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SCIENCE POLICY IN LATIN AMERICA



SUBSTANCE
STRUCTURES
PROCESSES

PAN AMERICAN HEALTH ORGANIZATION
Pan American Sanitary Bureau, Regional Office of the
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prepared for the PAHO Advisory Committee
on Medical Research**



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This report contains the collective views of an international group of experts and does not necessarily represent the decisions or the stated policy of the Pan American Health Organization.

CONTENTS

	<i>Page</i>
FOREWORD.....	vii
1. Introduction.....	1
2. Observations and Recommendations.....	5
3. Why Research? What Kind and How Much?.....	10
4. Obstacles and Opportunities.....	17
5. Organization—Universities and Institutes.....	23
6. Organization—National Functions.....	31
7. External Influences.....	39
8. International Functions and Organizations.....	44

Appendices

A. A Study of the Structures and Processes Through Which Decisions Relating to Public Health and Biomedical Re- search are Made in Latin America.....	51
B. The Colombian Institute for Advanced Training Abroad (ICETEX).....	53
C. The Mexican National Institute for Scientific Research (IMIC).....	55
D. The National Research Council of Argentina (CNICT).....	56
E. National and Regional Organizations for Research and Higher Education in Brazil.....	60
F. The National Health and Welfare Fund of Peru.....	67
G. The Mexican Social Security Institute (IMSS).....	68
H. Institute of Nutrition of Central America and Panama (INCAP).....	69

FOREWORD

The Study Group wishes to express its gratitude for the opportunity to work on an important subject that both calls for concerted consideration by the entire Hemisphere and has tremendous potentialities for the betterment of mankind. The Group is grateful to the Pan American Health Organization for making the undertaking possible.

The Group has been conscious of the admirable dedication of distinguished scientists and men of affairs from all parts of the Hemisphere who have worked for years on the problem to which this report is addressed. Many contributed directly to the report, and many more made indirect contributions. The Group has also been aware of efforts to put into effect many of the measures again recommended in this report. The hope of the Group has been that its work can contribute to this continuing endeavor to lift and broaden the level of research in Latin America.

The origin of the present report was a proposal by the Advisory Committee on Medical Research of the Pan American Health Organization that the way in which Latin American countries set their general policies for biomedical research be the subject of a special study. This report, the outcome of that suggestion, is focused on biomedical research, but

as the study proceeded it became evident that biomedical research comprises a large share of the total research of many Latin American countries, that most aspects of policies for it could not be realistically abstracted from the total problem of science policy, and that most of the observations and recommendations made would have to deal with the whole rather than with the parts. Therefore, while the primary concern of the report continues to be biomedical research, it necessarily covers broader ground.

Another point that became apparent was that the questions of interest to the Study Group have been of concern to numerous people. In addition, many kinds of facts relevant to the work of the Study Group were available. Accordingly, the Study Group discovered little that was new with respect to individual countries. The central effort has been to synthesize observations made in specific countries, and the judgments of many informed people, into a report that would be primarily analytical rather than descriptive. The report is directed mainly toward observations and recommendations that may be helpful to those admirable leaders in the Latin American countries who have the difficult task of dealing in the real world with the problems set forth.

1. INTRODUCTION

1.1 The task of the Study Group

The present report was prepared for the PAHO Advisory Committee on Medical Research by a study group, an *ad hoc* organization established by the Director of the PASB on the advice of the Advisory Committee. The task it was requested to undertake was an examination of national policies for biomedical research in Latin America.

The purpose of the inquiry was not to examine the state of research itself—that is, the areas of investigation, the relative strengths of various fields, and so forth—but rather to study the general conditions under which research is conducted, the factors in various countries that tend to promote or retard research or to influence the field of investigations, the formal organizations for research, and the attitudes of governments toward research. The inquiry was directed toward biomedical research, but the nature of science is such that it was not possible or desirable to confine it to that field alone.

This report synthesizes the findings and recommendations of the Study Group. These are derived in substantial part from the observations made by its individual members in each country they visited, and also on the members' total experience and on the advice and criticism of a large number of people with extensive experience in scientific affairs in Latin America.

The countries studied as background for the report were Mexico, Guatemala, Colombia, Peru, Chile, Argentina, Brazil, Venezuela, and

the British Caribbean. They were selected as being broadly representative of nations with different traditions, political systems, and levels of income. Not only did they provide a diversified sample, but they also covered about 90 per cent of the biomedical research in Latin America, measured in terms of people involved or of investment. The sample was not intended to be representative in any statistical sense but rather to serve as an adequate basis for general conclusions. If time, funds, and personnel had been adequate, all the countries in Latin America would have been studied.

1.2 Study procedure

As the first step in this study, the Chairman of the Group prepared a brief prospectus, which was distributed to its members (see Appendix A). This served as the basis for a meeting in Washington, D.C., at which the Group discussed its task in detail. This meeting was followed by a period of work by the entire Group in Mexico City for a dual purpose—to examine the essentials of the Mexican structures and processes and to arrive at a common understanding of the questions to be asked. Thereafter, each member assumed responsibility for visiting two countries and writing reports on them.

Besides drafting country reports, each member also contributed ideas and draft material for inclusion in this report. The individual

country reports* are on file at the Headquarters of the Pan American Health Organization in Washington, D.C. The Chairman drew these ideas together for a draft report, which was the subject of a full discussion by the PAHO Advisory Committee on Medical Research at its Fourth Meeting from 14 to 18 June 1965. As was to be expected, the observations of the members of the Committee were penetrating and helpful. This final report reflects the views of the Advisory Committee on all major matters, although neither the Advisory Committee nor the PAHO necessarily agrees with every detail of it.

Because of the relatively advanced state of biomedical research in Latin America, this area of inquiry is so substantial that it must be studied not in isolation but as part of the total body of science. The questions of policy and organization for this field cannot be examined without viewing them in the context of science totally. The Group, therefore, found it necessary to interpret its terms of reference rather broadly.

Not everything in the report is complimentary. The intention of the Group was to be helpful, and it is futile to try to improve on perfection. Only by recognizing the absence of perfection could the good intentions be exercised. These intentions are to present a diagnosis and to make some recommendations by a group composed of some people who view the problems from "inside" (Latin Americans) and others who view the problems from "outside" (citizens of the United States).

1.3 The meaning of biomedical research

A word about biomedical sciences is necessary because this relatively new term has different meanings in different countries.

For the purpose of this report, biomedical sciences are those sciences that contribute to an understanding of the normal life processes of

man and to the treatment and prevention of disease states, which may be looked upon as abnormal life processes of man. In the United States, the term *medical research* encompasses both these sciences and the "clinical sciences"—such as internal medicine, surgery, oncology, gastroenterology, and hematology—that are directly related to medicine. Research in the basic sciences—that is, the biological, physical, and behavioral sciences—is also included within the term *biomedical sciences*.

The limit on one side may be very clinical in nature and involve studies in which the research problem is related to an illness of a patient. Such studies have come to be called clinical investigation. This may involve the kind of close physician-patient relationship that might prevail during an intensive study of a patient's illness under controlled conditions for the purpose of making a critical clinical observation. However, this is perhaps the most elementary effort describable as a clinical investigation. More typically, clinical investigation is represented by a situation in which the illness is studied in the laboratory without the close physician-patient relationship just alluded to and instead all aspects of science and actual collaboration with basic scientists are brought to bear on the clinical problem. In these oversimplified examples, clinical investigation is characterized by controlled studies and the application of the scientific method to clinical problems. Although patient or medical care may be involved, their involvement is only incidental to the studies and is not a requisite of clinical investigation.

The limit on the other side is represented by the basic sciences exemplified by mathematics, physics, and chemistry and the relatively new disciplines such as biophysics, molecular biology, and mathematical biology that have recently evolved from them. Although these sciences are not in their entirety classified as biomedical science, the techniques, theory, and concepts of the physical sciences and the work of personnel trained in them have been brought to bear on clinical and biological aspects of the study of man in health and in disease.

* Document RES 4/6B, 19 May 1965.

1.4 Unity and diversity

The Group faced an obvious problem arising from the breadth of its charter. In dealing with one immense continent and part of another, subdivided into 22 political jurisdictions with wide political, cultural, and economic differences, it is legitimate to ask whether any generalizations that are narrow enough to be meaningful can have a useful degree of validity. Useful generalizations are possible, largely because some important common factors tend to reduce the effects of wide diversity.

First, Latin America has common language bonds and important common elements of culture.

Second, the inquiry dealt to a great extent with government organizations and universities. Even with the amount of diversity that exists, the operating framework of government and the structure of most universities have a degree of similarity that greatly simplifies description.

Third, the inquiry dealt with science—and with a limited area of science. This too broadened the base of common practices, assumptions, and structures examined. The subculture of science is common to all countries that practice science. The attitudes of mind prerequisite to good science are common. The alternative ways of organizing science are relatively few, and their comparative merits have been discussed at length by competent people.

The Group found that this underlying unity permitted the kinds of generalizations made later in this report. One can legitimately speak, in a certain sense, of the state of biomedical research in Latin America when considering common fundamental factors.

On the other hand, wide differences in the actual state of development of biomedical research exist among Latin American countries. This means that extreme caution must be observed in drawing any general conclusions or in making generally applicable recommendations. Not to attempt to set up a rigid classification, the countries of Latin America can be placed in three groups with respect to the state

of development of biomedical research. The groups are as follows:

Group I

Countries with multiple centers of research

Argentina	Colombia
Brazil	Mexico
Chile	Peru
Venezuela	

Group II

Countries with emerging points of strength

Costa Rica	The Caribbean area
El Salvador	Panama
Guatemala	Uruguay

Group III

Other countries

Bolivia	Honduras
Cuba	Haiti
Dominican Republic	Nicaragua
Ecuador	Paraguay

Different observers might not arrive at this precise classification, but it provides a generally useful means of separating countries into categories that have many common characteristics.

The seven countries in Group I, which together account for 70 per cent of the economic product of Latin America, have diverse and relatively large structures for biomedical research. Each has a fairly elaborate university system. In each there is a wide variety of investigation, both basic and applied. Their best laboratories are superbly equipped and often installed in excellent laboratory structures. The two countries with national research councils are in this group, as are those that are considering the establishment of such bodies. In each of the seven there is a substantial group of distinguished investigators and a solid tradition of research. The links of the biomedical research community of these countries to the world scientific community are relatively diverse and strong. The points of scientific

strength have survived political turmoil and economic instability so that a strong, continuing tradition of research is established. These countries typically have ministries of health that are interested in research as a means of increasing the effectiveness of the health measures for which they are responsible.

In the second group of countries, there are points of excellence in research unsurpassed in any Latin American country. However, these countries do not possess the resources required for a large and diverse research effort. Each has a university, and hence a base for the further development of research. Each has economic resources that, although limited, provide a further base for further development.

Biomedical research in the third group of

countries is relatively weak. Various combinations of economic and political difficulties have combined to forestall the development of a strong system of biomedical research. As is true of each of the three groups, there are wide differences among the countries in this group, including the rate at which science may be expected to advance in the future.

One special aspect of diversity needs an explanation—the Caribbean area. The traditions, culture, and problems there are so different from those of Central and South America that the area is not considered in the general part of this report. The Caribbean area is considered in a relatively full report on the area as such that is on file at PAHO Headquarters (Document RES 4/6 B).

2. OBSERVATIONS AND RECOMMENDATIONS

2.1 The need for research

Latin American countries might well set as a goal the investment in research of .5 to 1 per cent of the gross national product, depending on the relative wealth of the nation. Research is an investment, not an expenditure. Biomedical research is essential to the intellectual and cultural advancement of nations and to the attainment of both humanitarian and economic goals. Carefully planned investments in research and higher education are among the most profitable that a country can make, and most Latin American countries do not invest enough in these fields.

More intensive and effective applied research is a general goal of high priority, which should be sought by building applied research without lessening efforts in basic research. It is a paradox that the Latin American countries, which urgently need applied science as a tool of development, find science turned in other directions—toward basic research.

More fundamental than the division between fields is an increase in the total investment in research. *The development of science and the use of science to aid man depends more on an understanding society than on an affluent society.* The most fundamental problem confronting the development of science—including biomedical science—in Latin America relates not to any specific deficiency but to a complex of social attitudes that result in a nonscientific or an antiscientific attitude on the part of the population generally and often on the part of political leaders. Leaders of science in Latin America bear a heavy responsibility to change these attitudes.

2.2 The state of biomedical research

Biomedical research in Latin America is more strongly developed than any other broad field of investigation. Virtually every field of biomedical research is represented by at least one individual, a small group, or a laboratory that is recognized as a world leader. A network of strong points exists, and they should be fostered. Indeed, the breadth and depth of biomedical research are such that this area of investigation can be adequately assessed only by looking at science as a whole.

Further emphasis on applied health research is needed, and those who are leaders in science in their countries have a responsibility to bring about such a change. As is true of applied research generally, investigations in public health administration and public health practice have lagged behind laboratory research. On this score, the health sciences have not altogether fulfilled their social function.

2.3 Advanced education and jobs

The link between research and advanced education is as close in Latin America as in the rest of the world. In the past, most training at the Ph.D. and the postdoctoral level, the levels prerequisite to the production of independent investigators, had to be procured outside Latin America. Much of it has been obtained in the United States in recent years; fortunately, fellowships have been available for the most able people. They constitute the new generations of scientific leaders in Latin America. However, not all the people trained have re-

turned to situations where their advanced training can be used.

There is an urgent need in many countries to consider, before people are trained, how many the country can absorb in advanced specialties—clinical and scientific. Serious questions have been raised about the productivity of providing more fellowships before the issue of jobs and careers is resolved.

The absence of a means by which all factors affecting research can be considered in their relation to each other is a major disability for most countries, and a major reason for establishing national bodies competent to deal with such problems. Indeed, the entire complex of training, support of research, university structure, full-time jobs, and all the other factors vitally affecting a country's capacity to conduct a vigorous research effort must be considered together.

2.4 Fragmentation and isolation

A characteristic of biomedical research that is both prevalent and deleterious is inadequate organization and coherence. There are obvious dangers in overorganization, but Latin American science suffers from ineffective organization. The individuality of each person, the fragmentation of the university, the lack of coherence in science at the national level, and the weakness of international collaboration are all evidence—at different levels—of inadequate organization.

2.4.1 Individualism

The difficulty of establishing collaborative scientific relationships among individual investigators and groups, spirited competition for funds, and personal animosities all seem to stem from the pronounced tendency of individuals to go their own way. This is a trait of temperament with which the recommendations are not designed to deal, even though it may be a significant factor affecting problems at higher levels of organization—universities, national structures, and international organizations.

2.4.2 Isolation

No nation can wisely pursue a policy of autarchy in science. The smaller the country, the more the difficulties in establishing a strong structure for science and the greater the need for strong links to world science. A degree of isolation can be useful to scientists as a protection against unproductive conformity, but such isolation can be productive only under special circumstances.

The fundamental need for communication establishes a particularly strong case in Latin America for more widespread efforts to establish free and easy collaboration within countries, an increased flow of scientific information and people among nations, and a stronger network of international activities.

2.5 Individuals, institutes, and universities

Biomedical research has advanced rapidly, particularly in the internationally known centers of strength, and continues to advance because of a number of specific factors. At the same time, the rate of advance of biomedical science, as of all sciences, is slowed by some obstacles that are deeply rooted in the history, culture, and political structures of Latin America.

A major impetus has been given to biomedical research by a few world-famous leaders, whose work has often but not always been supported from external sources. These leaders have typically founded institutes that are high points of world science. Many of these institutes have become self-perpetuating institutions with vital teaching as well as research functions. They have survived the departure of the founder. But this transition to a strong, continuing research-teaching function is difficult, and some institutes have not sustained their early momentum.

A cardinal point of science policy should be the support of existing points of strength, many of which are found in institutes that are not parts of university faculties. All institutes of high quality are

centers of specialized teaching as well as research. In the main, independent institutes are linked formally or informally to the universities, and as a general policy the links should be sustained and strengthened.

For Latin America as a whole, the university constitutes a most important factor in determining successful research. Universities play a large role in establishing traditions of research and in educating scientists. However, the lack of a well-rooted research tradition in many universities hampers and limits their scientific output. Moreover, universities interested only in transmitting knowledge develop a style of teaching that does not foster research attitudes—scientific curiosity and logical and independent thinking. The only way to learn how to do research is to do it.

A successful scientist must have a well-trained mind that will permit him to solve unforeseen problems. However, instead of training the minds of their students, many Latin American universities feed them with facts and information, trying to anticipate difficulties in detail by organizing courses to deal with them. Frequently this approach is fruitless. Students soon forget the information. Furthermore, nobody can foresee the specific problems and challenges of the future, particularly when, as is now true, everything changes so rapidly and we are overwhelmed by an explosion of knowledge. It is therefore time for universities to clarify their objectives and alter their programs accordingly, aiming at the development of the student's intellectual power, not merely at filling him with information.

Continuing the ancient pattern of organization of the Italian universities, many Latin American universities consist of isolated units under the same rector—a collection of academic islands. This contributes to unnecessary duplication, ineffective use of what little money is available, inability to establish strong points when several professors teach the same subject in different faculties, barriers to interdisciplinary teaching and investigation, and inability to establish advanced teaching and research of high quality.

Many universities are in the process of revising their general structures and curricula. Accelerated movement in this direction is a clear prerequisite to broad extension of universities' ability not only to serve as a base for investigation but also to perform well all the functions that society legitimately expects of them.

No solution or specific recommendations are offered for the deeply rooted problems of most Latin American universities. Certainly, those who are working toward the needed fundamental changes deserve every encouragement. As a general principle, assistance should be directed so far as possible to strengthening the position of those who are undertaking to modernize the outlook and structure of universities, as against supporting those who oppose modernization.

2.6 Establishment of national bodies for research policy

Every Latin American country with multiple centers of research that does not now have a formal national structure for science policy should establish such a group; every country with emerging points of scientific strength should consider establishing such a group.

The establishment of a national research body should not be considered desirable simply because it is the fashion to set up such organizations. There are real and important tasks to be performed for science. One of these is essentially political—the decisions made in all countries on investments in science as contrasted with other fields. These are generally and quite properly made by political authorities. Often these authorities have little comprehension of the power of science and technology in relation to economic and cultural development. A national science body can be a vital link between the scientific and technological communities and political authorities.

A second reason is scientific, and relates to the problem of choice. Every nation has a science policy, which consists of *de facto* decisions.

The real question is how these decisions are made, or whether they are made in a context that reveals the possible consequences of choices before they are made, permits an examination of alternative choices, and exposes for prior study the general relationships between use of resources for research and higher education and their use for other important goals—such as investment in public works, secondary education, or defense. If such choices are to be made with a reasonably high degree of rationality, and if governments are to be guided toward intelligent choices, deliberate attention must be paid to these matters at the national level. In this respect, a national research body can be invaluable.

Finally, national research bodies can also serve for securing and analyzing data on resources for science and technology, for improving communication among scientists within the country and with scientists in other countries, and for providing a link to international bodies and sources of scientific collaboration and support in other countries.

The Pan American Health Organization, in cooperation with other international scientific bodies, should continue to assist groups now in existence, to encourage the formation of others, and to arrange for professional advice for any country that wishes to study the matter. In this connection, the activities of the National Research Council of the United States in collaboration with research councils in Latin America are most important. As was suggested at a meeting of these groups held at the National Academy of Sciences in Washington from 29 to 31 March 1962, a federation of research councils might, for example, be of substantial assistance in strengthening scientific communication among Latin American countries. Obviously, such an arrangement should deal with science as a whole and not solely with the biomedical sciences.

2.7 Assessment of resources for science

To set priorities and to make rational choices within science and between science and other

functions, facts are necessary. This base, consisting primarily of measurements of funds spent for research and of scientific manpower resources, is either inadequate or nonexistent in most Latin American countries. All of them should follow the lead of those that have surveyed their resources for science, by instituting such an investigation.

2.8 Study of migration

The loss of professionally trained people and technicians to other countries constitutes a severe drain on the intellectual resources of Latin America, and it is also extremely costly in economic terms.

The Pan American Health Organization should institute a study of the migration of scientists, in cooperation with all groups that have an interest in the question, for the purpose of obtaining a more specific diagnosis and a practical prescription. The study should consist first in discovering the relevant facts. The numbers and characteristics of migrants should be much better known, and the nations concerned should cooperate willingly in efforts to determine them. Secondly, the forces leading to migration should be analyzed. Such an analysis should result in suggestions for practical, acceptable measures to reconcile the legitimate aspirations of scientists with the legitimate needs of countries for highly trained manpower.

2.9 External help to develop indigenous science

Latin American science, including the biomedical sciences, has depended heavily on support from Europe and the United States. The influence of the Rockefeller Foundation has been particularly significant, and the shift of emphasis of Foundation activities away from Latin America is having serious consequences. The grants of the U.S. National Institutes of Health have been extremely helpful, particularly to the development of excellent laboratory research. It is a matter of regret that foreign assistance to biomedical research in the

laboratory has not been better balanced by the provision of greater aid for research on immediately applicable matters.

An urgent need exists for stable general support for science and medical education, and this can be achieved in most countries only with external assistance. However, the constant objective must be the strengthening of indigenous science and education, and for this the nations involved have a responsibility that they have not yet adequately met.

To the extent that the strengthening of science in Latin America, the application of science to national development in Latin America, and the use of science as a means of forging cultural links between nations are an object of United States policy, the existing system of grants and contracts for biomedical research could be substantially improved. The general line of improvement can be indicated very simply: to adopt for part of the total U.S. activity the general policies, operating methods, and staffing patterns, evolved over years of experience, of the Rockefeller Foundation.

2.10 Expansion of the international intellectual common market

The central idea of an economic common market for Latin America should be extended to the creation of a wider intellectual common market, building upon the excellent steps already taken. To further the idea of an international intellectual common market in the health sciences, it is suggested that PAHO take the lead in arranging for a meeting, under appropriate auspices, of the leading private and public agencies interested in these fields, to discuss the specific measures required for its establishment. The agenda for a meeting of this kind might include discussion of such matters as the scope and priority of functions that could be served, the types of organization, the range of disciplines to be included, the identification of centers in various fields, the determination of priority levels of training, and the resources that are currently needed and are potentially available for the effort.

3. WHY RESEARCH? WHAT KIND AND HOW MUCH?

3.1 Introduction

When countries have the most urgent needs of all kinds, it is proper to ask why they should undertake research. In the field of health, as in other fields, more is known about the cause and cure of disease than is being applied. Why, then, should countries with limited resources—as is true of all the countries in Latin America—devote part of their resources and part of their precious stock of highly trained manpower to a search for knowledge, when the urgent tasks are to use existing knowledge for the betterment of the people's health? Why not let more richly endowed countries produce the new knowledge, which can then be freely used to elevate standards of well-being? These are real and complex questions, and they deserve serious attention. Among persons without scientific training and among some dedicated public health workers it is frequently held that biomedical research is a luxury underdeveloped countries can ill afford. Virtually all observers who have studied research in developing countries have encountered this attitude. For example, T. H. Silcock, in the final chapter of his *Southeast Asian University*, notes:

It is easy for countries with low national incomes to suppose that research is a luxury they can dispense with in planning economic development. They may aim at high standards of training for as many people as possible but postpone research until more wealth has been developed.*

* Silcock, T. H., *Southeast Asian University: A Comparative Account of Some Development Problems*, Duke University Press, Durham, North Carolina, 1964, pp. 158ff.

Some university student bodies are opposed to the faculty's devoting time to research, believing that the primary and main responsibility of the faculty lies in teaching.

Conversely, many scientists think that research is its own justification and that the only proper guide to research policy is "more"—more money, more buildings, more equipment, more staff, more students.

The countries of Latin America have no alternative so far as the conduct of research is concerned. They must support research, both basic and applied. Ultimately, the rationale for this support is based on the performance of social functions by science. The social purpose may be the enrichment of man's knowledge of the world. Or it may be the solution of health problems, and it is in this more limited sense that the social responsibilities of science are invoked. The relative emphasis to be placed on different ways of fulfilling the social purposes and responsibilities of science is an important and a perplexing problem. To be specific, there are hundreds of times more deaths in Latin America, particularly of infants, from diarrheal diseases and from lower respiratory diseases than there are from cancer. The urgency of giving health authorities the knowledge they need to deal with the real problems they face cannot be denied.

The Advisory Committee on Medical Research of the Pan American Health Organization has usefully summarized the case for research in terms of short- and long-range goals:

The immediate purpose of supporting research in Latin America is to solve problems related to health in

a manner which will promote human welfare. . . . The long-range goal is to promote upgrading of the community in its most human aspects through the cultivation of science. Indeed, science, if understood properly as a form of culture, is a means of eventually providing the whole community with an objective awareness of the proper context of man; it gives a holistic view of the universe, in keeping with man's intellectual nature; it will eventually provide a basis for mutual understanding; and it is in any case a proper basis on which to build education.*

3.2 Why basic research?

The conduct of basic research in the biomedical field is essential to placing the scientists of any nation in the stream of development of modern science. Research of this sort is required if any nation is to exist as a twentieth-century nation in the twentieth century. The conduct of basic research is essential to the development of scientists for the future, to the maintenance of a tradition of learning, and to the inculcation of a quantitative, skeptical approach among students. Basic research in biomedicine is required fundamentally by the values of science and not by the need for raising health levels. These values of basic research and the need to sustain it are cited because this view runs counter to the philosophy of those who argue that relatively poor countries should not concern themselves with basic research.

But basic research is not in any sense superior to applied research. Those engaged in it are not doing more significant or more difficult work. Basic research should not be on problems unrelated to the practical problems of a nation, and it should not be given an automatic priority. One of the most fallacious and destructive myths of science is the inherent intellectual superiority of basic research and of those engaged in it. Basic research, like applied research, can be unimaginative, trivial, and repetitive. Basic research must be excellent as well as basic.

* PAHO Advisory Committee on Medical Research, Report of the First Meeting, 1962, Document RES 1/19, p. 2.

Latin American traditions are such that in general the area of applied research is the one in greater need of deliberately planned stimulus.

The real questions are not "either-or" but ones of balance, and of practical means of attaining balance. The balance between basic and applied research differs among countries, and the balance shifts within countries. Argentina, for example, has a strong tradition of basic research, but the Minister of Health is now starting a determined effort to strengthen public health research. In Brazil there is a strong tradition of research related to practical problems of disease, but first-class laboratories in fundamental research have come into being.

A high degree of pragmatism should exist in deciding—at least over the short run—how much basic research a country should support. The pragmatic element lies in the support of extremely able people. Since few countries can support all fields of basic science, they can probably best select fields of emphasis by betting on good people—regardless of the fields in which they work—rather than by setting up abstract priority schemes in basic research. Over the longer run, efforts can be made to exert gentle pressures toward certain fields or toward basic problems of significance to economic growth, but these efforts must be exercised skillfully and without coercion if they are to be effective.

More important than the division of research among fields is the total investment in research and the quality of investigations. The problem of balance, difficult though it is, is more easily dealt with than that of generating awareness of the significance of scientific inquiry and the need to expand national investments in this area.

3.3 Why applied research?

The case for applied research rests on the potentialities of investigation as a means of elevating levels of health. Research applicable to health is an investment, not an expenditure. Moreover, this investment, together with

education and health, is one of the most profitable a country can make. Latin American countries have not invested adequately in these fields.

It is often argued that since so much is already known that is not applied, further research by less developed countries is pointless or of low priority. This is a dangerous doctrine, which will imperil the future of any nation that takes it seriously. In the first place, many techniques of health protection are not general-purpose techniques applicable in all countries under all circumstances without modification. The blind acceptance of diagnostic, prophylactic, or therapeutic measures without consideration of the effects of local circumstances can lead and has led to serious error. The same is true of administrative matters—the organization of health services and the assessment of their effectiveness. A questioning attitude on these matters, a willingness to put accepted doctrine to practical tests, and a preference for quantitative evidence derived under local conditions are all necessary to the fully successful adaptation of applied health measures. These are the attitudes that underlie applied research, and with such attitudes applied research will exist. The function of applied research is, in fact, to promote these attitudes as well as to produce data relevant to the solution of obvious public health problems.

A flexible, inquiring, skeptical, technically competent approach both to existing practice and to innovations is necessary if countries are to recognize weaknesses in existing practice and to take advantage of innovations. A nontechnical, nonresearch society is incapable of taking advantage easily, quickly, and by its own efforts of technological progress—scientific or administrative—generated elsewhere. A group of people competent in applied research and currently engaged in research is a prerequisite to the absorption and adaptation of new technology. Assistance from other countries can substitute for national capacity in this respect, but this is a short-range and not a long-range solution.

Having a group engaged in applied research

is an efficient way for a country to discover the existence of health problems of which it is not aware, or to measure correctly the relative significance of its health problems. This information is indispensable to efficient use of the resources available for the protection of health.

Finally, a tradition of applied research and the widespread diffusion of research throughout government operations and universities is important to the effective operation of government itself. Again we rely, for a statement of this principle, on Silcock:

Research skill is particularly important in economies where an attempt is made to secure planned economic development. The government must act on factual information scientifically collected and not on the arrogant certainty of the petty bureaucrat. It is this careful fact-finding which is too often lacking, mainly because of mistaken notions about what it is that universities are there to do. They are there not merely to produce trained and competent men—many other training institutions do that—but men who realize that they do not know enough to solve their problems adequately and can methodically reduce their ignorance. Research thus should be what the university is there to teach, as well as something closely related to the teaching process itself.

3.4 Research as an approach: The universities

Research has a significance transcending the usual categories of "basic" and "applied." The skeptical, inquiring, free, challenging, factual, quantitative, experimental way of approaching problems in basic or applied science or in any other field is the characteristic of science that gives it its immense power. This set of values characterizes societies in which science is strong. In contrast, the search for revealed truth, ultimate reliance upon authority, and faith in formal logic and rhetoric characterize societies in which science is weak. Acceptance of change, rather than the continuation of the status quo, is one of the basic psychological shifts that must come about if traditional societies are to develop effectively,

for without change there is no development. The attitudes necessary for research—basic or applied—are those that lead people to accept and deal with change.

Universities are powerful institutions for setting, preserving, and changing the basic values of societies. They are conservative institutions with radical functions. Societies must rely heavily on universities as agents of change, as a means of introducing and fostering the idea of change as the norm, and particularly as agents for the widening of the scientific approach to the solution of national problems. If universities are to be effective in this role, they must have a research tradition and a research approach. This is a fundamental observation the significance of which has been seen throughout the world. It is repeated here for emphasis, and again Silcock has stated the case succinctly:

The function of research in the university is to ensure that the student learns from one who is in the habit of learning, that he learns a method and an attitude taught by example. Its functions in the country are first to add to the country's relevant knowledge of its environment, and next to add to the general store of human knowledge what can best be gleaned from that country by appropriate local methods. Research which performs either of these functions should be undertaken and published, regardless of whether it would be appropriate to undertake it or publish it elsewhere. A research tradition will produce the facts and the national planning based on facts which can make the best use of whatever trained people there are, at any standard; but people with no skill in exploring new methods, trained to a high technical standard appropriate to another environment, may merely be frustrated by lack of resources which they feel they need.

This view of the general significance of research as a means of establishing a point of view, an attitude, and an approach to the solution of problems is fundamental. It is for this reason, among other compelling considerations, that research in Latin America should not be considered esoteric or as in competition with resources for development.

Of course, research—either basic or applied—is not the only means through which a skeptical,

experimental approach can be inculcated. For example, the entire tone and spirit of elementary and secondary education has an important influence in determining how young people approach problems. National officials face the difficult problem of choice and balance, and the point of this review of policy is to note a general tendency to underestimate the leverage of research as a means of influencing the flexibility and productivity of university-trained scientists, engineers, and physicians.

3.5 Research, public health measures, and population growth

Beyond any doubt, the rapid increase in the population of many Latin American countries poses a grave threat to elevation of the levels of living. It appears highly probable, if not certain, that per capita real income and per capita food consumption will actually decline over the next decade unless simultaneous efforts are exerted to expand the economic base, increase food supplies, establish better methods of distribution, and moderate the rate of population growth.

This prospective situation has led many influential persons to advocate that deliberate efforts to extend public health programs be discouraged and that little or no assistance be given to the development of such programs. The rationale of this position is that measures to improve levels of health, which tend to reduce infant mortality and to lengthen the life span, simply add to the number of consumers and tend to thwart the goal of reducing the rate of population growth.

However, deliberate refusal to extend public health measures is deeply immoral. Refusal to adopt measures that are known to preserve life and to reduce suffering amounts to a decision to deny a basic human right—the right to life and the legitimate hope of a life not dominated by physical suffering, weakness, and lassitude. Refusal to adopt public health measures amounts to adopting a conclusion and a course of action in a situation so complex

that the predicted outcome may not occur. And the chosen course of action involves a decision to refrain from extending lives and from reducing suffering. Human beings have an inherent right to benefit as individuals from the fruits of scientific advance. This right transcends the right to deny the immediately beneficial application of knowledge because of the long-range social, economic, or political difficulties that may thereby be created. The considerations in this specific case are fundamentally similar to those existing when proposals are made to halt the advance of science and technology on the ground that these advances do more harm than good. And the answer is the same. Man should not be denied the right to think, to act, to explore, and to change. Denial of this right is the denial of a basic human goal—a goal more basic and more valuable than the attainment of tranquillity, prosperity, or physical well-being.

Apart from the fundamental moral considerations, which should govern apart from any practical considerations, denial of public health measures will tend to thwart rather than further a rational total policy of economic and social development and a rational policy with respect to population growth. A basic goal of all measures for economic development is to raise the level of living. Elevation of standards of living tends to reduce infant mortality, extend the life span, and reduce the prevalence of illness. It is as irrational to forgo public health measures because they have these effects as it is to forgo all economic development efforts because they have the same effects. Admittedly, the effects of public health measures on population can be more direct and powerful than those of general measures for economic development. Moreover, the population effects of public health measures can precede rather than follow increases in the level of living. However, these differences are quantitative, and they do not always exist.

Also to be taken into account is the fact that elevation of levels of health can increase the productivity of the population by increasing the physical vigor, alertness, and motivation

of the labor force. The greater the degree to which the horsepower of an economy is manpower, the more significant can be the effect of public health measures on the economy's productivity. Such public health measures may include malaria eradication, the provision of water (preferably but not necessarily clean water), improved sewage disposal, nutrition education and the provision of a better diet, and medical services ranging from rudimentary mass measures to individual attention.

Finally, in relation to population control, the effectiveness of any set of measures will depend decisively on the existence of organized means of educating the population, on the provision of advice and assistance, and on the furnishing of birth-control devices. There is no more effective way of providing the surrounding circumstances essential to the effectiveness of large-scale birth-control measures than through a network of public health clinics. An organized service for providing health services is not antagonistic but prerequisite to effective population-control measures. One of the tasks of high priority in population control is to investigate the optimum relationships among all the public activities involved. This includes investigations of social, economic, cultural, religious, and political factors that affect the accessibility and acceptability of population-control measures.

3.6 The state of biomedical research

Biomedical research in Latin America has come to be stronger than any other broad field of investigation. Medicine has traditionally been a prominent and prestigious profession. Medical faculties have tended to be stronger than science faculties. The practice of medicine has until recently provided a stronger economic base for individual investigators than other fields of science had available. Accordingly, when assistance to the development of science was provided from outside sources, first by the Rockefeller Foundation, medicine became the natural focus of attention. Not only was this

field relatively advanced, but medicine and biology were the sciences most obviously relevant to the solution of human problems. These influences gave research in biology and medicine a strong and early impetus. The lead became cumulative, since talent attracted talent and money attracted money. As a consequence, the biomedical sciences are the strongest area of science in Latin America as a whole and in most of the countries individually.

In total, the variety and depth of investigation is impressive, particularly since much of the development of modern research has been after World War II. The leaders of research are highly talented, laboratory facilities and equipment in many fields are excellent, and the number of superbly trained younger investigators is increasing. In Latin America virtually every field of biomedical research is represented by at least one individual, a small group, or a laboratory that is recognized as a world leader. These areas of inquiry come to mind: endocrinology, carbohydrate metabolism, embryology, neurophysiology, genetics, bacteriology, virology, physiology, cardiology, and nutrition.

Basic research tends to be stronger in Latin America than applied research, and some reasons for this are clear. Basic research tends to be academic research, and since much research in Latin America had its origins in universities the "basic" approach predominated. The tradition of the amateur in science has been important and productive. But the amateur is generally not interested in practical applications. Social and cultural pressures have tended to give prestige and other rewards to basic rather than to applied research.

In economies that have tended to be agricultural and traditional, the actual area in which applied research would be accepted or used has tended to be narrow. Finally, applied research is relatively expensive as a rule. The sum total of these considerations leads to the paradox that countries that urgently need science as a tool of development find it turned in other directions—toward basic research.

However, efforts to strengthen applied research in Latin America encounter philosoph-

ical and practical problems. All the forces that have led to the pre-eminence of basic research continue to exist. From within the scientific community, the doctrine—in many respects a sound one—that the way to build science is to support points of strength militates against the development of a strong applied research effort. The doctrine of support of strength is fostered by assistance from outside Latin America, which tends to put existing excellence high on the list of criteria that determine eligibility for research support.

Biomedical research shares this common characteristic of all science in Latin America. Thus, research in public health administration and public health practice has lagged behind laboratory research for a number of reasons. Latin American physicians are typically trained to be practicing physicians. They are strongly attracted to metropolitan areas where economic, social, educational, and cultural opportunities are most plentiful. Departments of preventive medicine are often weak or nonexistent, and there are only ten schools of public health. Public health measures are administered by ministers of health. In some countries these ministers have proud traditions of accomplishment, including research. In others, however, the attainment of a continuing, high professional level of administration of public health has proved difficult and there has accordingly been little or no research. Another factor that may account in part for the relative lag in public health research is that this type of inquiry is strongly affected by local traditions and practices. Consequently, it is difficult to transfer experience from one country to another. Laboratory research, on the other hand, while affected by local conditions, is to a greater degree conducted uniformly throughout the world. Training in one country is relatively easily transferred and used in another country.

One indispensable element of a general movement to strengthen applied research in health, and in fact in all fields, is the exercise of vigorous leadership by those who are the leaders in research. Without their prestige,

influence, and active support, it would be difficult to achieve a markedly stronger applied orientation. In this connection, the discussion should never take the tone of applied research *versus* basic research. Nothing is gained by weakening what is strong in science. The problem is rather to use existing points of strength as the advanced salient toward which all sectors of science should move.

3.7 Quantitative goals

It is premature to establish quantitative goals for the research investment of most Latin American countries because the essential prerequisite—quantitative measures of the existing investment—is missing. Every country that has not already done so should undertake to quantify its investment in research. The rationale for doing this and the benefits to be expected are spelled out in section 6.4 below.

Once nations have a reasonably accurate measure of gross national product, as is now true of most countries, the establishment of an estimate of research investment permits its

expression as a percentage of gross national product. Such a ratio enables countries to see what proportion of their current output is devoted to research, and to compare their experience meaningfully with that of other countries. When this is done, it is found that countries with relatively low per capita gross national product spend from .2 to .5 per cent of their gross national product for research.*

For example, India and Ghana spend about .2 per cent of their gross national product for research. The comparable figure for Iceland and Finland is .3 per cent; for Venezuela it is .5 per cent; for Australia, Norway, and Canada it is about .7 per cent; for the civil research of the United Kingdom, the United States, and the U.S.S.R. it is about 2 per cent.

From the rough figures that exist, the nations of Latin America might well set as a goal the investment of from .5 to 1 per cent of their national gross product in research, depending on the relative wealth of the country.

* Organization for Economic Cooperation and Development, *Science, Economic Growth, and Government Policy*, Paris, 1963, p. 25.

4. OBSTACLES AND OPPORTUNITIES

4.1 Introduction

Biomedical research in Latin America has advanced and continues to advance. The reasons for this advance can be identified and are noted in this section. At the same time, progress has come about through overcoming difficult obstacles. Most of these still exist to varying degrees in different countries. They are deeply rooted in the history, culture, and political structure of Latin America.* Even though these obstacles are well known, it is useful to reiterate them briefly because most if not all efforts to advance science must take them into account.

The obstacles to the development of biomedical research in Latin America are being progressively removed, and there are positive factors that tend to elevate the quality, diversity, and quantity of biomedical research. It is

difficult for any area of intellectual activity to rise much above the level of the total intellectual structure of a country. Yet this has happened in biomedical research in many countries. Advances come not through broad, logical, and simultaneous elevation of the whole structure but through carefully selected efforts in specific fields. Then by the force of example, and by the demonstration that advances are possible, the pioneering in a single area becomes a rallying point and a standard to which other fields realistically aspire.

In considering the development of science in Latin America, some important general favorable factors should be borne in mind. There is first the historical fact that the adoption of wise policies and the infusion of a powerful set of simple ideas can shift the quality of higher education and research in a nation over a short period. Modern graduate education was introduced into the United States, largely on the lines of the German tradition, between 1875 and 1900. Medical education in that country was transformed in two decades after the appearance of the famous Flexner Report in 1904.

It is instructive to observe that the state of higher education and research in the United States was at a relatively low ebb only a few decades ago and that the flowering of research is a phenomenon of the past two decades.

On the one hand, it is unrealistic to expect that the extremely complex problems involved with the total process of national development will be solved quickly. On the other hand, there is historical evidence, both from Latin America and from other parts of the world, that the development of research and of

* The following articles provide deep insight into fundamental aspects of Latin American culture that create difficulties for the rapid development of research:

Atcon, Robert, "The Latin American Universities," in *Die Deutsche Universitätszeitung*.

Garcia, Rolando, "The Latin American Universities," in Ruth Gruber, ed., *Science and the New Nations*, Basic Books, Inc., New York, 1961, pp. 230-237.

Houssay, Bernardo A., "El pasado y el futuro de la ciencia en la América Latina," *Ciencia e Investigación* (revista patrocinada por la Asociación Argentina para el Progreso de las Ciencias), Febrero 1954, Vol. 10, No. 2, pp. 52-60.

Houssay, Bernardo A., "La libertad académica y la investigación científica en la América Latina," *Ciencia y Tecnología*, Vol. 5, No. 19, octubre 1955, Departamento de Asuntos Culturales (Sección Ciencia y Tecnología), Unión Panamericana, Washington, D.C.

Houssay, Bernardo A., "Importancia del adelanto científico para el desarrollo y prosperidad de las Américas," *Ciencia Interamericana*, Vol. 1, No. 1, enero 1960, Unión Panamericana, Washington, D.C.

points of excellence in higher education can proceed much more rapidly than other broad national indices of development—such as per capita income. This is particularly true when countries are expanding from a relatively small scientific base.

4.2 Aspects of personality

It is difficult to make generalizations in this connection, but there do seem to be aspects of culture and sets of values that tend to militate against the most effective development of scientists and the acceptance of science as an honored pursuit. In general terms, Dr. Bernardo Houssay, in his frank and perceptive analyses, has noted some of these factors: lack of broad understanding of the nature of science, of the nature of training for science, and of the conditions necessary for the effective pursuit of science; diversity, individualism, and a search for personal prestige that tend to inhibit cooperation; the tradition of the inferiority of manual work; an approach to education that stresses description and definition rather than critical and skeptical conceptual thinking; a tendency to dogmatism; a failure to observe obligations to others and to rules in general; a tendency to give greater weight to friendship and family than to objective factors in making decisions. To the extent that such traits are common, they tend to militate against the development of science.

On the positive side, however, the process of selection for advanced education and training, and the obstacles to a research career, are such that those who come to the forefront are an exceptionally able and highly motivated group. The single-minded drive of the relatively small band of leading investigators found in virtually every country is awesome. These scientists—almost without exception trained in Europe, the United States, or both—typically possess not only mastery of their own field but a keen sense of the general deficiencies of science in their countries. They are often leaders in university affairs generally and in the social and political affairs of their countries.

4.3 Emergence of a new generation

Medical research in Latin America is on the verge of a shift in leadership to a generation that has reached maturity since World War II. The existence of such a group is a prerequisite to the perpetuation and broadening of the traditions established in a few places by the heroes who pioneered the establishment of biomedical research in Latin America. This group has some common characteristics—high intelligence, driving purpose, excellent training, high scientific attainment, and an urge to progress and to change. One important factor of great significance, seen in country after country, is the strong influence of training abroad and the relative increase in the proportion of persons who have had part or all of their advanced education in the United States. This has been in part a historical accident.

World War II made it impossible during a number of years for Latin America to maintain its traditionally strong ties with the educational and cultural institutions of France and other European countries. The educated class was almost completely isolated from its usual contacts. As a consequence, the United States replaced Europe as the major site for the advanced training of Latin Americans both in the biomedical and in other sciences. They were exposed to a different system of education, with more freedom of action, smaller classes, informality between the professor and themselves, tremendous independence in the prosecution of their research programs, and an opportunity of broadening their experience through collaborative programs. They worked on a full-time basis and quickly saw the benefits that accrued. On return to their respective countries, many of them have become leaders in teaching and research, or will do so.

4.4 Adequacy of planning

Since the recommendations of the Conference of Punta del Este, the Latin American countries have been elaborating general plans of develop-

ment. However, such plans usually fail to give proper consideration to the development of science as an integrated and highly important part of the general development plans. This is no doubt due to the inadequacy of governmental or university structures to coordinate scientific research in general and biomedical research in particular. One of the most serious consequences of failure to plan adequately relates not to general national policies but to a very practical problem—the establishment of a reasonable relationship between training opportunities and career opportunities.

In the years immediately following World War II, the shortages of trained people in all categories in virtually all Latin American countries was such that expansion of all kinds of training outside Latin America was indicated. However, the number of opportunities for advanced training, particularly in medicine and the biomedical sciences, rather rapidly expanded to the point at which simple increase in the number of people trained was no longer a guide to policy. Attention has to be centered on demand as well as supply—on jobs and career opportunities as well as increased training opportunities.

In many countries, there has been a very weak relationship between the number of people trained to high levels—typically abroad, and particularly in the United States—and the existence of current jobs and long-term career opportunities in their specialties after they return. In part, this situation is caused by the policies of those from other countries who offer training opportunities. Sometimes enthusiasts in various fields—governmental and nongovernmental—from the United States and other countries outside Latin America have assumed that it is inherently good to increase the number of Latin Americans trained in their specialties. This approach led in the past to failure to recognize that there are definite limits to the number of people in highly specialized fields that can be absorbed by many Latin American nations. Serious efforts have been made to rectify the situation, largely by strengthening the means for general considera-

tion of the numbers needed in various specialties and for assuring reasonably specific job and career opportunities to those who have been trained abroad.

To an increasing degree, the problem has become one of national planning in the various Latin American countries, for in the last analysis the establishment of a reasonable long-run relationship is a matter that must be influenced by internal as well as external actions. In most countries, better information is needed on the long-range demand for people trained in various specialties, on the total number being trained, on the terms under which various training opportunities abroad are offered, and on specific current needs in teaching, research, and service.

This situation is so serious that the desirability of reducing training opportunities in specialized fields has been suggested. This would seem to be a counsel of despair and a suggestion that should be adopted only after other approaches have failed. But the situation cannot simply be ignored, and other approaches must be defined and adopted. Some countries have been more effective than others in dealing with this problem, and the Pan American Health Organization might well consider a study of this subject for the benefit of all countries—those from which people come and those in which advanced training is given.

4.5 Size, isolation, and communication

Many countries are too small and do not have the wealth to permit them to establish large and strong research structures. Few things are more difficult than the maintenance of high scientific capability and enthusiasm in isolation. Research flourishes in a subculture of research and in a total culture that understands and values science. In a number of Latin American countries, the critical mass has not been attained. This means that many individuals work as individuals, in isolated groups, and not in

the midst of a large, diversified group of scientifically trained people.

Such a system contains further inherent dangers. Since the number of persons competent in any one field tends to be small, the self-regulating mechanism that operates in large scientific communities is weak or nonexistent. This sometimes permits mediocrity to succeed. On the other hand, such systems tend to provide no haven for nonconformists. Rejection of the potentially productive eccentric—or the authentic genius—does not occur only in small systems, but it is more likely in small systems.

All these considerations raise the obvious point, discussed later in this report, that forms of international collaboration are imperative if each country is to use its resources most effectively and if the total resources of the Hemisphere are to be used most effectively for the benefit of all countries. Fortunately, in no field of science is the tradition of international collaboration among the American states so strong as in medicine and biomedical research. These are also the fields in which private foundations and governments have provided the most sustained assistance to Latin American countries. The nature of this collaborative effort is spelled out in the later section on organization.

As a final point on the effect of size, isolation can be productive by insulating investigators from scientific fads and by directing attention to local problems. But for isolation to be productive, special circumstances must exist. The investigators concerned must be excellently trained, well equipped, and well financed, and they must have reasonable access to the main-streams of science through reading, visits of others to their laboratories, and travel.

The means of communicating in science are deficient in Latin America as in the rest of the world, but the consequences are particularly severe in Latin America because of scarcity of resources. As a rule, libraries are not rationally located so that they can be used most effectively by students and by those engaged in teaching and research. Precious library re-

sources are often found in relatively inaccessible places where they are either unused or in effect the private property of individuals or small groups. Perhaps because of the rarity of books and journals, they tend to be viewed more as museum pieces than as tools to be used in the day-to-day work of learning, teaching, and exploring. The scarcity of books extends to standard teaching texts and basic periodical resources.

With few exceptions, the tradition of the local research journal is wasteful. The small periodical devoted to the publication of papers written by the local staff of institutes or departments represents more a cultural artifact than a serious addition to the world's mechanism for communicating scientific findings. The funds devoted to the publication of such journals might more profitably go for salaries or other urgently required expenditures.

The deficiencies in communication in Latin America are further emphasized by the scarcity of rapid, informal contact among investigators interested in the same field. The invaluable specialized "newsletter" circulated informally in the United States and Europe is virtually unknown in Latin America.

Fortunately, these problems are being vigorously attacked. Imaginative but sensible plans for more effective use of modern technology, for printing cheap texts, for the consolidation of libraries, and for the establishment of central reference centers will be followed, it may be hoped, by the investment of funds required to make the plans operative.

4.6 Instability

A certain degree of political and administrative instability characterizes all nations and is not unique to Latin America. The characteristic of such changes that often produces distinctive effects on science in Latin America is their tendency to affect all levels of government. A change of government or even a change of ministers can result in changing the leadership

of scientific institutions. This discontinuity has had bad effects both on current work and on the long-range plans of some institutions. Many research workers have had to emigrate as a result of political shifts. Of course, the emigration of scientists cannot be attributed only to political and administrative instability, but this emigration is often influenced by mismanagement of research institutions.

4.7 Poverty, inflation, and growth

Even the very few Latin American countries with stable economies have faced problems in obtaining research funds. Government funds for research are allocated in competition with heavy requirements for economic and social development. Private local foundations willing to contribute to biomedical research are still few, but in recent years their number has been growing quite promisingly in various countries. So, far, the pharmaceutical industry, which is rather powerful and rich in the more developed countries of Latin America, has not been making significant financial contributions to the development of research, at least on the serious health problems that affect rural populations.

Inflation has had serious adverse effects in a number of Latin American countries in which biomedical research is relatively developed. This factor aggravates the shortage of financial resources, hinders the implementation of long-range research plans, and frustrates plans for establishing adequate salary scales for university people and research workers. Moreover, inflation forces governments to adopt strict measures on imports of foreign-made products, such as scientific equipment and supplies.

A common assumption underlying the financing of many Latin American universities is that government is responsible only for supporting the basic teaching function through the payment of faculty salaries and basic operating costs. This is partly a matter of lack of resources and partly a matter of an archaic view of the university's function. Additional re-

search costs—such as expenses for supplies, equipment, salaries of technicians, or experimental animals—are generally not provided in the university budget. The faculty member is usually personally responsible for procuring funds to meet them. Sometimes local funds are available, but the custom of private giving to support research is not widespread. This tends to generate reliance upon foreign sources.

But the question of resources must be seen in perspective. While few scientists have all the space, equipment, assistants, and funds they consider essential, there has been on the whole a steady expansion of resources for medical research in Latin America. There are still many laboratories inadequately equipped by any standards, and there are some that have declined from earlier periods. But on the whole the space, equipment, and ancillary staff are better and more extensive than at any time in the past. Much of the improvement results from assistance from outside Latin America, and represents international recognition of the quality of scientific leadership.

The countries of Latin America have, in the main, been so hard pressed financially that they have found it difficult to finance what they consider the paramount functions of universities—the conservation and the diffusion of knowledge. Again, in historical perspective, a major step still to be taken in many countries is recognition, made concrete through the provision of resources, that teaching and research are inseparable in universities. In universities of developing countries research should be understood as a natural and essential component of both teaching and learning. So much the better if special units with particular emphasis on research can be provided. But in no case should the situation be "research *versus* teaching." This point is made because, with limited resources available, there is sometimes the tendency to establish so-called realistic priorities—in appearance only—between the one and the other. Not infrequently one hears that "there is barely money for teaching" or that "for lack of funds no research is done." These phrases

indicate that the concept of research—in a very broad sense—as integral to effective teaching is not universally understood or accepted.

4.8 Deficiencies in education—secondary and university

With few exceptions, primary and secondary-school education in Latin America has been inadequate. High rates of illiteracy, except in a limited number of countries, are a consequence. In most countries, the church-run school, available almost exclusively in the urban areas, provides elementary and secondary education. Even relatively low tuition is too high for poor people. In the rural areas, schooling at best has been at a rudimentary level. The deficiencies are qualitative as well as quantitative, and preparation in science is often poor. Once the student completes secondary school, the university and higher technical schools and faculties have been available to him free. Under the socioeconomic conditions extant in most of Latin America, only children of relatively well-to-do families have been able to take advantage of this opportunity. Paradoxically, free higher education has tended to foster not free access regardless of economic status but a state-subsidized system for the education of the relatively wealthy.

The realities of access to universities, the actual quality of teaching in science, and severe structural problems have combined to generate difficulties that have hampered the development of teaching and research in science.

There exists in many countries of Latin America, however, a lively sense of the deficiencies of the traditional university organization. The question of university function and structure, and of reform efforts, is so significant that it is considered in detail in chapter 5.

4.9 Migration

In a number of countries, many scientists have become so discouraged by the obstacles

facing them in building a career in science and teaching that they have migrated. They are in effect pushed out of their native country, and in this sense migration is a derived rather than a primary problem. On the other hand, they are pulled toward countries where career prospects are much brighter in both economic and intellectual terms. The country with the most attraction in recent years has been the United States. While the facts about the migration of physicians, scientists, and engineers are not known with precision, it is abundantly clear that in some countries the loss of talent is a severe handicap to national economic, cultural, and intellectual development. Much more attention has been paid to the outflow of capital than to the outflow of another fundamental national resource—brains. This problem is not, of course, confined to the biomedical sciences. But here again they loom so large that they can best be examined in the context of all science.

Whether the forces that repel or those that attract are most powerful is not the central problem. The central problem is how both forces may be moderated in a suitable way. There can be no realistic hope that the forces leading to the emigration of scientists from Latin America can be done away with and that migration will cease. The forces at work are too deeply ingrained and too powerful. Moreover, the cessation of migration is not only impossible but unwise. International migration of scientists is a productive phenomenon with which the world has long been familiar. The object of policy should be to establish conditions under which the rate of migration from Latin America will be moderated by the voluntary choice of individuals. Fortunately, it appears that practical measures that will reduce migration can be instituted at moderate cost.

Basically, the measures that will reduce migration are simply those that establish the minimum conditions under which scientists can work productively. This entire matter should be thoroughly studied from the standpoint of the countries that lose highly trained people and that of the countries they go to.

5. ORGANIZATION—UNIVERSITIES AND INSTITUTES

5.1 Why organize?

Before the organization of universities and institutes is discussed, some thoughts on organization itself—applicable from the local to the international level—will be presented. Questions relating to organization for research* are complicated, and they often generate heated discussions. The root of the complexity lies in some fundamental considerations. Research is done by individuals who must be free if they are to be creative, and creativity is essential to productive research. Science is primarily self-organizing. That is, individuals are ultimately the source of new ideas, and science has a structure into which these new ideas fit in a way that extends the structure of science in a productive way. The scientist must be free if his contribution to the structure of science is to be most effective.

Scientists cannot, however, be completely free for at least two reasons. First, there are rarely, if ever, enough resources—money, space, people, equipment, supplies—so that each investigator can have all that he wishes. Accordingly, resources have to be divided by a process that the scientist, or all scientists combined, may influence but cannot control. This process, in effect, sets limits to the freedom of investigators. Secondly, society places demands on science. Science is such a powerful tool for the solution of problems—including

health problems—that society will use it. In less abstract terms, national governments urgently require attacks on such social problems as malnutrition, malaria, schistosomiasis, occupational hazards, air and water pollution, and venereal diseases. Funds, including funds for research, are provided by governments to attack these problems. These efforts are a means of allocating scarce resources, and particularly scientists, to problems that are important to society but may have low priority when measured in scientific terms. Such allocation of resources represents, in a sense, a reduction in the freedom and autonomy of science, since the decisions on priorities are taken from outside science and not from inside.

These questions are not philosophical abstractions but the essence of a very practical debate. Decisions on such matters as the budgets of ministries and the relative effort devoted to laboratory and field research rest implicitly on the answers to the basic questions.

Often organization is considered to be the enemy of science and scientists. But in Latin America the weakness or absence of effective organization tends to weaken science itself. The reason is that science in Latin America must rely heavily on government. Strong organization of science, through an active academy or a national research council or some similar organization, can educate and influence government in many ways. In the absence of an organization for science, individuals tend to exert strong claims for support. This is not necessarily bad, but when support is provided personally for individuals rather than impersonally for an activity the support is more likely to be unpredictable and

* By organization is meant the association of people with common interests and goals in order to promote those interests and goals. Organizational forms include such groups as laboratories, institutes, universities, foundations, professional societies (national and international), ministries, and international inter-governmental organizations.

to take into account factors other than scientific merit.

Through organization, scientists can accomplish many objectives. They can point out to governments the ways in which research is relevant and essential to national development. They can suggest policies on national issues, such as the significance of research as an integral part of advanced training in the sciences, the relative significance of various areas of research, and the terms and conditions under which government funds should be made available for research. In concept, such activities represent the means by which science exerts counterpressures on society. Without such counterpressure, the influence of demands from society is likely to be detrimental to science and to lead to a poor response by science to the needs of society.

Organization is not only a means of exerting social pressure but a device for communication. Communication in science is an essential condition of productivity and freedom. Workers are most effective if they know what others have done. The free selection of areas of work lies at the root of the process through which scientists produce a rational, organized division of work. The effective operation of this system depends on information. Information is transmitted in science primarily by talking and by writing. The transmission of information in both spoken and written form is aided by the organization of science.

On a national level, an organization for science provides a point of advocacy for this important activity and is particularly useful as a means of guiding external assistance along lines most consistent with national objectives.

5.2 The significance of individual scientists

The efforts of outstanding scientists in Latin America have been significant not only because of their individual scientific contributions, important as these have been. Research has typically been established in Latin American

countries as a consequence of the efforts of a very few talented individuals. They have often worked in a culture and an environment indifferent if not hostile to science. Funds for salaries, for equipment, and for supplies have often been inadequate, and developing laboratories have suffered vicissitudes as the consequence of political change. In the face of such difficulties, these heroes of science have not only carried on research but also have served as the prime advocates in the establishment of a scientific tradition and of government recognition for science. Typically the organization required for research has been the creation and the reflection of an outstanding man.

Scientists in Latin America have traditionally contested as individuals for small sums often provided through a process heavily dependent on personalities. This tends to create intense rivalry and competition, both within and among fields of science. A major reorientation has been required when the approach of scientists has been shifted from the older one, of individual competition for a share in a fixed sum, to that of cooperative effort by the entire scientific community to expand the resources available for research and change the underlying conditions that hamper the development of science. The competition of individuals and institutions is productive, but it is more productive if it occurs within the context of a joint effort.

In the course of the development of science in Latin American countries, a central problem has been to pass from the stage of heavy or total reliance on individuals to a stage characterized by strong institutions that persist as centers of research while individuals come and go. Research is always the product of individual minds, and the growth of strong and stable institutions does not mean decreased reliance on the worth of individuals. It does mean that the productivity and even the existence of an institution does not depend on a single irreplaceable individual.

But how are organizations built around individuals to survive, grow, evolve, and re-

main productive after the strong individual has left? One absolutely essential condition is the establishment of a strong teaching function as an integral part of research activities. It is through the incessant process of producing the next generation of investigators that continuity is assured. This teaching need not necessarily be a part of a university. Much of the best teaching in Latin America, particularly at advanced levels of science, is done in institutes. However, the university—with all the weaknesses that have sometimes characterized this human institution—has proved over the centuries to be the most effective device invented by man for the maintenance of an intellectual tradition, for the preservation of the intellectual heritage of mankind, and for the extension of knowledge.

Maintenance of the momentum provided by individual leaders in science can be assured only if there is conscious recognition of the problem of continuity and survival. The concept that teaching and research at advanced levels are different aspects of a single process must be deliberately fostered. Research institutions—institutes, university faculties, or whatever they may be—that have not been strong centers for the production of new investigators have tended to become sterile, to shift from research to various kinds of service responsibilities, and to lose their status as strongholds of intellectual excellence. Conversely, those institutions that have sought out and fostered the development of outstanding students have thereby contributed to their own continuing vitality.

A practical consequence of this practical philosophy is that research institutes and universities that are outstanding centers for the production of scientists as well as of research should be amply supported by governments. Conversely, any institution that purports to provide scientific training but does not simultaneously serve as a site for research is incomplete and should be helped to fulfill its total mission. Similarly, deliberate pressure to engage in advanced training should be exerted on research institutions that do not do so.

5.3 The universities

Latin America can be proud of its university tradition. The University of San Marcos in Lima was chartered by Charles V of Spain in 1555, the Royal and Pontifical University of Mexico was similarly chartered in 1551 and began functioning in 1553; the University of San Carlos in Guatemala was founded in 1562. These institutions, which began as church schools, were secularized during the ensuing centuries. Early in their history they offered advanced degrees in theology and philosophy. Medicine and law were added later. Subsequently, other universities were established, so that there now exists a wide network of universities throughout Latin America. They are most varied, ranging from diversified centers of teaching and research of high quality to poverty- and tradition-ridden institutions that are universities in name but not in substance. The tremendous task facing most countries is to lift all their universities to the level required to make them productive as centers of culture, of scholarship, and of expertise for national development.

Many Latin American universities still suffer from common defects. The rigidity of the often outmoded curriculum is one of these. Teaching by lecture and learning by memory have been common. Laboratory work has been deficient and in some universities absent in science courses. Organization of instruction based on chairs that are, so to speak, the incumbents' private property for life imposes obstacles to modernization of the curriculum, to cooperative teaching among the various disciplines, and to the development of younger people.

The title of "Professor" is still extremely important, especially in medicine. Respect for the authority and power of the professor has been fostered in some universities to the point where creative thinking, challenge to authority, and intellectual competition have been discouraged. In Latin America the power inherent in the title has sometimes been abused. For example, it has been used at times to augment

private incomes, a practice not unknown in other parts of the world.

The organization in many universities is rigid and compartmentalized by faculty. Traditionally, in Latin America, each of the major faculties or schools of a university has set up its own department in all relevant disciplines, duplicating similar departments in other faculties. Thus, biochemistry has been taught in the faculties of arts and sciences, dentistry, pharmacy, and medicine. Students have been required to take the particular course given in their own faculty, even if it was inferior to the same course given in another faculty. This has created inordinate expenses for duplication of facilities, equipment, and staff in institutions already lacking adequate funds. It has also tended to hamper the development of strong points in science. The structural changes necessary to reduce the self-sufficiency of the faculties is a major object of university reform, and the requisite adaptations have been made by many universities.

The prevalence of part-time teaching, a special aspect of the "multiple-job" mode of employment of many professional people in Latin America, has had serious adverse effects on the quality of teaching in many universities. The salaries paid to part-time professors have often been a token. This system was rational in earlier years, when the only practical means of obtaining faculty was to rely on the part-time services of people engaged in the practice of various occupations and professions. However, it is clear that today research and teaching of high quality require full-time dedication. Bio-medical research in Latin America has until recent years been pursued by the very few persons with professional prestige, who are usually situated in institutes either associated with or apart from universities. Adoption of the full-time system is a major prerequisite to full professionalism in the faculties of the universities.

The idea of a full-time career in research and teaching is relatively new in Latin America, and the idea has been translated into practice in comparatively few places. Science is in the

process of shifting from the avocation of part-time amateurs to the full-time task of professionals. The transition requires extensive institutional adjustments, changes in attitudes and in the location of authority, and a great deal of money. Hence the process of shifting to the establishment of professional scientists as a reorganized class—numerous, respected, well rewarded, well equipped and housed, and established in stable institutions—can be expected to continue over a long period.

The sporadic and discontinuous character of research in many universities has been a handicap. This discontinuity is traceable in large part to the dominance of individuals; to the absence of a system, which leads to perpetuation of an outdated research tradition; and to simple intellectual pre-eminence. Sometimes younger leaders have not been trained to take over, and institutes and departments have therefore become intellectually moribund.

The prestige of a university degree and the development of a middle class have combined to generate a tremendous rise in enrollment in most Latin American universities. Few restrictions have been placed on enrollment. Classes of thousands of students have not been unknown. Entrance examinations have seldom been required, and students have rarely been dismissed because of failure. Since it is impossible to meet adequately the needs of large student bodies with professional staff and facilities adequate only for normal-size classes, research obviously suffers. The use by teachers of part of their time for research has been strongly criticized by students in some universities, who called it unnecessary "scientificism." There have been instances in which students have prevented the acceptance by their universities of donations for research, especially if the funds came from foreign sources.

The career question is closely linked to the prevailing system of prestige and awards. Only recently has the scientist in some Latin American countries been accorded the standing given to physicians, lawyers, and generals. In contrast with Europe, the United States, and

other countries with advanced scientific structures, science does not rank near the top of the occupations that command the highest prestige. Students see few examples of full-time scientists who earn a decent living. This part of the problem is typically traceable more to custom, forms of organization, and government budgetary practices than to poverty.

The system under which the government of universities is shared by faculty, students, and alumni is found in many universities. This system has deep and complex roots and also important effects upon virtually all universities so governed. Generally, though not always, the system of co-government acts to restrict the development of research. This is because of widespread emphasis on the need to improve the quality of teaching and the capacity to teach more students, combined with erroneous notions that any research detracts from, rather than enriches, teaching. The foreign origin of much financial support for research has also generated opposition to research in some universities with a system of co-government.

With all their handicaps and difficulties, the universities are important in every country, and in many they constitute, in total, the most significant site for research. There is a keen desire among members of the faculties at all levels to expand and develop research. However, many universities have historically had a struggle to establish faculties of science and to maintain freedom from political influence. Their autonomy is therefore jealously guarded. Separate faculties or schools often have research committees, but in general it is the individual faculty member who determines the topic of his own research. Support for it is derived at times from university funds but for the most part from abroad. Under the circumstances it is surprising that so much good work is done, but it is not surprising that for the most part there is a tendency to over-emphasize laboratory research.

Most biomedical research in universities is conducted in medical schools, and attention will be turned first to them. These schools have

been strongly affected, like the universities as a whole, by the rapid rate of increase in the university-age population, by the emergence of a more numerous and powerful middle class in many countries, and by the accompanying pressures to increase tremendously both enrollment and the number of professional schools. Thus, in the middle of 1960, for a population of approximately 202.5 million there were 88 medical schools in all Latin America; by early 1964, there were 108; and during the past year at least 3 or 4 more have been in the process of formation. The recently inaugurated schools are for the most part employing new systems of education.

Although it has been found extremely difficult to introduce major reforms in the traditional patterns of the well-established schools, such changes are more easily brought about in the newly formed schools. Some examples, which are illustrative rather than comprehensive, will illustrate this point. In the Faculty of Medicine of Ribeirão Preto of the University of São Paulo, established about 12 years ago in a rural area in the interior of the state, the entire faculty, preclinical and clinical, is full-time. This medical school has its own hospital, completely staffed by full-time personnel. The University of Brasília also has a modern structure, and extensive changes are being made in the structure of the University of Brazil in Rio de Janeiro. In Venezuela, the new University of Oriente, in Ciudad Bolívar, is experimental in nature. All the students there are required to take two years of basic courses (except premedical students, who take only one year) before entering one of the faculties. Members of the staff of its Faculty of Medicine are all full-time and are carefully chosen for their research interest as well as for their training and teaching ability. The faculty also has its own modern 400-bed teaching hospital, in which a great deal of emphasis is given to community health. Where research-minded people cannot be found among Venezuelan nationals, the school is hiring foreign staff members.

The University of Valle in Cali, Colombia,

is another institution in the forefront of development. The medical school in Cali is strong in breadth and in depth. With substantial aid from the Rockefeller Foundation and with outstanding leadership, this medical school has become in many respects a leader for the Hemisphere.

In Argentina, new private universities are being formed to try to bring about necessary and sought-after reforms. One of these, the University of the Saviour in Buenos Aires, started functioning in 1959, under Jesuit auspices, as soon as the law that expressly forbade the establishment of private universities was changed. Again in Buenos Aires, a group of clinical researchers, who had formed a Center for Medical Education and Clinical Investigation (CEMIC) in 1958 in one of the hospitals under the Ministry of Public Health, have successfully raised funds from private sources to build a hospital and nursing school that it is hoped will serve as a standard for other hospitals and for fine postgraduate training.

In Chile, the Institute of Sciences was established in 1962 as part of the University of Chile to train basic scientists. Its staff is being carefully selected from any of the already existing faculties, and all are on a full-time schedule. The objectives, as given in the charter, are to stimulate studies and research in various fields of science and to provide teaching and training that will lead to academic levels in science with which to improve higher education. It is hoped that students graduating from the basic course will either continue for their M.S. or Ph.D. or enter one of the other professional schools of the University. Although some of the faculties are disturbed over the loss of good members of their staffs, it is expected that in relatively few years the Institute will be graduating high-caliber personnel in adequate numbers to assume positions in faculties throughout the country.

There thus exist numerous points of university and medical-school excellence that provide practical demonstrations of the policies needed to elevate standards of teaching and research.

How each university and each country is to adapt its institutions to take advantage of general principles whose utility is clearly demonstrated remains ultimately a responsibility of each country, and to a substantial degree of each institution.

Biomedical research is also conducted in faculties other than those of medicine. It is interesting to observe that schools and institutes of agriculture and animal husbandry in many countries carry on research of high quality and devote their efforts to problems of practical importance to the nation. Some possible reasons are evident. The agricultural and veterinary schools are relatively new. They are typically less bound by tradition. A larger proportion of their staffs have been trained in an environment in Europe or the United States that places high value on the practical applications of research. Medical education is often almost totally oriented toward clinical medicine and private practice rather than toward research and service. Schools of veterinary medicine and agriculture, because they tend to be located in the provinces rather than in capital cities, are freer to concentrate on their essential tasks.

5.4 Institutes

Biomedical research in Latin America cannot be discussed without recognition of the predominant role of research institutes. To recall the outstanding achievements of biomedical research is to recall outstanding individuals and the institutes with which they have been associated. Given the disabilities under which traditional-minded universities have suffered in the age of modern science, the research institute outside the university has provided the major institutional form within which the prerequisites for high productivity in science could be met. These peaks of excellence have achieved the status of world centers in their fields. They are integral parts of the international network of laboratories pre-eminent in specialized fields. Their staffs—senior and junior—

move freely among the key laboratories of the world, and collaborators from these laboratories are always found at work in the pre-eminent institutes.

It is difficult to identify these institutes by name because, on the one hand, a complete catalogue is impossible and, on the other, an illustrative listing will omit some institutes comparable in excellence to those mentioned. Nevertheless, specificity is necessary to make concrete, for those who do not know the situation well, the identity of some of these strong points. The National Institutes of Nutrition and of Cardiology and the National Institute of Scientific Research of the Children's Hospital in Mexico come to mind. In Brazil, the Butantan Institute, the Adolfo Lutz Institute, and the Institute of Microbiology of the University of Brasil are prominent in various areas of investigation relating to tropical medicine. The Institute of Biophysics of the University of Brazil is an outstanding center of basic research. In Buenos Aires, the Campomar Foundation Institute of Biochemical Research and the Institute of Biology and Experimental Medicine are famous throughout the world.

Maintenance and strengthening of the assets represented by outstanding institutes should be a central element of national research policy.

At the same time, the fact that a research organization is called an "institute" is not a guarantee of excellence. In fact, institutes differ so widely that the word really does not describe a single homogeneous class of institutions. A few institutes are privately financed; most are publicly financed. Some are large, and some are small. Some are completely divorced from universities and have extremely limited teaching functions; some, on the other hand, are integral parts of universities and the use of the word *institute* is simply a means of emphasizing an area of teaching and research. Institutes have a variable degree of autonomy. In addition, they are not static. Like all institutions, they can grow or diminish in strength over a period of time. There are examples of very strong institutes whose

productivity has declined. Often this is traceable to the loss of an outstanding leader or to a shift in aspects of scientific growth without a corresponding shift in the institute's approach. Other institutes have flourished and continued to grow in quality, in breadth, or in both. Institutes face the problem of self-renewal and of transcending their dependence on individuals. Many have solved the problem and have become, as far as can be judged at a given time, permanently strong centers of investigation. Achievement of this goal depends on sustained, wise leadership.

The relationship to the universities of institutes that are not part of them requires special mention. These institutes have historically been a means of establishing centers for full-time research of high quality, generally depending on the great talents of a single person or a small group, when conditions were such that a new institution was required. Often the universities have not, in fact, provided the fundamental elements prerequisite to modern research—salaries high enough for full-time work, administrative freedom to organize for research and to provide research service adequately and promptly, sufficient space and equipment and freedom from excessive teaching requirements. These reasons for establishing research institutes outside of universities are not unique to Latin America. In Australia, for example, biomedical research was first established on a substantial scale in institutes separate from universities, and the example of the Kaiser Wilhelm and the more recent Max Planck institutes in Germany is well known. In both cases, as has been true to a substantial degree in Latin America, the development of institutes outside the standard university structure reflects the rigidity of the latter and its inability to adapt to new developments in science.

However, the question is not whether the autonomous institute or the university is the "better" form of organization. There is no theoretical and no practical answer to this question. The indicated course of action is to define goals, to determine the essentials re-

quired to achieve these goals, and then to use, modify, or create the institutions best adapted to the purpose. In this perspective, it is clear that the best institutes should be cherished and strengthened. At the same time, the individuals and private organizations concerned, and the governments, face the practical problem of restoring vigor to institutes that have become less effective over the years. Similarly with universities: the preceding section has noted both the indispensability of this tried and

tested institution over the long run and also the extremely difficult practical problems in lifting many universities from the realities of their present capability and outlook to the ideal model of the university in the modern world.

If any generalizations are possible in this complex of problems, it is probably that both institutes and universities are required and that both of them must, in different ways, participate actively in research and in teaching.

6. ORGANIZATION—NATIONAL FUNCTIONS

6.1 Introduction

While research is conducted by individuals and groups that are situated physically and administratively in university faculties or in institutes, their work is influenced by a superstructure of national groups of various kinds. This superstructure typically deals with more general problems than those dealt with by scientists as scientists or by the institutions in which they work. The establishment of a productive national structure for biomedical research, or for all research, is a difficult matter. No nation has evolved a system with which it feels fully comfortable. A sense of experimentation arises from the fact that only recently has the significance of the interrelationships between science and national policy been recognized. A sense of uneasiness arises from the fact that national science policy is the interface between science and politics.

The meaning of *national policy* is elusive in any field, and the meaning of *national policy for research* is no exception. A useful definition of national science policy is "the totality of actions deliberately taken by national governments with respect to research." These actions include the decisions arrived at as a consequence of the interaction of individual ideas, organizational interests, the limitations imposed by shortage of resources, the compromises necessary when scarce resources must be allocated, and the general cultural and political forces that bear on decisions. It is worth noting that these decisions are made in all countries. In this sense, as has been said above, every nation has a science policy consisting of *de facto* decisions. If the decisions are to be

sound and the government's choices intelligent, deliberate attention must be paid to these matters at the national level. Attention can be centered on them adequately only if there is some machinery available for collecting the information prerequisite to rational examination of the issues and if some governmental device or devices exist for exposing the choices to be made.

No single organization should perform these tasks in any country, and structures will differ among countries. Yet there are common forces and principles, and these are outlined below.

The major conclusion to be drawn from a close examination of the question of a structure for science policy in ten Latin American countries is that few have paid deliberate attention to the development of science—including biomedical science. The development of science is seldom included in the general development plans they have been drafting in accordance with the recommendations of Punta del Este. Nor have steps been taken in many countries to strengthen science deliberately through national activities not encompassed within formal development plans.

6.2 Ministerial activity

In most Latin American countries, the university systems are linked to the government through the ministries of education. The actual relationships vary, in different countries and at different times, from active ministry support of universities through neutrality to the imposition of bureaucratic red tape and political interference. All in all, there is a need for a

sustained, far-seeing, stable statesmanship on the part of ministries of education that will be helpful in university development.

The ministries of health are more significant for biomedical research than the ministries of education are. The ministries of health of the various countries differ in the degree of their involvement in research. The majority participate through research institutes and schools of public health, and through support of specified field-research programs in faculties of medicine. In these cases, however, there is obviously opportunity for significant development. Ministries might make greater contact with schools of public health (where these are separate from the ministries) and with the departments of preventive medicine in faculties of medicine. Their combined efforts and the facilities available (e.g., local health units, laboratories, hospitals, and record systems) would make practicable much greater study of local communities, which in most of Latin America are undergoing rapid change. Studies of morbidity and mortality rates, record systems, the epidemiology of diseases, demographic changes, states of nutrition, and health education and disease control programs are examples of the kinds of joint activity that would contribute significantly to student training and to communal knowledge. Undoubtedly, this kind of data collection would in itself generate as many questions as answers. In this connection, it is important to recognize the need for marked development of the social sciences in Latin America and to recognize their potential contribution to public health research.

One aspect of public health research that needs sponsorship at the ministerial level is administrative research. This entails studies of costs for particular services, travel distances, and so on, and when effectively performed yields invaluable information relating to the economic and efficient use of limited funds. Such information can be made applicable to a variety of planned or proposed services and differs from public health program evaluation.

In general, the conduct of research in the hospitals of the social security systems and

national health services is in its infancy. However, these hospitals employ a large proportion of the trained medical manpower of many nations, and they are more or less well financed. It would be a matter of wisdom to encourage these physicians to undergo periods of post-graduate training in universities or research institutes that can offer it.

As a general rule, most biomedical research is not conducted in establishments responsible to the ministries of health. The institutes are generally autonomous, as are university faculties, even though they are generally state-financed and even though the universities are often placed administratively in ministries of education. This arrangement is commonly considered preferable to placing all biomedical research under the control of the ministry of health.

6.3 Scientific societies

Scientists in virtually all the Latin American countries have recognized the importance of private professional associations. The professional society plays a unique role by providing the individual scientist and those who speak for working scientists with a means of communicating more effectively with their fellows and for expressing the views and advancing the interests of their specialties. Although in practically all Latin American countries there are societies that deal with biomedical problems, their scope is usually local, and some of them, furthermore, are more interested in the "practical" problems of professional practice than in scientific matters. There are only two major organizations that group together societies of the different countries—the Latin American Society for the Physiological Sciences, with headquarters in Uruguay, and the Latin American Microbiological Congress. Both are of recent foundation: the first in 1956 and the second in 1958.

Academies of medicine and similar societies usually limit their activities to the organization of scientific meetings, the publishing of

journals and memoirs, and frequently the dispensing of scientific awards. There is, however, the exception of the Argentine National Academy of Medicine, which supports two special research centers—the Institute of Cardiology and the Institute of Hematology.

These academies and scientific societies, many of which have prestige and distinguished leadership, should constitute centers of stimulus, clearinghouses for ideas, and foci of professional goals, not only for their members but for other scientists as well.

There is a need for more societies that would encompass the activities of several countries and for better planning of the publishing activities—on a regional or continental basis. There is also a need for rejuvenation of some of the societies.

Assistance to make possible the holding of Latin American congresses and meetings should be encouraged. Usually Latin American scientists do not know each other, and if they do become acquainted their introduction very often takes place in the United States or in Europe.

6.4 National research organizations

6.4.1 Functions

Most countries with extensive research activities are discovering the usefulness of some organized means of dealing with fundamental issues relating to science development. Traditional academies of science are not best equipped to perform this function because they tend to view science solely in its own terms and not in terms of the social, political, economic, and administrative complex within which it operates or in terms of its social functions. Professional societies are too specialized. Ministries are primarily concerned with their operating functions, and they are subordinate parts of government.

Accordingly, new organizational forms to deal with science policy are evolving and their growing significance is recognized throughout

the world; these can be called "research councils" for convenience, even though their names and characteristics vary widely among countries.* The general function served by these groups is to provide a setting in which science can be considered as part of society, in which the roles of various institutions in science can be examined, in which thought can be given to means by which science can best be developed as science and as an instrument for elevating levels of human welfare, in which the resources available for and necessary for science can be estimated, in which the relationships between science and education can be assessed, in which the desirability and characteristics of common national measures for science can be discussed, and in which some elements of programs for the development of science can be administered. One important role for a national research body is to serve as an effective link between individual scientists, their societies, and the universities and institutes on the one hand and international organizations on the other. The facilities, resources, and influence potentially available to the scientific efforts of individual countries can be provided most easily and most effectively if the international organizations have some group to which they can turn in each country. Conversely, the needs of each country can be expressed most coherently and effectively through a national body. The existence of such a body should by no means preclude other approaches, but two-way communication is speedier and better if a national body exists. Not all these functions need be performed by research councils, and others not listed may be performed, but this brief inventory indicates the general nature of the tasks that can be carried on by research councils.

* *The Organization of American States and the Development of Science: Final Report of the OAS Advisory Committee on Science Development*, Pan American Union, Washington, D.C., 1959, pp. 20 and 38. Organization for Economic Cooperation and Development, *Science and the Policies of Governments: The Implications of Science and Technology for National and International Affairs*, Paris, 1963, pp. 37-45.

6.4.2 Characteristics

Even though the nature, authority, functions, and structure of research councils differ widely among countries, enough experience has been gathered to establish the validity of a number of basic principles:

a) Biomedical research should be considered in the context of science generally, not dealt with as a separate matter.

b) The training of scientists and the conduct of research should be considered together.

c) The group—National Research Council or whatever it may be called—should not be part of any ministry, since its functions cut across many ministries. It should report directly to the chief executive.

d) Research activities should be fostered and encouraged in many ministries and in universities and institutes. Research should not be concentrated in a ministry of science.

e) A national group should represent the need and aspirations of provinces as well as of the national capital, and the membership of the group should reflect this diversity.

f) The group should have a small full-time staff and an operating budget for modest studies, committees, travel, and so forth.

g) It is useful for the group actually to administer science research grants and fellowships and exchange professorships, even if the programs are small. The operation of such programs tends to keep the group in touch with the real problems of universities and other research organizations. Such funds can be very useful in meeting high-priority needs that cannot be met by other sources, domestic or foreign.

h) The members of the group should be predominantly but not entirely scientists. The chairman should be a scientist who commands respect in the nation and internationally, among nonscientists as well as scientists.

i) The group should act as a national voice for science, undertaking to educate the general public and the political community and to develop a reasonable sense of unity within the scientific community. A national intellectual

common market is a goal that many nations have not yet achieved, and such a group can contribute to this end.

j) Deliberate efforts should be made to involve a large number of scientists from a wide variety of disciplines in the affairs of the group, particularly in studies of various fields and in the allocation of research funds and fellowships.

k) To be effective, a national research council need not deal comprehensively with all problems of science policy but can work productively in certain strategic areas such as the improvement of training opportunities and the establishment of better career prospects.

l) The group should place high priority on the quantitative assessment of resources for research.

6.4.3 Significance of study of resources

The final point deserves amplification because of its significance both to countries that are considering the establishment of research councils and to those that have already established them.*

The significance of such information has been stressed in a study of science and the policies of government:†

Informed policy decisions must be based on accurate information about the extent and forms of investment in research, technological development, and scientific education. There must be data available on numbers of persons engaged in the various activities, on research and education budgets, and on expenditures for technological development. Data must be broken down into appropriate categories, and should preferably be comparable from nation to nation. Such statistics are inadequate in many countries and virtually nonexistent in some, partly because there are few bodies specifically charged with collecting and analysing them, and partly because considerations of privilege make them difficult to acquire, particularly from

* A recent example of such a study is *Bases para la creación de un Consejo Nacional de Investigaciones Científicas y Tecnológicas en Venezuela: Informe que presenta la comisión preparatoria designada al efecto*, Caracas, junio 1964.

† Organization for Economic Cooperation and Development (OECD), *Science and the Policies of Governments*, op. cit., p. 24.

industry and the military. Provision for compilation of such data is an indispensable prerequisite to formulating an effective national policy for science.

Carefully analyzed data can be helpful in these ways:

a) They can set a steady course for the development of science by making it clear how resources have been allocated. When a country has a very large and diversified scientific effort, the interplay of numerous powerful forces tends to exert a stabilizing influence that can prevent major errors in national policy without stifling diversity and initiative. When a country's scientific effort is smaller, the avoidance of mistakes may be more difficult and the consequence of a single error (such as overinvestment in physical facilities) can be more serious.

b) They can indicate the resources available for research in terms of professional talent, facilities, and funds, and thereby furnish a guide to rational priorities for investment in facilities, training of manpower, or equipment.

c) They can provide a rational base for considering the current distribution of national scientific effort by field of inquiry and by types of institutions.

d) By showing the total national investment in science as a percentage of the national budget or of the gross national product, they permit comparison of the intensity of scientific effort in relation to that of other countries.

e) They make possible an assessment of national investments in health research as against other kinds of national investment (for agriculture, communications, education, and so on) and as against investment in other types of research.

f) They provide a means of judging in quantitative terms the rationality of patterns of investment in health research in relation to national needs and goals by measuring investment according to field of research (communicable diseases *versus* chronic diseases, for example).

g) They contribute to the education of scientists, the general public, and political leaders and indicate to potential sources of aid

to science in other countries the total dimensions and distribution of scientific effort.

It is somewhat difficult for countries to begin to collect such information. Data must be collected from diverse sources, and access to information is not always easy. Problems of establishing definitions, and of securing common understanding of definitions, can be imposing. For example, what part of the salary of professors engaged in teaching and research should be considered a research cost? How are distinctions to be made between current and capital costs? Nevertheless, the only way to obtain the data is to start, recognizing that at first they will be rather rough. In starting, the experience of countries that have undertaken the task provides practical guides:

a) The first efforts in either direction—the study of resources or the strengthening of mechanisms—are not likely to be entirely successful. Persistence seems to be a necessary virtue.

b) The willingness of a group of leaders to devote a good deal of time to the effort seems indispensable.

c) A good study is costly, more in terms of contributed effort than in terms of actual expenditure of money. Most of the money expenditure will probably be required for the salary of a full-time executive secretary.

d) A competent full-time staff is necessary. At least one person, preferably a scientist or an engineer with an interest in science policy, is indispensable.

e) The cooperation of all major organizations involved with science—governmental and quasi-governmental—is desirable. It is generally difficult to establish a study group that will be regarded as providing balanced representation of all interested groups, but the group must at a minimum be so composed that its findings are broadly acceptable.

f) The study should be under the direct auspices of the head of state or prime minister.

g) The existence of a solid statistical base is desirable but not essential. It is a great advantage to have such figures as the numbers of people with academic training in various dis-

ciplines, measures of national economic output, and reasonably accurate measures of national expenditures for research.

h) There must be a substantial and reasonably diverse national science structure, including at least one well-developed university, before a survey is worth while.

i) Technical assistance from other countries and from international organizations may be helpful in assessing national scientific resources.*

Venezuela has recently completed a full study of its human and material resources for research. Mexico and Colombia are engaged in intensive studies of human resources.

6.4.4 Existing Organizations

The national bodies that have the characteristics of research councils fall into two groups—those that perform specialized functions and those that perform a wide array of functions. It is not possible to prepare a full list of these groups, particularly those that perform specialized functions, because the definition of a "national body" must be somewhat arbitrary. Moreover, the organizations change, and new ones are formed from time to time. Therefore, the descriptions that follow are intended to be illustrative and to indicate patterns, rather than to represent a full catalogue of organizations.

Of the organizations that perform some of the functions of a national research council, those dealing with manpower questions are probably the most numerous. This is logical, since the training of manpower is a central problem in most countries. The Colombian Institute for Advanced Training Abroad

(ICETEX; see Appendix B) ranks with the CAPES organization of Brazil (see Appendix E) in terms of its powerful influence on the training of manpower. It is vigorous, is relatively well financed (with a budget of about 3 million dollars a year), and conducts varied activities ranging from the provision of fellowships to assistance to other countries that have wished to create similar organizations. The only organization in Mexico that has functions approaching those of a national research body—the National Institute for Scientific Research (INIC)—actually concentrates upon the granting of fellowships (see Appendix C). With a budget approximating \$300,000 a year, it cannot now fully meet the needs of students for support. In the future, however, it may well evolve into a fully functioning national research body.

A primary task for the future is to strengthen the relationships between what might be called the "supply function"—the provision of training opportunities through fellowships and other means—and the "demand function"—the provision of opportunities for jobs and careers in various specialized fields. The weakness of the relationship between supply and demand is characteristic of many countries, as has been said. One of the strongest arguments for establishing a national research body with broad functions is that such an organization can deal more effectively with the interrelated questions of supply and demand. At a minimum, the national organizations dealing with manpower questions should maintain very close relationships with the organization—or organizations—that know about or can influence demand for people in various specialties.

So far as organizations with general national responsibilities for science are concerned, four exist. The strongest are the National Council for Scientific and Technological Research of Argentina (see Appendix D) and the Brazilian Research Council (see Appendix E). The Mexican National Institute for Scientific Research serves general national functions, as noted above, but its operations are in fact confined largely to the provision of fellowships.

* UNESCO (Place de Fontenoy, Paris VII, France) and the Department of Scientific Affairs of the Pan American Union are prepared to consult with countries that wish to review the status of their scientific efforts. A professionally prepared manual of instruction is available to countries that wish to measure their scientific and technical activities—a monograph entitled *Proposed Standard Practice for Surveys of Research and Development*, prepared by the Directorate for Scientific Affairs of the Organization for Economic Cooperation and Development (Chateau de La Muette, Rue André Pascal, Paris, France).

Finally, Trinidad has a research council, and the Standing Advisory Committee for Medical Research, in the British Caribbean, actually performs as a regional research council for the biomedical area.

In some countries there are national biomedical research programs under the auspices of varied forms of social welfare organizations. These are not national research councils in the generally accepted sense, but they are nevertheless an important part of a number of health research programs. Among these are the National Health and Welfare Fund of Peru (see Appendix F) and the Mexican Institute of Social Security (IMSS); see Appendix G). Such organizations typically concentrate on clinical research because of the training of the staff and the availability of patients for study in the hospitals operated by the various welfare organizations.

Chile, Peru, and Venezuela are formally considering the establishment of full-fledged national research councils, and this subject is of such wide interest in Latin America that studies may be in progress in other countries.

The National Council for Scientific and Technological Research of Argentina was formed in 1958 under the leadership of Dr. Bernardo Houssay. It has served science in Argentina in a most impressive way, first by helping universities and research institutions to establish a stronger intellectual base in the early years of its existence. The Council provides grants for research (about 400 in 1963), for fellowships in Argentina (about 500 in 1963) and other countries (about 350 in 1963), and for the career support of investigators (about 250 in 1963). The last of these has been a particularly important means of ensuring salaries adequate to permit selected investigators to remain in academic teaching and research. The Council is supported by government funds, but its decisions relating to the distribution of funds are made by representatives of the scientific community.

While the Council supports all fields of science, it has concentrated on medicine and biology. In 1963, almost half of the fellowships,

about 40 per cent of the research grants, and 60 per cent of the career awards were in these fields.

Apart from the significant support function, the Council has served as an important agent for expressing the needs of science and for providing a better system of scientific communication. The net effect of all of these activities has been to afford science substantial, though not complete, protection from economic and political difficulties. All this has been accomplished on a budget amounting to about 3 million dollars in recent years, which demonstrates that much can be accomplished with a relatively small investment and that no nation need be intimidated by cost when it is considering extension of the support for science through establishing a national body.

The National Research Council of Brazil has also been a significant factor on the national scene, although it has not in fact administered programs with the breadth of those managed by the Argentine Council. In Brazil, however, as contrasted with Argentina, there has existed a separate national body for the training of advanced personnel (CAPES), which works closely with the Council. CAPES has had an extraordinarily important influence on the development of scientific personnel in Brazil, primarily through the provision of fellowships.

CAPES had a budget of about 3.2 million dollars for 1965 (with the exchange rate calculated at 1,850 cruzeiros to the dollar). Of this, about 40 per cent will provide fellowships and another 40 per cent will provide equipment, personnel, and funds for graduate courses at selected institutions; 10 per cent will go for exchange professorships and meetings, and another 10 per cent for studies, publications, and administration.

The National Research Council of Brazil had a budget of about 4.2 million dollars in 1965 (at the same rate of exchange). These funds provide fellowships, research grants, assistance in importation of equipment, assistance for summer science seminars, and publication of texts. The Council also helps to finance a number of specialized research institutes, such as

the well-known National Institute for Research in Amazonia (including the Goeldi Museum in Belém).

It is probably not coincidental that the only Latin American municipal or provincial bodies for the advancement of science are in Argentina and Brazil. The strongest of these is the Foundation for the Support of Research of the State of São Paulo, Brazil, which has a budget approximating a million dollars a year. This organization is guaranteed an income equal to

.5 per cent of the state's budget. In terms of the needs to be met, this is the strongest research council in Latin America. Its existence and growth are attributable not only to the wealth of São Paulo but to the strong academic tradition of the state. The second local research council is the Research Commission of the Province of Buenos Aires, Argentina. While this organization is not as strong as the research foundation of São Paulo, it contributes substantially to the research of the province.

7. EXTERNAL INFLUENCES

7.1 Introduction

Heavy reliance on the resources of other countries and on extensive collaborative efforts is a fact of life in the biomedical sciences in Latin America. This reliance appears in two forms, which are interrelated. The first relates to North America and Europe, and particularly to the United States. The world center of gravity in most fields of science, including biomedical sciences, is now in that area. Students and fully trained scientists work for varying periods in the laboratories of Europe and the United States. Strong professional ties exist between numerous Latin American investigators and their counterparts in the northern part of this hemisphere and in Europe. Resources—funds, equipment, and supplies—are made available from those areas to laboratories in Latin America. Their bilateral relationships are discussed in this section.

There are, however, a number of important scientific activities that depend upon effective international, as contrasted with bilateral, arrangements. These international efforts are primarily Pan American, but also to some degree Latin American. In the next chapter, attention is centered on international activities.

One of the most difficult practical problems facing those who are responsible for the development of biomedical sciences—and, in fact, all sciences—in Latin America is that of finding an acceptable, productive, practical means of expanding international activities. This is true primarily for the basic reason that no Latin American country is large enough to develop within its own borders a full replica of world science, and even in fields of strength

each country depends on outside resources.

In spite of the undeniable significance of various kinds of international involvement in the development of all sciences in Latin America, it is well to bear constantly in mind that the foundation for productive development over the long run is within each nation. The whole effort in each nation continues to depend on the wisdom and foresight with which domestic affairs are handled. With sound domestic policies, international efforts can add a great deal. Without sound domestic policies, international activities tend to be episodic and ephemeral.

One obvious characteristic of the bilateral arrangement for biomedical research is the heavy involvement of the United States through both private and governmental channels. Many other nations have participated in this effort to establish and cultivate a field of learning, and much of the external assistance has been through international organizations. Still, the duration of the relationship with the United States, and the volume and diversity of the effort, warrant special description, not only because of their positive effects but because they pose particularly difficult policy problems for many Latin American countries.

7.2 Private foundations, particularly the Rockefeller

In the second decade of the present century, the Rockefeller Foundation began its important work of helping to deal with problems of public health on an international scale. It was influential in developing schools of public health

and in training a growing body of physicians, nurses, and technicians. It subsequently became involved in medical education and finally in biomedical research, with such important effects and important lessons that the story is worth recounting in some detail.

The story of yellow fever is an instructive case of the interaction between health protection and research. In 1923, the Rockefeller Foundation initiated the Yellow Fever Service in northeastern Brazil and in other Latin American countries, taking complete responsibility for its activities. After the surprise outbreak of the disease in Rio de Janeiro in 1928, the Brazilian Government, realizing that the control of yellow fever was a national rather than a local problem, took steps that resulted in bringing under one administrative head all responsibility for the investigation and control of this disease throughout the country. The Rockefeller Foundation remained a partner in the program for the eradication of *Aedes aegypti*, the urban vector of the disease, until 1940, when the Brazilian Government took over full responsibility for the National Yellow Fever Service at its own expense. As a corollary to the yellow fever program, a great deal of research was carried on that led to our understanding of the etiology, epidemiology, and prophylaxis of the disease, including the discovery of animal susceptibility, the rediscovery of the virus origin, the demonstration that other mosquitoes than *Aedes aegypti* can and do transmit the virus, the development of the protection test for determining immunity, the proof that unrecognized yellow fever is widespread, and the demonstration of the disease as one of jungle animals in many countries of South America.

The Brazilians used their experience to transform their expensive temporary *aegypti*-reduction campaigns for the eradication of yellow fever into economic permanent services for the eradication of the *Aedes aegypti* species itself. This Yellow Fever Service still continues as perhaps the finest organization of its type in the world, serving as a model for other similar organizations.

Efforts to control malaria again emphasize the interplay between control measures and investigation. In 1939, after the cataclysmic epidemic of malaria transmitted by *Anopheles gambiae* (introduced from Africa) threatened the population of northeastern Brazil and perhaps even more extensive areas, the Rockefeller Foundation joined hands with the Government of Brazil to organize the Malaria Service of the Northeast. Both contributed monetarily and with personnel to try to stem the tide of the malaria ravaging that part of the country. The Rockefeller Foundation took responsibility for organizing and coordinating the service, setting up the program for the training of personnel for field and laboratory work. At first, the Malaria Service of the Northeast had a free interchange of material and personnel with the Yellow Fever Service. The presence of the personnel already trained for a large control operation made possible the rapid success of the Malaria Service. In less than two years *Anopheles gambiae* was eradicated from Brazil. As in the case of yellow fever, a good deal of research was accomplished during the period of the campaign and continued thereafter. The Brazilians active in the yellow fever and malaria campaigns later developed into the most versatile and active persons in public health practice and training in the country. A large number are still engaged in research and have been responsible for the training of subsequent generations in many aspects of biomedical research. Many of them have had positions of great responsibility in the universities and medical schools.

As a result of these experiences with yellow fever and malaria, there was a kindling of interest in research and advanced training. At about this time, the Rockefeller Foundation offered numerous predoctoral and postdoctoral fellowships for study in the United States and became involved in the development of science departments and in supporting the research activities of exceptional individuals. It began its work at existing local levels and then attempted to contribute to continuing improvement. The programs ranged from the most

applied to the most fundamental research, with consistent emphasis on training so that there would be a constantly increasing number of persons contributing to progress in these fields. A large proportion of the Latin American leaders in biomedical science were recipients of fellowships or other support from the Rockefeller Foundation. Because of the flexibility of private foundations and their ability to earmark funds for long-term programs, the Rockefeller Foundation was able to offer stable support that is particularly important in the development of a department or institution or in highly experimental scientific projects. Through their use of "matching funds," they have done much to increase the involvement of Latin American institutions in supporting their own programs and scientists.

During the past two years, the Rockefeller Foundation has begun to withdraw from its traditional support of the biomedical fields, concentrating its efforts abroad on the conquest of hunger, population dynamics, and strengthening the developing centers of learning in the newly emerging nations, primarily in Africa. While the Foundation is continuing its support in Latin America for the development of a limited number of training centers in the biomedical sciences, the restriction of its program is having serious effects.

The change in the policy of the Rockefeller Foundation is counteracted somewhat, but not altogether, by the activities of other private foundations.

Foundations other than Rockefeller have been important in developing medical research in Latin America, although their approaches have been different. The Milbank Memorial Fund has stressed medical education and studies of national resources—particularly manpower. The Kellogg Foundation has been an important factor in stimulating research and training in public health. The Ford Foundation has invested substantial sums in university development, and particularly in the development of new patterns of graduate education in the sciences. Although the combined efforts of these foundations have not been directed

specifically toward biomedical research, they have played an important role in developing the people and the institutions that are indispensable to a sound medical research effort.

7.3 Governments, particularly the United States

A number of governments outside Latin America have provided substantial assistance to biomedical research in the area. However, it has not been possible to measure the nature and volume of this assistance except that part of it coming from the United States. Most of the aid from Europe is in the form of exchange of students and professors and in opportunities to use European research facilities. Spain, Portugal, France, Great Britain, and Italy are among the countries making these cooperative opportunities available.

One of the important enduring indirect effects of World War II on Latin America has been to reorient the entire scientific community from Europe to the United States. Before World War II, study and work in European laboratories and universities was the goal of most of the able advanced students in Latin America. During the war transportation between Latin America and Europe was disrupted, and only the United States was available for those who desired advanced work outside Latin America. During these years and later, science in the United States underwent a tremendous quantitative and qualitative expansion. The flow of students and professors to the United States continued and expanded after the war; the result was the establishment of a closely woven set of personal and professional relationships in all fields of science.

Since the biomedical sciences had developed most extensively in Latin America, these relationships have been most extensive in this field. They have been a fundamental fact in the external influences on biomedical research in Latin America over the past 20 years.

Various branches of the United States Government have provided a number of forms of

assistance to biomedical research in Latin America. The annual volume of support in the form of research grants and contracts approximates 3.5 million dollars a year, distributed roughly as follows:

<i>Agency</i>	<i>Amount (in millions of dollars)</i>
National Institutes of Health....	2.6
Department of Defense.....	.5
Other.....	.4
Total.....	3.5

The 137 research grants of the National Institutes of Health in fiscal 1964 were distributed as follows:

<i>Latin America</i>	<i>137</i>	<i>\$2,609,814</i>
Argentina.....	20	308,176
Brazil.....	30	299,872
Chile.....	13	166,886
Colombia.....	5	98,819
Costa Rica.....	2	23,065
Ecuador.....	1	13,370
El Salvador.....	3	44,903
Jamaica.....	4	36,627
Mexico.....	22	278,003
Panama.....	1	20,000
Peru.....	16	411,907
Uruguay.....	6	125,932
Venezuela.....	4	135,963
INCAP ¹	7	336,914
PAHO ²	3	308,898

The screening procedures of the National Institutes of Health are such that the awards to Latin American scientists are to investigators of high competence for studies of high scientific merit.

There is no doubt that the total pattern of relationships between the United States and Latin American countries in the biomedical

science has been productive for both parties, both directly and indirectly. In terms of science, the funds have provided a strong stimulus to productive investigators. In terms of advanced learning, those who have studied in universities and hospitals in the United States now form a substantial proportion of the leaders in biomedical research. This training has provided not only technical competence but also new views on the organization of universities and graduate education. Finally, learning is becoming to an increasing degree a two-way process, as more scientists from the United States establish collaborative relationships with colleagues in Latin American laboratories.

On the other hand, the assistance from the United States is not an unmixed blessing. Indeed, from the point of view of the United States—though not from that of the Latin American countries—the word *assistance* is a misnomer. Virtually all the United States research funds are supplied not to develop science in Latin America but to finance research of high scientific excellence that is relevant to the tasks of the various parts of the United States Government. They are, of course, extremely helpful to the individual investigators and to the laboratories receiving the funds. They also contribute to the development of science in the countries concerned. There are some administrative deficiencies—delays in payment, language problems, customs difficulties, and so on—but these are not basic. However, from the standpoint of the national policies of the Latin American countries, the fundamentals of the system itself are sometimes questionable. For example, the United States grants and contracts are almost entirely for highly sophisticated laboratory research. These fields are important in Latin America, but the characteristics of research supported from U.S. sources are not the same as would result from carefully considered national decisions made by the Latin American countries. As another example, the United States funds are typically made to the individual investigator without reference to university or national authorities. This is often a distinct

¹ Institute of Nutrition of Central America and Panama.

² Pan American Health Organization. These grants are administered by the Organization, and the research is done by Latin American investigators.

strength from the standpoint of science, because it protects the individual from various unproductive influences. However, the system makes no provision for the consideration of needs broader than those seen by individual scientists.

To the extent that the strengthening of science in Latin America, the use of science for national development in Latin America, and the use of science as a means of forging cul-

tural links between nations are an object of United States policy, the existing system of grants and contracts for biomedical research could be substantially improved. The general line of improvement can be indicated very simply: to adopt for part of the total U.S. activity the general policies, operating methods, and staffing patterns that have been evolved over years of experience by the Rockefeller Foundation.

8. INTERNATIONAL FUNCTIONS AND ORGANIZATIONS

Many problems of concern to the biomedical sciences in Latin America are best approached through collaborative international efforts, as contrasted with bilateral arrangements. The network of general and specialized organizations connecting the nations of Latin America and linking them with the United States and Canada is the oldest and in many respects the most seasoned and productive in the world. This is true in the area of health. In this section the rationale for international collaboration and the major characteristics of the Hemisphere system for collaboration in science are described.

8.1 An international intellectual common market

8.1.1 *The basic rationale*

Pooling of resources, enlargement of markets, free movement of goods among countries, enhanced opportunities to diversify and specialize as a consequence of wider markets are all contributing to economic growth, and these are leading towards the establishment of an economic common market for Latin America. The central idea of an economic common market should be adapted to the creation of a wider intellectual common market, building upon the excellent steps already taken.

Uneven distribution of resources—an opportunity, not a handicap: The absence of certain economic resources in a nation is not in any way a reflection on the ability of that nation to organize its economic system and to produce effectively. Rather, uneven distribution of resources is the condition that permits nations to concentrate,

to specialize, to exert productive efforts most effectively, and to obtain other resources and products through exchange on favorable terms. In an analogous way, nations cannot expect to have all branches of science and research developed to an equal degree. Intellectual resources, in terms of laboratories, outstanding leaders, and strong fields of research, are unevenly distributed just as all economic resources are.

These resources can be exploited, in the sense of being used most effectively, by expanding their capacity to serve as centers available to all nations in the intellectual common market. Joint planning for the use of these resources, under a general plan by which nations would simultaneously receive students in some fields and send students abroad in other fields, would benefit all the countries concerned. Each nation need not undertake to be equally strong in all fields, just as each nation need not undertake to produce all the economic goods it needs.

The kind of international exchange of brains proposed here is a way of expanding the effectiveness of limited resources for the good of all.

The intellectual common market as a means of expanding the area of self-sufficiency: The development of indigenous economic resources through the development of common markets is a means through which Latin American countries become less dependent on imports from countries outside the region and, in the long run, less dependent on imported skills. This does not mean a closed Latin American market, but it does mean that resources are husbanded so that the trade that does take place with countries outside Latin America is on the

most advantageous basis to all concerned. In precisely the same fashion, a more fully developed intellectual common market provides a means of developing indigenous talent in a manner that in the long run will decrease dependence on training outside Latin America and concentrate the use of resources for such training on those specific, highly specialized areas that are found in relatively few laboratories in the world. Conversely, the further development of unique centers of excellence in Latin America will make these few centers points of attraction for the scientists of the world.

A major consequence of establishing a stronger intellectual common market would be an increasing tendency to train students to the utmost possible extent in Latin America. Expansion of the ability to use the excellent laboratories of Latin America to the fullest for the training of students who now go outside Latin America would provide important dividends of many different kinds. For example, more students would learn of the excellence of Latin American research centers, and the custom of looking first for study opportunities outside Latin America would be weakened.

The establishment of a tradition of, and high prestige for, training in Latin American laboratories is most important. The constant presence of the best students in Latin American laboratories would tend to strengthen the laboratories themselves. Students would work in a Latin culture, and with colleagues with whom they would develop strong and continuing professional relationships. The training would be more economical, because two or three students can be trained in Latin America for every one sent to the United States or to Europe. Students could develop in an environment more closely related to the environment in which they will work subsequently. Fewer developing scientists would be tempted to emigrate if they got all but their most advanced training in Latin America. Finally, full use of indigenous training opportunities is not a kind of scientific isolationism or regional chauvinism but a rational use of opportunities and resources.

Concentration of training outside Latin America in those specialized, advanced fields that are not developed in Latin America represents the most rational use of scarce funds. Since points of outstanding excellence in science are found all over the world, it is not to be expected that the goal should be the elimination of exchange of students and professors on a world-wide basis. The more rational use of resources, with increasing capacity to train scientists in Latin America, should stimulate international exchange and make it more effective.

8.1.2 Existing Activities

The principle of the intellectual common market has been recognized and enunciated by informed and influential groups. It was, for example, the subject of a specific recommendation by the OAS Science Advisory Committee at its first meeting in 1958. The Committee proposed the "expansion of the support and activities of a relatively modest number of existing research institutes, with a view to using them as Regional Centers of research on an increasingly international basis."^{*} In 1959 the U.S. National Commission for UNESCO proposed that at least six regional research centers should be established, including centers for biophysics, biochemistry, and microbiology.[†] First steps have been taken in the direction recommended by these reports. For example, the Latin American Society for the Physiological Sciences has served as the agent to coordinate ten laboratories, and the Pan American Federation of Associations of Medical Schools has strongly urged this approach. In fact, all the strong centers of research in Latin America attract and welcome students and mature scientists. To take a couple of examples, the outstanding National Institute of Cardiology in Mexico City has welcomed 450

^{*} *The Organization of American States and the Development of Science*, op. cit., p. 43.

[†] National Science Foundation, *Science in the Americas: Papers Presented at the Scientific Section of the 7th National Conference of the U.S. National Commission for UNESCO*, Denver, Colorado, 1959.

foreigners over the last twenty years as specialists, professors, or investigators.* Of these, 350 came from other Latin American countries, 75 from Europe, 20 from the United States and Canada, and 5 from elsewhere. Other centers in Latin America, such as the Institute of Nutrition of Central America and Panama (INCAP) have a comparable experience, although generally on a smaller scale. In the Caribbean, the Trinidad Virus Research Laboratory serves as an important training ground for Latin American scientists and technicians in the field of virology, and the Puerto Rico Nuclear Center serves as a training center for nuclear physicists.

8.1.3 Next Steps

This pooling of resources might be made even more effective through such measures as a more pointed and organized effort to identify, through common agreement, those institutions, universities, faculties, laboratories, institutes, schools, or whatever they might be that have special competence in given fields of graduate education and research.

With respect to education, more extensive organized efforts might be exerted to send students from various countries to these centers for advanced training and research experience. The selected centers would, in turn, benefit from the presence of excellent advanced students from a number of countries. Those who completed advanced training would predictably be leaders in later years in their own countries.

With respect to research, the strong centers in various countries in selected fields can serve as a framework for the development of investigation on a broader basis than is possible when the laboratories are not closely related. Laboratories, and individual scientists, must retain their individuality and the capacity to carry out their own ideas. But easy association of investigations and students with colleagues in other

laboratories can provide a strong stimulus to the development of ideas.

The places that are strong in special areas of investigation are with rare exceptions also the places that are best suited for advanced training in these same areas. As a general rule, the use of these centers for education and for research should be considered together.

This report deals only with health-related sciences, but the basic idea has broader applicability and might well be pursued in other fields of science.

Just as an economic common market does not mean economic isolation, a wider intellectual common market should not mean intellectual isolation. Important goals, significant economies, and more effective use of scarce resources can be achieved by concentration on the Latin American aspects of intellectual exchange. Other goals, such as the need to train a few people in highly specialized fields not represented in Latin America, can be achieved only by wider involvement of people and institutions. Attention to the productivity of a wider Latin American common market should not divert attention from the importance of sustaining close relationships with world science. Careful scrutiny of tasks that can be more effectively performed within Latin America should simultaneously highlight the aspects of research and training that depend vitally on the strengthening of Hemisphere and world ties. This review of function should provide a guide to organization and structure, with the general presumption being in favor of a Pan American approach as contrasted with separate Latin American and North American approaches.

8.2 International organizations

To meet the needs for international collaboration in research, the Hemisphere has at its disposal a network of international organizations, some of which are world-wide and some focused on the Hemisphere.

* *The National Institute of Cardiology in 1964. On the Twentieth Anniversary of the Foundation.* Report by Dr. Ignacio Chávez, Founder and Honorary Director, p. 70.

8.2.1 *The Organization of American States*

One of the most influential factors in bringing about changes in the educational and research scene in Latin America is the existence of the international agencies that deal with the problems of the Americas as a whole. The Organization of American States came into being in 1948, its charter providing that the Pan American Union, functioning since 1890, should serve as the General Secretariat of the Organization, with its headquarters in Washington, D.C. Early in 1958 the Secretary General of the OAS invited a group of about 20 distinguished natural scientists from Latin America and the United States to advise on a program of science development that could be carried out by the PAU and the OAS. This first meeting of the group, which was called the OAS Science Advisory Committee, was held at the National Academy of Sciences in Washington under the joint auspices of the OAS and the Academy in June 1958. One of the outcomes of this meeting was the establishment of the PAU Department of Scientific Affairs. Its activities can be grouped around (1) the improvement of pre-university and university-level education in the biological and physical sciences, mathematics, and engineering; (2) promoting basic and applied research; and (3) dissemination of science information. The Department has sponsored technical meetings and symposia in the sciences and in the peaceful application of nuclear energy. It has been publishing the science information newsletter *Ciencia Interamericana*. It has sponsored special advanced courses and has given assistance for summer institute programs. There are also three general programs of the Pan American Union that have supplemented the work of the Department so far as the biomedical field is concerned. These are the OAS Fellowship and Professorship programs and the Exchange of Persons program. Since the programs encompass a wide variety of fields, only a relatively small part of the total funds goes into support of the biomedical fields. However, through programs in the basic sciences, science

institutes to help improve secondary-school teaching, inter-American conferences on teaching, and other peripheral programs, the OAS is helping to improve the scientific milieu and the essential foundation in basic education and training on which all specialties are based. Many of the programs under the auspices of the OAS may receive special support, either monetary or technical, from private U.S. foundations, from the National Science Foundation, or from some of the institutions in the member nations.

8.2.2 *The Pan American Health Organization*

As early as 1902, the Latin American republics joined together to form the first international organization in the field of health, the Pan American Sanitary Bureau. In 1949 this entity, the executive organ of the Pan American Health Organization, assumed the additional role of Western Hemisphere Regional Office of the World Health Organization. The experience of health-related professionals from different countries working together toward a common goal served to point up deficiencies in the public health practices of one country or another and in the teaching and research that lead to the practical applications. Representatives and employees of the PASB visited the member countries; many had the opportunity to take graduate work in public health in the schools of the United States, all leading to an appreciation of improvements that could be made in the fields of medicine and public health in the various countries.

With the accelerated development of science, increased industrialization, and the tremendous and continuing rise in population, attention to health and the health-related professions and sciences has been intensified. The Pan American Health Organization has been the principal entity involved in Latin America. When, in 1949, it assumed the role of the Regional Office of the WHO, it accepted further responsibilities. Agreements at about the same period with the Organization of American States and subsequently with the Inter-American Development Bank gave it an even

broader base of operations, with much more diversification than in the original charter. Within a very few years, because of the requirements of the member nations, PAHO was charged with the following responsibilities: to make available consultants in the fields of public health administration, environmental sanitation, eradication and control of communicable diseases, nutrition, medical care, nursing, public health education, veterinary medicine, health economics, dentistry, and mental health; to help in the education and training of professionals; to directly run various research centers; to stimulate national efforts in various fields of research; to coordinate the international public health efforts in the Americas; to coordinate information and epidemiological and statistical services and try to establish standards; to help support various activities of the member countries, such as publications of studies; to back seminars; and to provide coordinated information on training opportunities.

Only recently has research emerged as a major activity of PAHO. In 1962 the XVI Pan American Sanitary Conference approved the establishment of research as a major item in PAHO policy. The Task Force on Health at the Ministerial Level, established through PAHO in accordance with the Charter of Punta del Este (Alliance for Progress), resolved, at its 1963 meeting, to make the best possible use of knowledge obtained through scientific research for the prevention and treatment of diseases. It was realized that health progress must rely heavily on improved knowledge of the life sciences and that biomedical, engineering, and sociological research was needed to provide the necessary knowledge. In 1962, with the help of a planning grant from the National Institutes of Health, the Pan American Health Organization established its Office of Research Coordination and appointed experts to its Advisory Committee on Medical Research. By 1964 the research program of PAHO consisted of 45 projects involving the participation of scientists and institutions over the entire Hemisphere. PAHO is of the opinion that its involvement in research in Latin America

should be primarily with that which engages several investigators in different countries, leaving support for the research of a single individual or laboratory group to others.

One of the most productive international efforts in which PAHO has taken part has been the establishment of the Institute of Nutrition of Central America and Panama (INCAP; see Appendix H). This international laboratory concentrates on applied research relating to the nutrition of low-income groups in Central America, a practical problem of the first importance. The Institute, located in Guatemala City, is well equipped and staffed by a competent and diversified group. One of the major accomplishments of the laboratory has been to develop a very low-cost source of high-quality protein and, equally important, a product so acceptable that it is now being commercially produced.

One of the most significant aspects of the invigoration of PAHO efforts in the field of research has been its effect on approaches, values, and philosophies. There is a common and understandable difference in viewpoint between the man of action and the man of thought, between those who accomplish things and those who observe and criticize, between those who will do the job with the tools available and those who question both whether the job is being done well and, indeed, whether it is worth doing at all. In the field of health, as in other fields, tensions exist between people with these different approaches. The two groups are typically those engaged in the application and operation of health programs and those engaged in research. Sometimes the difference in approach leads to the establishment of group attitudes and destructive stereotypes, with "research people" viewing "operators" as unreceptive to change and not possessed of the higher degrees of intelligence and with "operators" viewing "research people" as unproductive and even disruptive theoreticians.

Furthermore, budgets for health are generally too small to do more than a small part of what ought to be done. Often the monetary demands for operational health programs are in

competition with demands for funds for research. This tends to increase the tension between approaches and between individuals.

8.2.3 *The UN family*

While PAHO is by far the most significant arm of the United Nations so far as biomedical research in Latin America is concerned, other parts of the UN have been helpful. UNESCO, for example, has stimulated research in Latin America by supporting conferences on science policy and by providing technical assistance to countries interested in surveying their resources for science and their structures for science policy. The World Health Organization, through its central office in Geneva, has provided moderate support for biomedical research in which it is interested. The Food and Agriculture Organization has provided valuable help in the field of agricultural research.

8.2.4 *International organization of universities*

Since 1951 the majority of the Latin American universities have been associated through the Union of Latin American Universities. In 1958 the Carnegie and Ford foundations gave grants for the formation of the Council on Higher Education in the American Republics (CHEAR). Both the Council and its Executive Committee are composed of Latin American and U.S. educators in about equal numbers. Each year, meetings are called in a different country, at which there is high-level discussion of higher education. Themes are presented and discussed by Council members and others. Seminars in special fields are also held during the year. These meetings serve as forums for the interchange of ideas, with the improvement of university education as the goal.

In Central America, the Higher Central American University Council (CSUCA), with headquarters in San José, Costa Rica, is an example of how the resources of regional university groupings in Latin America can lead to more effective use of resources. This organization has a staff and operates continuously, unlike CHEAR with its annual meetings.

8.2.5 *International organization of medical schools*

Although as early as 1951 a Pan American Congress of Medical Education took place, it was not until 1958, under the auspices of the Union of Latin American Universities, that the Conferences of the Latin American Medical Faculties were established on a regular biennial basis. At the second meeting, in 1960, a resolution was approved for the formation of a Coordinating Center of Latin American Medical Faculties at the University of São Paulo to promote better preparation in research and education. This was to be accomplished through Preparation Centers to be established in Latin American institutions that had demonstrated their ability to carry out recognized scientific research and had a full-time regimen, adequate facilities, financial support, and a good library. In 1961 the Association of American Medical Colleges invited the deans and directors of the medical schools of Central and South America to attend the annual meeting of the AAMC; there were also special sessions at which were discussed the steps necessary to form the Pan American Federation of Associations of Medical Schools and some of the major problems confronting the teaching of medicine at the present time. At the III Conference of the Latin American Medical Faculties, held in 1962, the formation of the Pan American Federation of Associations of Medical Schools was approved formally, the statutes were drawn up, and the organizing committee was established.

With financial assistance from the Milbank, Kellogg, and Rockefeller foundations pledged for a number of years, the Federation is now functioning. Its objectives are (1) to determine the problems of medical education and the needs of doctors in the Hemisphere; (2) to seek solutions to the problems and stimulate the development of proper concepts and methods for teaching and for the welfare of teachers and students; (3) to facilitate the continuous exchange of experiences in medical education so as to elevate the professional and teaching level

of the staff and the humanistic and cultural level of the students; (4) to promote the formation and development of centers for scientific training and teaching for professors and researchers in various countries of the Americas that satisfy the minimum requirements established at the II Conference of Latin American Medical Faculties, and to coordinate the activities of these centers in terms of organization and financing of fellowships; (5) to organize programs for the exchange of professors between the various medical schools, and to promote the development of cooperative programs in research and medical education; (6) to advise national associations of medical schools,

on request, about programs designed to raise the level of the schools to the minimum requirements established by the Federation and by the World Health Organization; (7) to draft general standards for the opening of new medical schools; (8) to establish a medical education information center, to disseminate facts and research data in the sciences and in the teaching and technical fields, and to prepare material on teaching and scientific documentation; and (9) to maintain relations with other international institutions and organizations that have similar goals, by including representatives of these groups in its own organization.

Appendix A

A STUDY OF THE STRUCTURES AND PROCESSES THROUGH WHICH DECISIONS RELATING TO PUBLIC HEALTH AND BIOMEDICAL RESEARCH ARE MADE IN LATIN AMERICAN COUNTRIES

A. Purpose

The urgently needed elevation of levels of health and of biomedical science in Latin America cannot be achieved without a more intensified and diverse research effort. This general proposition, which can be spelled out at some length, will be taken as a point of departure for the examination of a series of questions related not to the validity of the goal but to means of achieving it.

A further basic assumption will be made: The rate at which a nation approaches the goal of an adequate public health and biomedical research program depends to a critical degree on the strength and effectiveness of national institutions whose functions include the fostering and conduct of scientific study in the areas under scrutiny.

B. Content

Of the many approaches to investigation of the vitality and relevance of research in public health and the biomedical sciences that might be taken, this one concentrates on the institutional approach. The first facet of the study is factual and includes answers to questions of this sort:

1. *What are the institutions primarily responsible for research in the selected fields?*

What are their missions?

What are their actual past, current, and proposed activities?

What are their material and human resources, and how are these deployed by area of research?

Where do the institutions responsible for research stand in relation to general national research organizations and in relation to the sources of power in government?

2. *How well are people at various levels and in various disciplines trained, and what deliberate attention is paid to training?*

3. *What formal organizational status is given to research?*

Is the activity recognized as such, or is it an element of programs organized primarily for other purposes?

What influence is exercised by those responsible for or conducting research?

4. *Are the equipment and physical facilities in optimum proportion to the numbers, capability, and tasks of the staff?*

5. *Are research plans realistic in terms of human and material resources available?*

What seems to account for either adjustment or maladjustment of plans to resources?

The second part of the study involves judgments on questions such as the following:

What are the strong points and the weaknesses of the research programs? To what can both the weaknesses and the strengths be attributed?

What are the basic factors that indicate a productive future? What basic factors inhibit or threaten the development of an optimum program?

To what degree does the development of a national research program depend upon the influence of one person, as contrasted with the influence of impersonal institutions?

What are the relative strengths of biomedical and public health research? To what are the differences attributable?

What conscious attention is paid to the direction of research toward problems of high national priority?

What are general attitudes towards the relative significance of research and other aspects of public health work?

What is the power structure through which decisions are made on the total research investment and the selection of priority areas?

What general trends can be observed in the evolution of national research programs?

In terms of general acceptance or rejection of research?

In terms of stability of support for research?

In terms of volume of support?

What is the quality of research in various fields? Which are recognized as strong and which are weak?

To what extent do research programs in various fields break new ground, and to what extent do they replicate earlier studies?

C. Scope in Terms of Countries

Ideally, all Latin American countries would be included in such a study. Resources are not adequate to permit such an extensive investigation; a kind of rough sampling is called for. The sample should include countries with less and with more highly developed structures for research; with extensive and with rather restricted public health services; with a wide disparity in the strength of universities and other research institutions. The sample should include countries with markedly different cultural elements and backgrounds, and countries both large and small in area and population.

Countries that have been more and less heavily engaged in international health activities should be included. A selection of countries with these diverse characteristics should provide a range of observations sufficient to permit valid generalizations to be drawn for Latin America as a whole.

The countries suggested for study are these:

- | | |
|--------------|---------------|
| 1. Argentina | 6. Jamaica |
| 2. Brazil | 7. Mexico |
| 3. Chile | 8. Peru |
| 4. Colombia | 9. Trinidad |
| 5. Guatemala | 10. Venezuela |

D. Study Group

Given the limitations of time, it is suggested that the study be a group effort under the leadership of one person, with the following participants:

Dr. Charles V. Kidd, Chairman
Dr. Ernani Braga
Dr. Hernando Groot
Dr. J. C. S. Paterson
Executive Secretary: Dr. Herbert Dalmat

E. Study Procedure

1. Existing data will be examined and analyzed. This includes material available in the files of PAHO, OAS, NIH, and other sources in Washington (such a review can proceed simultaneously with other lines of activity).

2. An initial planning meeting will be convened in Washington on 16 October 1964 for the following purposes:

a) To arrive at a firm understanding of the objectives and limits of the study, and particularly of the matters felt by PAHO to be most urgent.

b) To modify and ratify the study guide and make work assignments.

c) To brief Dr. Dalmat, who will be obtaining and analyzing existing written material.

d) To conduct as a group a study of one country (Mexico), to ensure that the general understandings are valid in practice and that all members of the group have the same concepts and approaches. This visit will take place in Mexico City from 17 to 25 October.

3. Dr. Horwitz will send to the proper officials in each country selected a letter explaining the purpose of the study, forwarding a copy of the study plan, requesting cooperation, and arranging for interviews.

4. The country studies are to be divided as follows:

Mexico—the Group

Guatemala and Colombia—Dr. Braga

Chile and Peru—Dr. Paterson

Brazil and Argentina—Dr. Groot

Venezuela, Jamaica, and Trinidad—Dr. Kidd

5. Each member of the group will write up the countries for which he is responsible, in accordance with the agreed-upon outline.

Each member will be responsible for making preliminary general observations, and drawing preliminary general conclusions.

The country visits and preliminary text are to be completed by December 1, 1964.

6. The Chairman will be responsible for drawing together the country reports, editing them for reasonable consistency, and preparing a draft of a general section synthesizing the general judgments and to reaching general conclusions.

This is to be done by February 1.

7. The study group will review the text of the entire report, prepare criticisms and suggestions, and meet for a review of a manuscript approaching final form.

This is to be done by March 1, and a final report is to be prepared by April 1.

Appendix B

THE COLOMBIAN INSTITUTE FOR ADVANCED TRAINING ABROAD (ICETEX)

ICETEX was created on August 3, 1950, by Legislative Decree No. 2586. It was based on a project proposed by Dr. Gabriel Betancur Mejía, in accordance with the thesis he had presented in 1944 at the University of Syracuse to obtain his master's degree in public administration. With the establishment of ICETEX, Dr. Betancur Mejía was appointed as its head.

ICETEX is an autonomous government organization with allocated funds and independent resources subject to fiscal control by the State. Its primary purposes are to promote, finance, guide, and conduct high-level training and specialization for

technical and scientific personnel at the leading educational centers of the world, in accordance with the country's most pressing needs.

The major part of the program is carried out through medium-term loans at low interest rates. The loans are repaid by the recipients after they come back to take up professional activities in Colombia.

According to its by-laws, ICETEX functions are as follows:

- a) To grant loans to eligible candidates for advanced training abroad.
- b) To make interest-free loans to Colombian students who pursue a university career in the country.
- c) To determine, on a national scale, present and future needs for high-level trained personnel.
- d) To coordinate, to the best advantage of the nation and the individual, all technical assistance and scholarship programs offered by foreign nations, private entities, or international organizations.
- e) To give advice and assistance in placing foreign-trained professionals to their own and the country's advantage.
- f) To select the educational centers most suitable for the training of applicants in their chosen field of study.
- g) To supervise the academic progress of ICETEX-sponsored students abroad.
- h) To cooperate with firms that conduct technical programs by sending selected staff members to foreign countries.
- i) To fulfill Colombian international agreements for cultural interchange of students.
- j) To administer public and private funds for the financing of technical and professional education within the country.
- k) To serve as secretariat of the National Fellowship Committee, of which ICETEX is a member.
- l) To manage the nationally sponsored program of fellowships to prominent Colombian artists for study abroad.
- m) To authorize currency exchange to cover the expenses of Colombian students abroad.
- n) To administer the financial resources of the Colombian Linguistics Institute (ILCA).
- o) To supervise an ICETEX-sponsored program of loans of commercial banks to college students.

ICETEX is set up as an autonomous institution, has its own capital, and is subject to government audit.

The management of ICETEX is in the hands of a board of directors, a director, and a deputy director.

The board of directors consists of five members, plus the same number of alternates, who represent the national government, the private and public universities, the commercial and industrial associations, and the established Church. The director, appointed by the President of the Republic, is selected from a list of four candidates presented by the board of directors.

The various ICETEX services are handled by specialized departments coordinated by means of administrative and academic secretariats.

These departments are Loans for Studies Abroad, Coordination of International Scholarships, Currency Exchange for Studies Abroad, Loans for Graduate Studies in Colombia, Research on Human Resources, Accounting, Financing, and Credit and Collection.

ICETEX has contributed to the training and advanced studies of 12,889 students during its first ten years of operation, through financing, supervision, academic control, and other programs.

In 1953, the financial resources of ICETEX amounted to the Colombian equivalent of \$40,000; in 1962, the capital outlay was nearly \$3,000,000. Services were amplified through the administration of other public and private funds.

Financial resources have come from three main sources:

30% in government appropriations.

58% in income from the administration of private funds.

12% in surplus accumulated by ICETEX after paying all administrative expenses with its own funds.

In 1964, ICETEX activities included the following:

a) It obtained from AID a loan of \$1,000,000 for educational credit within the country, to become effective early in 1965. This is the first international loan ever made for such a purpose.

b) It gave technical assistance to two countries on the establishment of organizations similar to ICETEX: the Educational Revolving Fund, in Panama, and the Dominican Educational Credit Institute (IDCE).

c) It established the first regional offices of the Institute, in the Departments of Antioquia and Valle.

d) It initiated a large-scale fellowship plan, LASPAU-ICETEX, sponsored by major U.S. universities and designed for graduates wishing to take a complete course in the United States and become teachers on their return.

e) It completed negotiations for an educational agreement with the State of Florida.

One of the most important aspects of ICETEX activities is a survey of talent in specialized fields. The Association of Colombian Medical Schools, with the aid of both the Milbank Memorial Fund and the Pan American Health Organization and in agreement with the Ministry of Health, is also conducting a study on health manpower. Because of its limited scope, this will be a study in depth. In addition, the ICETEX programs are aimed at learning the country's needs.

In cooperation with the National Planning Office, the School of Public Administration, the National Apprenticeship Service, the National Department of Statistics, and other public and private entities, ICETEX is investigating national needs for highly qualified manpower.

The analysis covers the following topics:

a) Current statistics on the country's human resources.

b) The present and potential supply of professionals and technicians.

c) The actual long-range requirements for professionals in the country's various economic, administrative, and social sectors.

d) Shortages and surpluses in these occupations.

This analysis will contribute toward the formulation of ideas for a policy on professional education.

The study recognizes the need for integrating the national economic and social plans and for training a group of highly specialized technical and scientific personnel urgently required because of the country's expansion.

Appendix C

THE MEXICAN NATIONAL INSTITUTE FOR SCIENTIFIC RESEARCH (INIC)

The National Institute for Scientific Research, created in 1950, may be regarded as the only federal government agency involved in the development of scientific manpower. It replaced an earlier organization known as the Commission for the Promotion and Coordination of Scientific Research, which was established in 1942. The principal purpose of the new organization (INIC) was to make possible the undertaking of research. The Institute has sometimes been considered a national research council and has participated as such in major international scientific efforts. In 1961, the Institute was reorganized so that it might be able to give realistic consideration to the needs of the country and to use its funds for the training of researchers whose work would be fruitful. The aims of the Institute are

- 1) To stimulate through competition a more widespread and active interest in the sciences, so that help given to a few will affect positively a considerably larger number of people.

- 2) To assist a limited number of carefully selected students and researchers to carry out studies in the pure and applied sciences.

- 3) To promote and support scientific training in fields that are short of personnel but important to the development of the country.

- 4) To encourage the development of scientific and technological schools and centers in the states.

- 5) To stimulate and coordinate the interest, efforts, and support of persons and institutions, both Mexican and foreign, that are involved with the training of scientists and technicians or with the improvement of the country's scientific environment.

These aims seem well conceived, and their effect on the scientific endeavors of Mexico would be even more salutary if the Institute received full support to carry them out. Unfortunately, the budget given it at the time of the most recent reorganization was \$120,000, the same amount it had been granted during the previous ten years of activity. In 1963, the budget was increased to \$280,000, a sum still inadequate for more than surface movement in the directions stipulated by its aims. The Institute has spent approximately 70 per cent of its funds on 91 fellowships at the master's and the doctoral levels in Mexico and abroad. Nine departments or institutes were given grants for some phase of their scientific work, and nine scientific publications received monetary grants. The INIC also undertook to make an exhaustive inventory of scientific institutions and scientists in Mexico, and of persons or institutions, national or foreign, supporting the development of scientific research in the country through grants, fellowships, or other types of economic aid. This compilation is expected to start in 1965.

INIC and the support it has given to the development of science are not well known. It would be well if the purposes and activities of the Institute were to be extended, if the membership were to be representative of the entire country, and if the budget could be increased. Perhaps after the inventory of scientific personnel and supporting organizations active in Mexico is completed, the INIC may assume a more active role in expanding and coordinating the research activities of the country. At present, almost all scientific research in the biomedical field is carried on in Mexico City. As the number of trained scientists in Mexico increases and they are better distributed in other parts of the country, the INIC will probably assume more fully the responsibilities of a national research council.

Appendix D

THE ARGENTINE NATIONAL COUNCIL FOR SCIENTIFIC AND TECHNICAL RESEARCH (CNICT)

The single most important force for the promotion and support of research in Argentina is the National Council for Scientific and Technical Research (CNICT). There is also a similar organization for the Province of Buenos Aires. The CNICT was created in 1958 to serve as the scientific adviser to the Executive Branch of the Government and to promote, coordinate, and orient both basic and applied scientific research.

Organization

The CNICT is under the direct authority of the President of Argentina. Its highest authority is its fifteen-member board of directors. One member is the Director of Cultural Affairs of the Ministry of Education; another is a representative of the Research Council for the Armed Forces; the 13 others were, for the first time only, appointed directly by the executive branch and are now nominated by the board itself and then appointed by the executive branch. Every year one third of the Council is renewed. In practice, the candidates, chosen by the board from among well-known scientists whose names have been suggested by major scientific institutions, are presented to the executive branch for appointment. The candidates must be actively engaged in research.

The board elects a chairman and a vice-chairman from its own members. The executive committee is composed of the chairman, the vice-chairman, and three other board members and is in charge of planning and supervising the various activities of the Council. This committee meets once a week.

The chairman of the board is Professor Bernardo A. Houssay, who was the organizer of the Council and is its moving force.

To assist the board there are a fellowship committee, a committee on grants, and a committee for the promotion of scientific careers.

Moreover, there are several honorary committees for different branches of science and for different geographical regions, composed of well-known scientists. At present there are commissions in the following fields: biology; medicine; chemistry; mathematics; physics and astronomy; earth sciences; technology; anthropology, archaeology, and history; philosophy, psychology, philology, and education; and social sciences, economics, and law. There are six regional committees: for the Central Region (Córdoba, La Rioja, and Santiago del Estero), for the Northwest (Tucumán, Salta, Jujuy, and Catamarca), for Cuyo (Mendoza, San Juan, and San Luis), for the Littoral (Santa Fe and Entre Ríos), for the Northeast (Chaco, Corrientes, Formosa, and Misiones), and for the South (Province of Buenos Aires—except for La Plata—La Pampa, and Patagonia).

The administration of the National Research Council is in charge of an executive secretary who directs sections on fellowships, grants, scientific careers, statistics and surveys, libraries and bibliographic information, advisory committees, international relations, printing, and general administration.

Training and Support of Scientists

The main programs of the Council are directed toward the training and the support of scientists. Fellowships are available for study in Argentina or abroad, for initial or advanced training. They are given only to persons who are or will be working full-time.

Scientific Career Awards

The scientific career awards were established to provide adequate pay for investigators who work full-time. In most cases this is done by supplementing their salaries up to a satisfactory level of remuneration, which varies according to experience and qualifications. For this purpose scientists are grouped in six categories, from junior research assistant to full director of research, and each class has several subdivisions. The salary scale is revised periodically, supposedly to meet the cost of living. Under the revision of September 26, 1964, the monthly salaries for unmarried scientists ranges from 30,000 pesos (\$200) to 78,000 pesos (\$520). There is an additional 4,000 pesos (\$27) for a wife and 1,000 pesos (\$7) for each child. (In these calculations the official exchange rate of 150 pesos per dollar has been used.)

Grants

Grants are given mainly to help specific research projects in official and private institutions. Some grants are also given for the development of libraries, for travel related to research, for repatriation of Argentine scientists, for contracts with outstanding foreign scientists, and for other purposes.

Other Programs

Various other programs are carried out by the CNICT, including the following:

- 1) The establishment of its own research centers, such as the Institute of Limnology at Santo Tomé, near Santa Fe, to study the biology of the Paraná River.

- 2) Collaboration with other institutions to establish new research centers—for example, the National Cosmic Radiation Center, together with the Argentine Atomic Energy Commission, the Faculty of Exact and Natural Sciences of the University of Buenos Aires, and the Institute of Radio-Astronomy, and in cooperation with the Carnegie Institution.

- 3) A Scientific Register of information on scientists, research centers, and research facilities in Argentina.

- 4) The Documentation Center, which coordinates national documentation services; supplies photocopies and microfilms; makes translations from languages other than English, French, Italian, and Portuguese; prepares lists of publications in Argentine libraries; and establishes relationships with similar national and international centers.

- 5) The granting of scientific awards (Weissman, Mibashan, and Bunge and Born).

- 6) The program for the improvement of science teaching in secondary schools.

- 7) Activities to promote the adoption of administrative measures to facilitate research, such as changes in custom duties and import regulations.

- 8) Coordination of scientific activities, the fostering of cooperation between scientists and institutions, promotion of meetings, and assistance in the creation of scientific societies.

A very important role played by the National Research Council is that of an intermediary between grantees and foreign (usually U.S.) sources of research funds.

Current Activities

During the six-year period ending January 31, 1964, a total of 833 fellowships (493 internal and 340 foreign) were awarded by the Research Council. The major single field involved was the medical sciences, with 278, or 33 per cent; and 107, or 13 per cent, went to investigators in biology.

During the same period, a total of 367 grants (in the amount of 115.5 million pesos) were given, mostly in medicine (108 grants, totaling 28.3 million pesos). The second place was held by biology (68 grants, totaling 19 million pesos).

On January 31, 1964, there were 258 persons receiving scientific career awards, 94 (36.4 per cent) in the medical sciences, and 63 (24.4 per cent) in biology.

Sources of Income

The Council's income has been from regular government appropriations and occasional local and foreign grants. The government appropriation for the first year was 100 million pesos; more recently it has been about 204 million pesos per year.

Local funds have included a 20-million-peso grant in 1961 from the National Institute of Agricultural Technology (INTA) for the training of scientists and researchers in agronomy and related fields, which has expired, and sums from the Di Tella and Michel Torino industrial firms. The Council has funds for scientific prizes such as the Weissman and Mibashan awards.

Foreign grants include those from the Ford Foundation (\$150,000 during 3 years, for fellowships in social sciences; \$150,000 for education fellowships; \$325,000 for repatriation of scientists; and \$750,000 for the improvement of science teaching in secondary schools), from the Rockefeller Foundation (\$150,000 for two years to help in the establishment of returning scientists), and from the National Science Foundation (\$18,500 for the improvement of biology teaching).

In addition, as has been said, the Council has acted as intermediary for grants given by other agencies such as that of the Office of Scientific Research of the U.S. Air Force to the University of La Plata, that of the Population Council to the Buenos Aires Faculty of Medicine, and those of NIH/USPHS to several institutions.

Budget

For the year ending October 31, 1963, the following were the available funds, in pesos:

Reserve (balance) from previous years	110,709,712
Government appropriation	204,792,554
Grants	35,141,580
Sale of microfilms	48,828
Total	350,692,674

The grants were from the Rockefeller Foundation (6,400,000 pesos), the Ford Foundation (about 27,000,000 pesos) and the National Institutes of Health, USPHS (nearly 1,500,000 pesos).

During the same period, expenditures were as follows:

	<i>Amount in pesos</i>	<i>Percentage</i>
Fellowships	49,465,841	21.5
Grants	87,609,050	38.0
Scientific Career Awards	53,675,142	23.3
Miscellaneous	476,100	0.2
Publications	1,520,250	0.7
Equipment	6,739,728	2.9
Building, 3rd installment	6,346,666	2.8
General administration	24,273,667	10.6
Total	230,106,444	100.0

For the year ending October 31, 1964, there was a similar appropriation from the Government (about 204 millions, plus a reserve consisting of funds unexpended in previous years). These combined amounts—approximately 295 million pesos, or 2 million dollars at the official rate of exchange—have not been sufficient, however, to meet the needs of the Council during the same period, owing to the further devaluation of the Argentine peso and to the ever-increasing cost of living. The situation is aggravated, moreover, because a significant part of the expenditures, such as the foreign fellowships and the imports of scientific equipment, must be covered in hard currency.

The Council has asked the government for an increased appropriation to cover the expenditures during the year ending October 31, 1965. The Ministry of Economy, however, has not been able to support the request. The budget is now under discussion in Congress. Needless to say, if a significant rise is not obtained, the Council will be forced to limit its programs, thus endangering all of them, especially the career support. The stipends provided by this last barely cover the needs of its scientists. The budget of 204 millions was estimated when the rate of official exchange was 83 pesos to the dollar. Now it is officially 150, and higher on the black market.

Research Commission of the Province of Buenos Aires

The Research Commission of the Province of Buenos Aires promotes and supports research in the Province of Buenos Aires, particularly in the city of La Plata, where its offices are located. Members of the National Research Council report that the Commission spends approximately 75 million pesos (\$500,000) a year and that its funds come from the provincial lottery.

Appendix E

NATIONAL AND REGIONAL ORGANIZATIONS FOR RESEARCH AND HIGHER EDUCATION IN BRAZIL

Three organizations in Brazil have the specific task of promoting research or higher education on a national or a significant provincial basis: the Coordinating Agency for Advanced Training (CAPES), the National Research Council, and the São Paulo State Foundation for the Promotion of Research. All are government agencies with special structures that give them autonomy and great administrative freedom. The first two are federal. Since their role in the promotion and support of research and in the training of scientists is so important, they merit a separate description.

A. Coordinating Agency for Advanced Training (CAPES)

The Coordinating Agency for Advanced Training was organized in May 1964, uniting three different institutions with quite similar objectives related to the promotion of higher education:

The National Campaign for Advanced Training (also known formerly as CAPES).
The Committee for the Institute Plan (COSUPI).

The Program for the Expansion of Technological Training (PROTEC).

The old CAPES was created in 1951, under the Ministry of Education, to improve higher education and the training of university professors and specialists. The program comprised chiefly fellowships in Brazil and abroad. COSUPI was created in 1958 to improve technological instruction and to promote applied research in universities and in industry; it contributed to the establishment of major research centers, particularly in technology.

Objectives

The objectives of CAPES are as follows:

To collaborate in the development of a variety of programs for advanced training, including the establishment of graduate courses in fields with special priority.

To collaborate in the training of university professors.

To improve teaching and research conditions in universities and institutions of higher learning by means of technical and financial assistance in establishing full-time faculties, acquiring equipment and libraries, and constructing buildings.

To promote integrated teaching and research in universities, with similar fields grouped into academic units where resources and facilities can be adequately concentrated.

Organization

CAPES is under the Ministry of Education but has a large degree of administrative freedom and is organized like a private enterprise. Its policies are set by a consultative Council in charge of defining policies, and an executive director is in charge of carrying out the Council's decisions.

The Consultative Council is composed of nine members, among them the Chairman of the National Research Council (CNPq) and the Director of Higher Education of the Ministry of Education. The remaining seven are appointed by the President of the Republic from candidates submitted by the Ministry of Education. They serve for three-year terms, one third of which expire each year. (The present members of the Council, all well-known leaders in education and science, are Raymundo Aragão, Antônio Couceiro, Paulo de Góes, Ernesto de Oliveira, Oswaldo de Lima, Metry Bacila, Frederico Brieger, Pedro Penido, and Ernani Braga.)

The Executive Director is assisted by five secretaries, one for each of the following activities: 1) university programs and training centers, 2) technical and scientific personnel, 3) planning and documentation, 4) fellowships, and 5) administration. The Executive Director and the five secretaries are appointed by the Minister of Education. The present Executive Director is Dr. Susana Gonçalves.

Relation to the National Research Council

Although the National Research Council is said to give fellowships for professional training and CAPES fellowships for research training, the two institutions appear to sponsor very similar activities. Problems of overlapping are minimized, however, by a certain coordination between the agencies and by the participation of the Chairman of the Research Council in the administration of CAPES.

Priorities

The objectives mentioned earlier have to do with the following fields: basic sciences (mathematics, physics, chemistry, and biology); technology (engineering, chemical engineering, and agronomy); and medical sciences (medicine, pharmacology, dentistry, and nursing).

Activities

CAPES activities follow the norms of the Bureau of Higher Education of the Ministry of Education and are closely coordinated with the National Research Council. They include a fellowship program, studies to determine needs, and grants for strengthening training centers and for miscellaneous purposes such as the contracting of qualified foreign professors, scientific meetings, publications, and studies on the problems of higher education.

The Fellowship Program

The program includes the following categories:

- a) Full-time graduate training in Brazil for students who have distinguished themselves at the undergraduate level, to assist them in preparing their master's or doctoral theses and getting started on scientific research.
- b) Full-time advanced training in Brazil for young faculty members, intended to enable university instructors or research workers to carry out specific study programs and familiarize themselves with new scientific methods.
- c) Advanced study abroad for young faculty members and for exceptional graduate students, aimed at training personnel in categories a) and b). This is available only when training at the level needed is unobtainable in Brazil.
- d) Full refresher courses for older faculty members.

The Strengthening of Training Centers

CAPES is developing a plan to strengthen a limited number of training centers, so-called "islands of excellence." The limitation to a specific number of training centers permits a concentration of effort that will contribute more to scientific development than would a plan distributing funds more widely. So far, 63 centers have been selected to receive financial assistance for equipment and libraries. This assistance amounts approximately to the equivalent of \$4,000,000.

In the selection of centers, CAPES takes into consideration their record in producing scientists, the scope of their scientific activities, the nature of their scientific environment, their capacity to train students at advanced levels, and their willingness to serve as regional, national, or international centers for training in basic sciences.

Obviously, it is desirable that key personnel be on a full-time basis and that laboratory, library, and financial resources be more than minimal.

The centers are in these fields: biology, 14; agronomy and veterinary medicine, 11; chemistry, 10; technology, 9; physics, 7; mathematics, 6; and earth sciences, 6. They are in the states of São Paulo, Guanabara (city of Rio de Janeiro), Pernambuco, Paraná, Ceará, Bahia, Sergipe, and Rio de Janeiro and in the Federal District (Brasília). Sixteen centers will receive special aid from a Ford Foundation grant for the training of scientists. Five of these are in the field of biology: the Institute of Microbiology and the Institute of Biophysics of the University of Brazil, the Laboratory of Cell Physiology of the University of São Paulo, the Oswaldo Cruz Institute, and the Departments of Biochemistry and Microbiology of the Paulista School of Medicine.

Sources of Income

The main source of CAPES funds is the allocation made by the Federal Government. The current program of fellowships and assistance to selected centers for the advanced training of university professors amounts to about \$7,630,000 for a period of three to four years. This amount will be covered by \$2,500,000 from the Brazilian Government, \$1,130,000 from the Ford Foundation, and \$4,000,000 from a loan granted by the Inter-American Development Bank on December 21, 1964. This loan is to be repaid by the Brazilian Government through the Economic Development

Bank in twenty years at 1.25 per cent annual interest on the balance, plus the customary 0.75 per cent for service.

The loan money will be used for the purchase of new equipment and for enlarging libraries in the 63 centers. The largest amounts of funds will be used for physics (21 per cent), biology (18 per cent), and agronomy and veterinary medicine (14 per cent).

The Ford Foundation grant will be used mainly for fellowships for 16 training centers. These fellowships will be as follows: 673 one-year domestic fellowships, 38 fellowships abroad for the same length of time, 32 refresher courses.

1965 Budget

The budget for 1965 was estimated in October 29, 1964, at 5.99 billion cruzeiros—\$3,652,000 at the exchange rate of 1,640 cruzeiros to the dollar. After the rate went to 1,850 cruzeiros to the dollar during December 1964, the budget corresponded to \$3,238,000.

The estimated expenditures will be as follows:

	<i>Cruzeiros</i> (millions)	<i>Dollars</i> (at 1,850)	<i>Per cent</i>
Fellowships.....	2,358	1,274,595	39.4
Aid to training centers (equipment, personnel, graduate courses).....	2,500	1,351,351	41.7
University interchange (foreign professors, meetings).....	550	297,297	9.2
Studies, publications.....	150	81,081	2.5
Administration.....	432	233,514	7.2
	<u>5,990</u>	<u>3,237,838</u>	<u>100.0</u>

The fellowship program for 1965 includes 400 domestic fellowships and 50 fellowships abroad. (Domestic fellowships are estimated at 2.5 million cruzeiros per year, those abroad at \$7,500 per year.) The percentage distribution of fellowships, by subject, is as follows:

<i>Basic Sciences</i>		<i>Medical Sciences</i>	
Mathematics.....	3	Medicine.....	15
Physics.....	6	Dentistry.....	6
Chemistry.....	8	Pharmacology.....	5
Biology.....	12	Nursing.....	6
	<u>29</u>		<u>32</u>
<i>Technology</i>		<i>Other</i>	
Engineering.....	18	Psychology.....	1
Chemical Engineering..	3	Economics.....	1
Agronomy.....	10	Administration.....	2
	<u>31</u>	Philosophy.....	2
		Letters.....	1
		Sociology.....	1
			<u>8</u>
			100

From the 2.5 billion cruzeiros allocated for aid to training centers, 760 million (\$410,800), or 30.4 per cent, are in the fields of biology and medicine.

B. National Research Council (CNPq)

Objectives

The National Research Council of Brazil was created by Law 1310, dated 15 January 1951, as a direct dependency of the President of the Republic to promote scientific and technological research in any field.

Organization

The highest authority is the Consultative Council, composed of up to 27 members: 2 selected by the President of the Republic (these serve as Chairman and Vice-Chairman); 5 selected by the Government as representatives of the Armed Forces and the ministries of agriculture, education, foreign relations, and labor and industry; 1 representing the Brazilian Academy of Sciences; one representing industry; one representing public administration; and from 6 to 15 well-known scientists selected by the Council itself from universities and other institutions of higher learning. The term is three years, and each year one third of the membership is replaced. The Council meets four times a month.

A Technical and Scientific Division is in charge of planning the Council's activities. It comprises 8 sections: technical, physics, mathematics, chemistry, biology, geology, agronomy, and technology. Each section has a director, and the Division is headed by a scientific director. Furthermore, there are several advisers for the different subjects chosen among the best-qualified scientists.

For practical purposes the executive activities are carried out by the Chairman, the Vice-Chairman, and the Scientific Director. At present the Chairman is Dr. Antônio Couceiro and the Scientific Director Dr. Manoel da Frota Moreira.

The Council has three main programs: fellowships, grants, and special institutions.

The Fellowship Program

The Council provides fellowships for a) beginning studies in science, b) advanced training or specialization, c) graduate work, and d) research. Fellowships for categories a), b), and c) are given in Brazil or abroad. At present there are 60 students abroad. These fellowships are for training in research, not for professional categories: research assistant, research worker, and director of research. Fellowships for research assistants are given for two-year periods but are renewable. Those for research workers and directors of research are given for three-year periods and are also renewable. The monthly value of the fellowships is set in accordance with the category of the fellow, his scientific production, the cost of living, and the size of his family. The Council supplements researchers' salaries up to a certain ceiling, which may vary from 40,000 to 500,000 cruzeiros. These fellowships are given only to persons working full-time.

Grants

The Council gives grants for the purchase of equipment, supplies, and books; the contracting of special services; travel, scientific missions, and expeditions; and publications. These grants are only for individuals or institutions on a full-time basis.

Special Institutions

The following organizations are dependencies of the Council: the Brazilian Institute of Bibliography and Documentation, the Institute of Pure and Applied Mathematics, the Organizing Group for the Space Commission, the Institute for Highway Research, and the Institute for Research in Amazonia.

The last two of these work in cooperation with other governmental organizations. The Atomic Energy Institute used to be under the authority of the Council.

The National Institute for Research in Amazonia has two major divisions: the Institute proper, located in Manaus, and the Emilio Goeldi Museum in Belém. Its purpose is to study the Amazon Basin in the interests of developing the area and improving the people's economy, health, and culture. Its support comes from the National Research Council and the Supervisory Council for the Economic Development of the Amazon Basin, which contribute approximately equal amounts. The Goeldi Museum is well known for the quality of its research.

Other Programs

Other programs include the adoption of measures to facilitate the importation of equipment, assistance for summer science seminars, and aid in the publication of Brazilian textbooks.

Current Activities

The Council has played a very important role in the education of scientists and in the promotion of research. Several fields have received special emphasis, such as the activities of some research centers and research in the utilization of semi-arid regions (the study of the Cerrado Region), oceanography, and fisheries.

During 1965 and 1966 a program of activities based on well-considered priorities will be carried out. In the biomedical field the fields include neurophysiology, pharmacology of natural substances, genetics of microorganisms, immunochemistry and immunopathology, virology, schistosomiasis, and Chagas' disease.

The Council awarded 558 research fellowships during 1963: 70 in agronomy, 230 in biology, 66 in physics, 27 in geology, 24 in mathematics, 106 in chemistry, 33 in technology and 2 in the technical section. Most of the research workers (290) came from the city of Rio de Janeiro (Guanabara State). In biology the distribution is as follows: Guanabara, 118; Rio Grande do Sul, 29; São Paulo, 25; Minas Gerais, 24; Pernambuco, 15; State of Rio de Janeiro, 7; Paraná, 5; Bahia, 3; Sergipe, 2; Santa Catarina, 1; and Ceará, 1.

The Brazilian Institute of Bibliography of the National Research Council has undertaken a survey of the research work in progress in the country. It sent out 4,530 questionnaires addressed to all the research laboratories in the technological institutes at federal and state universities and in public offices throughout the nation. Thus far, 810 replies have been received.

Budget

The income of the Council consists mainly of federal government appropriations. The Council has also received occasional grants, such as one of \$75,000 from the Rockefeller Foundation for scientists returning to Brazil.

The regular budget for 1963 was 1,450 million cruzeiros (\$1,450,000 at the rate of 1,000 cruzeiros to the dollar); and for 1964, 3,750 million cruzeiros (\$2,287,000 at the rate of 1,640 cruzeiros to the dollar).

For the year 1965 the budget was estimated at 7,868 million cruzeiros (\$4,798,000 at the 1,640 rate, which was in effect when the budget was prepared; \$4,253,000 at the 1,850 rate effective as of 1 January 1965). Of this amount, 6,671 million cruzeiros have been assigned for research grants and fellowships in the following percentages: agronomy, 5.3; biology, 18.0; physics, 16.5; geology, 7.2; mathematics, 3.3; chemistry, 9.0; technology, 9.8; technical section, 2.1; strengthening of activities during 1965-66, 2.8; and special institutes, 26.0.

C. São Paulo State Foundation for the Promotion of Research (FAPSP)

The São Paulo State Foundation for the Promotion of Research was created by Law 5918, dated 18 October 1960, in pursuance of Article 123 of the state constitu-

tion of 1947, which declares that research should be promoted by a special foundation receiving not less than 0.5 per cent of the income of the state.

Objectives

The main objectives of the Foundation are the financing of research, both official and private; the financing of new research centers; the establishment of inventories of research facilities and research activities; the study of the status of research in São Paulo and in Brazil, for the determination of priorities; the exchange of scientists, at both national and international levels, by means of fellowships for study or grants for research; and the promotion of publication of findings.

The Foundation has no authority to develop its own centers of research. This is in contrast to similar organizations at the national level, such as the national research councils of Brazil and Argentina.

The Foundation devotes a significant part of its income to building up an endowment of its own. At present about 40 per cent of the income goes for this purpose.

Organization

The Foundation authorities form the Superior Council, which sets policy. The Technical and Administrative Council is in charge of carrying it out.

The Superior Council is composed of twelve members noted for scientific achievement. Six are selected by the state government, three by the government from a list of nine candidates submitted by the University of São Paulo; and three by the government from a list of nine candidates submitted by other institutes of higher education or research in the state. The Superior Council is headed by a chairman and a vice-chairman named by the government from among the members.

The Technical and Administrative Council is composed of three members appointed by the government from candidates submitted by the Superior Council. One of the three members is the chairman, another is the director of administrative matters, and the third is the director of technical and scientific matters.

Furthermore, there is a group of scientific advisers in the various sciences. At present the Chairman of the Technical and Administrative Council is Dr. Jayme Cavalcanti and the Technical and Scientific Director is Dr. Jead Hosne.

Budget

During 1963 the income of the Foundation amounted to 1,492 million cruzeiros, 6 per cent of which came from the endowment. Expenditures amounted to 1,148 million cruzeiros—42 per cent (482 million cruzeiros) for research grants and fellowships, 54 per cent for investments for the endowment fund, and 4 per cent for general administration and miscellaneous costs.

Current Activities

Of the 482 million cruzeiros spent on grants and fellowships, 386 million (80.2 per cent) was for 361 grants and 95 million (19.8 per cent) for 200 fellowships.

The funds for research grants and fellowships were distributed as follows: biology and medical sciences, 26.7 per cent; mathematics, 14.2 per cent; agronomy, 12.2 per cent; chemistry, 8.2 per cent; social sciences, 6.5 per cent; geology, 4.1 per cent; geography and history, 3 per cent; industrial technology, 21 per cent; other fields, 1.6 per cent; meetings and publications, 2.6 per cent.

The percentage distribution of grants and fellowships is as follows: University of São Paulo, 66.6; other official institutions, 22.6; private research institutions, 2.6; private industry, 3.8; meetings, associations, and publications, 4.4.

During 1962 a total of 298 research projects received financial assistance from the

Foundation. Of these, 129, or 43 per cent, were in the biomedical field (67 in biology and 62 in medicine).

The Council publishes periodically both a list of grants and progress reports on all research.

Appendix F

THE NATIONAL HEALTH AND WELFARE FUND OF PERU

The Peruvian Government has an Office of Planning that formally is in charge of buildings and research; in fact, however, the latter attribute is purely nominal, and the Office does not actively support research. Nor does the Ministry of Education. The Ministry of Health and the Army support a little research and the Ministry of Agriculture a good deal, especially at the Agrarian University. The Peruvian Atomic Energy Commission receives support from the International Atomic Energy Agency and is an active organization that would like to see more development of research in Peru. This attitude is quite common in many circles, and there is much evidence that genuine attempts are being made to raise local funds to supplement, if not in all cases to match, funds derived from overseas. In some instances these local funds are derived from government agencies, from industries, and from university budgets, which, in the case of the national universities, are tax-supported.

The National Health and Welfare Fund was established in 1952. It derives its funds from a 3-per-cent tax on all wages and hence is independent of ordinary government appropriations. This Fund has responsibilities in health, social development, and research and training and in the provision of facilities for these activities. Its total budget is of the order of \$20 million. It has a ten-member board of directors composed of representatives of industry, business, the universities, unions, and other interests and a professional director. Funds for research and training have been given to the universities annually, but their use has not been specified. A yearly sum also goes to the Welfare Institute, a charitable organization, in support of its efforts to aid the indigent. The previous director, who in 1962 tried to earmark \$1 million for research, had requested the assistance of NIH in setting up the pertinent organization. This would have required a change in the law governing the Fund, which may yet come about. At present, it is argued emphatically that research is needed in the epidemiology and pathology of endemic diseases, in nutrition, in adaptation to high altitudes, in sociology, and in demography. There is also a strong awareness of differences between national and university responsibilities. For example, it is the responsibility of the universities to train personnel and to generate new knowledge, and the national responsibility to establish local health facilities and institutions to spread knowledge. It is in consequence somewhat difficult to be specific about the Fund's place at the moment in the structure of biomedical research, but it seems highly probable that in the future its role in support of research will grow.

In 1964 the Peruvian Association of Medical Schools was formed, with representatives from each of the 5 faculties of medicine, and on 18 September its Directing Council was officially installed. It had already held its first seminar, on the curriculum, the need for establishing a roster of professors, and the minimum requirements for a faculty of medicine in Peru. Although it is not directly concerned with the research

structure, the formation of the Association represents a considerable advance in national intercommunication, and it has recognized the need to discover and foster potential investigators among the students.

It is clear that although a good deal is going on in Peru there exists no organization charged with establishing or coordinating research policy. Under a resolution dated 24 February 1964, therefore, a committee was formed to consider the establishment of a national research council; this committee was enlarged on 16 July 1964. The principal force behind it is the Ministry of Health, assisted by the Peruvian Atomic Energy Commission. It is believed that the committee might find it necessary to obtain outside help in the preparation of all the background material necessary for reaching decisions on the scope, composition, and responsibilities of a national research council. This is an important step forward.

Appendix G

THE MEXICAN INSTITUTE OF SOCIAL SECURITY (IMSS)

During the past 35 years Mexico has been undergoing very marked changes. With modern communications, there has been a large movement of population to areas surrounding the big urban centers in search of the jobs created by rapid industrialization. This has accentuated some of the public health problems. The citizens were aware of the inadequacy of the available medical care, and the government realized the importance of good health to the developing country. In 1944 the Mexican Social Security Law became effective. Through the years various groups of workers were added to the plan. The IMSS cares for approximately 6 million people—2 million employees and 4 million dependents—at present and is expanding constantly. It does not cover federal employees, the armed forces, railway or petroleum workers, or self-employed professionals and businessmen. The federal employees (about 2 million, with their dependents) are covered by a separate system (the Social Security and Services Institute for State Workers, ISSSTE), as are the armed forces (2 million people). The railway and petroleum workers also have separate programs, but these are gradually being absorbed into the larger social security system. In short, the IMSS, ISSSTE, and armed forces programs care only for somewhat over 10 million of Mexico's 40 million inhabitants.

When the social security system was established, research was not one of its aims. In staffing some of its hospitals, however, persons with strong research interests have been employed, and they are incorporating scientific investigation into their program. One such installation is the Children's Hospital in Mexico City. This hospital, originally built by the Ministry of Health, was sold to the Social Security Institute for \$4.8 million less than two years ago. It attracts a group of well-trained, research-oriented men.

In mid-1964 a research committee was established, consisting of the director and four other persons, which is concerned with approving and supervising research and with problems that may arise in connection with the welfare of patients under study. The research now under way is essentially clinical in nature, but more basic research is anticipated in the future. No special funds are allotted for research purposes, the

costs having to be covered from the regular budget. It is expected, however, that this problem will soon be solved.

Although it has no formal relationships with the National University at the moment, the Children's Hospital is in the midst of the necessary arrangements to enable it to serve as a teaching and practicing installation for the Medical School. It has 470 beds, with 92-94 per cent occupancy, for children up to 16 years of age. Every day 400 outpatients are seen and there are 25 regular admissions plus 15 emergency cases. On the staff are 78 full-time physicians, the others working on a part-time basis. The Hospital is hoping to initiate a "geographic full-time" policy, under which the professional staff will remain at the hospital throughout the day and opportunities for service and research will thereby be improved.

Appendix H

INSTITUTE OF NUTRITION OF CENTRAL AMERICA AND PANAMA (INCAP)

The Institute of Nutrition of Central America and Panama was organized in 1949, with funds from PAHO, the member countries, and the Kellogg Foundation. PAHO also has administrative and coordinating functions with respect to INCAP. The Institute has been engaged in many aspects of nutritional research—both epidemiological studies and the most refined laboratory work. Persons coming to INCAP from the member nations who have shown exceptional talents have been sent to the United States for advanced studies. The Institute has not only been conducting research on nutrition and trying to find solutions to the problems (such as the development of the inexpensive soybean food supplement Incaparina) but has also been training large numbers of persons from Latin America and some from the United States who are involved with nutritional problems. Young physicians from various Latin American universities are accepted for a one-year period during which they do research to satisfy the thesis requirements for the M.D. degree. Nutrition courses are given annually to Latin American dietitians (3 months of basic study and 8 of field work). A 10-week summer program is given in English and Spanish for groups of up to 15 physicians. Under an NIH training grant, INCAP also accepts people on research fellowships. A major part of the funds for Institute research activities is derived from NIH research grants.

Very recently (June 1964) INCAP entered into an agreement with the University of San Carlos whereby it will have university status, not only to carry on undergraduate and postgraduate programs but also to serve as a center of advanced training for professors and researchers throughout Latin America. This agreement places INCAP within the structure of the Higher Council of Central American Universities (CSUCA) and consequently in a position to work with all the universities. Several staff members of INCAP already enjoy staff status in the Medical Faculty of San Carlos University. As an outcome of this arrangement, a real impetus to interest in research or regional health problems can be expected.

Although INCAP is certainly a positive force in Latin America, especially in Central America, in terms of biomedical research and its application to the improvement of nutrition, it does have various problems. A principal one is its current great dependence on the NIH for research funds. Should this source be cut off, the INCAP

program would be seriously affected. A second problem is the difficulty the Institute has in promoting its program among the member nations, where research is traditionally considered a luxury. The governments believe the Institute does too much basic research instead of devoting itself to practical application and advisory functions. Perhaps through the demonstrated results of the INCAP program and the understanding that its graduates bring back with them, the attitudes of the persons concerned in the various countries will gradually change.
