BASES FOR THE FORMULATION OF SCIENCE AND TECHNOLOGY POLICIES IN THE HEALTH FIELD IN LATIN AMERICA

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BASES FOR THE FORMULATION OF SCIENCE AND TECHNOLOGY POLICIES IN THE HEALTH FIELD IN LATIN AMERICA

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I. INTRODUCTION

It is only in recent years that Latin America has begun to show an interest in the organization of scientific activity. Although during the decade of the 1950s certain countries such as Brazil and Argentina created national research agencies, the primary purpose of these organizations was to create and develop research groups, usually at universities, with no clear responsibility for relating scientific activity to socioeconomic development. It was not until the end of the 1960s, largely as the result of initiatives by agencies such as UNESCO and OAS, that it became widely recognized in the Region that the field of science and technology was one of the major issues in development, and that it was necessary to define and adopt explicit policies on science and technology development. These policies needed to be formulated by central agencies, which would also be in charge of coordinating national science and technology systems.

The decade of the 1970s was marked both by the establishment of this type of central agency in almost all the countries of the Region—in most cases as part of the ministry of planning—and by the adaptation of existing agencies to these new trends, as shown, for example, by the fact that the agencies changed their name and location or were moved from the ministry of education to the ministry of planning.

At the end of the 1970s and principally during the 1980s, there were signs that expectations with regard to governmental planning and organization of science and technology were going unfulfilled. Although progress had been made in establishing a science and technology infrastructure in some sectors and countries, no genuine science and technology system had ever been created that would allow a free flow of knowledge and technology between entities in the areas of research, development, and production of goods and services. Science and technology policies continued to focus on the expansion of supply and thus never became public policies, open to public debate and articulated with general development policies. The state continued to be practically the only entity responsible for execution, financing, and demand in relation to scientific production. Nearly 80% of spending on science and technology in Latin America

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1 This document is not intended to be a scientific article, but rather what is commonly referred to as a position paper. The objective is to provide topics for discussion, with a minimum of bibliographic citations and empirical evidence.
America came from the government, and the goal of designating 1% of the GNP to finance the sector by the end of the 1970s was never achieved.

Since the mid-1980s, cutbacks in public spending, one of the principal strategies of the austerity policies implemented in the Region, have had a serious impact on the science and technology sector. This sector has been a sensitive target due to its lack of solid social legitimacy, which in turn is the result of its isolation from other social sectors. Because of this extreme dependency on state resources and the unlikelihood that other financial sources can be found in the short term to ensure the necessary levels of investment, the survival of the science and technology infrastructure created in previous years is threatened, which could undermine the future possibilities of the countries of Latin America for entering a period of renewed development.²

Given the importance of preserving the initial infrastructure that has been created, and of recognizing that the field of science and technology has a central role to play in helping the Region to overcome the current economic and social crisis, now it is more urgent than ever to encourage debate on this issue so that it will be possible to choose which directions the field should go in. However, it is also clear that this debate cannot consist of a rehashing of old formulas, both because this has largely failed in the past, and also because the rapidly changing context makes it necessary to reconsider the role of science and technology. Besides being focused on supply, the policies on science and technology development in effect through the mid-1980s reflected development models that were based on import substitution, the comparative advantages of abundant raw materials and cheap labor, protected national markets, and government as the central agent of development. This was definitely not a very encouraging scenario for science and technology development since import substitution in protected markets could be achieved, and in fact was achieved, by importing previously developed and even obsolete knowledge and technologies, with no thought given to the importance of staying competitive. The radical changes in the above context have made it mandatory to reexamine the role of science and technology according to new bases. This document is intended to be a modest contribution to that exercise.

² As an example of the sector's vulnerability to political and financial instability, it is worth mentioning the Argentinean case. In 1973, according to statistics from ISI (Institute for Scientific Information), Argentina published 1181 articles on the health sciences, which accounted for 41% of all articles published in Latin America in this field. Only eight years later, in 1981, Argentina's scientific output had dropped to 23% of the total for the Region, although it produced more or less the same absolute number of articles (1228), because meanwhile the Region as a whole had increased its output by around 45% during the period.
The following sections are intended to focus on the issues in science and technology development in the health field, recognizing that this field is where the general issues in science and technology development overlap with major concerns in the health field, and that these in turn are strongly influenced by the accelerated changes in the economic, social, and political spheres at the global and Regional level. There is a sketch of the general context and the status of science and technology in the health field, followed by a discussion of some of the factors involved in organizing a system of science and technology in the health field that is ready to respond to the new challenges.

II. THE CONTEXT

One of the most notable phenomena during the final years of this century—and one with almost worldwide repercussions—is the accelerated transformation of productive structures through the introduction of new technologies, new raw materials, and new methods of organizing production. This has led to what is known as the "dematerialization" of production. Control of these new technologies is redefining patterns of competitiveness between countries and reinforcing the importance of the market, since rapid obsolescence of processes and products means that large investments in research and development must be recovered rapidly. Another effect has been a strengthening of the ties between universities and business, with early privatization of research findings at even the most basic level, and reinforcement of international mechanisms for the protection of intellectual property. At the same time as competition is becoming stronger, schemes are being developed to create alliances between countries and companies to gain access to innovations, and megamarkets are being established, which puts science and technology at the hub of international relations and promotes globalization of economic activity. These changes at the level of productive infrastructure are being accompanied by important changes in the political context, notably the disappearance of so-called "pure socialism" and the adoption of market economies by the countries, while the importance of cold war ideology is fading in international relations.

The internationalization of capital and labor and the creation of a global market is a universal phenomenon which has not failed to touch Latin America. Agriculture, traditional industry, the service sector, and consumer demand in the Region have been affected by that process, which has hastened the deterioration of the development models that prevailed until only recently. These models have never

3 For example, it is estimated that a microelectronic product has an average useful life of 4-5 years, which means than a 7-8 year investment in research and development must be amortized within 2-3 years.
actually succeeded in promoting development or political stability, or in solving serious social problems. And now they are being replaced by new models based on a market economy, whose principal features are economic liberalization, with a narrower role assigned to national markets in the orientation of development policy, and reformulation of the government’s role, with a marked trend toward deregulation, privatization, and reduction of the state apparatus.

These changes in the fundamental features of development models are also causing a shift in policy which previously, although often only in the rhetorical sense, focused on promotion of growth and sharing of wealth, but now has been reduced to coping with the crisis and the austerity measures. The goal of providing a state of well-being is no longer the guiding principle of social policy, and the social impact of these changes is no longer clearly an issue. At the same time, however, positive gains can be seen in the political sphere, with the establishment of democratic regimes in most of the countries, new types of organization for civil society, increased opportunities for minority or culturally subjugated groups, and decentralization of decision-making and resources.

The health situation in the countries of Latin America, which is strongly influenced by these economic, social, and political factors, as well as by the use of technologies that have a significant impact on mortality in some age groups, continues to be characterized by the aging of the population and the predominance of mortality from chronic degenerative diseases and accidents, trends that have come to be known as demographic and epidemiological transitions. Unfortunately the Region doesn’t have reliable information systems or indicators that are sensitive enough to detect short term changes in health conditions resulting from deteriorating living conditions. Despite the lack of more precise data, however, it is possible to confirm the following trends: stable or increasing differentials in the morbidity and mortality profiles of different social groups; a sizeable increase in violent deaths and other effects of violence; an increase in the incidence of diseases previously on the decline, such as malaria and tuberculosis; and a resurgence of diseases once believed to have been eliminated, such as cholera. All this evidence points to the impact of social deterioration in conjunction with the general shift toward an age and nosological profile that more closely resembles that of developed countries.

With respect to the organization of health care, a significant trend can be seen toward decentralization of health systems, with the municipal level assuming more responsibility for their administration. Despite widespread discourse on the importance of adopting an intersectoral and comprehensive approach to health problems, public health practice still tends to be limited to selective care for risk groups based on simplified technologies (vaccines, oral rehydration, dietary
supplements, etc.). Another important trend, at the level of individual care, has been diversification of the modes of providing and financing services, with a marked increase in the role of the private sector. The consequences of this include, inter alia, more segmentation of the people served and important changes in the nature of medical practice, such as the loss of control over their own working process that health professionals have experienced, since that process increasingly reflects a cost/benefit approach in terms of the return sought on the investment.

Finally, in the midst of all these changes, which don’t always help to promote equity and social justice, the right of citizens to enjoy health as one of their basic rights is being recognized both formally, in new constitutional charters or other legal instruments, and at the level of political practice, in social movements or government entities.

III. SCIENCE AND TECHNOLOGY IN THE HEALTH FIELD IN LATIN AMERICA

Before describing the specific scenario of science and technology in the health field in Latin America, it would be useful to mention some general problems relating to science and technology as a whole. In addition to the organizational issues already mentioned, such as gaps in the flow of production, distribution, and utilization of knowledge and the vulnerability engendered by the fact that the state is traditionally the principal or sole agent for the funding and execution of research, scientific production in Latin America has been limited, highly concentrated, and, with rare exceptions, of unsatisfactory quality. According to an IDB report, based on data from the Institute for Scientific Information (ISI), in 1984 Latin America accounted for 1.14% of the articles listed in the ISI data base and only 0.6% of the bibliographic references, figures even lower than those for countries like Belgium or Israel. In addition to being limited and largely unknown, this output is also highly concentrated. According to that same report, during the 1973-1984 period, just five countries (Argentina, Brazil, Chile, Mexico, and Venezuela) produced nearly 90% of all the publications. And production became even more concentrated during the period, as shown by the fact that in 1973 these five countries accounted for 87% of scientific output, and in 1984, for 91.3%.

The same general characteristics can be found at the level of health research, including concentration of production in only a few countries. In the report cited, health research accounted for 55% of the articles published in the Region in all scientific fields between 1973 and 1984. But the traditional importance of health research as a part of scientific activity in the Region began to decline during the period, from 60% of output in 1973 to 42% in 1984, as it yielded to other areas such
as physics, which expanded its share from 9.2% to 19.5%, part of the trend toward diversification of scientific activity.

Despite some successes in both biomedical research—for example, the development of new vaccines and diagnostic methods through the use of modern biotechnological techniques—and public health research—such as the development of new epidemiological approaches—health research in the Region suffers from serious quantitative and qualitative flaws that affect the Region's ability to cope with current challenges. The new challenges arising from demographic and epidemiological transition, changing living conditions and their impact on health, the political and economic consequences of decentralization and privatization of services, control of new technologies, and others of today's priority issues can only be addressed by a scientific community that has sufficient technical and organizational capacity to generate the necessary knowledge. All the signs would appear to indicate that the sector is a long way from being ready to respond to such complex problems. With PAHO support, a study was carried out in six countries (Argentina, Brazil, Chile, Cuba, Mexico, and Venezuela) to determine the characteristics of the projects in progress (1987-1989) and scientific output (1972-1989) in the health field. The study found that there was a marked preference for the individual approach to the study of problems (biomedical and clinical) at the population level (more than 80% of the projects in progress were in the first category); that research on technological innovation was extremely limited (around 5-6% of the projects); and that the medical and biological sciences predominated (accounting for more than 90% of the projects in progress), with only limited participation by the social and engineering sciences. This last finding is correlated with the profession of the researchers, the vast majority of whom were physicians or biologists.

Despite the somewhat discouraging picture described above with regard to the situation of science and technology in general, and of science and technology in the health field in particular, it is still very difficult to pinpoint what is going on in these fields in relation to the development models that are being implemented in the countries of the Region. There are several reasons for this, including the magnitude and rapidity of the changes that have occurred during the last two or three years, particularly in those sectors where the government is or was a major presence; the fact that existing scientific and technical information systems are not sensitive enough to register short-term changes; and the heterogeneous situations in the various countries. In some cases, there clearly appears to have been a rapid deterioration in the institutions and the working conditions of researchers, accompanied by a more rapid brain drain, both external, to other countries, and internal, to other more prestigious or lucrative activities. In other cases, by contrast, there are signs of more diversity in the financial sources and mechanisms used for science and technology
activities—for example, the growth of university-business consortiums—as well as a broader range of subjects and types of health research. The proliferation of nongovernmental organizations (NGOs) in some countries, often with high scientific quality and strong ties to other countries, is another recent and significant phenomenon.

Although there still needs to be a more objective evaluation of the current scenario in science and technology, and specifically of the situation of science and technology in the health field, it is clear that most of the countries still haven’t defined specific public policies that are consistent with a socioeconomic development perspective. To reaffirm the position that it is both necessary and possible to define such policies, the following section lists some important elements that can serve as guiding principles.

IV. CONCEPTUAL BASES FOR THE FORMULATION OF SCIENCE AND TECHNOLOGY POLICIES IN THE HEALTH FIELD

Science and technology in the health field is a field of social activity, wherein the "field" is considered to be a set of processes and the players involved who cause a particular type of product to be made, circulated, and used in the society. This field obeys its own laws and participates in the overall social structure, but at the same time is governed by a specific operation.  

In line with this conceptual viewpoint, science and technology in the health field long ago stopped being restricted to research basically carried out by physicians in the area of health services. The demedicalization of health research has been accompanied by the expansion of its universe of problems and the diversification of disciplines, approaches, types of research, professional training for researchers, institutional settings for the conduct of research, etc. The increasingly complex process of generating knowledge has been associated with increasingly complex processes for disseminating and utilizing that knowledge, as well as greater complexity in the entities and mechanisms that regulate those processes and articulate them with other spheres of social activity.

The expansion and diversification of science and technology in the health field, in combination with the complex global and Regional context where this activity is taking place, creates significant challenges when it comes to defining policies that will

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guide this area. But despite the diversity of situations in the countries of the Region, those policies should contain some common guiding principles.

A. Regional integration

As noted above, the new dynamics of science and technology development are changing the face of international relations by giving rise to new types of alliances aimed at developing and controlling new technologies, ensuring market expansion, etc. In addition to this, no country, however developed, can face certain challenges alone, as in the case of environmental problems or epidemic outbreaks of diseases such as AIDS. If this is true for developed countries, then it is even more important for the countries of the Region in light of the enormous problems they face. The development models that are being adopted in Latin America transcend national boundaries and recognize the need for global policies, particularly in the context of Regional integration.

B. Integration between production and utilization of knowledge and technology

The relative failure of efforts to create science and technology systems that permit a free flow of knowledge and technology between research institutions and producers of goods and services is frequently cited as one of the most serious flaws in the science and technology development policies based on supply expansion that have traditionally been adopted in the countries of the Region. This situation has kept existing small scientific communities in isolation and prevented science and technology from playing more than a small role in the development of those countries. In order to create open and competitive societies and resolve social problems like those in the health field, the advances of research and development must be able to flow freely to those groups that can put them to use for the benefit of society. For this to happen, as mentioned earlier, there needs to be a stronger exchange between those who are active in research, development, and production so that they can work together to identify problems and solutions. It is also important to establish mechanisms that promote the development and transfer of knowledge and technology, such as legislation to facilitate transfer agreements and contracts, technology parks, risk capital, etc.

C. Elimination of false dichotomies

The debate over how to orient policies on scientific and technical development in Latin America has featured opposing viewpoints through the years that have provoked fervent discussion among their proponents. The perspective gained through
experience and particularly the new conditions have eventually made it clear that most of these opposing arguments are actually false dichotomies that should not be the focus of any more attention. Some of these dichotomies are described in the sections that follow.

- Prioritization vs. lack of prioritization

The proponents of scientific autonomy, who see any attempt to define priorities as a threat to this autonomy, have found and still find themselves in conflict with those who want to channel scientific activity in order to fulfill certain objectives. But in fact this much-praised autonomy has never really existed, except in a very relative sense, since science, particularly as it becomes more institutionalized, is strongly influenced by a range of factors connected to the material life of the societies where it develops. In addition, these external factors, whether they orient scientific work in an organized fashion or spontaneously, are neither its sole nor its most important influences. The dynamics of science are also affected by internal factors, so that the possibilities for development at any given moment in time depend on the knowledge acquired previously.

The above explanation helps us to understand that the dilemma is not over whether or not to prioritize or channel scientific activity. As noted, within the limits established by its own internal logic, science develops according to the influence exerted by the society around it. In other words, science is not independent of society and free to move according to the whim of independent scientists; rather, it responds to the demands of various sectors within society. The genuine issue has to do with the kinds of demands that are made, who makes them, and how they affect science and lead it in certain directions. In the context of the new development models that are being implemented in the Region, one widely held opinion is that, once market forces are freed up, they serve as the vehicle through which a society expresses its needs. It is enough to pay attention to these forces to know what direction to move in. But obviously this approach is completely inappropriate in a social sector such as health, where following the dictates of the market would mean basically ignoring the demands of certain groups and promoting inequity, something which is ethically indefensible.

In addition to generating the knowledge required to respond to the needs of various social groups, science and technology in the Region must be able to handle the extremely competitive dynamics of science and technology development on a global scale. This means building up the capacity to analyze trends and prospects in the development of this area, evaluating the field's specific strengths, and working in conjunction with the central players to choose the right directions to take. In other
words, now it is more important than ever to eliminate this false dichotomy, focusing instead on the intrinsic and extrinsic factors that shape the development of science and defining priorities. This will make it possible to follow the example of countries that have succeeded in making science and technology an integral part of their development projects.

- Indigenous knowledge vs. imported knowledge

Another dichotomy that has been debated long and hard in relation to policies for science and technology development in Latin America has to do with whether it is better to promote internal or indigenous knowledge or to import it from other countries. For all the reasons mentioned above—the prevailing trend toward globalization of science and technology development and the fact that no country, however developed, can face the challenges of today’s world alone—this is yet another example of a false dichotomy. The real problem is to build up sufficient capacity to obtain knowledge and technologies, no matter where they come from, which means developing access channels and learning the “rules of the game” for transferring them. Of course this does not mean that it is not important to have a solid internal scientific and technical infrastructure in a number of areas, since that is essential to being able to select, evaluate, absorb, adapt, and develop knowledge and technologies.

- Basic research: application or development?; or: push vs. pull

The new dynamics of science and technology development have shown that any dichotomy between these types of research is false, and that it is not essential to resolve the dilemma over whether to promote science and technology development founded on basic research (“push”) or based on development (“pull”). There are many past examples of an entire field of knowledge that has developed as a result either of technical changes, for example the birth of thermodynamics in response to the need to improve the performance of steam engines, or of basic scientific discoveries, such as the development of modern biotechnological industry based on the findings of molecular biology. As noted, the fundamental goal is to create a system that allows knowledge and its applications to flow freely among all levels of development. The various kinds of partnerships between companies and research centers that are flourishing in developed countries are expanding the windows of communication between them and making it possible to identify possible applications of the most basic developments at a very early stage. As mentioned before, this trend can lead to early privatization of fundamental knowledge, making it difficult to disseminate that knowledge and, in the long run, compromising the actual process of universal scientific development. All these factors make it even more essential for the countries of the Region to strengthen their scientific infrastructure by creating critical masses
in the various scientific fields to keep up with advances in knowledge, preserve their own developmental dynamics, and respond quickly to the demands that are presented to them.

These basic guidelines for policies on science and technology development that try to reflect current challenges can be generally applied to science and technology development in the health field. In this case, there is the double challenge of responding to changes in the situation of health and health care services by developing and incorporating new health knowledge and technologies that make it possible to face these challenges, while at the same time taking advantage of the opportunities that the health sector offers to control new technologies, such as biotechnology, electronics, information science, etc., whose spin off effects will benefit other social sectors.

V. THE COMPONENTS OF SCIENCE AND TECHNOLOGY POLICIES IN THE HEALTH FIELD

It isn't unusual for science and technology policy in a given field to be confused with a list of research priorities prepared based on expert opinion. The narrowness of this concept is clear in light of everything that has been discussed in the preceding section. In addition to defining research priorities, science and technology policy must contain a number of other elements, some of which, relating to the health field, are presented below.

- The task of identifying the health field's main problems--which can only be solved by developing new knowledge and which, as a result, need to be the nucleus of research efforts and resources--must be seen as the responsibility not only of experts, but also of various social agents with their own interests and perceptions, expressed in a context that facilitates consensus-building.5

- Naturally there is also a technical side to the democratic and participatory process of identifying problems. When defining priorities for health research, this technical dimension traditionally has to do with what can be ascertained from the morbidity and mortality profile. But although it is important as a basic reference for

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5 This has nothing to do with defining the research problem in a specific project, which is something that the researcher is expected to do, based on his background knowledge, the theoretical and methodological instruments he has mastered, and the way he perceives, interprets, and experiences reality. Within the global sphere of science and technology policy, the central task is to identify a set of general, socially-determined problems that can make up a reference framework to orient the definition of specific research objectives.
this task, the morbidity and mortality profile shouldn't be the only element that is used, in part because health problems cannot be described solely in terms of a list of the most common diseases or causes of death, and also because there is not an automatic correlation between what constitutes a health problem and what constitutes a health research problem.

- Keeping in mind that the dynamics of scientific development depend on both internal and external factors, a policy on scientific development in a specific field such as health should acknowledge both categories of factors. The priority problems in the field would be those areas where the two categories overlap.

- In the case of health, the external factors are basically the characteristics of the health/disease process in a specific society. This is a process (which by definition is affected by changes and transformations) that includes the health situation and its determinants, notably the living conditions of the population groups and the social responses to the health/disease profiles generated by those conditions (i.e., health services and well-being). A problem identified in relation to the health situation, living conditions, and social responses should be prioritized according to its magnitude and severity, the potential effectiveness of interventions, the knowledge available on the problem, and the feasibility of doing short-, medium-, and long-term research given the state of scientific development.

- As mentioned before, the above factors are not enough to identify priority problems in health research. Another category of factors, the internal ones, also needs to be taken into account. Although strongly influenced by its social setting, scientific development has its own internal dynamics, consisting of the knowledge that accumulates and the questions that it raises. In recent years some very dynamic areas have developed which have become quite strategic, both in terms of their impact on the development of other scientific fields, and because of their usefulness for solving health problems or their potential economic importance. Finding realistic ways to promote and guide the development of such areas as biotechnology, molecular pharmacology, immunogenetics, health economics and sociology, and various other fields must be an indispensable part of any science and technology policy in the health field in any society.

- Those areas where the problems generated by the health/disease process overlap with the questions raised by the activities of the most dynamic fields of science should be designated as research priorities. However, no matter how careful a list of priorities is prepared, that list is not equivalent to a science and technology policy, nor will it automatically be implemented. In order for this to happen, measures promoting scientific activity need to be planned that take into account the
various processes that make up that activity and its respective components. Scientific activity includes the processes of research, transfer, and incorporation of knowledge and technologies, as well as the factors that influence those processes. Each of those elements has its own characteristics and individual features which must be addressed by strategies that promote their articulated development.

- The process of generating knowledge (or the research process) involves, among other elements, the distinctive individuals who work as researchers (and who need specific kinds of training and working conditions), highly specialized theoretical and methodological instruments and materials (which need to be mastered and incorporated), and also particular physical entities, such as research units. In order for research to be carried out on the identified priority problems, a science and technology policy must provide mechanisms for promotion and orientation that reflect the specific requirements of the elements mentioned. Similarly, the process of transfer and incorporation of knowledge and technology into the production of goods and services for health and well-being is carried out by specific entities and has specific requirements, all of which must be addressed by science and technology policy.

- In addition to having these specific components, all three basic processes in scientific activity have general determinants as well. Because of its strategic nature, an intervention at this level exerts a powerful persuasive and guiding influence. We are referring to the entities that handle the financing of scientific activity, management, scientific and technological information, human resources education, social legitimation, legislation and standards in areas such as intellectual property, incorporation of technologies, and others.

- The diversification of sources of research funds in Latin America is one way to expand the available resources by getting different sectors to commit themselves to this activity, thus making the field less vulnerable than it has been because of its almost exclusive reliance on public resources. This would involve, among other measures, creating incentives so that resources from other sources, particularly the private sector, can be added to those that are currently allocated to science and technology activities.

- Strengthening of science and technology management at all levels is another critical element for global development of scientific activity. At the national level this would entail political and technical strengthening of central agencies for the planning and administration of science and technology so that they are able to define and implement policies to meet today’s challenges. The same is true of institutions carrying out research, which not only need to improve their traditional administrative
processes, but also to develop new capabilities that will allow them to obtain resources, establish agreements with sectors that produce goods and services, manage technology transfer, etc. At the level of the health services, management of the incorporation of technology is a present need, not only for the rationalization of health care, but also for clearer identification of knowledge and technology needs in the services.

In the recent past the comparative advantage that the countries of Latin America enjoyed in the broader economic picture derived from their abundance of raw materials and cheap labor. However in the new development scenario, this natural or demographic wealth is becoming less important. The Region's new comparative advantages will have to be built upon the development process itself, and will largely depend on the quality of the human resources in its societies, which in turn will be based on their levels of health and education. Control of knowledge and technology is a central component of economic and social development in today's world and requires a large pool of human resources at all levels who are able to access scientific information. In this context, the concept of human resources for scientific activity is not limited to the principal agents in the research process, the actual researchers themselves, but also includes all members of society who in one way or another should be part of this activity. Several countries of Latin America made a notable effort during the 1970s to provide specialized training for researchers, either by creating Master's and Doctoral programs in all areas of science, or by arranging fellowships for training abroad. Unfortunately this training effort was not carefully articulated with a clear policy on how to absorb these resources, which has only made the brain drain worse and recently has threatened the very survival of the previously established structure for graduate study. Human resources development, whether of individuals who are directly involved in the production of knowledge, or, in a broader sense, of those who work in any of the various spheres of social activity that have been so strongly impacted by scientific and technological advances, is the central element of science and technology policy in any field. It is human resources development that determines the success or failure of these policies.

As noted earlier, it is necessary to develop the capacity to keep up with trends in science and technology development, to establish channels of access to these trends, to determine social needs and to frame them as scientific needs, and to strengthen ties between those who produce and utilize knowledge so that it can circulate more freely. To a large extent, this means strengthening the bases, systems, and flow of scientific and technological information, as well as improving the capacity to analyze and evaluate it. It also implies the need to clearly define standards and procedures, in other words, the "rules of the game," for accessing and utilizing information (in this particular case the task is made more complicated by the diversity
of interests and the increasing trend toward privatization of knowledge). Finally, it entails strengthening the bases for legitimizing scientific knowledge. The countries of Latin America have not been entirely successful in implementing the mechanisms traditionally used by the scientific community to evaluate the quality of scientific production, such as peer review of scientific projects and articles. Aside from the need to strengthen these mechanisms, there is also the need to develop the capacity to evaluate the quality of knowledge and technology in terms of usefulness and impact.

VI. SCIENCE AND TECHNOLOGY POLICY IN THE HEALTH FIELD AND THE ROLE OF SOCIAL AGENTS

In the recent past, scientific activity in the health field has practically been limited to the work of two fundamental agents: the government, as the financial agent, and the scientific community, as the active agent (in the health field, this group has mainly included physicians). The fact that there has not been a role for other agents has helped to limit the social legitimacy of science, which, coupled with the loss of public resources, as its only source of funds, is threatening the very survival of scientific activity.

The shrinking role of government as the engine or central player in development, the democratic movement, the strengthening of participatory mechanisms, and the demedicalization of health research are some of the forces that have opened the door to participation by new agents in the formulation and implementation of public policy, thus creating new power relationships.

In this new context, the principal challenge in taking a science and technology policy beyond the theoretical stage to effective consolidation as a public policy with a legitimate social role lies in mobilizing, from the time that the policy is drafted, the various agents involved in the production, dissemination, and utilization of knowledge.

The participation of social agents in a given activity is not a foregone conclusion; rather, their involvement is the result of the actual process of carrying out this activity. In the case of science and technology in the health field, in addition to the participation of new agents, changes are being proposed in the patterns of behavior of traditional agents, such as the government, researchers, producers of services and supplies, health professionals and others, who are accustomed to power relationships and rules for interaction that are disappearing.

The legitimacy of the state's role in the former context largely derived from its ability to provide funds. In the new scheme of things, although the government will
still play an important role, it will also need to be able to promote opportunities for the diverse interests and perspectives of various social agents to be expressed, and for everyone to work together to choose the directions that the field will go in. In this situation, the government will be a legitimate participant, not only as a source of resources, but also because of its ability to enlist support and to exercise leadership in order to protect the public interest.

It has already been observed that, in relation to scientific policy, it is wrong to think that the market can serve as the legitimate expression of all social needs and that it is therefore enough for policy to respond to market demands. In extremely heterogeneous societies, particularly in relation to health issues, it is also indefensible on ethical grounds to respond only to market demands, since this only serves to aggravate existing inequities. Because of the broad range of living conditions, each population group has a profile of health needs and health problems, as well as health research issues, that will not necessarily be expressed through the market. Another legitimate role for the state in development models based on the market approach has to do with its commitment to equity. In other words, the government can promote activities that generate social responses which fit various needs, thus correcting the distortions caused by the market approach.