experienced by members of our society.

3) The technology must be developed so that the interests, needs and skills of differing age groups are satisfied. In addition, the needs of other specific user groups (such as the handicapped) must be recognized.

4) The development of techniques which will effectively safeguard the privacy of individuals. Privacy must be considered paramount even when weighed against considerations of economic efficiency.

5) The impact on quality and quantity of employment. The introduction of videotex systems will affect work in a variety of ways. Attention must be given to displacement of workers, retraining, education and perhaps even to a reappraisal of the nature of work itself.

6) The issue of equity. Lack of access to videotex systems could create a new form of poverty.

7) The provision of adequate safeguards to offset the potentially centralizing tendencies of this new technology. Techniques should be developed to facilitate the use of the system by individuals as information providers.

8) The need for sufficient untied funds from commercial information providers, as well as government, to support data bases of specific community interest.

9) The adequacy of data bases so that overall homogenization of society is not exacerbated. Systems that are developed must be responsive to geographical needs and sensitive to the social and cultural diversity of Canada.

In particular, Items 6, 7 and 9 bear precisely on the concerns of this thesis in that they address explicitly or implicitly key questions of equity and autonomy. The question of frugality is not raised.
(In view of the fact that the sub-committee's budget for the fiscal years 81/82 and 82/83 was $34,000 each, it is unlikely they can hope to program for any of the above goals, but they will necessarily learn to practice frugality.)

Within the language of the sub-committee's report there are two assumptions that need explication.

The first of these relates directly to the earlier discussion about the role of technology in shaping society. The Social Impacts sub-committee is not of the dystopian school, but does recognize that technology has some impact on society. Moreover, the style of the language of the report very clearly reveals an acceptance of the inevitability of the emerging information technologies and therefore seeks only to mitigate their impending effects. In short, the sub-committee undertakes its assessment with the assumption that the public choices about videotex do not include the option of outright rejection of the technology.

The second assumption is that the videotex system can be fine-tuned as it develops to make it responsive to emerging social goals; that is an incrementalist view of technology change. As the Social Impacts sub-committee proceeds with its tasks, five other sub-committees and the parent CVCC are actively promoting the technology in the name of economic opportunity. To put that procedure in perspective, it is as if the Berger enquiry had been undertaken simultaneously with pipeline construction.

Nevertheless, the sub-committee is aware that the technology is taking a form that is potentially disruptive to society. They argue that Telidon can only achieve its potential by becoming fully interactive.
The means they recommend to achieve that are:

- input of information by users;
- terminal-to-terminal communication between users;
- transactional services;
- down-loading of computer programs;
- interconnection with related services;
- management of closed user groups. (112)

As with all advocates of the diffuse model, the sub-committee has encountered here the inherent problem of how to reconcile the expensive 'ideal' system with full and equitable access.

The problem arises because the technology possesses "potentially centralizing tendencies" which, according to the sub-committee, can be overcome by deliberate interventions such as legislation, public enquiries and governmental support of public advocacy groups. Meanwhile, as the social issues gradually emerge, suggesting appropriate interventions from time to time, the technology is being rapidly developed and is taking an admittedly centralist configuration.

In light of the foregoing, it is apparent that no known satisfactory assessment of Telidon or videotex has yet been carried out, even by conventional TA standards. There is, however, obviously an assumption by DOC and industry officials that the technology should proceed to full development or, at least, is unavoidable -- confirming Winner's concept of autonomous technology. The aggressive marketing stance of the partners would seem to suggest a self-fulfilling prophecy.

At this point it will be instructive to this thesis to frame an outline of an assessment strategy for videotex/Telidon employing the ATA paradigm.
The first task is to attempt to find the threshold for communication/information technologies. Here is a case where threshold is at least elusive, if not downright impossible to find.

Rather than pursue the problem from that end, it might be more productive to approach it from the other end: What would constitute a radical monopoly of information technology? To answer that, the concept of information ecology may offer insight.

Information ecology suggests that information is made up of a host of inter-related types and sources of information, much of it contradictory and elements of which hold different significance for different perceivers. One might even extend the ecology metaphor by pointing out that information is made up of a hierarchy in which some kinds of information "feed off" or are made up of smaller bits. Others maintain symbiotic-like relationships, while the whole system is at risk when it loses variety.

By way of example, it is readily apparent that the information eco-system is made up of common languages, skills, tacit and cognitive knowledge, memory, experience, complex sensory mechanisms and expectations.

The more these elements are shared, the less need there is to communicate them explicitly and the more information the community can convey iconically, as it were. Conversely, the less they are shared, the more need there is to convey the affective domain by translating it into the cognitive. These two conditions represent the conditions found in traditional and modern societies respectively.
Klapp describes the shift from traditional to modern communicator this way:

There are four main dimensions of change:

1) in channel, from personal (face to face give and take) to broadcast (mediated, one-way) transmissions;

2) audience, from primary group to heterogeneous mass of strangers;

3) communication content, from prescriptive (rules, norms) to descriptive (news, facts); and

4) source, from hierarchical (status in one's own system) to professional (skill and job as communicator).

(113)

At some risk of employing a circular argument, it can be said that, as information technology is manufactured to fit into this framework, it will have the effect of shifting society away from tradition towards modernism. As the shift occurs, less and less of the original experiences are conveyed by the technology. Memory, tacit knowledge, skills and feelings are conveyed in a representational rather than literal form. Writing, telephony and television have all demonstrated the alteration of experience through technological mediation.

As the process of technologizing information advances, less affective information is conveyed in its true form and the less value such information is given by members of society. All that is needed to create a radical monopoly is to streamline the technology so that it can carry most, or possibly even all, of the residual information requirements on one medium.

Videotex promises to be able to do that within a very short time frame. As Gordon Thompson promised, the "new medium" that will emerge from the direction suggested by videotex will provide,

- an easing of the access to stored human experience for the society at large;
- an increase in the size of the common information space shared by communicants (citizens).

(114)
When Thompson speaks of "access to stored human experience," he clearly means that which can be stored in computers, on video or audio tape and other electronic storage media -- all of which are or can be integrated into the videotex system.

That portion of human communications that is non-verbal or tacit cannot be so stored; it is stored only in collective human experience and can only be conveyed face to face. Thus, any "increase in the size of common information space" must be limited to the cognitive domain: metaphorically, a two dimension representation of three dimensions.

One result of technologizing information in the electronic age is that knowledge becomes segmented, as represented by the Telidon page system. More than that, information is lifted out of its environmental and situational context. It becomes objectified. It is in that segmented and representational form that videotex will store human experience and widen the common information space.

It needs to be said here that the current crude experiments in Telidon offer no imminent threat of radical monopoly. The early offerings of Manitoba's "Grassroots" program, for instance, manifest an obviously Macluhanesque tendency to employ the new medium in the old way: stock prices, events calendars and weather reports to farmers that have been available by radio for 50 years.

However, as the system begins to offer more appropriate interactive functions -- such as down-loading of computation functions like best use financial analysis -- it will supplant newspapers, radio, public meetings and residual forms of informal communications left over from a more traditional era. As the information environment becomes more monolithic, what constitutes information increasingly will be defined by Infomart and a radical monopoly will begin to emerge.
Nationally, continentally, even globally, the process will be entrenched by the rise of the so-called electronic highway which, as with its transportation equivalent, will degrade the secondary routes until they become so deteriorated as to justify abandonment.

In summary, it can be readily seen that the potential of videotex to displace existing information technologies and disrupt related activities, such as marketing or education, suggests it likely will become a radical monopoly of information.

There are not yet apparent means for fixing the threshold more precisely. It is likely that counterfoil research will yield a potentially useful formula based on the concept of information ecology.

It remains only to submit videotex to the four tests of appropriateness.

Test Criteria: ENVIRONMENTAL IMPACT

On cursory examination, all information technologies appear to rate low on environmental impact. In conventional concepts of the physical environment, much less damage is done by processing information instead of goods or people. It is forcefully argued by proponents of the "new medium" that electronic publishing, for example, destroys no trees and consumes minute quantities of energy.

While the merit of that argument must be acknowledged, a broader definition of impact will include the notion of information overload, a condition in which the amount of information available to the individual exceeds the human capacity to use it.
No doubt that condition has prevailed at least since the founding of Ptolemy's library at Alexandria 2,300 years ago. What raises modern concerns about overload is the fact that electronic information is mass information. As such, there are no apparent gatekeepers between the information resource and its user. The fact is that the gatekeeping function has changed location: it now occurs behind the library. In other words, information mediated by electronic technology is shaped before it goes into the mass storage medium, to make it more appropriately a commodity.

Of course, it can be said that videotex can resolve the information overload problem by purging redundancy and organizing information for rapid electronic scanning. The cost to autonomy is unavoidably apparent.

On balance, Telidon merits at least an ambivalent rating for environmental impact: low in narrow physical terms, but higher if the concept of environment is extended to include the social environment.

**Test Criteria: POLITICAL/ECONOMIC CONTROL**

At a public meeting in Vancouver held in February 1982, John Madden of Pacific Microtel, and an early developer of Telidon, stated that it was necessary to mass produce Telidon hardware so that the cost could be reduced in pursuit of equal access to the technology.

That abridgement of local autonomy in the interest of economic equity presents a clear example of the potential conflict of elements of the convivial paradigm which, if not resolved by other than a win-loss solution, leads to anti-convivial results.
In pursuing equity, economic control of the technology has been given to centralist, non-democratic institutions. Furthermore, political control of the technology is patently centralist, given the origin of Telidon in the federal bureaucracy. Finally, the nature of the data base will also reflect the interests of the large corporate information providers. (To counter this assertion, the IPs claim user demand will ensure that the data base is responsive to local needs. The argument only stands if it can be shown that marketplace mechanisms are inherently democratic — a point not conceded by all critics.)

Proponents of the diffuse model -- including the Social Impacts sub-committee of the CVCC -- have put forward system design criteria that would meet many of the above criticisms, but they have not addressed Madden's concern for economic equity.

It would seem that anything less than the industrial mode of implementation of videotex will keep the cost of videotex out of reach of ordinary people. In short, videotex fails almost completely to deliver local control of the technology in an egalitarian mode.

Test Criteria: VULNERABILITY

There are two aspects of the test of vulnerability that seem pertinent to an assessment of videotex.

The most obvious of these arises from the likelihood that the technology will displace existing diverse sources of information simply because of its superior capacity to store and disseminate it. In that event, the loss of diversity of sources raises the possibility of loss of information following civil or natural disruption, precisely when it is most needed.
A more critical vulnerability arises from the question raised earlier about who defines the information content of the system.

Whereas traditional society's gatekeepers were plainly visible, standing between the data base and the citizen, the modern electronic gatekeeper is hidden behind the data base. If the role of the information technocrat is altered over time to that of decision-maker about the content, Bell's prediction of the rise of a knowledge meritocracy may become true. (115)

Habermas has also described how

... science, technology, industry and administration interlock in a circular process... (116)

in which access to decision-making is removed from what he called the practical realm: the place where ordinary people interact politically.

It should be pointed out here that the very effort to ensure equal access to the technology will result in more reliance on videotex as the sole information source of the masses. Elites and the economically advantaged may be able to retain other more expensive or more privileged sources, yielding an information advantage.

A critical society, concerned about retaining diversity and choice, would view the high vulnerability of videotex as sufficient reason alone to reject the technology, even if it scored high in all three other tests.

Test Criteria: LABOUR/ENERGY RATIO

The theoretical ratio of labour to energy in videotex is apparently very high.
The human effort required to extract information from a richly diverse information ecosystem derives not only from having to search out sources but also from having to interpret and weigh each piece for its relevance to the whole. Videotex technology does most of that work for the information consumer.

From the perspective of convivial technology, the price paid for such convenience is a reduction in "each man's ability to produce change."

More concretely than that, the nature of work in the information industry is radically altered. A diversified information system employs diverse, individual skills. Videotex requires fewer skills because of the ability of the technology to organize data and because the nature of the data changes from being contextual and continuous to being discrete and segmented.

From the information consumer's end of videotex, the system is transparent -- that is to say, its inner workings need not be known (indeed, should not be known) if the technology is to remain simple to use. (The Social Impacts sub-committee would have it both ways: transparent and understandable.) (117)

One of the consequences of transparency is that the user can become intimate with the technology because of its high utility. An obvious example of this condition is found in the modern telephone system. Its outstanding utility and the appearance of responsiveness to the individual (direct dialling) leads some observers (Illich, Thompson) to rate it as convivial. In fact, the inaccessible, unknowable, inner workings of the telephone system and of videotex make them almost completely unresponsive to user control. The ability to command the machine to perform deludes the user into believing he controls it. What he commands is an overgrown Golem.
The extent to which videotex removes from the user the onus to find, organize and interpret information also proportionally diminishes the user's ability to shape the information environment. The contention advanced by proponents of the diffuse model of videotex -- that information users can also be information providers and thus influence the information environment -- fails on either of two grounds:

1) the diffuse model is unlikely to emerge in the face of the centralizing tendencies of the technology, or

2) if it does prevail, equality of access will be denied by cost considerations.

Assessment Conclusions:

The findings of the test for environmental impact are either ambivalent or negative, depending on how the problem of information overload is appraised; control of the technology lies well beyond either the local user community or the individual; the system is highly vulnerable, particularly for ordinary people; and the ratio of labour to mechanical energy is so large as to render the technology unresponsive to human intervention.

The dysfunctional expression in videotex is the threatened rise of radical monopoly. If it can be shown that widely accessible alternative sources of information would not be displaced by videotex, the technology would be ineffectual and therefore of little concern to the ATA process. In that case, it may well go the way of the ill-fated videophone or be of no more enduring interest than the hula hoop. In view of the massive promotion of the technology, it is more likely that it will prevail, unless a public assessment strategy can reveal its evident lack of conviviality.
Since we are technologically over-committed, a good general maxim in advanced countries at present is to innovate in order to simplify the technical system, but otherwise to innovate as sparingly as possible.

Paul Goodman, *New Reformation: Notes of a Neolithic Conservative*

**Summary:**

In spite of their profoundly different value premises, dystopians and utopians assign equal importance to technology as a prime shaper of the human condition. They are equally agreed that attention must be paid to the subject so that it can be understood -- as destroyer for one, saviour to the other.

Posed in the terms of the two extremes, the problem becomes irresolvable: the dystopians must utterly reject technology; the utopians need to hurry it on past its all too obvious fissures in an attempt to use technology to harness technology for abundance.

Of more practical value to ordinary people is the idea that technology can be both oppressor and liberator, depending on the characteristics intrinsic to the type of technologies employed: on who has access to it, and who controls it.

This essay has largely engaged in the first of these characteristics by employing the analytical concept of convivial technology. It has been shown that most (but not all) technologies
possess at least some capacity to relieve people from either oppressive, anti-human toil or equally oppressive, anti-human slavery -- at least up to a threshold, beyond which the tool begins to victimize its users.

A major impediment to society's ability to recognize the existence of thresholds has been shown to be not only the blindness of the experts but also the presence of a nearly universal technocratic ethos which denies the existence of limits. In short, two kinds of tools are needed: one a research methodology that focuses on thresholds and the other a process by which ordinary people are forced to take responsibility for adopting or rejecting the technologies that affect their own lives.

It has been demonstrated that even in its ideal configuration conventional TA cannot address the task of revealing the consequences of meta-technology because it is formed out of reductionist technocratic roots. Therefore, an alternative TA strategy has been called for which concentrates on locating the thresholds for a number of technology "families." It is suggested that a set of four tests, drawn from the praxis of appropriate technology, can facilitate the search for the locus of particular thresholds, even where they may not be definitively located. In those technologies where the presence of a threshold cannot be functionally fixed, an unmistakable indication that it has been exceeded is the rise of a radical monopoly.

The ATA model presented here outlines a process that likely will give rise to a growing public consciousness of the influence of meta-technology on the lives of ordinary people. It does so by displacing technology experts from the decision-making roles and replacing them with ordinary people.
Finally, the tentative ATA paradigm was tested against the emerging videotex technology which was found to be significantly anti-convivial and likely to result in time in a radical monopoly of information technology.

What remains is to indicate the contingent questions and suggest areas of useful further research.

Contingent Concerns:

At various points in this exploration, contingent issues have surfaced which, if pursued, would have expanded the task beyond reason. Three of these, however, are sufficiently pertinent to the topic to merit at least an outline showing the relationships and suggesting areas of possible further examination. Without meaning to imply a priority ranking, they are the following:

1) What organizational techniques might be adopted to ensure control of technology by ordinary people?
2) How should emerging technologies come to an ATA process?
3) Can established anti-convivial technologies be rendered convivial?

The scope and direction of an investigation into these three questions will now be suggested.

1) AN ORGANIZATIONAL TECHNIQUE

Even the most radical critiques of the conventional TA process fail to address the relationship between expertise and political power. In the most socially critical analyses, there is usually a call for citizen participation in TA, always as lay team members, invariably on the premise that widespread information dissemination will result in the right course of action being taken. As Hazel Henderson points out, there is already widespread support among politicians and bureaucrats for citizen participation in the TA process. (118)
What she and other critics do not do is explain how such nominal citizen participation will alter the decision-making structure other than by creating a handful of better informed citizen activists.

What is needed is a fundamental re-structuring of the process by which technologies are adopted.

A brief introduction to a possible organizational structure was provided by Figure 3:3, which may offer the opportunity of radical restructuring. The intent of the model is that the participating citizens should function somewhat like a jury in criminal trials and civil tort proceedings -- that is to say, within established rules of procedure and evidence, the jury's findings are binding on all parties, including the judge.

It is likely that existing rules of evidence would adequately serve the technology jury procedures; it is less likely that the existing judiciary would be either appropriate to or competent for the adjudication role. (That said, it should be noted that the landmark study of the environmental and social impacts of the proposed Mackenzie Valley pipeline was carried out by a justice of the Supreme Court, albeit an unusual one.)

Inevitably, a procedure such as this would be as adversarial as those of the criminal and civil justice systems. That outcome need not be of concern. The existing court procedures already accommodate the interests of third parties and there is, in fact, a conflict of interest between technological entrepreneurs and numerous groups of citizens (for example: trade unionists, other entrepreneurs threatened with dislocation, environmentalists, pregnant women, natives, etc.).

It serves no useful purpose to perpetuate the myth that technology is neutral.
One other aspect of this tentative proposal needs to be made clear. If one of the important objectives of an ATA mechanism is to arouse public consciousness about meta-technology, it follows that the procedures should be of active interest to all citizens. Accordingly, as with the legal jury system, all citizens should be required to serve as and when they are called and with appropriate compensation and protection.

Needless to say, there can be no assurance that such citizen juries will avoid errors in judgment, some of which may have profound implications for society. However, it has already been pointed out that expertise has not protected society in the past from the unwanted or unintended consequences of technology. The difference here is that the blame cannot be attached to 'them.'

2) EMERGING TECHNOLOGIES

A footnote in Chapter III raises the question of how new technologies come under the scrutiny of the TA process. No OECD country now has legislation in place that will capture all new technologies as they surface and submit them to analysis. Instead, the judgments of senior bureaucrats and, in the case of the U.S. Office of Technology Assessment (OTA) (119), designated legislators are relied upon to identify those that seem to be most pressing, potentially disruptive and/or beneficial.

As a result, many emerging technologies either escape detection or are assumed -- without examination -- to be insignificant. Often, after the technology is in place (for example, VDTs), its potential problems become clear. It was argued in Chapter IV that videotex has escaped assessment in Canada (though not in the U.S.) partly because it is an organizational technique made up of several in-place technologies and partly because the bureaucrats were its parents.
The only conceivable method of capturing most new technologies would be to require all patents and copyrights to be submitted to at least a preliminary impact assessment before they are registered. Others may be controlled through existing or new regulatory bodies.

Alternatively, a mechanism could be put in place which allows any citizen to challenge a new technology, thus requiring it to undergo a public assessment hearing.

The financial and organizational implications of such possible policies are at least problematical, if not downright awesome. By way of illustration, the U.S. OTA budget for 1982-83 was $12 million and resulted in only a handful of studies.

It must be said, however, that scientists might be inflating the scope of such studies more in their own career interests than in the interests of public protection. It should also be pointed out that the existing court system carries a substantial price tag, one largely acceptable to the public because it ensures some degree of civil rights and societal protection.

Whether the present ad hoc TA system actually protects society, and whether a wider ATA net might actually effect system-wide economies, should be amenable to appropriately designed researches.

3) ESTABLISHED TECHNOLOGIES

All proposals to take hold of technology seem to founder on the rock of reality of an immensely complex, inter-locking, inter-dependent web of machines, organizations and attitudes. If we cannot escape the logic of Illich's case for a bicycle level transportation technology, shall we then do away with jet planes and automobiles?
The image of the attendant chaos renders the suggestion ludicrous to ordinary people. Yet the direction the entire foregoing argument takes us in is precisely to that logical end.

It may be, of course, that some essential natural resource will simply become exhausted, forcing society to live within its means. Alternatively, the masses may finally rebel against oppressive waste and regimentation, throw off the entire apparatus and start again with a convivial outlook.

Both these possibilities seem to require a passive acceptance of rampant technology until it dies a natural and inevitable death. It leaves no option for action.

There is a hint of a strategy suggested by Winner; an activity he terms epistemological Luddism. (120) He contends that the Luddites were not simply destroying machines that threatened their jobs, but in fact they were assessing machinery by a set of conscious and intelligent criteria. Whether that was so or not, the idea of an experimental educational dismantling of technology holds merit.

The suggestion is not to smash machinery. In fact, Winner and Ellul have both shown that the machine, while highly visible, is not as pervasive as the organizational and human techniques which employ them. Rather, he proposes to experimentally disassemble parts of the social technology in an effort to learn,

1) the kinds of human dependency and regularized behaviours centering upon specific varieties of apparatus,

2) the patterns of social activity that rationalized techniques imprint upon human relationships, and

3) the shapes given everyday life by the large scale organized networks of technology. (121)
The object is to learn -- publicly -- what these relationships are so that new configurations of technology may be derived, ones that more humanly serve society.

Attempts to institute an experimental Luddism have and are being made in isolated circumstances, but without the benefit of a coherent theoretical rationale for doing so. The kibbutz, Ashram and Ujamaa communities were at least at inception experimental. Chinese food and energy technologies have had great potential as learning tools, although little research has been done on them for a variety of political reasons. At least one Third World country, Papua-New Guinea, has written AT into its constitution, but there is no sign that anyone is studying the outcomes.

Two striking examples emerged briefly in this province in the early 1970s.

Between 1972 and 1974, a government MLA made a low keyed proposal to experimentally remove Vancouver Island hydro electric energy supply and distribution from the mandate of B.C. Hydro and Power Authority. The intent was to allow Island residents to reconcile for themselves the tensions between resource conservation and development. The proposal collapsed with the government late in 1974.

During that same period, a senior B.C. educator proposed to close down the entire public school system for two years in an effort to achieve consensus about the purposes and practices of education. Her objective was not, however, to study the impact of educational technology on society, but to work for community consensus. A strategy more appropriate to Winner's idea would be to remove some portion of the system from the control of the Public Schools Act, the bureaucracy and the credentials network.
One of the most attractive aspects of Winner's idea of an experimental Luddism is that it does not simply call for a stop to enquiry and innovation. Still, the idea would have better definition if some sort of guidelines could be imposed on the experiments, guidelines that address voluntary frugality.

A sense of finiteness of resources does not necessarily imply a lack of freedom to explore alternatives. It only says that the alternatives are constrained within boundaries which already exist but which our profligate attitudes towards technology have denied: a change in outlook, not substance.

A different kind of technician is called for by the job of experimental Luddism. In another context, Levi-Strauss suggested such a difference might be found in the "bricoleur" who is,

... adept at performing a large number of diverse tasks; but, unlike the engineer, he does not subordinate each of them to the availability of raw materials and tools conceived and procured for the purpose of the project. His universe of instruments is closed and the rules of his game are always to make do with ... a set of tools and materials which is always finite ... (122)

The bricoleur is something of a cross between a 'jack of all trades' and a magician who sees new relationships in old materials and means. Bricolage employs the kind of tool kit that Illich sought for convivial technology.

The limits it operates within need not prohibit innovation or even growth. Indeed, it is arguable that the task of experimental Luddism -- to design for the special elegance of simplicity -- is more creatively challenging than the employment of inelegant brute strength to power a self-defeating progress.
Conclusion:

In the limited sense used here, technology is either autonomous or on the verge of becoming so. It is so only because society fails to fully comprehend the possibility that its technologies may be dangerous and therefore makes no coherent effort to control them. Only when that comprehension changes can the task of controlling technology be undertaken.

Unfortunately, the habits of technology are nurtured by technology. Thus, the suggestion there is more than a minor problem of periodic adjustment must appear to the technologically illiterate as ludicrous as Chicken Little's cries of imminent disaster. Yet there are the beginnings of doubt in ordinary people about technology raised by the evidence of lost rivers, dying species, nuclear terror and the myriad results of increasing social dysfunction.

A means of democratizing technology assessment can't help but spread awareness of its pervasiveness for daily life.

More importantly, such means promise to render ordinary people technologically literate. When that happens, tools for understanding technology will be eagerly taken up.
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79. Illich-Political Inversion, p. 28.


83. Ibid.


94. Subject categories were defined as follows:

   Apparatus (after Winner): hardware, machines, tools and processes such as logging, mining, farming.

   Government Policy: programs, legislation, other government initiatives.

   Organization (after Habermas): rational-purposive social structures other than governmental.

   Political (after Habermas): meta-technology concerns, usually expressed as editorial content and/or signed columns.

The relative weights of the numbers are not significantly altered if Columns B and D are collapsed to conform with Ellul's categorization. There were no articles dealing with human technique.


101. Figures 3:2 and 3:3 are derived by author.


104. Winner, p. 75.


107. Godfrey, p. 56.


109. Personal Correspondence.

110. Demirdache, p. 194.


112. Ibid., p. 8.


118. Henderson, pp. 331-338.


120. Winner, p. 330.

121. Winner, p. 331.

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