

## **SCIENCES IN LATIN AMERICA: Diagnosis and proposals\***

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The scientific and technological research is the creative cultural work performed, on a methodological basis, with the purpose of increasing the knowledge of man on Nature and on the society he lives in. It also involves the use of this knowledge to search for new applications. These activities comprise three categories:

- I) Basic research = To know: directed to understand the observable facts and their underlying foundations.
- II) Applied research = To transform: directed mainly to an specific objective.
- III) Technological development = To systematize: systematic work projected from some pre-existent knowledge in order to produce a usable and useful device.

The importance of scientific and technological research in a modern society is easily proved as this activity is at the base of the welfare and progress of the nations. Contemporary technology is, no doubt, the product of the intelligent applications of scientific research. The high scientific and technical level of developed countries has been possible because of the excellence of their scientists and technicians and because of the huge inversions made on instrumental facilities and possibilities of information and interchange. The absence of a solid scientific and technological structure leads, on the other hand, to an unwanted social and economic dependence. Therefore, this should be a matter of constant care in the developing countries with the purpose of stopping the increasing difference which separates them from the developed ones. Our Latin American countries share the generalities mentioned above and in order to save the potentially increasing differences, they demand the continual maintenance and increment of all the existing highly qualified scientific and technical personnel. This is another reason why basic research as well as a big portion of applied research must be developed chiefly at the University.

It is not a question of simply introducing the leading technologies of the first world, it is about generating the psychological, cultural and social conditions to apply the Science and the Technology to the development of the natural and human resources of the country. This process should be dealt with in the interest and for the benefit of every inhabitant, not only for some privileged group, in order to assure them a dignified life.

Governments must avoid the uncontrolled application of new technologies which would lead to a pauperization of society. They should impede the destruction of traditional technological and cultural values in order to prevent their consequent exploitation from the industrialized potences. Actually, one important obstacle emerges from the fact of not taking adequately into account the cultural identity of the countries in the process of transferring technologies from the developed countries. So that to avoid frustrations and negative results,

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it is of the utmost importance to better understand the problem of cultural identity, identifying Science with Culture and promoting a harmonious cooperation among countries with different traditions.

In order to apply the new technologies in the third world, the concept of “technology blending” has been developed. It implies:

- i) Improvement of conventional and traditional technologies.
- ii) Achievement of benefits for both rural and urban population.
- iii) Gradual efforts to reduce the gap between modern and traditional sectors of the country through the observation of three basic rules:
  - a) Preservation and improvement of the traditional technologies by means of the introduction of appropriate changes, quality control and marketing techniques.
  - b) Selective use of the new technologies in the fields where they are better and easily adapted.
  - c) Application of the new technologies to traditional activities in order to promote modernization and improve efficiency.

In relation with the previous paragraphs it is worth remembering that there exist in Latin America those who say that the separation between rich and poor countries and the difference between rich and poor citizens in a given country has no relation with political conditioning factors such as the underlying economic power. Many scientists would like to declare themselves apolitical (unwillingly adopting, of course, a political position). Science is a human activity intimately linked to society. Scientific advances arise from abstract speculations, from programmed or unprogrammed experiments, in any case they respond to the researchers questions. The scientific institution involves everything that is necessary for research practice: scientists, universities, research institutes, scientific societies, technicians, students, administrators and above all the agencies to finance research. Although the laws of nature and the knowledge in general are universal, the complex we call the institution of science is strongly dependent on the society it belongs to. It has local characteristics because it is a phenomenon organically attached to all the rest of human behaviour. Furthermore, being Science a part of the social and cultural evolutionary process of a given people, it has psychological and subjective requirements as any other human activity.

#### *Limiting factors for the Latin American Scientific development*

Scientific development in our Latin American countries cannot be analyzed without taking into account the social and economic development of the region and the general state of the educational system. Nevertheless, as it is impossible to materialize such global study, we will restrict our analysis to the enumeration of the factors and the problems that we think are at the base of the local difficulties for a harmonic development of science and technology.

- o) Social lack of understanding of the fact that Education is not a luxury.
- i) Society as a whole is scientifically “illiterate” and therefore it does not place any value on science. The importance of the scientific activity is not recognized and consequently its basic role for the technological development is ignored: scientific activity has no social effect.

- ii) Lack of the appropriate respect towards the University and the Science from the public power forces.
- iii) Non existence of a systematic support for scientific cooperation projects due either to the absence of political decision or to the influence of corporative interests. The resulting isolation is critical mainly at the stage of formation of new research groups.
- iv) There exists a big dispersion of isolated individual efforts together with an inefficient use of physical resources, due to that dispersion, produced by the lack of a fluid communication among researchers.
- v) The infrastructure for scientific research is deficient and lacks a plan.
- vi) There is a strong scarcity of personnel trained for the scientific work at the intermediate level of engineers, technicians and administrators.
- vii) The evaluation of the current research projects, if performed, is in many cases inadequate.
- viii) The social and ecological consequences of the scientific projects are not adequately considered.
- ix) The continuity of the support to scientific projects is not guaranteed either from the institutional point of view or from the provision of the essential economic resources. Scientific development is progressive and must be patient, tenacious and continuous.
- x) Increasing of the technological dependence due to political measures which base the eventual development on the local settlement of branches from powerful transnational companies which produce goods for exportation and for the consumption of a small proportion of our populations. The research in connection with these technologies is performed outside the country where these companies have their own laboratories.
- xi) The brain drain produced by the above mentioned problems.

### *Initiatives*

I) To make an exhaustive analysis of the scientific sector in order to determine the initial parameters and thus begin the corrective and developmental actions, to define a Scientific and Technologic Program. The following steps are proposed:

1. To record
  - 1.1 Groups that work on science and classify them according to level and potentiality of development.
  - 1.2 Area of each science and their classification according to level of development and to their geographic and institutional location.  
Occupational destiny of the human resources formed in science.
2. Identification of associated scientific and technological areas which should be stimulated
  - 2.1 Areas which are not faced and should be developed.
  - 2.2 Areas precariously covered that should be stimulated.
  - 2.3 Areas reasonably covered that should subsist and improve.
3. Definition of strategies and recommendations for the development of the scientific sector.

- 3.1 Priorities and means of institutional support in equipment, bibliography, etc.
  - 3.2 Adequacy of the university curriculum
  - 3.3 Recovery of emigrants.
4. Mechanisms and recommendations to support strategies
    - 4.1 Fellowships
    - 4.2 Special funds for exchanges within the country, the region or the north
    - 4.3 Types of agreements between institutions
5. Evaluation and control mechanisms of the Scientific Program
    - 5.1 Through advisory commissions from the National Science Council
    - 5.2 Through periodic reports
    - 5.3 Through periodic visits and evaluations.

II) To guarantee the personal contact between scientists and technicians from all over the country and the region so as to share ideas, new subjects of study and in this way to collaborate for the improvement of new non centralized research and development groups. On the other hand, it is of the utmost importance to be updated with the last international developments, making contributions if possible and maintaining, at the same time our own scientific and technological system. It is also necessary to assure the participation of these groups in Latin American and international schools, conferences and workshops to show the local advances and get the new ones in order to implement and adapt them to local needs.

A particular system of benefits for the personnel dedicated exclusively to scientific and technological research to enable them to move freely to contact other professionals. This will be a valuable contribution to keep scientists and technicians from emigrating as well as to favor the return and insertion of the ones already abroad.

The benefits arising from an adequate scheme of interchange and devoted to the educational system of the university, which as we have said is the natural location for research work, will foster professors, researchers and communicators in a permanent recycling.

III) To promote the formation of Regional Research Networks constituted by scientists from the region working on related subjects. The only possible way of overcoming the scientific isolation existing in most of the Latin American countries is through a long term organization of groups of research able to reach a "critical mass" at a regional level. It is possible to foresee solutions in this direction mainly because of the strong positive impact of electronic communications through existing and forthcoming networks.

IV) To urge scientist to participate in the industrialization process of the country. For that purpose it is necessary to define a National plan and a particular strategy for each industry. This will lead to the specialization of students in technology and to the development of home industries which will use Science and Technology. The industries to be encouraged should be the ones which have research laboratories in order to cover the needs of the present time, because new technologies, due to their own dynamics, are not expected to last for a long time. The birth of the Industrial Lab will give a vital impulse to the scientific development of the country.

V) To define a project for the diffusion of science at all levels, using all possible means. Through the years, astrologers, parapsychologists, chiromancers and other people devoted to the pseudosciences have been developing an intense activity in the mass media with the non-existent critical response on the part of Science. Faith in pseudosciences has a strong social resonance and those who encourage it should be responsible for it. Faith is the word that best describes the supporters of these practices, who only want to believe and pay no attention to failure when their predictions are scientifically proven wrong. In spite of the efforts of some researchers and a few scientific journalists, science is systematically ignored while pseudosciences are the object of constant attention. The ordinary citizen is surrounded by horoscopes, miraculous cures, promises of good fortune and the continual offers from witches and sorcerers. In front of this fact, not only the scientific community in general but also the governmental scientific institutions assume a passive role. Therefore, Mass media have to participate playing the leading part in scientific education and obstructing pseudosciences at the same time.

### *The end*

Nowadays science is a part of culture. The ignorance of Newton's laws, of the role of Darwin in biology or of the knowledge of DNA should be considered as wrong as not knowing Cervantes, Bolivar, Mozart or Leonardo.

Society should be made aware that something fundamental is being missing: the knowledge of Science.

We Scientists should participate in solving social problems but we must take into account that there are no magic formulas to attack them. Social problems are far more difficult to solve than scientific problems. On the other hand, when we do obtain good results we must not give all the credit to Science because these successes are also the result of ethic choices. Science advances when we accept that we are ignorant and open the door to doubt. Scientific knowledge has components with very different degrees of certainty. Some of these components are more uncertain, others are almost certain but none of them is absolutely certain. This fragility of science is the feature that makes it noble and prevents it from authoritarianism as well. At the same time this feature defines our responsibility with society.

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