

# Europe Facing Its Futures

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## ABSTRACT

This paper presents a distinctly European view of both futures study and the foremost challenges to be met chiefly in the field of energy and technology. The prospective approach is distinguished from the forecasting approach. The relative decline of U.S. power may prove to pose more serious long-term problems for Europe than its rising energy bill.

*C'est à l'imprévisible qu'il faut à tout instant pouvoir et savoir s'adapter.<sup>1</sup>*

## What Is the Prospective Approach—and Why Is It Needed?

### WHY CARRY OUT PROSPECTIVE STUDIES?

Our century is one of change, uncertainty, and action. The acceleration of change contributes to the uncertainty of the future and so makes forecasting all the more necessary to guide our present actions.

But what is the use of anticipating future difficulties when we are already beset by the ills of the present? The answer is quite simply that today's problems are the result of the forecasting failures of yesterday.

During recent years we have been confronted with a series of crises—monetary, energy supplies, economic, and so on—and each time we have had to wait until the crisis became major before we reacted to it. The steady acceleration of technological, social, political, and economic change makes future disturbances increasingly probable and increasingly imminent. Our only alternative is to catalog the promising opportunities and to identify the problems before they become critical, so that appropriate actions can be taken in good time.

This alternative is, however, full of traps. We no longer count on studies of the future with the many forecasting errors to which they so often give rise.

Without claiming to carry out an *n*th prospective investigation of the world of the future, we can, nevertheless, ask ourselves questions concerning it. The most risky attitude to adopt towards the future is not to think about it. Gaston Berger has expressed this very well in his phrase, “the faster we drive the further the headlights need to reach.”

### THE CRISIS IN FORECASTING

The monetary, economic, and energy crisis had arrived—and no one (or almost no

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The ideas expressed in this paper are those of the author and not those of the organization to which he belongs. They are largely based on previous or current works [1–3].

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<sup>1</sup>“It is essential, at all times, to be able to forecast and adapt to the unforecastable” [4].

one) had foreseen it. It will be recalled that in France in 1972, to take one example, decisions on energy were based on assuming the continuation up to 1980–1985 of falling trends in oil prices. These forecasting errors led to the crisis in forecasting. The paradox of history is that forecasting developed at the precise moment when it was easiest—and least necessary. Economic models made it possible to demonstrate, with the aid of the computer, what everyone already knew without all that trouble, namely, that practically everything could be more or less correlated with the national product, and this was rising by 5% per year. Time, therefore, became the best of the “explanatory” variables.

Since 1973, however, the future no longer resembles the past and the horizon of the prospective approach, that is to say, breaks in the continuity, becomes nearer. Models based on the data and relationships of the past are powerless to forecast these discontinuities, which depend on new behavior patterns for the actors involved.

In 1975–1976, after the quadrupling of the price of oil and at the very moment when it was still being assumed that the crisis was only an accident (as could be shown by the fact that the price of oil began to fall in constant money terms), it was very difficult, even after analysis and demonstration, to get those companies that had launched prospective studies to admit that the most probable scenarios necessarily integrated new and major rises in the cost of energy—to the extent of doubling or trebling the existing costs. What has now been seen to be an accurate forecast was, at the time, at best accepted as an extreme variant, almost as if to please the analyst who had produced the study. There is always a greater trend towards conformism when it allows an optimistic interpretation of the future.

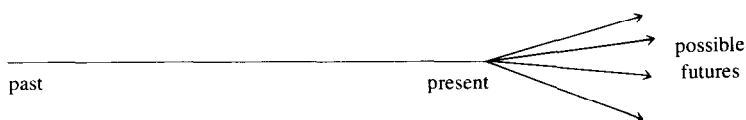
Finally, those who *did* see clearly found that no one would listen. This observation obviously gives no additional credit to irrational forecasts but rather gives reason to suspect a number of the accepted conjectures and concepts. From this point of view the primary aim of the prospective approach is to question the comfortable state of mind, to arouse consciences soothed by false certainties. In order to be heard the choice is a clear one: Even if there is an even chance of being wrong it is essential to cry wolf every time, and to cry wolf even louder the next time if the first turns out to be a false alarm. Erroneous forecasts are an additional reason for reinforcing the effort put into prospective studies, to anticipate future ills so that they do not, in fact, arrive. In this way the crisis in forecasting has resulted in the growth of the prospective approach.

#### THE FOUNDATIONS OF THE PROSPECTIVE APPROACH

What good is it to reflect on the future if it is already written in advance? In our opinion this is not a fair question, since, apart from a certain determinism, the future largely remains free and open. This postulate of freedom conditions the greater part of the grid (actors, projects, wishes, problems, changes, etc.) on which we project.

#### *The Future Is Not Written: It Is Still To Be Constructed*

The prospective approach was born of the realization that the future is the field of operation simultaneously of determinism and of freedom. What will be *suffered* in the future results from *past actions*; what is *wished* explains *present actions*. Furthermore, the future must not be seen as a unique and predetermined line in prolongation of the past: The future is both multiple and indeterminate. The plurality of futures and the degrees of freedom of human action find a mutual explanation: The future is not written—it is still to be constructed.



### *Multiple Futures and the Role of the Actors*

In an essentially unequal and conflictual world *the future is only the resultant of the confrontation of unequal human forces*, “corrected” by the “underlying” trends and the constraints. At the present moment the future does not belong to all in the same way and to the same degree. Certain actors influence it more “heavily” than others. Therefore, while several futures are possible, that future that will in effect be produced will be born as much from the plans of the actors and of the relationships of forces as from the evolution of trends.

### *For the Actors the Future Is the Raison d’Etre of the Present*

The image of the future is imprinted in the present. For example, an individual’s consumption at a given moment depends not only on his previous income (savings) but also on anticipated future income (credit), as has been effectively demonstrated by Milton Friedman’s theory of permanent income. It is necessary, therefore, to look to the future to illuminate the present, so that “the future is the *raison d’être* of the present.”

## THE LOGICAL CONSEQUENCES

### *The Necessity for a Global Vision*

Partial forecasting, retaining only a few explanatory variables, generally economic and quantified, and not taking into account the evolution of force relationships and the appearance of new trends, is misleading and of no value. This failure to forecast results in particular from the economy’s being regarded as an autonomous sector, with economic forecasting cut off from social and political forecasting and then divided into forecasts concerned with the aspects of technology, population, and so on. Furthermore, and as the rate of evolution accelerates, interdependence becomes reinforced, so that everything acts on everything else, all other things are by no means equal, and a global vision becomes essential.

On this point it is interesting to note that the French word “prospective,” implying a global and normative vision of the possible futures, has no strict equivalent in English. The word “forecasting,” like its French counterpart “*prévision*,” retains the connotation of a desire for quantification and extrapolation.

### *The Impossibility of Forecasting the Future Solely on the Basis of Data from the Past*

explains the impotence of all the classical econometric models that do not integrate qualitative and nonquantifiable parameters such as the plans and behavior of the actors. In passing it should be pointed out that the *dangers of incorrect quantification*—since quantification always involves giving priority to what is quantifiable over that which is not—must not lead to the rejection of figures but only to great care in their use.

### *The Absence of One Unique Model of Evolution*

Far from accepting determinist interpretations of history, whether liberal or Marxist, which assume a unique model of evolution tending towards an ideal final phase, the prospective philosophy leaves room for a multiplicity of possible evolutions.

### *The Plurality of Temporal Horizons*

To accept that there are multiple futures, and that there is no unique model of evolution, means also implicitly accepting the fact that the horizons of the prospective approach have to be seen in the plural. In practice the concepts of the short, medium, and long term only make sense in terms of the problem being studied. The horizon of the prospective approach is that of the possible discontinuities, resistances, and structural changes. The acceleration of change, coupled with the variety of systems being studied, leads to an acceptance of the plurality of temporal horizons.

### *The Limits of the Prospective Approach*

*The absence of neutrality in the prospective approach.* Any approach calls for choices to be made at the level of basic hypotheses. The results are conditioned by a value system, an ideology, both implicit and explicit, and are only valid to the extent that this system is itself acceptable.

*Decisions are bets.* The future is an emerging continent with unknown boundaries: The constraint is that, despite the unknowns, it is today necessary to take those decisions that commit the future. *Bets must be made, without, however, mortgaging the future, since the future is increasingly changing and uncertain.*

### *Conclusion*

The object of the prospective approach is, therefore, to guide our present actions so as to enlarge the field of what is realizable tomorrow, that is to say, to seek maximum *flexibility and adaptability in the face of the future.*

These are the characteristics that, in our opinion, distinguish the prospective approach, the development of which is now more than ever necessary if we are to meet the challenges of the future.

## **The Challenges of the Future**

### THE UNCONTROLLED AND DISTURBED BACKGROUND

Over and beyond the multiple trends and constraints operating on Europe and its environment one main characteristic of the coming decades now seems confirmed: *increasing geopolitical, energy, and technological uncertainties*, where no trend is certain and no discontinuities can be totally excluded. As a consequence geopolitical, energy, industrial and food prospective studies are more than ever needed. The components of the world imbroglio are multiple, and if we accept the view of Daniel Bell, according to whom "governments are becoming too large for the small problems and too small for the large problems" [5], it is difficult to see how they can be disentangled.

*The trend of a relative American decline*, while it may continue at the economic and political levels, and even at the military level when several Third World countries possess atomic weapons, will in no way resolve the existing disorder but rather will undoubtedly reinforce it. The bipolar world is no more, but the *multipolar world* will take some time to appear, and the absence of a regulator will be sorely felt. Japan is still too narrow a base to

play this role, and the European Community is still too weak. It is undoubtedly necessary to envisage an affirmation of different poles of attraction for each major region of the world.

Faced with the monetary disorder institutionalized by floating exchange rates (the dollar now playing a role that is more disturbing than regulating), Europe has instituted a monetary zone of relative stability, giving rise to the EMS in 1979. The question still remains of knowing whether it can withstand the turns that wrecked the "snake."

Undoubtedly the EMS represents a step in the right direction, away from the vicious circle. If it succeeds, the ECU (European unit of account, based on a basket of European currencies) could, in tomorrow's world, play the role of a standard or at least share this role with the dollar, in the light of the fact the Europe, representing a third of all trading, is the leading commercial power in the world. However, the constraint the EMS will exert will weigh most heavily on those least able to support it. In fact, without a painful restructuring the constraint of a reduced flexibility in exchange rates could lead certain countries into a situation of chronic deficits.

While waiting for this to happen there still remain, unfortunately, such various forecastable breaks as wars and revolutions, and it is to be hoped that the chain reactions resulting from these will not involve a widespread conflict. At the same time the domestic problems in the Eastern bloc countries, coupled with the formidable *power of the USSR* and the *withdrawal of the United States* raise more acutely than ever the question of a real *European defence*.

An answer to this question becomes increasingly urgent, for the population of Europe does not account for more than 5%–6% of the world total. The consequences of the changing population structure and the aging of Europe are numerous, including excessive demand on the educational apparatus, the increasing needs of the elderly and aged, difficulties for pension funds, and consideration of the advisability of lowering the retirement age.

In addition to these domestic consequences, the aging of Europe together with the vigorous population structure of the Third World could make the North–South dialogue more difficult while the geopolitical equilibria become increasingly delicately balanced. It is difficult to see how "*aging Europe*" would be able to understand, adapt itself to, and find the necessary imagination to meet the challenges that the young nations of the Third World will continue to pose.

More particularly, the contrast will be emphasized of a Europe with excess agricultural production and the hunger that will continue to exist in many Third World countries. Europe has a role to play in this respect; its domestic outlets remain limited, but how can it dispose of its production at prices two or three times those on world markets—and to insolvent populations? The answer may perhaps be found in a European Marshall plan designed to convert interdependence into interdevelopment.

#### ENERGY: THE PRICE OF ABUNDANCE

##### *The Errors of the Past*

Oil accounts for nearly 20% of world trading and, for example, about the same percentage of France's imports. However, the energy bill (imports plus investment in replacements) for the nine countries of the European Community was, on average, 5% of their GDP. Consequently the problem is less the size of the oil bill (the contribution of

manufactured products to the GDP of the developing countries is very much higher) than its rapid rate of increase.

*Energy is too expensive only because it was too cheap for too long.* We became accustomed to abundance at low prices, and all our socioeconomic structures were predicted on a future seen as the image of the past. In retrospect it may be regretted that oil prices had fallen so much in the past: A progressive increase in prices during the 1960s would undoubtedly have made it possible to avoid today's crises. Growth during the 1960s might have been less frenetic, but certainly that in the 1970s and 1980s would have been much higher.

By the same reasoning, it would perhaps have been better to have agreed to indexing raw materials, as Third World countries wanted after 1974, and at the same time to have extended this to oil. In this way we would have avoided sudden and uncontrolled price increases, since the price of oil would have kept step with our inflation.

Finally we dreamed of catching up to the United States, but this dream was unreasonable because an American consumes twice as much energy every year as a European. The world could no longer plan its future indefinitely on a model of hyperconsumption and wastage.

#### *Expensive Energy Is Abundant*

*A count down of reserves and the abundance of resources* are two different propositions. The proven reserves represent those which are, with certainty, immediately producible from existing wells, under the existing economic and technological conditions. Total resources are an estimate of what actually exists, but only part of which can perhaps be worked with present prices and technology.

Consequently, the forecast evolution of economic and technological conditions implies a prospective consideration more concerned with resources than with reserves. In effect, the limit of the reserves, like the line of the horizon, retreats even further as we approach it. If the usable reserves are multiplied by 3 when the price rises from \$10 to \$25 per barrel, then they will be extended even further when, as seems probable, the price of oil rises to \$50 or \$60 per barrel. The days of cheap energy are over for good and for all. Yet expensive energy does not mean a shortage of energy—quite the contrary: *Energy will be abundant precisely because it is expensive.*

#### *The Price to Be Paid*

Saudi Arabian production, despite its importance today, is still not enough to ensure control of prices: the other OPEC countries, following the events in Iran, have discovered that the best way to get the highest return is to sell less at a higher price. Certainly temporary falls in the price still occur as a result of fluctuations in supply and demand, but the habit has been formed, and the more the price of oil rises the less of it the OPEC countries will sell. (Why accumulate dollars when the best investment is to leave the oil in the ground!) Under these conditions, and with each increase in the demand, the price of oil will rise slightly—and never fall. *In this way oil will move toward its true price*, namely, the production cost of substitutes, at the present time estimated as at least \$40 per barrel. Furthermore, it must be pointed out that the cost of the substitutes (where they exist, which is not the case with all uses) is constantly being revised upwards. There are also limits to substitution: “Even if all American maize harvest was fermented to produce alcohol it would still only supply one-eighth of the total demand for petrol” [4, p. 210].

Finally, it would seem to be unreasonable in those countries such as Brazil suffering from malnutrition to “cultivate” energy, that is, to plant sugar cane for alcohol production at the expense of cereals.

#### *What Crises Lie Ahead?*

Despite the abundance of energy resources in the long term, particularly in the case of fossil fuels such as oil, natural gas and coal, the following can be seen:

The physical abundance of fossil energy does not exclude the possibility of a temporary crisis of capacity resulting from inadequate investment in research and exploration—as can be seen from the quasi-stagnation in proven resources since 1973, which is mainly explained by the fact that only 20% of all research drilling has been carried out outside North America.

The inertia of the energy structures shows that it is necessary to develop the new forms of energy (solar and geothermal) immediately if they are to play a significant role in the first decades of the 21st century. From this point of view *any price increase is a necessary stimulant*. The capacity crisis could serve as the detonator for *a double crisis in supplies, both political and economic*, as a result of a sudden price rise.

If the era of high-priced energy is beginning, it is to be feared that the international disorder will be incapable of accepting and controlling progressive price increases, and the economic and political consequences will be all the greater as the rises become more brutal.

The necessary intensification of investment and research work in developing new forms of energy implies the mobilization of considerable financial resources at the time when other priorities are necessary (industrial reconversion). This *financial crisis* could double the problems of adjusting the energy structures to more decentralized forms.

#### *The Route to a More Sober Growth*

Finally, then, the era of high-priced energy has begun. Is it necessary to pull the emergency cord? Higher prices are not, of themselves, a bad thing (we are paying the consequences today for oil's having been too cheap for too long); it is necessary that the *rise* in prices should be *sufficiently rapid* to encourage economies and replacements, and *sufficiently progressive* for the economies of the industrialized countries to adapt themselves to them.

Resources exist, and are even abundant, but the price must be paid. This does not mean that supplies are safe, since they are subject to political factors (such as a revolution in Saudi Arabia?) and the desire to establish a dialogue between the countries of the North and the South.

Even if the era of expensive energy does not announce the last days of labor-saving technology (which replace human labor with energy) it does at least herald the dawn of energy-saving technology. It is necessary to accept the fact that, up until now, all taxation and social systems have encouraged companies to replace human labor by energy. Legislative *measures* of an appropriate kind are therefore needed *if taxes are to kill off energy rather than human labor*.

Growth will, therefore, be sober—or there will be no growth. Energy economies

involve decentralized and autonomous modes of production and consumption and consequently assume a complete reversal of our modes of life and of socioeconomic organization.<sup>2</sup>

#### EUROPE AND ITS CONSTRAINTS

A rate of growth double that of today, three or four times less unemployment, and inflation of a few percent; such is the image of the “paradise of the 1960s” that the nine countries of the Community, like other Western countries, have abandoned and that they no longer hope to recover. At the same time that it is necessary to pay an increasingly large bill for essential imports of energy and raw materials, Europe must face up to new industrial and technological challenges. The stakes are quite explicit—it is a question of being overtaken by both the United States and Japan, of being caught by the countries of the South.

By turning toward those *industries that are most advanced technologically*, and that are in general capital intensive, the developed countries run the risk of *aggravating structural unemployment*. The problem becomes the more critical since it is hardly possible to count on the existing tertiary sector to create jobs; the coming remote data processing revolution is more likely to reduce the number of jobs in the banking, insurance, and similar sectors.

The fall in the European birth rate will not make its effects felt until after 1990 as far as the active population is concerned; meanwhile, and particularly between now and 1985, this population will be considerably increased. A rise in unemployment becomes even more probable.

The organization of the redeployment of the industrialized countries becomes even more urgent as the more advanced developing countries start their own reconversion and so present the *new North–South threat emerging among the countries of the South*. After the iron and steel and textile industries, the new threatened sectors could be automobiles, petrochemicals, and aluminum. Will the developed countries know how to adapt themselves to this new situation? The answer seems to be in the affirmative for some of them—Germany, Japan, the United States, and France. It remains uncertain for most of the other countries. Within the developing countries it is now conventional to distinguish the Fourth World from the more advanced countries; in default of having been able to organize redeployment in good time, should not such a distinction now be introduced among the various European countries? Will it not have, as a consequence, a general return to *protectionism*, this *weapon of weakness* which will take away from Europe its role as the leading commercial power in the world, and which would be the negation of the Treaty of Rome?

The increasing divergences (economic, monetary, energy, industrial, social, and regional)<sup>3</sup> present a problem insofar as it is the weakest countries and regions that need to become aligned and to make the maximum effort, while these are just those who are least able to do so. It is to be feared that for certain of them the price of convergence will be too high at the economic and social levels (unemployment). Under these conditions, and

<sup>2</sup>Cf the report of the group of experts chaired by J. Saint Geours [6].

<sup>3</sup>It is perhaps in regard to the prospects for employment that the largest divergences between the European countries is seen. At present the average unemployment figures in the Community vary from 9% to 3.5% of the working age population, even falling to 2.5% for men in Germany.



without having recourse to an active European solidarity, these divergences may become accentuated and so lead to a *breakdown of the Community*.

Paralleling this, permanent recourse to the *Welfare State* in order to meet the aspirations (for health, education, and security) and to control the contradictions (unemployment and inequalities) of society, at the very moment when the financial resources of society are being reduced, can be seen in the increasing preponderance of public expenditure in the national income, and by the increasing charges imposed on the populations. The weight of the State increases, but *its efficiency is reduced*. States have become rudderless; the wheel no longer responds.

Finally, European societies are confronted with the difficult choice between opening up their economies, and so increasing their sensitivity to external influences, or limiting trade and so restricting their prospects of growth. While competition from the developing countries poses problems for certain industries, it opens up prospects for others. The more the developing countries export, the more they are able to import. In this way the *overall impact of competition from the developing countries on the industrialized countries is neutral or even positive*. This, at least, is what emerges from most of the studies so far carried out.

Furthermore, in the long term *raw materials* present a problem quite as important as that of energy. Despite abundant resources there is a fear of *inadequate supplies*. Since 1970, in fact, there has been a slowing down in the participation of European capital in mining investment in the developing countries, as compared with that in those developed producer countries which are regarded as politically safe. It should, however, be noted that the recent LOMÉ II agreements are moving in the right direction, since they extend their guarantees to raw materials.

### **Meeting the Challenges: Technology and Its Promises**

How can Europe face up, at the same time, to these increasing divergencies and to the changes in its geopolitical, energy, socioeconomic, industrial, and technological changes? *Technology*, the most abundant raw material in Europe, is one of the main levers that could be used to *relieve the challenges of the future* by facilitating the necessary evolution in our lifestyles and our socioeconomic organization, as is so clearly shown by the report "In Favour of an Energy Efficient Society" by J. Saint Geours [6]. Mastery of technological development will be an advantage Europe must possess if it does not want to trail behind the United States and Japan, particularly in the fields of electronics and the life sciences.

In aerospace the European Space Agency has demonstrated the results of fruitful cooperation by the technological and, before long, commercial success of the ARIANE rocket. Although aerospace technology represents an enormous reservoir of potential innovations for the future, we shall deliberately restrict our survey to two fields: the technology of data processing and the life sciences, where Europe must also make its efforts toward cooperation. Naturally this in no way reduces the importance, for the future, of two other technological fields; exploitation of the sea bed, and new forms of energy, which we shall not deal with here so as not to overload the summary.

#### THE MICROELECTRONICS REVOLUTION

The new data processing technology uses techniques strongly influenced, or made possible, by the technology of data transmission and, to a large extent, by electronics (electronic data processing, automatic text processing, or control and measurement

technology) and by progress in the field of semiconductors (miniaturization and integrated circuits). The impact of this new technology has been such that it is not unreasonable to talk of the formation of an information society.

According to the theories of Colin Clark and Jean Fourastié, the development of an economy should follow an inevitable trajectory towards the postindustrial society described by D. Bell: employment first moves from agriculture to industry, then develops in the service sector. In other words, the growth of public and private services of low productivity and for which the social demand increases steadily (health, education, or leisure activities) will compensate for the loss of jobs due to gains in productivity in industry and agriculture. The NORA-MINC report on the development of the information society [7] has swept away this illusion: “*Remote data processing* will result in considerable gains in productivity; initially this will *aggravate unemployment*, particularly in the service sector.”

On this subject Edwin Parker suggests dividing up the various categories of active people into four sectors instead of three, separating those engaged in the acquisition, processing, or distribution of information (in the broadest sense of statistics, general knowledge, relations to events, or thought). In this way we would have the four sectors of information, industry, agriculture, and services. As has been emphasized by A. Danzin [8], as of 1980, “the number of active workers in information activities will be greater than the total of those in work of an exclusively agricultural, industrial or service nature.”

The microprocessor revolution has the remarkable characteristic of resulting in *gains in productivity* in terms not only of *labor* but also of *capital* because of the steady and impressive reduction in the cost of components—a reduction by a factor of 1000 since 1960. It is because of this past reduction, which can also be forecast for the future, that the *spread* of the microprocessor revolution must be *rapid* not only in the service sector and in households but also in industry. In this way the replacement of labor by capital in most industrial branches must accelerate. The almost complete *automation* of production processes is no longer fiction but reality, since several production lines of this type are already operating in the automobile industry.

As a consequence, microelectronics will introduce a new factor in the distribution of comparative advantages, since low wages have far less influence when a production process is completely automated. For this reason the return of certain activities such as textiles *to the place where they were born* can no longer be excluded. It is also possible to put one’s finger on one of the major problems associated with the microprocessor revolution; the attempt to hold it back in the name of its negative consequences on jobs and skills runs the risk of being more damaging than useless:

Competitiveness would be affected.

The exodus of certain activities to the United States and Japan would be inevitable.

Europe would not profit from the creation of jobs resulting from the growth of microelectronics, but would end up by suffering massive losses of jobs in industry and in the service sector.

This is a real threat confronting Europe from the United States and Japan. Under these conditions Europe must reply, and reply quickly; it was to illustrate this that the Commission presented a report to the Council of Europe in Dublin showing that European industry covered less than their share of the market (30% of the world market for telecommunications, 16% for data processing, and 10% for components) [9].

In conclusion, therefore, the importance of microprocessors and of the “new data processing” in general depends on

their positive and negative effects (jobs and skills) on all the industrial sectors, the service sector, and the international division of labor;

their influence on consumer behavior;

their potential for decentralizing economic processes and services; and

their interrelations with “social innovation,” that is, with sociopolitical developments and trends.

#### THE BIOLOGICAL REVOLUTION

One can see, or at least catch glimpses of, many possible applications for the fundamental knowledge being acquired in biology, so that some consider that biology will have as much influence on industry in the 21st century—and hence also on society—as physics and chemistry had on the industry of the 20th. To show this it is only necessary to list some of the possible applications [4].

Energy: methane-producing bacteria, anaerobic production of methane by the *in situ* fermentation of algae, and other fermentation processes;

Animal feedstuffs: proteins obtained from the fermentation of algae or by the action of yeasts on hydrocarbons;

Agriculture: bacteria capable of fixing nitrogen and converting it into ammonia, thus making nitrogenous fertilizers unnecessary, and nonpolluting biological pesticides and insecticides;

Chemistry and metallurgy: biological catalysts, and bacteria capable of concentrating metals;

Pharmaceuticals: bacteria that produce pure pharmaceutical substances such as insulin;

Genetic engineering: the possibility of creating animal or vegetable cells with pre-selected characteristics (e.g., silk).

Here again Japan and the United States are in an advanced position:

According to certain estimates the utilization of microorganisms already accounts for about 5% of the Japanese GNP;

The major American companies, particularly the oil companies, have invested in such biotechnology as bioreactors, pesticides, and veterinary products.

The activity of European companies in these biotechnologies generally remains at a lower level, as is shown by Table 1, listing the percentage of patents applied for by companies in Europe, the United States, and Japan.

Thus, as the “Sciences de la Vie et Société” report suggests [4], “If there is one field which demands the closest cooperation between the European nations it is that of research into the life sciences. . . .”

**TABLE 1**  
**Patents Applied for**

Field	Europe	United States	Japan
Enzyme technologies (1969–1975)	20%	50%	30%
Stabilization of enzymes	10	21	69
Chemical products obtained by fermentation	15	18	67

Source: Document CCE XII/122/79.

#### MASTERING THE POSSIBLE FUTURES

Technology plays a central role in making it possible to meet the economic, energy and industrial challenges which confront Europe. *Mastery of technological development will be a determinant comparative advantage Europe must possess if it is not to trail the United States and Japan.* Consequently, the European countries must, as they have already done in the aerospace field, increase their cooperative efforts in scientific and technological development, particularly in the fields of electronics and the life sciences.

The many *promises of technology* must not, however, make us forget those *threats* posed by biology for various species (including man) and by data processing for autonomy and freedom. To misunderstand these potential dangers would be damaging and could result in a backlash against biology and data processing—as already exists in the case of nuclear energy—so running the risk of holding back a development which, taken overall, could only be a healthy one. It is necessary, therefore, to separate the wheat from the chaff.

In this way “telematics,” that is to say, the marriage between electronics and telecommunications, opens up new lines of consumption (telecopiers, instantaneous data banks, videotexts, etc.) that are full of hope—but also of uncertainties and questions. In practice only quantifiable information can be effectively computer processed: It is of value in administration and in seeking a mathematical optimum, but qualitative information totally escapes it. Clearly, major decisions, the search for a consensus, cannot and should not be formalized. The growing size of files is also a disadvantage. As their size increases the risk of errors becomes very considerable, while detection of the origin of the error becomes almost impossible.

The most disturbing feature of all, however, is the “reductionist character of data processing. It is very suitable for simple information, but it simplifies what is not simple, . . . depending on the precise key words used to effect filtering” [10]. This leads to the concept of contrasting *personalized DP* and *telematics* so that the microprocessor revolution can become truly synonymous with “decentralization, autonomy, and increased respect for the individual.”

Furthermore, it is no use ignoring the fact that the new era of increasing yields from technology, which will result in *fabulous increases in productivity* in industry and the service sectors, will also initially have repercussions on *employment*. While it is true that the massive increases in productivity in the period of high economic growth of the 1960s were accompanied by almost full employment, it is nevertheless true that, despite the fall in productivity in the 1970s, unemployment increased because of an even greater fall in the rate of economic growth. Consequently, and in the absence of recourse to shortening the working week, to adopt the hypothesis that the rate of growth of productivity will be

higher than that of economic growth is to admit that *unemployment* will continue to increase and that it is unfortunately not improbable that it will *double* (from 6 million to 12 million) during the 1980s.

Because of its destructive effects on the individual such an increase in unemployment is intolerable. Paradoxically, however, necessity has its own laws and *unemployment* could be *creative* since the fight against underemployment will involve *new lifestyles* and a new distribution of work. There can be no other result since *recourse to technology is a necessity that will aggravate unemployment, but will do so far less than if we resign ourselves to a halt in innovation.*

In conclusion, therefore, the risk Europe runs is less that of being caught by the countries of the South than of being outdistanced by the United States and Japan. It is the latter alone that will be able to benefit from the promises of technology if Europe decides to renounce the advantages in the name of real or potential threats. Since Europe will in the long run have to suffer from these it would consequently be better to meet them here and now.

Only the accelerated development of *technological and social innovations* will provide the essential *flexibility and adaptability* our societies need to face the *uncertainties* of the future. This is the price Europe will have to pay if it is to master its possible futures.

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