

SCIENCE, TECHNOLOGY, SOCIETY IN FRANCE TODAY\*

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It may seem that what I am presenting here is only of limited interest because I am referring to my observations about what happens in France. Yet an experience of several decades has taught me that in the final analysis the "French case" is not so special, and that often what one observes there is a good microcosm of almost all phenomena of the Western countries. The problem of "Science-Technology-Society" has changed considerably over the past decades. Summarizing and simplifying my essay I could reduce it to two theses:

On the one hand there is uneasiness and uncertainty among the scientists with respect to Science in general.

On the other hand, this self-examination does not at all affect the technologists. This, therefore, entails a certain dissociation of the world of the technologists from that of the scientists, while the technologists are more and more linked to the administration.

The Calling into Question of Science

I shall not focus on the problem of epistemology and of objective knowledge; thus I shall not take up again the well-known works of Karl Popper or C. von Weizsäcker, for example. But on the experimental level I could say that scientists in increasing numbers present themselves as less assured of the validity of what they are doing. Of course, there is first the question of the purity of Science. Everyone knows Oppenheimer's phrase of thirty years ago: "We have known sin." Many (but by no means all!) scientists now experience anxiety over what can become of the discoveries they make. They have become certain that Science is not innocent because one can no longer conveniently dissociate the pure scientist or scholar from the impure politician or technologist. The scientists recognize that if they were not to make a certain discovery, the technologist would not be able to derive any application from it, and the politician would no longer have any use for it.

This was not yet the case at the time when the following small but significant incident occurred. In 1960, during the war in Algiers, there was a French propaganda service which applied the best methods available for psychological warfare. A group of psychologists at the Sorbonne, who were virtually all leftists, wrote a public letter to declare that they, in no way, were responsible for the use which the army had made of their

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psychological discoveries and that they, thus, were totally innocent. Yet, if they would not have made these discoveries, the army would not have used them!

Today the scientist knows that everything which he discovers will immediately be recaptured, transformed, and put to use; he knows that he can never guess how and by whom it will be applied, nor what consequences one will derive from it, nor the advantages one will seek to get from it, nor finally the risks which a certain capitalist organization or a given government agency is willing to take to increase its power. The scientist knows that in any case they will be used. And thus their anxiety increases because it is no longer possible not to ask the double question about the finality of Science (because it no longer is pure "knowledge") and about the good or evil with respect to what one discovers. Scientists have gradually begun to become convinced that actually the principal source of power comes from knowledge and that they, whether they want it or not, participate in the increase of the powers and the forces in our modern world. One knows thus, without a doubt, that beyond a certain power the moral values become obliterated. Max Weber once wrote (in: "The Scientist and Politics") that the first duty of the men of science is to realize what they are really doing; one can say that in France today, this wish of Weber is in the process of being fulfilled. There are more and more hesitating scientists who are having a bad conscience.

To be sure, there are still scientists who pretend to keep their hands clean, such as the molecular physicist, Leprince-Ringuet, who declared that at CERN he served nobody nor any political system, or the geneticist, P. Chambon, who said: "It is not the scientists who decide what one does with science." But these are the "old ones." Among those who are forty years old anxiety reigns.

Secondly, I witness a calling into question of the validity and usefulness of a great number of research projects. In medical circles, for instance, one questions the usefulness of the greater part of the ultra-modern diagnostic methods. It is not that they are erroneous, but one pretends that with the direct observation methods which have been employed over fifty years, without any monumental equipment but with the meticulous experimental knowledge of interpretation of the most minute signs by the physician, one can arrive at diagnoses which are as certain, but less costly, dangerous, and fatiguing for the patient. And I should say that almost in the same manner all physicists are caught in a well-known difficulty: since the discoveries by Einstein one knows that Newton's physics is false; but when one turns to practice one is obliged to do as if it were exact. Besides there are quite a number of other themes marked by scientific uncertainty. To repeat, this is not the famous epistemological problem by itself, but the problem of the validity of the methods of a great number of sciences and the problem of the very object of science.

With respect to the validity of the methods used, I shall limit myself to citing the example of the enthusiasm for the use of mathematics in the human sciences. One thought there that one would finally reach true "scientific status" if one were to do econometrics, sociometrics, or psychometrics...; the application of mathematics seemed to guarantee scientificity. Actually one has come back from this and there are no longer many sociologists and economists who believe in the exactness of the results obtained by mathematics. And this is all the more so, as the consequences of the conflict within mathematics itself make themselves

felt severely (namely the half century old quarrel between Hilbert and Gödel), and as a growing number of mathematicians refer to the incompleteness and undecidability theorems. In the same way, an entire set of principles once held to be true (such as the reversibility of elementary phenomena, the conservation of energy) are now rejected by many. And even the object of research itself seems to disappear gradually. The very remarkable book of D'Espagnat (In Search of the Real, 1979) shows that in the final analysis the modern physicist no longer knows on what he really is working. Is there only one reality? The real escapes us and never is what one once believed it to be. And the incoherent phenomena which one establishes are incapable of receiving a unitary explanation. In order that the real has consistency, one must thus refer to an "other" dimension, which serves as support and substratum for these phenomena; and yet with the help of physical and mathematical methods one can neither grasp nor explain what D'Espagnat calls the "veiled real."

Finally, in this uncertainty the scientists have the feeling that they progress into a world which reveals itself unceasingly as being more complex, more indefinite; and at each step of the way the horizon continues to recede. We are far away from the epoch in which the scientists were convinced that "one day" they would be able to explain everything. If, for example, in physics one accepts the theorem of non-separability (1) one finds himself confronted with a complexity of millions of parameters to be brought into play which is incapable of being grasped. In the domain of biology there are other "impossibilities" which one runs into. And so far I have limited myself to the so-called exact sciences.

The skepticism or embarrassment is even much greater in domains such as history, for instance. Here we rather have the consequences of what one could call the "hermeneutic crisis." We are less and less certain about the interpretation which has been given of the documents of the past. We are more and more convinced that one will never grasp the historical "fact" in itself. To be sure, our knowledge grows, the methods become more refined, but the historian more and more loses hope of being able to give an account of the human reality of past societies. A great French historian, Veyne, could at the end write: "Finally, to do history is to tell stories." What I am reporting here is not the result of an abstract reflection, but the outcome of my contacts with scientists, during numerous meetings, where I have been invited as an "observer," or as an "outside eye." And this very fact is already a very interesting phenomenon in itself, namely that specialists invite a non-specialist to attend their meetings, to attempt to have a discussion with them, to understand what is going on. Twenty years ago this would have been unthinkable.

But at the same moment an interesting "counter-phenomenon" is occurring. Politicians and administrators are completely convinced that the entire life of society, its economic development, and so on, is bound up with scientific "Research," with the growth of our laboratories, with the results from the sciences. We go from progress to progress, we accumulate the results, we produce more and more sophisticated techniques. And we do this so well that one places the man of science on a royal throne at the very moment that he himself has doubts over what he is doing. But this operation of glorification of science is a fact brought about by the technologists on the one hand, and by the bureaucrats (and following them the politicians) on the other. Now it is quite correct to assert that the contributions of science and their utilization in each case have giver

a new momentum to a society in difficulties. If it would not have been for the intervention of theoretical physics for atomic energy yesterday, of "artificial" intelligence with respect to our data processing today, and of genetics in regard to a bio-industry still in full development, our economic, political, and industrial system would have yielded to its internal contradictions and the decreasing output of technology. J. Monod once said that the established powers depend as much on science as an addict depends on his drugs. J. Attali correctly shows on the economic level that the car appeared just in time to solve the economic problems which existed before 1914, the electrical household appliances for those between 1933 and 1940, and the "medical prostheses" for those of today. But we see here again that the main issue is raised by the technological application.

For the economist and the administrator, truly interesting is the technical result. One thus witnesses a kind of welding of the technician to the administrator (taken in the broad sense). The scientist is left alone with his problems (intellectual problems and problems of conscience); one asks him only to work on projects which can be translated into technologies for the greatness of the nation and the growth of the economy. And in view of the fact that he cannot do his work except with the help of considerable research grants and thanks to positions which depend on the government, he is bound to deliver a satisfactory piece of work. If the scientist is immersed in the difficulties which we mentioned before, the technologist totally denies him this kind of problem. He is completely confident about what he does. The generalized putting into application of regulating controls, the anticipation of the utilization of bacteria in order to fabricate "everything we need" (!), genuine micro-factories, the telecommunication for satellites, etc., etc., ..., all this makes the technologist enthusiastic. He does not know of any hesitation and never recognizes that one could have here considerable potential dangers. The technologist finds himself more and more separated from the men of science (while he produces the idea of an "aristoscience," as John Passmore calls it). He incessantly proceeds to sort out what appears to be usable from merely abstract theories. One demands of a technologist that he is efficient; he cannot let himself be seized by doubt.

Now, those who make this demand are at the same time the public and those in power. Informed by the Mass Media the public is always convinced of the "Miracles of Science," and that there one will go from progress to progress. Moreover, this entails as a "counter-consequence" that if this is not so, if one does not profit from all the benefits of science, then this is the fault of "someone," the fault of the capitalists or of the politicians. From the medical point of view, one just has to look in France at the discontent about the fact that, for example, not everyone can profit from the best technologies, from the most sophisticated surgery, etc., ..., and at the conviction that if it would not have been for "bad faith," everything would have been possible.

At the same time one notices that the bureaucrats exactly have the same conceptions as the technologists. It is true, moreover, that they themselves gradually have become the technologists of the administration. More and more close ties are being knit between the group of technologists and the bureaucratic organisms of power. Finally, all research projects are made possible only by these administrations. In France, it suffices to just think of organizations such as "Bridges and Highways,"

"Electricity of France" (EDF), or the "Commission of Atomic Energy" (and there are many others). Here one finds the exact pairing between bureaucrats and technologists. In France these institutions are becoming all-powerful. Nobody and nothing can oppose the decisions and projects of the EDF. It takes perfectly illegal measures, respects no rights, acts arbitrarily: even the government is bound to accept this, precisely because of the unity between technologists and administrators. Many men of science are opposed to the developments of the EDF, but they have absolutely no authority.

On the other hand, one must evidently also allude to the transformation of the French university under this influence. Little by little the teaching of all theoretical subjects (including general mathematics or theoretical physics), all teaching of abstract humanist subjects, etc., . . . , are being reduced. History, philosophy, sociology, psychology, political science, taken in their different branches, are little by little eliminated: they are not useful, efficient; there is no administration which is interested in all of this. And instead, one develops applied sciences. One replaces, for instance, the study of foreign literature by the study of "practical" or "commercial" English. One replaces Latin and Greek by a linguistics which can be adapted by information processing, etc. . . . . The university must serve to form the practical officials of the nation and of the economy; that is all. But this is obviously in disharmony with the scientists themselves: those who in France over twenty years have formulated the true, basic philosophical problems, are the scientists: Monod, Laborit, J. Bernard, Laguedec, Tubiana, etc. . . . . But they are not being heard. Those who dominate the evolution are the techno-bureaucrats who act by virtue of a science that is out-of-date, but still efficient in the concrete, and who mould the institutions, the territory, the production in function of their imperatives. This is why one no longer can pose the problem concerning the consequences of the developments in science, and present alternatives. For instance, it is quite true that data processing (virtually) could be an instrument of humanization, decentralization, a flexible organization of work, of a real economy of time, etc. . . . , but in fact this possibility does not exist because the issue has already been decided in advance. Information processing is taken over by the techno-bureaucracy which only wishes to maintain its own conception of progress and growth. Said in another way, it will serve as an instrument of centralization, control, and rigidity. This, it seems to me, is actually in France the dominant fact: this contradiction between the scruples of the scientists and the indifferent all-powerfulness of the techno-bureaucrats.

- (1) "If the notion of a reality which is independent of man but accessible to his knowledge is considered to be meaningful, then such a reality is necessarily non-separable." If one admits the reality of localizable particles in space, and if some of these particles at one time interacted according to certain definite modes when they were close to one another, they continue inevitably to interact, whatever their mutual distance may be.

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