The Science And Technology Revolution

—Potentialities and Problems—

By Yves Stourdzé

We are now living through the second great depression of the 20th century. And no one can recall the dramas and sufferings produced by the 1929 crisis without striving to devise and promote collective, original solutions between nations to prevent the crisis we are suffering today from becoming the catastrophe of tomorrow.

For the past ten years, in fact, the world economy has faced severe difficulties. And the various nations are no longer able to strike a balance between objectives which have shown themselves contradictory: growth, full employment, price stability and external balance.

Serious disarray has been apparent both in currencies and international trade.

But the economic depression we are experiencing, unlike the one of 1929, is taking place at the same time as a revolution in technology. This change can be either a source of hope, or alternately, extra reason for concern.

In fact, the economic crisis is superimposed on a complete redistribution of power relations in the area of technology. Part of the intense upheaval taking place in our societies derives from the upheaval taking place in technology.

Nothing remains unaffected: whether ideas for sophisticated or everyday products, the means to produce them, their distribution, or even their consumption. All organizations, whether social or professional, using acquired licensing rights or their own competence, are deeply challenged by technological change.

Perplexed and often troubled, civilian society is now discovering what the major military powers have been forced to recognize since the advent of atomic arms: namely, that mastery over science and technology is the key to international power relations. Power, security and the wealth of nations depend on control of technology.

Science and Technology As a Source of Wealth

In this regard, classic diplomatic models are increasingly running up against the fabric of new relations based on science and technology. Retention or transfer of scientific knowledge or technological know-how becomes a matter of major importance. International stability or disorder will thus depend very strongly on policies of scientific and technological cooperation.

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The prosperity of nations, their defense, their economic dynamism and social harmony are today linked intimately with control of science and technology. To such an extent that a nation which fails in its capacity to integrate innovation will fall behind, outdone by countries better able, at an earlier stage, to avail themselves of new products or processes. Such countries increase their productivity, lower their cost price, conquer new markets; in short, they endow themselves with comparative advantages. Science and technology thus become a source of wealth in the same way that possessing reserves of natural resources once did.

Obviously such a situation has not taken us entirely by surprise. For two centuries, in fact, our societies have faced scientific and technological upheaval. Innovations of all kinds have profoundly changed our economic and social structures and left their mark on our way of life. Nevertheless, today, to all appearance, we are faced with a radically new situation. Sciences of life, information, robotics, new materials, mastery of space and the oceans, and new forms of energy constitute a body capable of rapidly and profoundly revolutionizing our societies.

Not only is each sector of science and technology dynamic in itself, but each seems capable of interacting with others and seeing its own possibilities vastly multiplied.

Biotechnology thus draws support from developments in the information sciences. Developments reinforced, in their turn, by those produced by the study of new materials. Which in turn is enriched by experiments carried out in extreme environments. In this way, forefront technologies themselves constitute a whole universe of interaction, where progress seems to devolve more as an effect of the whole than as the juxtaposition of particular efforts.

The Society of Tomorrow

Let us take a quick look at the main directions of the future:

Biochemistry, microbiology and genetic engineering are likely to revolutionize our entire industrial framework in the realms of energy, chemistry and pharmaceuticals. Agriculture and food production especially should benefit from technological progress in improving soil usage, cutting back use of fertilizers, and optimizing natural and living resources. There should also be notable improvements in preservation techniques and extending the life of perishable goods. Human food requirements —a major problem—will thus be able to

be reexamined and original solutions found to problems which are critical today.

This will bring about a partial change in relations between countries of the North and those of the South.

It would also be appropriate to conduct technology transfers permitting the countries of the South to achieve self-sufficiency in food. Numerous technologies could be brought to bear on this objective, from aquaculture to teledetection, from soil improvement to the struggle against aridity, from photovoltaic production of energy to improving the management of water resources.

Telecommunications systems, microelectronics, optical fibers, and satellites have altered, and will increasingly alter, our industrial fabric, our organizations, our administrations, our schools, and our leisure. In ten years, the "electronic fleas," the building blocks of new information technologies, have seen their capacity multiplied a hundredfold and their cost cut to a thousandth. This process will accelerate even further during the present decade. The rate of appearance of new products on the market is reflecting it already, just as our industrial structures, faced with a rapidly increasing burden of obsolescence, are reflecting it.

In this regard, robotics is both a vector of threat and a source of hope. Threatening because it is often seen as a danger hanging over industrial employment. A source of hope because it can easily be substituted for human labor in areas where work is dangerous, dirty or repetitive, or in hostile environments.

New forms of consumption are appearing—microcomputers, magnetoscopes, video discs—as well as new forms of services and production organizing—robotics, flexible workshops, office automation.

Our energy resources themselves are undergoing profound changes, and will continue to do so. Geothermal, solar photovoltaic energy and photosynthesis are new paths rich with promise. Nuclear energy in different forms will also participate in the diversification of supply and expansion of available resources.

Already today, we can sense the beginnings of the society of tomorrow: it will comprise a vast network of interactions operating not just at a national but at an international level.

Interdependence will be the key-word. Interdependence between industry and the environment. Interdependence between energy resources and development, interdependence, finally, between economic expansion, systems of education, social behavior and cultural values.

This powerful network of interdependences will be the framework for a new civilization. Millions of terminals will be interconnected thanks to the criss-crossing of multiple systems of communication, both public and private. Links will thus be established between professional and private life, between work and leisure. Electronics will cut through a multitude of behavior just as it already impregnates a considerable variety of objects and services.

Communications will be internationalized with even greater vigor, as satellites, optical fibers and video discs make participation in the immense and multiform nervous systems that will link every corner of our planet more economic and more easily accessible.

The Need for Long-Term Objectives

This kind of evolution can bring hope. Mutual knowledge and enrichment through the density of contacts and information may thereby gain in force and intensity. But it is also capable of being a factor of fragility. This network could render information banal, make it superficial, and tend toward fashionable effects and simplifying emotions. Instead of being an assurance of solidarity, it could be a perverse amplifier, accelerating situations of mild conflict, as they take place, into critical situations.

This is what makes cooperation between our countries in science and technology so important, so that we reinforce and enlarge a community of exchanges based on stable relations, solidly organized around medium- and long-term objectives. So that projects will be such as to balance relations between nations, which tend to turn bitter or improve according to extremely changing contingent circumstances, in which very often the erratic movements of currencies and the stormy ups and downs of international trade are interconnected.

The social change which we are experiencing should be dealt with by structures and processes capable of handling both the medium- and the long-term.

We therefore need to think in terms of a comprehensive body of research and development cooperation, both in science and technology, which will assure a nucleus of stable contractual relations. One which will also provide the nations with a code of good behavior based on long-term consideration. So that the good progress of such projects will allow those responsible to think further ahead and more broadly than merely leaving things to contingencies, inevitably equivocal and fluctuating in a period of depression, would allow them to do.

Integration of Science And Technology

The potentialities of science and technology today are extremely concentrated. The seven member nations of the industrial summit meetings—Japan, Italy, France, West Germany, Canada, Great Britain, the United States, plus the European Communities—have exceptional resources at their command, thanks to scientific and technological research and development.

But at the same time, these exceptional resources still need to be developed. We must not let ourselves be carried away with technical and simplistic dreaming. There is no simple logic of scientific and technological development. Social and cultural groups react in different and contrasting ways to technological innovation. On the contrary, we must be careful to take into account what social, economic and cultural conditions are required for scientific and technological resources to actually be put at the service of both our economic development, social progress and cultural values.

Our societies must remain fertile ground in which the seeds of inventions and scientific and technological innovation can take deep root, flower and bear fruit. We must take care that the soil, that is to say, the social and economic humus, does not become acidic, and that the seeds do not dry or the plants wither.

In a period of change, both in technologies, know-how and lifestyles, we must stress the importance of the social acceptability of technical developments, and take care to avoid a divorce between our peoples and science and technology. The public—in all countries—must be able to progressively acquire scientific and technological knowledge. This acquisition requires effort both in information and public awareness programs. So one must not shrink from debate, but on the contrary, encourage it. A considerable effort of scientific and technological information is necessary, just as it is necessary to include more technology into the process of education itself. The culture of tomorrow must be a culture deeply imbued with technological fact.

It is also important to examine closely the economic environment necessary for a healthy and effective integration of science and technology. When our economies are depressed, interest burdens high and exchange burdens erratic, the climate is scarcely favorable for innovative investment. We must not forget that innovation goes hand in hand with taking risks. When this risk has superimposed upon it the hazards of an unstable environment, with credit expensive and hard to come by, the most innovative sectors, the areas most full of promise, are the areas most threatened.

The risk of a vicious spiral establishing itself then arises: unfavorable economic conditions dissuade innovation,

and the absence of innovation in turn reinforces the depressed aspect of the economic environment.

Such a spiral must be avoided. And many governments are tackling this problem. But clearly they are using different methods to do so. France, in this regard, has undertaken a resolutely voluntarist policy. It has chosen, at the very time when all countries are going through a period of economic difficulties and budgetary restraints, to preserve the chances of the future by actively betting on research and development, and mobilizing its creative energies and intellectual resources in order to dynamize its industrial fabric, as it were, through research and development, and thus lead the country toward the 21st century.

Science and Technology As Tools for Recovery

But while we may wish to be ambitious, we should also be pragmatic and clear-minded. Certainly we must look clearly at the impact science and technology can have on the level of employment and economic activity.

For a start, the beneficial effects of new technologies may not be immediate. It takes time for science and technology to make their effects felt, which makes it very important to allow for intermediate adjustments and to manage transitory effects.

Profound changes linked with technology are in effect overhauling the entire face of our societies, partially redistributing the map on a planetary scale. Regions which yesterday were prosperous, today are experiencing difficulties, and their fate at times takes on the appearance of real tragedy, economic, social and human.

On the other hand, in other regions the same activities, benefiting from different conditions, develop and prosper.

Public authorities cannot remain indifferent to the significance of such changes. Beyond a certain level, economic costs become social and human costs, and governments cannot remain indifferent to them.

For this reason, the fate of traditional industries is a crucial matter.

In this area, there is no fatality. Old industries can be revitalized by new technologies. This possibility of revitalization is essential. It allows us to affirm that there is no evil spell. Declining sectors can revive, on condition that they "recover their productivity," and this recovery is possible through the help of technologies.

Revitalization is a dynamic strategy whose objective is to restore viability to sectors of activity threatened with obsolescence, in order to bring them back into international competition. Without this will, such sectors, which generally account for a significant population, run the risk of being able to survive only with the help of public authorities. So that to safeguard employment in these industrial areas facing difficulties, protectionist reactions become inevitable. And these protectionist reactions are all the stronger today, when each country can easily suspect its competitors of endowing themselves with comparative advantages by means of subsidies granted in various forms for research and development. In order to break this vicious circle of suspicion and prevent each nation from shutting itself up in purely defensive protection of its threatened sectors of activity, we need to regard the actions of public authorities as extremely positive when these are aimed at helping threatened sectors achieve technological revitalization. This is the only way to avoid subjecting entire areas of activity to an artificial and costly extended life. An extended life, moreover, which leads automatically to protectionist attitudes.

The introduction of new technologies into old industrial frameworks should therefore constitute a program of international cooperation of the first magnitude.

Whether a climate of tension is created, or on the contrary, one of international expansion, will depend on whether old industries are allowed to rot or, on the contrary, are set going again.

The outlook—energy crisis, increasing scarcity of resources of all kinds, disorder in the international financial system and serious unemployment in our nations—leads us to see the potentialities of science and technology as powerful tools for getting us out of the crisis.

The Importance Of Cooperation

This is why scientific and technological policy cannot be separated from economic policy, social policy and international policy. Furthermore, the planetary dimension of science and technology is becoming more obvious day by day.

The role played by forefront technologies in international commerce in recent years has grown outstandingly, and can only continue to grow in the years to come.

Moreover science and technology are clearly matters of decisive importance from the point of view of national security. The prosperity and security of our countries are therefore linked extremely closely to the fate of science and technology. And this fate can be particularly compromised if we adopt the course of turning in on our own specific egos, however "sacred" they may be. If we confront each other each with a defensive attitude of closing up on ourselves, this will lead rapidly to sterility, bitterness and conflict.

On the other hand, unrestrained exposure to brutal, violent or unfair competition can only destroy violently and without transition the equilibrium essential to our societies.

The truth is that the excesses of these two policies may well feed upon each other. Unbridled competition may provoke brutal measures of defense in return.

The industrialized countries, therefore, have a common interest in a policy which would judiciously associate fair competition, stimulating invention and innovation, with industrial adjustment policies, allowing sectors of activity declining more or less rapidly because of obsolescent technologies, to restructure around technological processes and innovative products, so as to reestablish themselves in a healthy, vigorous and competitive international economy.

This competitiveness and vigor require, moreover, a certain vigilance, because the realm of forefront technologies must be effectively an open one, not limited, on an international scale, to the action of one or two all-powerful agents, operating to restrict access to knowledge and know-how, or setting a prohibitive price on it.

Finally, we must insist strongly on the specific responsibility of science and technology in relations between the countries of the North and those of the South. We must work together, to allow better access for the countries of the Third World to science and technology, and consider with them the most effective forms of transfer necessary to their development.

We must therefore establish, between the industrialized countries, a program of cooperation in science and technology capable of sweeping across the broad fields of future development. In particular, energy, health and food resources, living conditions and employment. Robotics, biotechnology, materials, communications, and nuclear science must be at the center of this program.

The important thing is to guarantee, between us, a period of international stability based on balanced cooperation and on a collective mastery of our future. ●

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