JACQUES ELLUL'S LECTURES ON FORECASTING AND PLANNING

transcribed and edited by

Randal Marlin

Editor's Note: This article is intended to capture the substance of a once highly influential futurist whose works are now enjoying a reassessment and revival. Jacques Ellul reviewed the manuscript and verified its accurate depiction of his views on forecasting. In addition, he has endorsed the synthesis concept, and plans to respond to *Futures Research Quarterly* following its publication.

The following is a paraphrase of sections from Ellul's final regular lecture series at the Institut d'Etudes Politiques. It is intended to be read as if listening to Ellul. The selection is organized here around three principal themes: the social phenomenon of technique; technique as the impetus to study of the future; and advice on forecasting and planning.

INTRODUCTION

Jacques Ellul is best known in North America for his work *The Technological Society*. Written in 1954 and published in English in 1964, it had a significant impact on social thought in the 1960s, calling into question the worship of technology and the myth of progress while bulldozers were tearing down the core of American cities in the name of the latter. His central concept is that technology is a social "technique." Instead of serving man, it has come to dominate him. Specialists tend to think of ends as defined and served by their own techniques rather than ends appropriate to the overall benefit of mankind.

Ellul retired from the University of Bordeaux in 1980, but has continued to publish prolifically on wide-ranging but interconnected issues. His background is in history and law and his early major work, the *Histoire des Institutions*, gave him a strong base from

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which to view the workings of modern society. Many of his well-known works are classified as sociology, such as *Propaganda, The Political Illusion, The Technological System* and more than a dozen others. These works are written in the language of social science, and they give little indication of the strong theological preoccupations of his work as a whole. He is like Kierkegaard in that the individual works take on greater significance in the context of the entire output. Not surprisingly, Kierkegaard, Marx and Barth are the main influences on his thought.

Recent attention has focused on his theological writings, and the Spring, 1985, issue of *Cross Currents* was devoted entirely to his work. It included a comprehensive bibliography of about 40 book-length publications and three articles. The articles were written by Ellul at about the same time as the lecture in this summary and can profitably be compared.

Ellul's main concern in all his writings is with human freedom. The modern world has replaced domination by the Church with illusions about the well-intentioned nature of humans generally and the capacity of admittedly remarkable human ingenuity to solve all problems. By contrast, Ellul recognizes the ever-present danger of good systems coming to grief because of narrowly-selfish interests of participants in those systems, or of well-intentioned systems coming to grief because of inadequate capacities to foresee all the intricate interactions with other systems. We see today, for example, the impact of medical technology on law and society with test-tube babies and the like. Nuclear power has a social-psychological dimension as apprehension among nearby residents comes into play. Television makes us more passive absorbers of information, with effects that we may not adequately foresee.

Ellul may appear on occasion to be defeatist, with a Calvinist view of fallen man. That impression is created by the tone of *The Technological Society* or *Propaganda* where it appears that there is no hope of avoiding enslaving technique or propaganda. It should be kept in mind that those works were written at a time of general over-optimism and were meant as a challenge to excessive faith in technique. Since then the experience of the 1960s, diminished expectations for urban renewal and the Green Revolution, plus growing fear of toxic pollution, have led to popular doubts about the value of modern technology. Today Ellul is more inclined to speak out against defeatism, even saying that a nuclear holocaust is after all still very unlikely. His recipe for a sound future is along the lines of the late Edward Schumacher, with development of small-scale technology around the world. His now famous slogan "think globally, act locally" sums up a whole philosophy of social action which he has put into practice in his own life, working with his Reform Church and with juvenile delinquents in the Pessac area of Bordeaux. The slogan was popularized by William H. Vanderburg's

Perspectives on Our Age which, along with *In Season, Out of Season,* is probably the best introduction to the whole range of Ellul's thinking.

A comprehensive bibliography of Ellul's works was published by Joyce Main Hanks in 1984 by JAI Press, Greenwich, Connecticut. Darrell J. Fasching has produced a book-length exposition, *The Thought of Jacques Ellul* (New York: Edwin Mellon Press).

Several of Ellul's works have not yet been translated, but the recent revival of interest suggests they soon will be.

As someone approaching Ellul from an analytical philosophical standpoint, I have found his works vulnerable to criticism for their overstatements. Frequently, his remarks seem in need of qualification. However, the virtue of his bolder statements is that they register forcibly on the mind of the reader, in a way that the cautious, carefully hedged, philosophically respectable claims do not. Ellul is in the business of communicating, and he does it with remarkable success. It is not that he is unaware of the need for qualification, but he does not lose himself in detail. It is the forest, more than the individual tree, that preoccupies Ellul's mind. It is refreshing to see broadly based but well-informed concern about mankind's future when to a large extent philosophy has become a specialized discipline, like so many others.

Ellul is capable of the cautious, philosophically respectable writing, but he has decided, again like Kierkegaard, to reach out to the masses and communicate in a language that the non-specialist can grasp without much difficulty. It has been said that Ellul does not attract disciples. The truth of the matter is that those who respond to Ellul will take to heart philosophy that is founded on good historical understanding and evidence from science and social studies, and do their own investigations. Ellul has given us both valuable theories and a profound, inter-connected, vision. But above all he has given us a good example.

THE SOCIAL PHENOMENON OF TECHNIQUE

A. The Pervasiveness of Technique:

We must cease to think of technique simply as a means to an end, and recognize that it has become a pervasive *phenomenon* of modern life. It is technique that has been principally responsible for increasing the velocity of environmental change, making thought for the future ever more necessary.

Technique is bound up with efficiency. To achieve efficiency you must compare different techniques with one another. You look at methods used in other countries, obtaining a harvest of information. A certain mind-set is developed of relating and combining techniques. The desire to change and modify everything grows. The desire to dominate everything takes root. From being something special, technique becomes typical in the sense of characterizing our outlooks. This outlook is very modern, and began with Diderot. Prior to the 18th century, one could speak of technique as subordinate to human aims and aspirations. In medieval times technique existed, but there was a clear vision of a sacred world, to which technique was subordinate. Today that vision has become displaced in favor of the new god of efficiency. The effect is to remove what is traditional and distinctive for example in the architecture of different countries, economic considerations being the great leveler.

Secondly, technique has become a milieu. It has become intermediary between man and his world. The worker was originally linked with the world. The artisan needed to know about wood, how to cut a tree, what kinds of wood had what properties, etc. As the machine came to take over more functions the individual worker needed to know less and less about nature. Work has become very specialized, with the result that it becomes very difficult to find people with the combinations of skills needed to do repairs when things go wrong.

Look at the urban milieu. We are surrounded by objects produced by technique. We are confronted with concrete, steel, glass; in short, a dead, mechanical world. Technique acts as a constant social intermediary. More and more it is interposed between humans in their contact with one another or their contact with nature. The telephone, radio, loudspeaker, the press are all familiar examples. Even if we want to visit the country, most of us have to go by car, bus or train.

The technological invasion brings with it the loss of a sense of natural time, biological or psychological rhythms and a replacement by the time of the mechanical world. Technique equalizes work time to accommodate technical necessity, regardless of biological considerations. Thanks to Edison's electric light, we can work at night, but our biology is more suited to working at day and sleeping at night.

Technique has brought an enormous increase in information, but our capacity for retention is greatly limited so we tend to reject everything and forget everything. Technique has also opened up possibilities of communication with enormous numbers of people at enormous distances. But whereas previously one had fewer contacts, they were likely to be more meaningful. Today the increase in quantity of contacts has brought with it increased superficiality in those contacts, and the reality of genuine encounter is evacuated.

In former times, knowledge of nature was necessary to survival. Today there is confidence that machines can rectify the vagaries of nature, extremes of climate and the like. It is much more important for survival today to recognize social signs, such as the significance of red and green traffic lights. It has become less important to be on the lookout for floods, for example, and more important to anticipate threats from pollution or other dysfunctions of the technological system.

The technical phenomenon involves, thirdly, the fact that technique has become organized into a system. A system is a totality of parts united in such a way that a modification of one part has repercussions on all the rest, and if the totality is modified so are the parts. A system is never static. It has a process of growth peculiar to it. It has production from within and a reaction on the outside. There is a feedback mechanism. In certain respects the system is autonomous. It is insulated from ethics by the pervasive belief that technique is itself morally indifferent, being capable of use for good or evil purposes.

The technological system is also insulated in certain ways from politics. Politicians are not equipped to interfere, and when they do it is often unsoundly. Recall Hitler's decision to dispense with the scientific research that led to radar. The politician who wants to survive in democratic society must have recourse to the experts, the technicians. But the technician is concerned with his or her own interests. The politician is useful for the technician as providing a buffer against public opinion. The idea of political control is a useful illusion for the maintenance of the technological system. It must be remembered that part of the technical phenomenon has been the existence of large numbers of highly paid technicians who have a strong interest in keeping their jobs. If techniques are not fulfilling their role of making life better for everyone, at least they make life better for the technicians themselves. Hence the built-in motivation, within the system, to seek solutions to problems caused by the techniques by developing further techniques rather than by eliminating the faulty techniques themselves. There is an incentive, if the machine is not adapting to man, to try to adapt man to the machine. Today we must face the fact that there is not one technocrat but groups of technocrats, and we often don't know whether certain techniques are controllable or not. It is not easy to take the prestige and power away from technocrats, and the challenge for the future is to ensure that techniques are being developed in ways that ultimately benefit people.

B. Technicians in the Policy Process

In theory the general populace should be able to say what large-scale policy it wants to adopt, and should leave it to the politicians to direct the technocrats accordingly. In practice, though, the active cooperation of the technicians will usually be found essential if a law is to be successfully implemented. An anti-noise by-law may express perfectly what citizens want, but without technically sound drafting it may prove to be unworkable. Perhaps you want to implement a policy of reforestation, and a national reforestation bureau is set up. It may tell the large corporations, power companies, construction companies, road-building companies and the like to re-forest, and then find instructions are ignored or imperfectly carried out. Or you may get reforestation in vertical or non-contoured rows on hilly terrain, where the effect may be an increase in erosion because of the straight lines on the curved surface.

Democratically decided value questions are all the more difficult to implement because of the problem of accountability. Between Paris and Orleans there are many miles of abandoned elevated railways, complete with stations, which have never been used. Through some legitimate process, it was first decided that reducing travel time from 55 minutes to 45 was worth the expense. After 50 billion francs had been spent someone else decided it was not economical even to complete what had been started. But no one was accountable for the fiasco. The portfolios of politicians changed during the construction, and the technical experts were part of a team. The designer was concerned only to meet the specifications that were provided. No one could be singled out for responsibility for the project as a whole.[1] Perhaps modern society needs some equivalent of the Roman institution of civic challenge. If the political man was wrong, he was banished from the political scene. If the citizen lost, he was banished from Rome.

C. The Social Impact of Technology as Reflected by Art

We can observe certain interconnections between science and art. Picasso's "Maids of Avignon," 1907, appears concurrently with Einstein's views on relativity. The painting seems to integrate time and space. Is this a miraculous coincidence? Picasso was not a mathematician nor a physicist. Rather, artists would seem to participate in a global evolution of thought and understanding. There is in the air in a general way an understanding of dialectics and existentialism, and you find artists seizing, more than others, the tendency or drift of contemporary thought. (This suggests that art may be a form of futures study.) They seize the possibility of expressing things differently. Perhaps analysis has a similar impact. With the paintings of Monet, one judges the canvas to be like Maxwell's electromagnetic field. There is a new vision of matter on the basis of the idea of a force field. It is not surprising that modern twelve-tone music should have arisen in Vienna, a center for new mathematical developments.

There are certain direct influences of technique on art. Landscape painting received an enormous boost with the development of tube paints, since the artist could then paint outdoors. Prior to 1830 the wind would have blown his paints away. In architecture, the invention of reinforced concrete meant that buildings could have facings with no supporting function.

Besides these immediate influences, technique has also, like science, influenced the thinking of artists. In some cases, there is a perception of the beauty of machinery, such as you get with the Italians early in this century, viewing the city as a machine for living. Or you have Ferdinand Leger, painting the machinery.

But there are more profound impacts, such as we can discover when reflecting on Malraux's museum of the imagination. Technique has above all enabled us to reproduce sound and sight electronically, so that we have available in a moment a vast array of the world's art and music. This gives rise to an incredibly difficult problem: how to be original? How to avoid repeating? With technically perfect reproduction of paintings and the making of innumerable copies there is loss of value in the original. The consumer becomes more of a curious tourist. All of this has greatly added to the search for difference and novelty. An artist or painter was formerly from a certain tradition. A lot of art was produced without the conscious goal of being artistic, in the production of beautiful housing, for example. Art needs to develop according to its own logic. But today the artist receives too many stimulants from too many different positions or traditions. The result is that today, with the premium on novelty and the speed with which a new idea is disseminated, a work is out-moded almost as soon as it is created. We live in a time of post-this or post-that because there is no rooted tradition to develop and flower. The artist is constantly on the lookout for gimmicks, such as the integration, by an American musician, of audience reaction into his final composition. Or we have a sculpture made of string and 200 pieces of sugar.

After 1968 we find mockery of sculpture with disposable art. Curiosity becomes dominant. There is no pretension of expressing a permanent vision of man. Malraux's museum of the imagination presents us with a negation of all other views of art. The aim is not to produce beauty (we don't know what that is). Nor is there pure subjective expression. There is no attempt to find meaning or sense in anything. Art instead becomes a game for one's amusement.

The mass media have had a profound effect on art. In traditional society, there were two different forms of art. There was popular art, done by the locals, which had a certain style: the Bearnais farm house was different from the Alsatian. There was a collective, impersonal, but individual style: this popular art existed in all domains—utensils, costume, cooking, dance, etc. Besides this popular art there was the art of the "savants," the elite, produced for the connoisseurs. Sometimes, as with Dvorak, the latter would take their inspiration from the former.

But towards the end of the 19th century this popular art tended to die out. Today we have a learned, noble, difficult art disseminated massively for a public who do not understand it. This "learned art" is produced for anybody and everybody. The media have taken control over the definition of art and culture. We are now left with the problem of deciding whether art should take its inspiration from the public (the Communist view) or whether art should seek to educate the public who know nothing. Attempts to educate the taste of the factory worker to "learned" art forms have not met with success, since the worker is looking for entertainment, not a wrestling match with the unintelligible.

To understand modern art we need to recognize two contrary currents. One current involves the *reflection* of modern society, the other the *refusal* of that society. In previous times art reflected nature. Today it reflects technique. Technique, scientific thought, mathematics are all abstract, and modern painting can reflect this aspect. Or there is the inspiration of being able to control everything with devices like moving platforms in the theater. Instant, disposable art is a reflection on the speed of modern production and the creation of waste.

The alternative, refusal of technological society, leads to an attack on production and a negation of objects. You find anti-art, a derision of art, such as with Dali's painting of a moustache on the Mona Lisa, or the destruction of musical instruments in a rock performance. Or there are compositions such as John Cage's "4'33" where the audience arrives for a concert, the pianist appears (David Tudor in the original performance at Woodstock, 1952), sits silently for 4 minutes and 33 seconds (hence the title), and leaves. The only noises are made by the audience with the usual coughings, shufflings, etc.

We may also see modern art as performing an ideological function for technological society, using Marx's classic concept of "ideology." In this classic sense, ideology serves to interpret reality while at the same time disguising aspects of it so as to make an intolerable situation tolerable. It is not possible for human beings to submit themselves to a perfectly rigorous mathematical milieu. Our irrational revolts against this notion. Ideology, however, enables us not to see when we are landing ourselves in such a milieu and helps us to justify being in such a society as technical domination brings. Modern art hides technique from us. It is an instrument for not seeing reality. It gives us a good conscience, permitting tolerance of the intolerable. It does this by showing life to be worse than it is, as with horror films, comics and paintings. Reality becomes transformed into a spectacle, and eyes are neatly diverted from it. If they are meant to awaken people to reality they do so in the wrong way. "All Quiet on the Western Front" was certainly pacifist in intent, but it had the effect of accustoming people to violence. Similarly with many modern films.

Modern art proclaims itself often enough as an awakener or breaker of values, as challenging dogma and performing a revolutionary function. Yet it is determined more by political and social circumstances than it acknowledges. It is the opium of technique-dominated society.

In art, music and literature the effect of technique is felt in the modern rejection of sense. When a classical musician composed, he tried to communicate something. There was a sense. With mathematical fiddling on a synthesizer there is no finality, no goal, no attempt to say anything. In literature we have novels written as a kind of game, such as Robbe-Grillet presented, where the reader enters something like a giant crossword puzzle, only more difficult. This is merely a game, not an artistic creation. It may be very subtle, but there is no overall sense transmitted. In all of this we encounter the penetration of pure technique into what was most signifying of all—art. This is not without danger. If we live in a universe where we are surrounded by sense-less art, we will be perfectly modeled for entry into the technical world. Such art is extraordinarily dangerous, and will contribute to the disintegration of man. Fortunately all is not lost, since the "nouveau roman" is already dépassé.

TECHNIQUE AS IMPETUS TO STUDY OF THE FUTURE

A. Technology as Generator of Uncertainty

Any adequate thinking for the future must come to grips with the way the technical system operates as a totality. Just think about the impact of an air controller's strike on other parts of the system: bus, rail, automobile, telephone, etc. There is an interconnection. Or think about failures in electrical power supply, or water supply, or sewage, and the extent to which techniques have become interdependent will become clear. The system of techniques incorporates human interactions, hence the development of techniques of management. If workers don't agree among themselves, the factory doesn't run. Personal conflicts between scientific researchers can block a whole research project. Thus technique, in the name of efficiency, is inserted into the area of human relations.

We also need to recognize that although rationality is a characteristic of any technique considered in isolation, it is not characteristic of the system of techniques. It is *little* instrumental goals that have the most impact on decision-making. The *broad* goals, such as happiness, independence, justice, and the like, are often too far distant to have a clear relation to concrete decisions in the present. And even concrete goals may be blocked by major obstacles. The idea of space research existed long before von Braun, but it took a war to get the process underway. The real determinants of growth are the many small goals posed by already existing technicians. Retrospectively, we think we wanted to get to the moon. But that is not the order followed by technicians. The immediate aim is to increase the performance of a computer, or the use of a given chemical. Or you reach a certain frontier, like doing or not-doing open heart surgery. With hundreds of small improvements, new possibilities on a grander scale are opened up, without a conscious decision to reach the more ambitious goals. Viewed as a whole, the system does not grow voluntarily. It is not guided by a unifying creative impulse under man's control. Man himself, although the condition of the system, is conditioned early on by playthings. The child is taken in by the system, and the human role becomes that of facilitating the growth of technique. Moral values become subordinate or forgotten.

The more complex the system, and the more numerous the parts, the greater is the danger of failure of the system. To guard against possible breakdowns, technicians try to anticipate them. But they often come up with contradictory results, and evidence may be delayed to a point where harms are not noticed in time to avert them. Technical effects are never immediate. If you take a sample of water in the Arcachon basin to measure pollution, you get a different result according to whether the sample is taken in January or August, at five meters depth or one meter.

B. Technique and Hubris

It is common to suppose that whatever problems technique brings it can solve. Such a reaction is in keeping with the "sacralization" of technique, the mythical portrayal of it as an uncanny, mysterious power. The pocket calculator is pure sorcery for some people. Technique brings prestige. Its possession gives meaning to life, to many people. A dam takes on something of a sacred character.

When science and technique took over from the early belief in an Almighty God there was a transference of beliefs about God to the new deity. (In Russia, for example, children are taught not to put their faith in God by comparing two plots of ground. One plot is seeded, fertilized and watered, while the other is neglected totally and only prayer is invoked for a good harvest.) There is widespread faith in the powers of the computer, and some new owners feel it will bring them a better life, though they are not quite sure how. To understand the growth of technique it is important to see that much of the power of technique depends on the belief of the people in that power. The belief in the rationality of technique may itself be irrational, but that does not stop the belief from being effective. Here we may note that some of the strongest defenders of technique are the philosophically- and literary-minded people who don't adequately understand it. Since they can't competently attack it, they defend it. By contrast, some of the strongest critics are those at the very top of the scientific and technological ladder who can afford to be skeptical without losing prestige. Those familiar with technique are aware of the ever-present law of diminishing returns.

We find among the general population two common attitudes. One is to submit meekly to fate: one cannot stop progress. Technique is experienced as an inevitable force, against which one can do nothing. The other is to respond with unlimited hope that technique can solve everything.

Instead of viewing technique in this mythical way, some hard-nosed, realistic attitudes are necessary if we are to control it. We need to take stock of where technique is taking us.

C. Thinking about the Effects of Technique

In thinking about the future, four different categories of effects need to be kept in mind:

1) There are the foreseeable effects that have been thoroughly researched and known. Everyone knows what happens when the accelerator of the car is pressed, when the car is operated and functioning properly: it moves faster. There is no problem here. The problem comes from mistakenly assuming that all effects are this simple, direct and apparent.

2) There are the foreseeable, but not thoroughly researched, effects. We know in a general way that cars pollute, and that by burning more gasoline we will be polluting more, but the overall impact is not known with precision.

3) There are foreseeable, but largely hypothetical, results. We link an increase of accidents with an increase of speed because, of course, at very high speeds an accident will be very likely. But we have no evidence that a slight increase in speed will be correlated with a slight increase in accidents. We foresee the possibility of the effect of greater accidents, but we don't have the evidence.

4) Finally, there are the totally unforeseeable effects. We need to be more and more on our guard in this connection in the case of most chemical and pharmaceutical products. It is impossible to do enough experimentation to reveal all the possible harmful effects of such substances. Products are marketed after determining that they do not have this or that specific harmful effect. But are the experiments done with different age groups, with different other medications, with persons of different blood groupings, with combinations of different foods, with their additives, etc., and in conjunction with persons of specific genetic deformities? The list goes on indefinitely, and some effects may not be determinable for years. When DDT was originally found not to be harmful no one thought to test it in a fatty solution. The thalidomide catastrophe resulted from not looking sufficiently at generational impacts. The drug was cleared for use on the mother, not the child. When we enter the area of psychological or genetic effects we often simply don't know of the possible harms. We need to be wary of the long-term effects of television, which may not be clear to us now.

It is necessary to take account of all these categories of effects when planning, say, a nuclear reactor, where the psychological and ultimately economic effects may not be predictable. It is necessary to think of the totality of consequences. You have to think of the police forces that will be necessary to protect us if it is made easier for small groups to make an atom bomb, or to prevent sabotage to the plant.

D. The Techniques of Futures Research

There are three main ways in which people make forecasts. The first is by extrapolating from known data within a given system (or sub-system of the technological system as a whole), to future developments connected with that system. Such forecasts are usually wrong. Things happen outside that system (or sub-system) that have an unforeseen impact.

A second kind of analysis and forecast is the scenario approach, where many hypothetical routes are contemplated. With enough possibilities considered, you will eventually/probably include one that is right, but that is not forecasting. Herman Kahn's approach sometimes approximated this, and even he did not foresee the advent of Pol Pot in Cambodia.

The third kind of prediction is the *synthetic prospective* analysis which chooses among many different elements the apparently dominant factors. It takes into account the interplay of different systems, and contemplates possible choices within the different systems, evaluating them in combination. This is the method least likely to be wrong.

An example of the synthetic prospective analysis is provided by Edward Schumacher who foresaw in 1961 the occurrence, somewhere between 1970 and 1975, of the OPEC crisis. It eventually occurred, as we know, in 1973. Instead of studying the figures of oil reserves, consumption needs, production capacity and the like, he took account of a great many factors including the following:

1) The movement of de-colonization.

2) The fact that Arab peoples would not likely be satisfied with de-colonization alone. They would still harbor some hostility toward their former colonizers.

3) The possession of oil is a source of great power.

4) The West with the cheap oil in the 1960s was giving up on alternative sources of energy such as coal and becoming totally dependent on oil.

5) The Arabs, knowing that Western countries could nationalize any company they might buy in those countries to protect their wealth, realized that oil alone was the real guarantee of their wealth. What could the Arabs do if they bought General Motors and found it nationalized the next day? Send in a gunboat to the US? Their real wealth lay in the oil. And, unlike farm crops which are renewed each year, oil is like a larder. Once empty, that is it. It was simply rational to cut back production to maintain the source of wealth, as Qaddafi did. With the sharp rise in price that ensued, the OPEC countries began to appreciate their power.

Schumacher could foresee this development because he had a certain breadth in his vision, a holistic approach of looking at the impact of different systems on each other, and making good common sense estimates of likely human decisions. He also pin-pointed the solution to the problems caused by the OPEC crisis, namely, development of alternate energy sources and conservation.

ADVICE TO PLANNERS

A. Practical Difficulties to Forecasting Technique and Its Impacts

Although the synthetic prospective approach to forecasting is superior, it will not by itself guarantee success. Certain endemic difficulties need to be understood and as far as possible taken into account.

The first of these difficulties is the disparity in the different sectors of technique. Some areas hit upon some breakthrough and attract disproportionate amounts of capital to develop them. In 1889 it was metallurgy. By 1900 this had stagnated. In the 1950s it was petrochemicals and plastics. In the late 1960s it was the green revolution in agriculture, which has lost steam in recent years. Since 1955 computers have seen a boom, with consequent strong impact on office organization and personnel.

A second difficulty with predicting technological development is that so much depends on psychological factors. When star-trekking captures the public imagination you get capitalist investment. Or government subsidies are generously forthcoming. Bright young people plan their careers around the aerospace industry and rational arguments often take a back seat to public opinion. But this may easily change.

The overconfidence people had in the ability to deal with pollution may give way easily to a state of panic. Additives can come to be feared as evil. Public opinion may win out against atomic reactors even when the experts defending them have sound arguments. Since 1968 there has been a less uncritical acceptance of technique. One finds more high-level scientist-technicians questioning the value of what they are doing.

A third difficulty has to do with economic factors. Commitment of capital to old techniques may be too great to permit adoption of radically new ones. A slow-down may be necessary while obsolescent technology is replaced at very high cost in jobs, plant and equipment. As a basis for re-structuring society, this is at least better than war. In any case, the economic situation will have its indirect effect on the future through the development or lack of development of certain techniques.

For both forecasting and planning purposes it is important to recognize that some undertakings are virtually irreversible. It is very difficult to de-nationalize. You can hardly get rid of autoroutes once they have been built. You also have to deal with permanent human structures. Trade unions are not likely to go away. The trade unions were in favor of continuing to build the Concorde even after it was shown to be not profitable. There comes to be less and less flexibility in decision-making. When plotting the probable course of any new development it is vital to anticipate the effects of its interactions with these fixed structures.

B. Caveats for Planners

Intelligent planning for the future should have ever-present in its thinking the awareness of (1) technical disorder, (2) four finitudes (to be explained) and (3) thresholds.

Technical disorder comes from allowing technique to develop on its own, in isolation from consideration of its impact on other parts of the system. It comes frequently from the interface between technique and social groupings. It comes from convictions that technique gives rise to in man, among them the myth of progress, or the belief that growth is necessary to avoid unemployment.

The four finitudes (or limits) are space, time, primary matter, and energy. Finitudes are natural realities. They are fixed and anterior to the problem of scarcity which is addressed by economics. Scarcity is a cultural phenomenon and so its form is dependent on a given culture. Gold is scarce, and hence valuable, depending to some extent on whether it is used as money. Gold is not indispensable. What we are calling finitudes are limitations for which there are no substitutes.

1) *Space*. We live on planet Earth which is of finite dimensions. It does not grow in size. Exploitation of other planets is not foreseeable for 100 years. Maybe we can send up 300 people into a space colony, but certainly not 300 million people. Increased population brings with it a need for more space. There are problems of crowding—congestion, blockages, increasing fragility of transportation and other systems. Quite apart from the ordinary non-renewable resources such as oil or coal we have the problem of disappearing humus. Humus is organic matter and soil micro-organisms that foster the growth of plants. It may take a thousand years to form, but can be quickly killed and is difficult to replace. With the growth of our space needs, the cost of space goes up and pressure is applied to turn agricultural land into suburban housing developments. We can plan wisely for the future only if we recognize the inexorable limits to available space.

2) *Time*. Temporal finitude is a condition of every human existence. Science may stretch that out a bit, and replace some of our organs like spare parts for a car. But another part soon goes and eventually useful functioning is no longer possible. There is a limit to our life span.

There is also a limit to any human civilization. What remains of old civilizations is very small. All societies go through a rise and fall. We can be sure that the fruit of our work, for the most part, will disappear.

These considerations should lead us to take very careful account of time factors in long-range and other planning. We have the natural rhythms of our biological lives which are sometimes ignored in factory planning. When we think of time as a commodity ("time is money") we make sure we get the maximum use from it. But if we look at overall planning, we find contradictory attitudes. We spend a lot of money to produce the Concorde, so that people will save four hours to cross the Atlantic. But what is done with this saved time? Along with the speedier travel comes more disequilibrium. Offsetting this gain is the enormous time wastage at the local level, where people will spend three hours a day in Paris going from home to work and back again. We save time by faster planes, but at enormous cost. The cost of saved time grows exponentially. Meanwhile society obliges many people to lose time through forced unemployment. Where is the rationality here?

3) *Primary matter*. Technique tends to exhaust non-renewable resources and needs to be checked. Air, soil and water are primary materials that are not inexhaustible and must be carefully guarded. The technicized world brings an increase of water consumption from 15 cubic meters in the Third World to 60 per inhabitant in many developing countries. Industrial consumption raises the figure to 1,000 cubic meters per person in the US. Recycling of water is difficult and produces dead water in the system. Or the temperature is raised, e.g. by nuclear reactors, with adverse effects on the biological organisms in the water. The Aswan Dam and its aftermath are a standing modern parable concerning technical interference with nature for the production of power. Without the floods, lime was no longer carried and the water lost its former fertilizing potency. Stagnant water behind the dam incubated huge increases of the debilitating Bilharzia parasite. The fish in the Delta nearly all disappeared, impoverishing a whole economic class of fishermen.

Likewise, when roads and concrete are contemplated, concern is appropriate, as noted earlier, for consequent loss of soil humus and the need to provide food for future generations. The limits of space are also important when we contemplate the accumulation of the things produced by technique. An average of three kilos of garbage is produced per person per day in France. Recycling works in Holland but not France, where individual discipline is more lacking. The more objects are produced, the more discarded objects you will eventually have. The consequence of having each technological sub-system develop independently is that we get over-production with consequent waste.

4) *Energy*. Greater energy dependence leads to centralized systems, as we see in the case of nuclear energy. The cost of production increases faster than the quantity of energy produced, contrary to what is often affirmed. You never get the complete cost of atomic energy. There is a highly variable computation. Technicians themselves do not weigh

in all the costs. The short life of reactors is very important. They are likely to last only 20 years, and the cost of construction is only covered after eight years.

The third and final caveat, thresholds, might also be termed a fifth finitude, for it concerns human limitations. Excess of information leads eventually to disinformation, as was noted earlier. The proliferation of laws as technical solutions to problems eventually leads to the impossibility of the citizen being aware of what is law and what isn't. The result is a return to pre-legal or extra-legal society. There is also the threshold of diminishing returns, apparent in the field of medicine. Techniques to prolong life under joyless circumstances have been perfected at great cost while millions of people elsewhere on the planet go without the most elementary essential medical care. The ecological movement has been promising, but the danger is that it has become fashionable. Fashions pass. Man must develop a deep ecological wisdom. Are we capable, and will it be done, or do we run into "limitations of human nature?"

C. Categories to Include in Planning and Forecasting

1) *Ecological Factors.* Planning should also take note of ecology and related sciences. Ecology is not new, Haeckel having pioneered the subject in 1866. The basic insight of ecology is the importance of studying interaction between a living organism and its environment, not just the organism itself. An organism does not just live in a milieu but interacts with it. Breathing, for example, alters the composition of air.

The milieu can become a danger to an organism, forcing the organism to adopt one of two survival paths. Either the organism adapts itself to the new environment or it alters the environment. A changing environment always puts some animals in danger. There is a series consisting of equilibrium, disequilibrium and a new equilibrium. There is no straight-line development, but rather a spiral path. We might think of a fork or bracket of survivability in the context of environmental swings. Insects have a very wide fork, or latitude, for survival. More complex organisms are more fragile and can tolerate less of a change. Below minus 140 degrees centigrade it is unlikely that we could survive the extreme cold.

From an ecological standpoint, man stands out as a parasite in the milieu. He takes from the system without restoring to the system. When an animal dies, its body gives back humus to the earth. When human beings are cremated there is no such restoration.

The study of ethology also can guide our thinking about the future. Konrad Lorenz was fundamentally right to perceive animals as aggressive. In the animal world the aggressivity has a function, such as beating off a weaker rival for mating. But it does not lead to total destruction of the vanquished. As soon as the latter admits defeat the aggression ends. Lions fighting over a lioness do not even extend their claws. There is a strong inhibiting reflex preventing total destruction.

Man has feeble natural weapons for destruction. But along with the feeble natural weapons go feeble inhibiting mechanisms. With the powerful nuclear weapons now at his disposal, man needs a comparably strong inhibiting reflex to develop.

The behavior of rats under crowded living conditions should also give us concern. Even with enough food, beyond a certain density rats start to kill each other. Or they go on a hunger strike and die. We may find that similar upper limits exist to human density of population. Living groups require a certain amount of space for survival.

2) *Technology and Food.* Modern agricultural science produces beautiful looking fruit and vegetables for the market. But pesticides, preservative chemicals and artificial coloring are involved to a great extent. In some cases larger, more attractive fruit is produced where the addition to the size is merely water. The mass production of animals for slaughter has brought with it a concentration of animal excretion, litter which is no longer mixed with straw in the old way. It is very poisonous and has a terrible smell.

In some cases non-agricultural technologies can have a destructive impact on a whole class of persons by affecting their customary food sources. Lapps and Inuit have both been contaminated by strontium radiation from eating reindeer. The reindeer in turn had fed upon lichens which had absorbed atomic radiation.

Oil exploration in the Sahara has meant that oases have become fewer in number. Nomads thus have had fewer stopping places. With the building of more roads there was also less of a need for their caravans. It is difficult to make a sedentary dweller out of a nomad and in consequence many nomads tried to live at the limit of the desert. They exploited the Sahel to death, leading to the expansion of the desert. They will need to get arable land nearer the sea if the expansion is to stop.

3) *Planning Aesthetically.* Without the existence of strong proof, pedagogues and psychologists are nevertheless becoming more and more concerned about a possibly profound effect of aesthetics on the human being. Children in ugly surroundings do not develop as well as those in beautiful surroundings. There seems to be a fundamental aesthetic need. When we destroy natural surroundings and replace them with glass and concrete, we find it difficult to live at peace. We have a need to see a horizon. It is unnatural always to have our gaze stopped at a short distance. Architects may try to make beauty to order, but their attempts have been very ephemeral in our technological age. We find in our shopping centers an absolute incoherence or hodge-podge of styles.

4) *Specific Warnings re the Information Society.* We are currently being led into the information society by all kinds of attractive

arguments. There are many positive aspects to a computerized society, among them the possibility of facilitating communication in a decentralized fashion. The technical possibilities of a wide variety of benefits are there, but it is illusory to suppose that the benefits will necessarily come about. The computer and other information devices enter an existing social order. The people who operate the systems want to live in cities. Those who invest in the systems want a financial return. The hardware is very costly. (If the materials were to be used in democratic ways the revolution would have to take place beforehand. The computer will not make a rigid society flexible. It will only confirm what already exists.)

We need to guard against ways of thinking which may be induced by the use of the computer. One such is the notion that the computer does not err. Another is the "cult of data" with its concomitant danger that reality is thought of in terms of data alone. Those who deal with computers know that the data are cleaned, separated and worked-over in order to be acceptable to the computer. Man himself becomes reduced, if care is not taken, to data. The inevitable consequence is the categorization, the labeling, the pigeon-holing of everything. Preeminence is given to the mathematicizable, while feelings and impressions are ignored. I have not found computers useful to my own thinking, which calls categories into question.

Inevitably, information systems will become concentrated and centralized. An aristocracy of technicians will produce the data banks, and they will make the key decisions. The ordinary citizen will be given access to information, but how will he know where to look for what he wants, which data bank to tap? Social privilege will flow even more than now to the big administrators, intellectuals and pressure groups or unions, whoever has the resources to get pertinent information. These people will have access to enormous quantities of information which the ordinary citizen is lacking. Secrecy will also be favored, inasmuch as there will eventually develop two levels of information. The first will be what goes into the data banks. The second, and more important, will be the information not provided by the banks but known to those who fed the data into the computer, who decided what to put in and what to leave out. This will be one of the gravest threats to our future freedom.

NOTES

1. This example was challenged by a noted Professor of Engineering and acknowledged expert on railway transportation, Julius Lukasiewicz of Carleton University, author of *The Railway Game*. I used the example in a lecture on ethics to his engineering class, and got the response that the aero-train referred to was an aberration, that one single engineer was responsible. His ideas were recognized by other engineers as screwball,

among other reasons because of the noise that would be generated through residential areas. Both Professor Lukasiewicz and most of the articulate engineering students were firmly of the opinion that it was humans that were responsible for mistakes, that technology itself was not to blame. Technology is itself good or neutral, its use can be for good or bad. The ensuing discussion was a very interesting application of Ellul's themes. How could one engineer be responsible, I asked? Surely there must have been many engineers working on the project? If the project was so inept, why did the other engineers not blow the whistle? "Well," I was told, "they had their jobs to look out for. They were concerned to develop their own knowledge and expertise. It wasn't their job to assess the undertaking as a whole." "But is that not exactly the problem diagnosed by Ellul?" I asked. Having just read Ellul's theological work, I responded that maybe technology is like money, also a human creation. It is well-known that money can become a human obesession, an end in itself rather than an instrument to be used for good purposes. Money is itself a technique, perhaps the oldest and most important of social techniques. The student responses showed how the very common understanding of the abuse of money applies in parallel fashion to technology in general.