

SCIENCES AND SOLIDARITY

PAUL GERMAIN

1. The explosive expansion of the sciences

It is not necessary to express at length the fantastic progress achieved by the scientific disciplines during the last century. All of them are today completely new, even those which already existed at its beginning. One may foresee that this expansion will continue and probably at an increasing speed. The twenty-first-century information sciences will allow communication of exchanges of knowledge and unprecedented performances in calculation. Within a few decades we should be able to build computers in quantity that will be a million times more powerful than the personal computers of today. These achievements will provide new methods of research in every scientific field and will give rise to extraordinary applications.

In physics, they will favor the possibility and the development of direct atomic-level manipulations. We will be able to conduct dissecting, manipulating and designing tasks with great success at dimensions which are today unavailable and even unbelievable. In particular, we will increase the field of nanotechnology and its numerous applications and build new devices for accomplishing new experiments. Chemistry will still increase its ability to realize new materials satisfying some prescribed properties for specific industrial use. In biology, we are cataloguing our own genes. We should be able to manipulate them to prevent and to cure many diseases and to reduce human suffering. Many unpredictable advances in molecular and cellular biology will allow a better understanding of the history of life and of the behavior of animals, plants, insects bacteria and so on. Sciences concerning the earth and the universe will benefit from the new achievements of launchers and satellites and will give us a new knowledge

of our world and of its history. Cosmology will be greatly enriched and will become a more well-founded scientific discipline. We are studying intelligence and consciousness. Maybe within the next century, we will be able to create astonishing artificial intelligence.

But what is more important for the daily life of people is the application of this scientific knowledge to what is called, for a few decades, new technology. It is the art of using scientific results and known techniques in order to build new objects or apparatus to be sold in the market. To be a good engineer, capable of developing a new technology requires a creative imagination, very broad knowledge, good judgement and a great capacity for predicting the chances of the success of the operation, which means its marketing. The work in technology requires a lot of research but of a kind quite different from the research in scientific disciplines. Time plays a different role: in technology the total time required for a realization including research, development, industrialization and sale must always be shorter, thanks to improvements and innovations. In science, the most important progress requires very often a long time of reflection and research which is not of crucial importance. In science the result is judged by peers and is appreciated by way of a good reputation. In technology, it is judged by the market and the appreciation is in the hands of the shareholders. Despite these essential differences between sciences and technology, for the public they are very close and the economists make no distinction and speak of technosciences. For them, the concept of science has no importance or it must be understood as a component of technoscience. Very often the word of science implies at the same time science and the technology which is generated by science

2. The great challenge for humanity

It is quite obvious that these wonderful achievements as well as the powerful methods and tools which have been found and used, open fantastic possibilities. We discover that we are in position, in a very fundamental way, to reshape ourselves and our world. The new technologies provide us with great hopes, for example hopes of eliminating diseases and poverty. But also they come with grave challenges and great dangers. I borrow the following example from a paper by Bill Joy in a recent issue of the Bulletin of the American Academy of Arts and Sciences: "We struggled for much of the twentieth century with controlling our capacity for biological, chemical and nuclear weapons of mass destruction.

The great advantage we had with these technologies was that these often required large scale activities or very specialized knowledge and facilities that were not widely available. In the twenty-first century, the new technologies of great power are much more likely to be small, portable and capable of being used by small groups of individuals and inherently much more difficult to control”.

Here is the great challenge to be met by humanity in the coming years: the necessity to make decisions concerning the orientation of the program of scientific and technological activities which could have many consequences for the future of human beings and for the societies, often without knowing what it wants to achieve. The situation is quite new. People for a long time wanted to travel by air and that was the perspective or the orientation of various scientific and technical research which gave rise to balloons and to airplanes. The same may be said for the wish to have a powerful and easily usable form of energy for improving people’s work and life. However when one has to deal with scientific and technical decisions which would affect the human being himself, his own nature or his environment or the life of future generations, the situation is quite different. What kind of a human being do we want to produce? What is our dream? It is impossible to formulate an answer which would receive a quasi unanimous agreement. Even now, at the present time , it is difficult to define what makes the dignity of a human being, what makes his singularity among all the living beings.

All these problems arise namely in the history of humanity at a time when science and technology have reached the level which permits an action on man himself, but also at a time when, as noted by Bill Joy, our connection to the spiritual and sacred is relatively weak. In the West, the principal conceptions of man, religious or philosophical, may be considered as “humanism”, which means that, for them, man is a very special living being who has special privileges and rights and who is worthy of great consideration and of great respect. Today, the validity of humanism could be doubtful. Sure, man is endowed with a great power. But, for a biologist, the specificity of man as a living being is not at all obvious. The difference between the human genome and the genomes of apes or monkeys like chimpanzee, gorilla, bonobo, orang-outang is very small. As far as the behavior is concerned, the difference is not as great as was thought. Some monkeys may have feelings and ethical behavior. Some people think that the “animal rights” have to be taken into consideration. Others may be tempted to deal with human beings, especially with embryos

or with very old people, in a somewhat loose consideration, at least less than it was in the past.

We will have to determine the fate of our species. But the problem is that we don't know what we want to become. Another unexpected consequence of this situation, a paradoxical one, is the decline of the scientific ideal. In most of the advanced countries, in the West especially, the number of young people who want to become a scientist or an engineer is decreasing.

This great challenge would be the most difficult problem of humanity during the coming years. It will require a lot of thinking and many discussions about what we want to become. Like Bill Joy, I do not believe that science can tell us what we should become. Our choices should come from our spiritual, artistic and ethical values. To find the good one will require time. The academies can help bring together groups of people to discuss the shape of our future. Scientists involved in the most advanced and crucial fields will, of course, like to go very fast. In my opinion, we must avoid taking decisions in a hurry. One must try to make a step only when a great proportion of people is thinking that it may be done safely.

But an urgent task and a useful one for the scientific community would be to redefine, as clearly as possible, the foundation of its ideal and to give precise examples of actions that the scientists intend to do for the benefit of society; in other words, to justify the choice to become a scientist. It is worth proposing already initiatives which may improve the present situation. An example is given by Claude Allègre, a recent Minister of Education, Research and Technology in France. Noting the diminution of the number of young students in science and in engineering, he decided to create for them new courses in history and philosophy of sciences in many faculties of sciences. He thought that that would be a good way to convince them of the high cultural value of a scientific education. The purpose was a good one, even if one may think that it was not the best decision to be taken.

3. "Human solidarity" as a good foundation for the new scientific ideal

The classical scientific ideal was to increase the knowledge on the universe and on the material and living world for the intellectual and moral benefit of "man" considered in an abstract way, independent of space and time. "Science has no frontier". In the present paper, it is proposed that this "man", the abstract man of the "enlightenment", be replaced by "human solidarity"; or if you want the "concrete man", which means all the people

of any nation or territory and all the future generations. The great difference is the following. In the classical conception, the scientists have to elaborate new results. Their application is done by engineers, technicians and companies which have to ensure their diffusion. In the new conception recommended in this paper, the scientists will have, as always, as first duty to increase knowledge, but they will also have the duty to see that it meets effectively the needs and the expectations of the world's inhabitants and, eventually, to participate in this action.

It would not be difficult to show the important consequences of this change of perspective. Generally speaking, it would imply partnership between scientists, and in particular between scientists belonging to the developed world and of the developing world. It is not necessary to comment on the benefit for Education which is for any country the best lever for improving its situation. As far as Research is concerned, it would mean, for instance, that more work would have to be done to cure tropical diseases or in biotechnology, for creating genetically modified organisms which could be used for overcoming the deficiencies due to parasites or to drought. As is now obvious, especially with the very recent report of IPCC, much investigation is required in order to limit the damage caused by the global warming.

The actions inspired by this new ideal would have a deep influence on the life of all countries, especially on the developing ones. A better understanding of what science is, what it can do and what it cannot do, would help to stimulate a good exercise of democracy which is necessary today for the decision-makers in order to take the best decision after good expert advice. A country which would be scientifically illiterate would not be able to take advantage of the new scientific and technical achievements. That is an unfortunate situation, not only for this country, but also for the whole world because it is a factor which would continue to increase the gap – or even the fracture- between the rich and the poor countries, a dangerous situation which has been worsening these past decades as shown by recent reports – see for instance the last paper of Pierre Papon, the Président of the *Observatoire des Sciences et des Techniques* in France.

This last observation shows that the ideal of human solidarity which is offered here to the scientific community is a factor antagonistic to the perspective of the technosciences. It tries to favor cooperation and not competition. The present economic world puts a strong accent on the free-market and globalization which is the main cause of the fracture already mentioned. Scientific solidarity would happily temper and balance this great and sometimes dangerous economic influence.

I want to conclude this paper by greeting the recent reinforcement of IAP – the Inter Academy Panel on international issues – and the creation of the IAC- Inter-Academy Council. Both seem to reveal an evolution in the direction recommended in this paper. It does not mean, nevertheless, that all the scientists are ready to adopt this position. The two first articles of the last issue of the “Bridge”, the publication of the National Academy of Engineering, are very enthusiastic about the expected progress, but, at least apparently, they don’t take account of public acceptability. On the contrary, the last reference is a plea for “a modern humanism”. Sooner or later “man” will be the crucial question of our future.

I am very grateful to have been invited to this wonderful symposium and to have the possibility to express my gratitude to Professor Carlos Chagas. Most of the ideas I have tried to express have been greatly influenced by many discussions and exchanges of view with our former President either in Rio or in Paris when he visited our Academy as one of its “Associés Etrangers” and of course in Rome in this marvellous Casina where he will never be forgotten.

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