Speech on Anthropotechnology
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CULTURAL MACHINES

In periods where a new form of technology triumphs, it appears as comprehensive as Minerva born helmeted and armed. No technical detail is questionable, the specific vocabulary is imposed, the work organization is not challenged and the sole purpose of staff training is to make each one a faithful servant of this marvellous system. Thus, the new technology appears as the expression of the culture of a group of persons at a given moment in the history of a country. The secret which accompanies some achievements may isolate two different methods of the same technology over a prolonged period and it is then noticeable that there is not "one best way", a repeated illusion of technologists. As such, the American approach of astronautics and the Soviet - now Russian - approach of cosmonautics differed considerably from the outset to the present day. The use of powerful computers and the development of the theory of systems led the United States to imagine total remote control from earth and unemployed astronauts, although this was never the case whether for the control of craft, or for their maintenance, or for exploration of the moon. In the USSR, the lack of development of the computer industry and the refusal by the USA to sell very powerful computers to the ex-USSR, like a certain conception of human psychology linked to the reflection theory, led Russian researchers to give major responsibilities to cosmonauts from the start and to conserve this trust to the present day. The recent opening of Soviet research centres to Western visitors has given an insight into these laboratories where the activities of cosmonauts are simulated on earth with great realism in large swimming pools where specialists, dressed as cosmonauts who exit from their capsule, try to perform the same repairs which have to performed simultaneously by their colleagues in space. The two teams, on earth and in space, go through the manoeuvre together by telephone.

In this example, we find certain fundamental ideas:

1) Every machine is cultural. Every person, or group of persons, who designs a technical system does so for a use linked to the conditions and persons he thinks or believes he knows. It is obvious that the use, the conditions of use and the staff used were not the same in the American astronautic and Russian cosmonautic systems, that the system designers had very different images of these characteristics and that their products clearly reflected these cultural data. It is noticeable that this is not abstract culture but rather the representation of a set of human and material data: the solutions chosen in the ex-USSR take into consideration both the poor level of Russian computer systems and the confidence which the Russians have in the qualities of the human brain for dealing with complex or hypercomplex problems.

2) At a given moment in time, there is never a single technical solution. In any event, it is the human brain which, in the end, enables the target to be achieved or not. Thus, no matter how comprehensive a technology is, it is not the master to whom the operator should be a slave, but a tool which the operator should use. Despite training and learning, the human body and brain cannot be changed much. The characteristics of man and their limits must be known in order to design tools which a person can use efficiently. An idea of the scale of these considerations can be seen from the fact that, in both the American and Russian programmes, the budgets for physiology, psychology, biomechanics and ergonomics research represented a quarter of the entire space budget.

3) The switch from one technology to another is difficult and requires considerable transformation, not only of the system itself, but, as in this case, most of the scientific research and the national industry. That is the reason why the powers allied to the USA and the ex-USSR took part in space flights as astro-cosmonauts and were not involved in their design. Technology transfer is not any easy thing.
In fact, the purpose of our speech is to get a better understanding of the difficulties of a technology transfer in fields which are determining but less prestigious than space. This transfer, which is an essential component of world trade, has suffered too many setbacks alongside brilliant successes and constitutes one of the causes of the debt situation - sometimes dramatic - of Industrially Developing Countries and even Newly Industrialized Countries.

TECHNOLOGY TRANSFER: THE SUBJECT OF ANTHROPOLOGY

This important question has not been ignored by researchers who, for the past fifty years, have been studying Ergonomics (Human Factors in the United States, Arbeitswissenschaft in Germany and Engineering Psychology in Russia). Ergonomics, or the adaptation of work to man, uses anthropometric, physiological and psychological data (limited to that which comes from so-called "scientific" psychology) in order to design and improve working arrangements. Although traces of this concern can be found in the 17th century with Ramazzini and Vauban, and although some work done by work physiologists at the CNAM in France and the Kaiser Wilhelm (now Max Planck) Institut fürArbeitphysiologie of Dortmund gave precious indications in the first quarter of the 20th century, ergonomics did not really appear until during the Second World War. Due to the extreme necessity they provoke, wars provide opportunities for breaks with certain social principles governing Science. In this case, it meant specialists from different disciplines working on the same project and especially the fact of having specialists of Man agree to use Science not with the disinterested purpose of knowledge but with the prospect of utility. It was discovered that Human Sciences, like physical and chemical sciences, could become the Sciences of the engineer. The end of the World War could have been the end of a deviation which was only justifiable by National Defence. But the Cold War, then the economic war, which is never-ending, enabled ergonomics to survive and to develop rapidly. For the last 20 years, ergonomics has expanded further due to the development of computers. If man is to be able to use computer systems efficiently, the working of his intellectual process must be known, hence the rapid development of cognitive ergonomics.

Some ergonomists did not fail to take an interest in the problems raised by countries which were very different from countries that had long been industrialized. The diversity of body sizes had to be studied so that cars would sell better on all markets. Codes and signals had to be checked to ensure they had the same meaning in all countries. And, finally, non-assisted commands had to be used by workers who had less muscular strength due to insufficient nutrition. But all this remained in the henceforth respectable framework of ergonomics based on laboratory experiments and had a reassuring theoretical aspect.

However, some ergonomists, especially those from the French-speaking world, discovered that some of the failures of ergonomic action were linked to the fact that they trusted the description of work provided by the company's management, the recommended task, while, in reality, operators performed very different activities - the real work - due to the constraints which they had to face in reality. Ergonomics was then directed towards the reduction of these constraints. But, beforehand, the reality of work had to be analyzed. This ergonomic work analysis revealed unsuspected operational difficulties linked to the work situation and to the representations which workers had of this. We remained within the framework of ergonomics. But, in industrially developing countries, we discovered difficulties and constraints which were totally different, so anthropotechnology had to be created.

In this respect, some authors, like Hendrick in the United States, talked about macroergonomics. We thought it was better to create an expression that was clearly separate in order to underline the epistemological leap which had to be performed. In effect, the origin of the difficulties was to be found in geography, economics, sociology, anthropology and even in history, meaning, this time, in the field of sciences studying human communities and not individual man. Although geography had always developed in a perspective of commercial or military applications ("The first purpose of geography is to make war"), although economics was created to understand and modify the policies of governments and companies (Adam Smith, Marx, Keynes), although history has always served political purposes and although sociology pretends to orientate the evolutions of societies from Marx to Touraine and even provide advice to companies, these social contributions have never been the main activities of specialists. If anything, it was the main theoretical perspectives which appeared essential, rather than the advice given to companies. Certainly, an exception could be made for the essential contribution constituted by the sociology of organizations from Max Weber to Michel Crozier.

As regards anthropology, the question is totally different. There are few historical examples of anthropological analysis directed at industry. And although anthropology was sometimes accused of deviating from its basic aims, this was in order to criticize it for having prepared and helped colonization, religious conversions and systems of foreign domination. In effect, anthropology long considered that its field was "others", "native populations" or "primitives" and not the societies themselves from which the ethnologist came. In any event, this was, and still is for most specialists, a matter of studying intact populations, i.e. those not penetrated by modern civilization, while our intention is to discover the means of this penetration and the possibility of a transformation desired by industry. This is all the more serious since the differences between peoples - whether or

not they have the frontiers of a nation - constitute most of the difficulties encountered by technology transfers.

As we can see, the ambition of anthropotechnology is considerable. Its aim is to redirect - at least partially - the sciences of collective man and, in particular, anthropology which is the furthest removed from this trend. In addition, for anthropotechnology to be efficient - since it is a discipline directed at an objective - it has to take work as the central object, while the dazzle of technology tends to keep work in the shade.

WORK - A REDISCOVERED PARADIGM

Selecting work as the point of convergence of various disciplines is not very original, since the traditional definition of man is "homo faber". Aren't present-day cognitive sciences the echo of "cogito ergo sum"? Although this reminder does not encourage our dialogue with geographers or economists, it nevertheless constitutes a precious relation with historians interested in the history of mentalities and customs, with sociologists who study social representations and especially with anthropologists who have successively produced ethnolinguistics, cultural anthropology and, in particular at present, cognitive anthropology. This direction taken by anthropologists, and by many cognitive psychologists, constitutes justification of the ergonomic activities analysis, a methodology common to ergonomics and anthropology.

The essential characteristic of work analysis is the direct and exhaustive observation of the reality of man's activities at work. Like the geologist, the geographer, the ethologist and especially the ethnologist, the specialist in anthropotechnology is only productive from the moment he establishes very precise facts in the field. He observes the action, observation and communication of operators' behaviour in terms of their real sequences and, through self-confrontation, tries to discover, along with the operators, the cognitive processes which produce the behaviour observed. This description is never complete since that would amount to underestimating the importance of the cognitive unconscious like the psychic unconscious. But the necessary effort of interpretation leads to the design of a tree of causes which goes all the further since the analysis exceeds the apparent and immediate determinants. Certainly, the work could be directed towards psychic or economic determinants, but in technology transfer situations, what we want to discover is rather the material (pragmatic) constraints and the ethnological characteristics since our objective is to act on those of the material constraints which we can modify and to remove the cognitive difficulties which may be provoked by language, traditional representations or the particular ethics. In fact, this is a methodology which has great similarities with the ethnological method. But convergence only takes place if the anthropologist becomes cognitivist and the ergonomist takes an interest in the different ethnic groups. In both cases,

this requires very detailed observations and an in-depth interpretation if the anthropotechnological viewpoint is taken since its aim, like ergonomics, is not to change human reality, whether biological or cultural, but to modify the technical and organizational systems.

It may appear a bit exaggerated to use so much scientific knowledge to deal with an apparently trivial problem like the correct operation of a solar pump in the Sahel or a sugar cane alcohol distillery in Brazil, but experience has shown that more limited approaches do not work. In fact, the transfer of know-how and technology is as old as homo faber. It is a vital element in relations between peoples and for the homogeneity of their development. Therefore, it fully deserves everyone's interest.