Pan American Health Organization

ADVISORY COMMITTEE ON MEDICAL RESEARCH

Fifth Meeting

Washington, D.C., 13-17 June 1966

Item 17 of the Agenda

SANITARY ENGINEERING RESEARCH POTENTIAL IN
LATIN AMERICA

(Note: See separate volume with above title).

Ref: RES 5/11
31 May 1966
Pan American Health Organization

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<td>National Autonomous University of Mexico - Faculty of Sanitary Engineering</td>
<td>A-57</td>
</tr>
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<td>University of Nuevo Leon, Mexico - Faculty of Sanitary Engineering</td>
<td>A-61</td>
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<tr>
<td>Peru</td>
<td>National University of Engineering, Peru - Faculty of Sanitary Engineering</td>
<td>A-65</td>
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<td>Venezuela</td>
<td>Central University of Venezuela - Department of Civil Engineering (Sanitary Engineering)</td>
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</tbody>
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SANITARY ENGINEERING RESEARCH POTENTIAL
IN LATIN AMERICA

FOREWORD

This report is submitted by the Pan American Health Organization's Environmental Sanitation Branch, as a staff document during the fifth meeting of the PAHO Advisory Committee on Medical Research, to be held June 13-17, 1966, in Washington, D. C. Battelle Memorial Institute, Columbus, Ohio, acted as consultant in the preparation and reproduction of this report.

The Advisory Committee focused attention on Sanitary Engineering Research Potential in Latin America at its Fourth Meeting in 1965. The following is quoted from the report of this meeting:

"The Committee took note of the report summarizing last year's Special Session on Environmental Determinants of Community Well-Being, and recommended that a research consultant mission of PAHO travel to selected areas in Latin America to analyze and evaluate the environmental health potential of the institutions visited, giving special attention to the availability of existing facilities and to the research interests of the scientific staff. For practical reasons, emphasis will be given, for the time being, to the fields of urban and rural water supplies, waste disposal, and air and water pollution. The consultants' report would provide a practical basis for developing specific projects which would be useful in exploring sources of research support to supplement local resources.

A progress report on the implementation of this recommendation will be reviewed by the Committee during the Fifth Meeting in 1966, for its delineation of specific areas of research which would be most fruitful in support of on-going environmental health programs in Latin America."

There are many factors to be considered in determining the need and potential for doing research in Latin America in the broad field of environmental sanitation. Among these are the economic growth trends and the environmental problems which can be expected to develop and may require research to control; the physical and personnel resources available and needed; and research ideas and how they might be supported.

Data in this report were collected in the field and supplemented with information obtained from discussions with PAHO consultants and a review of reports they and others have prepared following visits to many of the member countries. A questionnaire was sent to the PAHO Zone Offices, requesting data on selected academic institutions and other research laboratories in each Zone, where it was felt that pertinent data might be readily available. Information was received about the following schools and laboratories.
Argentina
University of Buenos Aires - Faculty of Sanitary Engineering

Brazil
Institute of Sanitary Engineering (SURSAN)
University of Sao Paulo - Faculty of Hygiene and Public Health
University of Sao Paulo - Polytechnic School
Inter-Municipal Commission on Water and Air Pollution Control (CICPAA)

Chile
University of Chile - School of Engineering
Institute of Occupational Health and Air Pollution

Columbia
National University of Colombia - Faculty of Mathematics & Engineering
University del Valle - School of Engineering
University of The Andes - Faculty of Engineering

Guatemala
University of San Carlos - Regional School of Post-Graduate Studies in Sanitary Engineering

Mexico
National Autonomous University of Mexico - Faculty of Sanitary Engineering
University of Nuevo Leon - Faculty of Sanitary Engineering

Peru
National University of Engineering - Faculty of Sanitary Engineering

Venezuela
Central University of Venezuela - Department of Civil Engineering (Sanitary Engineering)
This report is concerned with the field of sanitary engineering and the role of the sanitary engineer and related professional disciplines in research and problem solving. The related professional disciplines include those in the biological, physical, social, and paramedical sciences, and sanitary engineering, for this purpose, includes "air, water, and land pollution control, water resources, urban development, food technology, occupational health and housing, and the relationship of each insult to man's health, social and economic well-being".
SUMMARY

Among other things, the Act of Bogota and the Charter of Punta del Este set the stage for moving ahead with economic growth and social development in Latin America for the decade beginning in 1961. It can be expected that this growth will be accompanied by changes in environmental conditions, and will focus attention on the need for manpower development and research in the field of sanitary engineering. These changes and needs will be determined, in part, by the rate of economic growth with its accompanying demand for services and the size and structure of the population.

It is difficult to predict how fast this developing continent will grow. The 1965 report of the Inter-American Development Bank indicates that substantial progress was made for the second consecutive year. Actually, it will take only a few major developments to really accelerate this growth - such as the development of the great river systems and improved communications, which will unlock the impenetrable interior and reduce transportation costs. Other encouraging signs are the investments being made in Latin America by private organizations and lending institutions which could be considered a vote of confidence in the future.

As for population, Latin America has the highest rate of growth in the world, and the increase in urban growth, with its accompanying problems, is causing deep concern. These and other environmental problems will no doubt arise if the full realization of the goal of the Charter of Punta del Este is to be achieved, i.e., to provide potable water and sewage disposal facilities to a minimum of 70 percent of the urban and 50 percent of the rural population in Latin America. Also, industrial expansion will result in complex wastes being discharged into waterways and the atmosphere, require water to be reused, and create air pollution problems, which are already on the increase in the major population centers.

To cope with the total environmental problems requires ingenuity and development of new methodology, as well as field and laboratory studies. This means research becomes an essential aspect of remedial and control programs, and raises the questions of the adequacy of scientific resources; where investigations can best be undertaken; and the nature of the research.

The stage of development of scientific resources, including facilities, required to mount a research effort initially will limit investigations to those of an applied nature - i.e., applying knowledge and practices existing elsewhere to local conditions and aimed at utilization of local resources. Later, it can be expected that, as these programs develop, research of a more fundamental nature will be possible.

The linkage between research and advanced education is as close in Latin America as it is elsewhere in the world. Consequently, a research effort is usually best initiated in an academic setting. It is there that the nucleus of scientific resources is likely to be found, and the new knowledge gained from research can be of tremendous value in furthering any education program.
The situation with regard to scientific resources for sanitary engineering research in Latin American universities is encouraging. There are some full-time faculty members, but this number must be increased to take care of training needs and to do research. If additional financial resources are made available, it would be possible to attract additional personnel into the field and make full-time academic work economically feasible.

The student situation is related to this. No doubt, as courses of instruction improve, and as more full-time faculty members can devote their energies to teaching and doing research, larger student enrollment will result, with the expectation that their participation in research will likewise increase.

To establish research programs in academic institutions in Latin America will require overcoming administrative and financial difficulties. It is fortunate that there is some experience on which to draw. The successful PAHO engineering training program, which has been in operation since 1963 and was organized on the concept of maximum local participation and contribution, has resulted in active training programs becoming integrated as part of the regular activities of several schools that have accepted this new responsibility. This mechanism, already established in the training program, with the consequent establishment of a network of cooperating universities, will facilitate initiation of research programs.

Financial support for sanitary engineering education and research in Latin America is critical. It is a major factor in obtaining full-time faculty members who would be available for education and research; in developing advanced academic programs which will foster research; and in providing adequate physical resources. While many of the lending institutions and private sources are making funds available for education and training in Latin America, few of these projects are specifically related to the sanitary engineering field. This situation must be changed, particularly as it relates to funds available from the Inter-American Development Bank and AID.

Insofar as possible, sanitary engineering research laboratories should be developed with the concept of their providing services to governmental agencies and private interests in need of such services and facilities. This will help offset the high costs of education and will provide stability to the programs if and when outside sources are terminated.

The survey of institutions undertaken in conjunction with this report indicates that the research programs under way in some of the schools are on a modest scale. This situation could be improved, not only with full-time staff and more facilities and financial support, but also with technical assistance in developing meaningful research proposals and methodology. One of the serious problems is to increase interest in and motivation to do research, and to expose promising investigators and those who have had limited experience to the preparation of proposals and actually working on specific projects.

The library facilities in many of the universities are modest at best and need expanding. This need is evident, considering the volume of technical information available and continually being disseminated and the importance of this up-to-date information in any academic and research program. At present, nowhere is there an integral or effective overall plan for intelligence in sanitary engineering research. Communications
between researchers is inadequate. This must be improved and some mechanism established for coordinating and disseminating information to those in academic institutions in particular, although it is important that all technical personnel have access to as much information as possible, in order to keep abreast of and anticipate problems.

Periodically, it would be desirable to bring together key individuals in the member countries concerned with sanitary engineering education and research, to assess their situation and exchange ideas. The last meeting of this kind and on this subject, held in Lima, Peru, in 1961, was extremely successful. Today, the objectives of this meeting are still pertinent, and many of the recommendations are still being implemented.

Improving communications, providing technical assistance, and furthering the development of scientific resources to do research require establishing many cooperative programs and coordinated activities among the schools teaching and doing research in sanitary engineering in Latin America and academic and private laboratories in foreign countries. PAHO should consider establishing a mechanism to coordinate the many sanitary-engineering-research-related activities in Latin America and to consider utilizing an advisory group to assist in developing overall research policies in this specialized field.

Research needs in Latin America are great, and investigations should be undertaken now in order to cope with potentially unfavorable environmental conditions while they are still relatively well defined and manageable. This will permit gaining more knowledge about normal conditions and the interrelationships of man with the environment, and thereby provide a better position from which to anticipate the health, social, and economic implications. This is an altogether new research and engineering approach. The health hazards of today are too serious to be left to control after they have appeared; hence there is a real opportunity for the countries of Latin America to draw on the experience of others in North America and elsewhere to avoid costly mistakes and to prepare in advance for effective control of environmental problems. The countries of Latin America, as they advance in a new era of industrialization and urbanization, can demonstrate to the other emerging nations of the world that the problems of the environment need not be permitted, through neglect, to endanger the health, social, and economic well-being of millions more people.

All factors considered, there is evidence that many Latin American countries are willing to invest in their future, and will develop effective sanitary engineering research programs to cope with environmental problems. Already, there are a number of promising programs being developed which may prove excellent focal points for doing research. Others will no doubt emerge as additional support becomes available. Presently, among the noteworthy, are those mentioned on page 9.

While this report does not attempt to suggest specific research projects, there are, however, listed on pages 13 and 14, representative types of projects which may be undertaken productively at selected facilities in Latin America. There are projects of an applied nature and are focused on applying knowledge and practices existing elsewhere to local conditions and utilizing local resources.
In Latin America, as in many other places in the world, scientific resources are limited, making it extremely difficult for any one country to undertake research in all facets of environmental problems which are likely to need investigation. Consequently, research programs in Latin America should be developed with the objective of eventually establishing a system of collaborating research centers which would coordinate their activities, with each concentrating on those areas of research which could be most productively handled with the scientific resources available and under environmental conditions that may not be available elsewhere.
PAHO should establish a mechanism to coordinate the many sanitary-engineering-research-related activities in Latin America, and should consider utilizing an advisory group to assist in developing overall research policies in this specialized area. This would assist the Organization in implementing the following recommendations:

(1) Stimulate universities to participate in sanitary engineering research through the mechanism already established for the engineering training program now in operation. This concept of maximum local participation and contribution will permit establishing a network of universities from which research programs can be initiated.

(2) Work closely with member countries and major lending institutions to develop and get support for a greater number of sanitary engineering and related research projects, which will make it possible for more scientific resources to be committed to research in this field. Special attention should be given to programs administered by the Inter-American Development Bank and AID, and to increasing the number of projects supported by the U. N. Development Program.

(3) Encourage and provide technical assistance to promising investigators and those with limited research experience in developing and undertaking research projects and supporting such projects from PAHO funds and from other sources.

(4) Encourage investigators to undertake research of an applied nature — i.e., applying knowledge and practices existing elsewhere to local conditions and aimed at utilizing local resources.

(5) Initiate a sanitary engineering manpower and education study to determine the profile of those in the field, to make projections of future needs, and to determine the requirements for education and physical facilities. Such a study could serve as a basis for developing a realistic plan for improving sanitary engineering education and research in Latin America.

(6) Establish a data retrieval, storage, and dissemination system to make available technical information, on a continuing basis, to those doing research and to those in control programs who must keep abreast of and anticipate problems.

(7) Periodically sponsor symposia and technical sessions on various facets of research programs. Some could focus on areas of research need, and others could be held for the purpose of exchanging information and ideas, such as the conference in Lima, Peru, in 1961, on Sanitary Engineering Education and Research in Latin America. A similar meeting should be held in 1967.
(8) Assist in the development of sanitary engineering research programs in Latin America, with the ultimate objective of establishing an appropriate network of collaborating regional facilities, making it possible to better utilize the scientific resources available in each country.
Act of Bogota

During the year 1960, the most notable event affecting the destiny of Latin America was the Act of Bogota. Among other things, this document relates social progress to:

"conditions of rural living and land use; housing and community facilities; educational systems and training facilities; public health; modernization of domestic resources."

It creates a special fund for social development, whose purpose is to:

"contribute capital resources and technical assistance on flexible terms and conditions, including repayment in local currency and the relending of repaid funds, in accordance with appropriate and selective criteria, in the light of the resources available to support the efforts of Latin American countries that are prepared to initiate or expand effective institutional improvements, and to adopt measures to employ efficiently their own resources, with a view to achieving greater social progress and more balanced economic growth."

This was followed by the signing of the Charter of Punta del Este in Uruguay in 1961, and it was then that the Alliance for Progress had become a formal reality.

Charter of Punta del Este

In the Charter of Punta del Este, general objectives were established for the decade beginning in 1962.

Under Title I:

"to improve basic health services at national and local levels; and to intensify scientific research and apply its results more fully and effectively to the prevention and cure of illness."

Under Title II – Economic and Social Development:

"promoting the establishment and expansion of local institutions for basic and applied research."

Under Resolution A-1:

"encouragement of the teaching of the sciences and of scientific and technological research, as well as intensification of the education and advance training of scientists and teachers. intensification of the exchange of students, teachers, professors, research workers and other specialists in order to encourage mutual understanding and the maximum utilization of the available facilities for training and research.
reorientation of the structure, content, and methods of education at all levels, to better adapt it to the advance of knowledge, to scientific and technological progress, to the cultural needs of Latin American countries, and to their social and economic development requirements."

Resolution A-2:

".......to make best possible use of knowledge as obtained through scientific research for the prevention and treatment of diseases."

Resolution A-4 asked the Secretary-General of the Organization of American States to establish task forces to undertake investigations and studies of the most important problems in various areas of economic and social development, and to make recommendations for their solution to the interested governments.

In April, 1963, the task force, composed of the Ministers of Health of all the Governments that signed the Charter of Punta del Este, produced a final report. It contains both documented background and suggested lines of action for the control or eradication of communicable diseases; sanitation - particularly water supply and sewage disposal - ......., for the education and training of health personnel; ......... All this has set the stage for the grand assault on the enemies of public health in Latin America. How fast and how vigorously it will be conducted depends on many factors.

Inter-American Bank

Another major event in the early 60's, of direct import to the activities of PAHO, was the opening of the doors of the Inter-American Development Bank. This institution finances essential phases of the economic and social development of the Americas; accordingly, its technical advisory functions are growing in importance. Its fund for special operations is intended for the financing of social welfare programs, among which the Bank includes education resources and sanitation programs.

ECONOMIC GROWTH

There are many factors which are and will continue to contribute to the economic growth of Latin America. Among these are industrial expansion, land reform and land use patterns, and improved educational facilities.

Frequently, reference is made to the many weak and underdeveloped countries of the world, and in many cases Latin America is included among these regions. However, those who are familiar with the situation are convinced that this region is more one that is "undeveloped" and that if only communications can be improved by conquering the impenetrable wilderness, it will grow at a phenomenal rate. To accomplish this, though, will require the application of scientific and engineering know-how. It means building roads and landing fields, and making jungle lands habitable, and, among other things, developing the great river systems of the Amazon, the Orinoco, the La Plata, the Magdaline, and the Sao Francisco.
The economy of Latin America, as a whole, in 1965 registered substantial growth for the second consecutive year, as disclosed by the Sixth Annual Report of the Inter-American Development Bank, which covers the calendar year 1965. The economic growth of the entire area of the Western Hemisphere south of the U.S. grew at an annual rate of 5.4 percent up slightly from its 5.3 percent growth rate in 1964, and more than doubled the 2.1 percent rate recorded in 1963, when the area faltered below the minimum goals of 2.5 percent established in the Charter of Punta del Este.

While economic development of Latin America may not be proceeding as fast as some would like, and according to "the timetable" established, there are encouraging signs. Actually, it will take only a few major developments to really accelerate this growth. For example, the already mentioned development of the Amazon basin in Brazil would lead to a substantial development of the country's full resources, and thus open up new markets and industrial growth.

How much faster will be the growth if a road along the Andes becomes a reality? The "carretera marginal de la selva" ("the marginal road of the jungle"), which is envisioned as about 3000 miles running north and south along the eastern slope of the Andes, through Colombia, Ecuador, Peru, and Bolivia, may unlock this impenetrable interior. It will open up the fertile lands of the western Amazon basin for colonization and provide the central link in an interior transportation system, which will help improve communications among Latin American nations, reduce transportation costs, and increase trade among the various countries, thus making it cheaper to deal with one's neighbor rather than with those in other continents as is now the case.

Investment activities and changes in monetary systems are also indicative of growth. At a recent meeting of governors of Latin American banks a proposal was adopted to bring about reforms in the world monetary system.

ADELA - Atlantic Community Development group for Latin America - is considered a vote of confidence in the future of private investment in Latin America. This private unit - made up of 54 companies in Europe, North America, and Japan - is expected to strengthen the economy south of the border through joint ventures with local business in manufacturing, commerce, and agriculture. Also, some proposals are being made to establish a tariff-free trading zone which would stretch across Latin America, embracing a population of 220 million, with an annual gross national product of $78 billion.

External aid can only supplement local effort, not replace it. To improve productive capacities and the standard of living, Latin American countries must be willing to invest in their future. This means consuming less than is being produced, and spending the difference on modern communications, power plants, water resources development, and in improving scientific resources, particularly at academic institutions. There are encouraging signs that some countries are moving in this direction.
Why the Need

The need for research in sanitary engineering becomes evident as one reviews the potential for economic growth and the problems of the environment which are likely to develop. The PAHO Advisory Committee on Medical Research, at its meeting in June, 1963, put it this way:

"New problems will be tackled as old ones are solved. To be of real value, an international organization should respond to the needs of a changing world, and should enter fields of activity that enable it to meet the changing needs. From the point of view of health, the world may be considered to be in a period of transition. While the major problems in the developing areas are still those of communicable diseases and malnutrition, the more developed areas are now facing problems relating to aging and longevity, but the future has a host of man-made medical problems in store for us. Urbanization and industrialization are polluting our physical environment. The conquest of space has emphasized the need for a better understanding of human biology and physiology. The discovery of new sources of power is accompanied by new dangers to humanity. We are endangering future generations while attempting to solve the socio-economic problems of our times. A fuller understanding of human genetics and of environmental factors, likely to affect the physical and mental well-being of our successors, should be studied now if we are to ensure the health of future generations."

Problems of the environment are associated with such modern phenomena as the tremendous waves of population growth; the aggregation of these people into urban and suburban complexes; the tremendous growth and proliferation of industry; the development and use of new chemical commodities; the wide-spread use of fertilizers, pesticides and herbicides; and the fabulous revolution in communications and transportation.

Population

Latin America has the highest rate of population growth in the world. It is growing at the rate of 2.5 to 3 percent annually — about twice as fast as the rest of the world put together. It had 200 million inhabitants in 1960, and in 15 years it will have about 360 million.

The populations of both Northern and Latin America are shown below from 1920 to 1960, with projections to the year 2000. Estimates from 1970 to 2000 take into account a possible decline in birth and death rates.
Estimated Population of Northern and Latin America at Ten Year Intervals, 1920-2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Population in millions</th>
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<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Northern America</td>
</tr>
<tr>
<td>1920</td>
<td>208</td>
<td>117</td>
</tr>
<tr>
<td>1930</td>
<td>242</td>
<td>134</td>
</tr>
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<td>1940</td>
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<td>1950</td>
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<td>1960</td>
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<td>1970</td>
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<td>1980</td>
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<td>318</td>
</tr>
<tr>
<td>1990</td>
<td>794</td>
<td>336</td>
</tr>
<tr>
<td>2000</td>
<td>978</td>
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Comparison of Annual Rates of Growth of Population in 1940-1950 and 1950-1960 in Latin American Countries

<table>
<thead>
<tr>
<th>Annual per cent of growth</th>
<th>1940-1950</th>
<th>1950-1960</th>
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<tbody>
<tr>
<td>Number of countries</td>
<td>Per cent of population</td>
<td>Number of countries</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>100</td>
</tr>
<tr>
<td>Under 2</td>
<td>9</td>
<td>32</td>
</tr>
<tr>
<td>2-2.4</td>
<td>6</td>
<td>46</td>
</tr>
<tr>
<td>2.5-2.9</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>3-3.4</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>3.5 and over</td>
<td>--</td>
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Urban Development

The increase of city population in Latin America is breathtaking. From 1940 to 1960, the population of Sao Paulo, for example, tripled in size; in Santiago it almost doubled; in Caracas it increased five times; in Bogota, it more than doubled; and it more than tripled in Lima and Mexico City.

Changes in Urban-Rural Distributions of Populations in Three Latin American Countries From Recent Censuses

The problems of urban development run the full gamut – air and water pollution, housing, occupational health, accident, noise, not to mention the atrocious conditions that exist in the shanty towns to be found in the many urban areas of the world. These problems, however, are recognized and defined, which means that their solution is one of technical ingenuity and technical development, both of which deserve unlimited confidence and support.
Water Supply

In the developing countries of the Americas, water supply development raises many technical and managerial problems which cannot be satisfactorily resolved by conventional approaches. In many cases, such approaches are simply not economically feasible. There is a need to develop techniques fitted to local situations, as well as obtaining additional data on many aspects of the total water supply problem. Such investigations must be carried on if the full realization of the goal of the Charter of Punta del Este is to be achieved – providing potable water supply and sewage disposal to a minimum of 70 percent of the urban and 50 percent of the rural population in Latin America.

Water Pollution

Industrial centers and waterways are found to be intimately linked in Latin America, much as they are in the United States. Manufacturing processes spill by-product wastes into streams which must also provide water for a variety of public and personal purposes. As new developments create new substances and new products, newer types of wastes will be found in water. Some of these wastes are chemically complex, synthetic organics. Many of these defy easy and quick identification, collection, and analysis, and some are potentially toxic and will require investigation to determine their effects on humans. Also, treatment of wastes takes on greater meaning as water has to be reused.

Air Pollution

Air pollution problems are increasing in complexity. Major population centers, such as Sao Paulo, Lima, Caracas, Santiago, and Mexico City, already have serious air pollution problems, and several other Latin American cities are clearly headed in the same direction. There is need now to assess the sources of pollution, develop sampling and analytical techniques, and study health effects, meteorological conditions, and synergistic reactions so that adequate control measures can be adopted.

Environmental Controls

Problem-solving in environmental sanitation requires ingenuity, development of new methodology, as well as field and laboratory studies. Therefore, research should be considered an essential aspect of any effective control program.

The Latin American countries have an opportunity to investigate potentially unfavorable environmental conditions while they are still relatively well defined and manageable. Doing this now will permit gaining more knowledge about normal conditions and the interrelationships of man with the natural environmental factors, with the result that health, social, and economic implications may be anticipated in advance. This is an altogether new research and engineering approach. The health hazards of today are too serious to be left to control after they have appeared – hence, there is a real opportunity for the countries of Latin America to draw on the experience of others, to avoid costly mistakes that have been made elsewhere and to prepare in advance for effective control of environmental problems. The countries of Latin America, as they advance in a new
era of industrialization and urbanization, can demonstrate to the other emerging nations of the world that the problems of the environment need not be permitted, through neglect, to endanger the health and welfare of millions more people.

Research Resources

With regard to research resources, the PAHO Advisory Committee on Medical Research, at its second meeting in 1963, made the following statement:

"In developing economic solutions for these well-known and identifiable problems of environmental sanitation, it would be advisable to provide in each country sanitary engineering experimental institutes where existing technological knowledge could be adapted to local needs. These experimental stations should be developed in each country where solutions to problems of applied research, adaptation of known principles, and the training of technological personnel could be stimulated at such stations, and should be associated with technical institutions offering technological programs.

......and of the rapidity with which these hazards will change as Latin America becomes increasingly industrialized, the only solution is to create in each region a research center devoted to the study of the special environmental problems of the region. Needless to say, the very complexity of the problems involved demands the participation and therefore the training, of scientists with various kinds of skills."

The linkage between research and advanced education is as close in Latin America as it is elsewhere in the world. Consequently, a research effort is usually best initiated in an academic setting. It is there that the nucleus of scientific resources is likely to be found, and the knowledge gained from research can be of tremendous value in furthering any education program. If the universities in Latin America are to be successful in mounting a significant research program, they will need the scientific resources, including facilities, personnel, and means of financial support.

Personnel Resources

In any research program in an academic setting, the role of the faculty is important. It is the professor who stimulates the students. It is he who uses research to demonstrate the evolution and development of the subject matter in a dynamic way, and he who must point out the shortcomings of existing methods. One question which usually is raised is whether the professor should teach or engage in research, or do both, and if he does both - what is the reasonable proportion of each? This is a difficult question to answer. It suffices to say that a professor who is busy acquiring new knowledge via research is more likely to be aware of advances in allied fields, will bring a quickly-recognized freshness to otherwise very conventional subject matter, and will pass along to his students the awareness that answers are just being developed and that practice is, at best, only the current rather than the final solution to engineering problems. This is strategic because, with rapid and accelerating developments in science and technology, our educational systems must prepare students not for yesterday's problems and today's solutions, but for tomorrow's problems and possible solutions.
With specific reference to Latin America countries, it is generally recognized that the number of faculty members teaching sanitary engineering is small, and there is, in essence, no full-time teaching in the true sense of the word. For economic reasons, teaching generally remains a secondary part of the faculty member's life. The drive for a reasonable income forces him to engage in some other form of employment, in addition to teaching. In some cases, and most unfortunately, the outside pressures and economic considerations become so great that many of the teachers are forced out of the profession.

If the situation is to be improved, remuneration to professors must improve to the point where it will relieve the pressures for earning a livelihood through outside practice. Although a full-time man should be allowed to serve as a consultant, he should be required to spend the major portion of his time—approximately 80 percent—on teaching and research within the university.

The Latin American student is a hard-working, dedicated individual, but unfortunately his academic training leaves a great deal to be desired. The method of instruction is often such that it fosters noninvolvement in the learning process, and this is further aggravated by a lack of suitable texts or reference material and professional journals. Until this situation improves and there are opportunities for research in adequate laboratories of sanitary engineering in Latin American institutions, there will be little incentive for full-time university work, and little contribution by the students to the development of knowledge in the sanitary engineering field.

In an attempt to gather information to substantiate these general observations, a questionnaire was sent to the PAHO Zone Offices, requesting data on selected academic institutions and other research laboratories where it was felt that pertinent information might be readily available. A completed questionnaire for each school and laboratory is included in Appendix A.

The questionnaire was designed to bring out a number of basic situations pertinent to establishing research programs in each of the institutions being surveyed. The objective was to substantiate general impressions on the part of consultants who visited these and other countries, and what was fairly well known by the PAHO environmental sanitation staff. A staff comment has been made on many of the questionnaires with specific reference to full-time staff, training of staff, facilities, financial support, and research capabilities in general. It should be emphasized that the data and comments, unless otherwise indicated, relate to Sanitary Engineering programs at the universities, and to sanitary engineers and related disciplines.

General Conclusions from the Data

There are some full-time faculty members in various academic institutions in Latin America teaching sanitary engineering courses, although the number must be increased to take care of the training needs and to mount a significant research effort. By and large, the problem is one of financial resources which, if improved, would make it possible to pay adequate salaries and thereby attract additional personnel into the field, and make full-time academic work economically feasible. The student situation is related to this. There is no doubt that, as the course of instruction improves, and as more full-time faculty members can devote their energies to teaching and doing research, larger student enrollments will result and student participation in research will increase.
The research programs under way are on a modest scale because of the shortage of full-time staff, limited facilities and financial support for staff and research, and the need for assistance to those in academic institutions in developing meaningful research proposals and methodology. The last point is significant because while many of the professors have had some exposure to a research environment, very few have actually experienced preparing a project and doing the research.

The library facilities in general are modest at best and need to be expanded. This need is evident when one considers the volume of technical information available and continually being disseminated, and the importance of up-to-date information in any academic and research program.

Each of the leading universities surveyed has some physical facilities which would permit research in some facet of sanitary engineering. These should be adequate to get started and could be improved upon as more sophisticated research projects are undertaken.

There are a number of promising sanitary engineering programs being developed which may prove excellent focal points for doing research in various regions of Latin America. In Argentina, the Faculty of Sanitary Engineering at the University of Buenos Aires; in Brazil, the Institute of Sanitary Engineering (SURSAN), the Faculty of Hygiene and Public Health at the University of Sao Paulo, the Polytechnic School at the same University, and the Inter-Municipal Commission on Water and Air Pollution Control (CICPAA); in Chile, the School of Engineering at the University of Chile, and the Institute of Occupational Health and Air Pollution; in Colombia, the National University of Colombia's Faculty of Mathematics and Engineering, the Faculty of Engineering at the University of the Andes, and the School of Engineering of the University del Valle; in Costa Rica, the University of Costa Rica – School of Sanitary Engineering; in Guatemala, the Regional School of Post-Graduate Studies in Sanitary Engineering of the University of San Carlos; in Mexico, the National Autonomous University of Mexico's Faculty of Sanitary Engineering, and the Faculty of Sanitary Engineering at the University of Nuevo Leon; in Peru, the Faculty of Sanitary Engineering at the National University of Engineering; and in Venezuela, the Department of Civil Engineering (Sanitary Engineering) at the Central University of Venezuela. These will probably be some of the leaders for the foreseeable future, but no doubt many other universities will be increasing their capabilities as additional support becomes available through the U. N. Development Program, other lending institutions, as well as Governmental and private agencies at home and abroad.

Organization

Of fundamental significance in establishing research programs in academic institutions in Latin America is overcoming administrative difficulties. How can an initial effort be started in various regions from which other programs can emerge? Since local and regional participation and support are necessary, how could interest among the member countries be stimulated?

Since this is a difficult administrative problem, it is most fortunate that there is some experience to draw on which has direct application to this program.
Over the past few years, PAHO has organized a successful training program in cooperation with engineering schools in member countries. Briefly, the training program resulted from a resolution approved by the Directing Council, and was financed by the Organization of American States. In organizing the program, primary emphasis was placed on securing maximum local participation, with PAHO providing technical and financial assistance; but the funds awarded by the Organization covered only about 50 percent of the cost of any course. International consultants were used as visiting lecturers, and helped in organizing the program, but the local professors were in charge of 80 percent or more of the activities.

The procedure for organizing the training courses was to assign two coordinators to each course - a local coordinator representing cooperating schools, and an international coordinator, usually a PAHO project engineer in the country or in the Zone, was also involved. Emphasis was placed on the need for thoroughly planning the activities in advance. A manual was prepared outlining each course, including recruitment of international consultants and budgeting for activities. Also considerable attention was given to increasing the availability of technical literature. Response to the program has been excellent. Five courses were given in 1963, eleven in 1964, and in 1965 the whole program was enlarged considerably to include about 40 courses.

This successful program, which was organized on the concept of maximum local participation and contribution, has resulted in active training programs becoming integrated as part of the regular activities of several schools. This mechanism will no doubt result in establishing a network of cooperating universities to serve as focal points to conduct research and from which many more programs can emerge.

Technical and Financial Assistance

One of the serious needs in developing research programs is getting promising investigators and those who have had no research experience exposed to a research environment, and getting started to actually undertake projects.

Technical assistance for this group and others, in developing research ideas might be obtained through direct cooperation with those in other countries having cooperative programs with Latin American countries. One possibility in the United States is the Alliance for Progress' sister state program. Presently, California is cooperating with Chile; Idaho is cooperating with Ecuador; Utah with Bolivia; Texas with Peru; and the State of Rio de Janeiro has been designated as Maryland's sister state in Latin America. If assistance in developing research proposals and ideas is made a part of this program, there are no doubt many technical people in these states, and in their state universities, who are familiar with many aspects of the research needs in Latin America, who would lend their knowledge and experience to this endeavor.

Assistance is also possible through faculty and student exchange programs. An example of this is the Johns Hopkins University Faculty Exchange Agreement with the Peruvian University of Medical and Biological Sciences. This program which is supported by the Commonwealth Fund of New York is aimed at aiding the most promising schools in Latin America in developing the quality of their post-doctoral education and research programs. Such exchange programs as are developed should be focused on sanitary engineering needs.
The United States Public Health Service is making some efforts to further international research through its research grants activities. There are, of course, limitations to this program because the research must be for the purpose of advancing the status of the health sciences in the United States, and also there is the problem on balance of payments.

A university in the United States with a grant from the Public Health Service may cooperate with a foreign institution in certain aspects of their programs. This is referred to as a "paired grant". Presently, NIH projects involve only U.S. universities or medically oriented universities in foreign countries. It would be desirable if NIH could extend this program to include paired grants in the area of sanitary engineering.

Special foreign-currency funds have not been made available to Latin American countries for studies in the field of sanitary engineering. This program could further research in Latin America if funds available in each country were designated for health purposes. The allocation of these funds is determined by each country and, up to now, priorities have been given to uses other than health-oriented research. It is urged that those in a position to influence public policy and decision-making in Latin America make every effort to have their prospective governments earmark special foreign-currency funds for health-oriented research.

The Inter-American Development Bank's expressed willingness to extend financing to educational institutions in the health sector has opened up new possibilities. The Bank has made funds available for furthering education and research programs in Latin America but very few, if any, are in the sanitary engineering field.

The United Nations Development Program is providing funds for laboratory equipment, libraries, and special technical consultants to assist in developing the academic programs and research potential in some member countries. These are the projects in Venezuela (four universities), Chile, and in Brazil (SURSAN).

Using UNESCO as the Executing Agency, the UNDP is assisting in a major expansion and development of the College of Engineering of the National University of Colombia, at Bogota. Although much of this project is concerned with the development of programs in electrical, mechanical, and chemical engineering, the civil engineering program is being strengthened in its sanitary engineering option. The Organization has assisted in connection with staffing and other matters having to do with the sanitary engineering portion of this project.

Additional sanitary engineering research and service institutes are being considered for the University of Sao Paulo, Brazil, through its School of Public Health and its College of Engineering, and in cooperation with the Public Works Agency of the State of Sao Paulo; the University of Buenos Aires' School of Sanitary Engineering, Faculty of Engineering, in cooperation with the National Sanitary Public Works Authority of Argentina; in Mexico; in each of the five Central American countries; and in Panama and in Trinidad. Also, the Planning Division of the Ministry of Public Works of Chile is considering the establishment of a National Institute for Water Resource Research, to be operated by this Ministry in cooperation with the University of Chile, the Electric Power Authority, and ORFO (Corporacion de Fomento de la Produccion).
AID is making funds available for education. It is noted, however, that of the more than 17 currently listed projects totalling over $1,500,000, only two are in support of sanitary engineering programs. These involve the University of North Carolina and the Regional School in Guatemala and the National University of Engineering – Faculty of Sanitary Engineering – in Lima, Peru.

Cooperation With Government and Private Agencies

Sanitary engineering research laboratories and laboratory instruction should be developed with the concept of establishing, in the educational institutions, research and service facilities that would provide services and, in some cases, be operated for Governmental agencies and private interests. This will help offset the high costs of education and will provide some stability of support, if and when outside sources are terminated. This concept and objective is part of the program of the U.N. Special Development Program in Venezuela and Brazil, and those proposed in Argentina, Guatemala, Mexico, Panama, and Trinidad. Other examples are the Institute of Occupational Health in Lima and the Institute of Occupational Health and Air Pollution in Chile.

Communications

Communications is an important factor in developing any effective research program. At present, nowhere in the world is there an integral or effective overall plan for intelligence in sanitary engineering research. Communications between researchers is inadequate. Frequently, one learns of related research only when a paper is published in a technical journal, and may never be aware of unpublished work. This is particularly distressing for those in Latin America. If the effort in developing countries is to do research of an applied nature, then the more basic research findings must be readily available. What is needed is the establishment and maintenance of some system of research intelligence on a worldwide basis. It is anticipated that publication of an annual inventory of research in sanitary engineering will provide a useful record of active projects. This information may stimulate communications between research workers in specific and related fields.

The lack of communications is also a factor in not working out more cooperative arrangements among universities in Latin America and those abroad. Those doing research in universities in foreign laboratories, on projects that might lend themselves to some cooperative effort, are not aware of the specific capabilities of those in universities in Latin America to do research. Also, they are not aware of the opportunities (local conditions) to conduct research in situations not available in their own country. On the other hand, communications in Latin America are also poor, with the result that those in a position to do research are not communicating these capabilities elsewhere. It is suggested that PAHO provide some mechanism for improving this situation.

In this connection, it is gratifying to note that the World Health Organization's Executive Board endorsed a proposal for the creation of a World Health Research Center which would serve to increase the scope in facilities available to top-level scientists in
member countries. Such a Center would serve as a coordinating and communications center, and also possibly a basic research center to improve health status in the world, and should enhance the capabilities of keeping abreast of, and indeed anticipating, problems. This is very much needed.

The Engineers Joint Council in the United States has initiated a nation-wide course of instruction in abstracting and coordinate indexing. The objective of the plan is to improve the efficiency with which practicing engineers, engineering students, and individuals in associated professions can recapture the technical literature pertinent to their current work. This program should be explored in detail for implementation in Latin America as data retrieval, storage, and dissemination programs are developed.

Research Ideas

The research needs in Latin America are great. No attempt is made in this report to suggest specific research projects; however, the following is a list of representative types of projects which may be undertaken productively at selected facilities in Latin America. These are projects of an applied nature which do not require expensive equipment to undertake and many are focused on applying knowledge and practices existing elsewhere to local conditions and utilizing local resources.

Water

(1) Study of water-main capacities

(2) Epidemiological studies in selected areas of the relationships of improved water supplies (quality and quantity) to the reduction of infant morbidity in Latin America

(3) Technical development and testing of available and promising materials of construction for protection of springs, wells, pipelines, meters, tanks, plumbing, and the like

(4) Determination of beneficial water use requirements under conditions of commodity-priced, controlled water delivery, in different socio-economic and climatic settings, and working towards dissemination of information on appropriate per capita design norms

(5) Collection of runoff data for small water sheds under different topographical, soil, vegetation, and precipitation conditions

(6) Studies in the production and use of plastic materials of distribution systems

(7) Study of geological formations to determine hydrological characteristics of various water levels
**Water Pollution**

(8) Studies of oxidation ponds in the treatment of sewage under different climatic and operative conditions

(9) Studies of the effects of nutrients on the production of algae in lakes

(10) Development of design criteria for different types of treatment facilities

(11) Studies to obtain data on effects of pollution on water quality

(12) Studies to determine present and future pollution loads in drainage areas and the remedial measures needed to maintain water quality

**Air Pollution**

(13) Physiological effects of small, repeated doses of toxic or irritant gases or aerosols

(14) Studies to identify and measure general classes of air pollutants

(15) Studies to develop simple and less costly equipment to identify and measure air pollutants

(16) Study to identify and quantify air pollutants and determine the specific sources from which they derive

(17) Study of factors governing the dispersal and chemical and physical changes occurring under different meteorological conditions

**Housing**

(18) Determination of the combined effects on man of hygrothermal factors inside dwellings from the viewpoint of physiology, sensory repercussions, and work capacity

(19) Classification of types of climatic conditions as they affect different types of buildings

(20) Determination of risks introduced by new materials

(21) Developing low-cost building materials
Urban Development

(22) Studies to evaluate greater population mobility – short and long term – in relation to environmental health planning

(23) Studies to determine capacities, costs, operational characteristics and space requirements of various types of sanitation facilities and services, as related to planning functions
APPENDIX A

COMPILATION OF RESEARCH QUESTIONNAIRES
The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

Personnel:

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled?

Six in School of Sanitary Engineering

(2) How many of them are engaged in research?

Five

(3) Of those who are not, have they had experience doing research?

Two in technical research.

(4) How many of the faculty have had training abroad?

None

Which countries?

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?

Increasing the recommendations and stabilizing the appointments.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

Research beginning in projects on industrial sewage, atmospheric contamination and industrial hygiene.

Who are the key people in the program?

Two engineers.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

Yes.

Students:

Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

Ten full-time graduates.

(2) Does the undergraduate or graduate program have a thesis requirement?

No.

(3) Are any of the students now doing research?

No.

(4) Are there research fellowships available?

University offers limited number of research fellowships.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

Good library with many books and magazines in this specialty. Also a photocopy, diapositive and rotaprint reproduction service.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

Has at present:
- 2 chemical labs.
- 1 physical lab.
- 2 workrooms.

Under construction:
- 1 lab. for teaching & research in water and liquid residue
- 1 lab. for water & liquid residue research.
- 1 physical testing lab.
- 1 lab. for chemical tests of air pollution and industrial hygiene
- 1 lab. for solid waste
- 1 microbiology lab.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

University of Buenos Aires; Pan American Health Organization; National Sanitary Works; National Institute of Industrial Technology.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

(Not specified)

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

Great interest in the Sanitary Engineering School in developing research in this field. This is in its initial stages and consequently personnel essential to the development plan should be increased.

Serious sanitary problems existing in the country need to be investigated, and administrative staffs are aware of the need for research.

Funds are lacking for progressive development of these projects.

A National Scientific and Technical Commission is in charge of the nation's research activities

**STAFF COMMENT**

It is encouraging to note from this report that five of the six full-time faculty members are working on some research. Also, they do have some laboratory space and facilities, and a number of additional facilities are under construction. These include facilities for chemical testing of air pollutants and a laboratory for the study of solid wastes.

Financial resources for the support of research are limited and no doubt this is one of the deterring factors in expanding their program.

It may be that the research program at this University can be increased with some help from the National Scientific and Technical Commission, which is in charge of research activities in the nation.
University of Sao Paulo, Brazil

Faculty of Hygiene and Public Health
RESEARCH QUESTIONNAIRE

University of Sao Paulo, Brazil
Faculty of Hygiene and Public Health

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We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

**Personnel:**

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

1. How many full-time faculty members are there at the universities being sampled?

   Eight = Environmental Health 1  Industrial Hygiene 1  
   Aquatic Biology 1  Research 4  
   Statistics 1

2. How many of them are engaged in research?

   Four

3. Of those who are not, have they had experience doing research?

   Almost all have had prior experience in research.

4. How many of the faculty have had training abroad?

   Which countries?

5. What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?

   Higher salaries; relaxation of rules regarding means and facilities for travel, making contacts with other universities or companies, etc.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

- Sewage disposal; underground waters; distribution of potable water;
- Filtration of potable water; control of contamination of water courses.

Who are the key people in the program?

Four professors.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

None at the moment -- under tentative consideration is arrangement with University of Peru.

Students:

Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

Average of 25 full-time graduate students per year.

(2) Does the undergraduate or graduate program have a thesis requirement?

No.

(3) Are any of the students now doing research?

One student registered to begin Ph.D. research in September/66. Two professors also starting Ph.D. research.

(4) Are there research fellowships available?

No specific fellowships available for research in this field. A Federal Commission (CAPES) gives fellowships for all types of research, but the amount available is limited in scope (includes all professions).

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

Ample. Central library of 45,000 volumes; Departmental Library on Environmental Health = 2000 volumes, besides technical magazines. Teaching Section has various copies of each text for extended use of students.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

Principally from State of San Paulo. There is a State Research Fund with insufficient resources, besides what could be obtained from CAPES. Faculty has signed agreements with AID for research, and with FSESP (Faculty of Hygiene & Public Health) for teaching. Help from U. S. AID is established according to type of research agreed upon by both parties.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.
   (a) Adolfo Lutz Institute.
   (b) Control laboratories of Dept. of Waters & Sewage, Municipality of San Paulo and National Dept. of Sanitation Works could contribute some research.
   (c) Inst. of Technological Investigations, although oriented towards another type of research, could make some contribution in providing materials and equipment.

(2) An overall picture of: (a) Facilities and (b) Personnel.
   Adolfo Lutz Institute conducts research in Biology; has staff of 90 professionals full-time, including 2 sanitary engineers.
   (No details given re (1)(b) and (c) above.)

Other Information

Faculty offers some degree in Sanitary Engineering equivalent to a Master's. One could also choose the Doctorate in Sanitary Engineering, with further study and research. There are also short courses of which, this year, 31 are taught in all the fields of hygiene and public health.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

There appears to be interest, incentive and the necessary knowledge for research work, even though the physical and financial facilities are not entirely adequate to cope with the urgent problems of this area.

There should be greater definition of certain lines of action and coordination of activities in existing facilities for research in Sanitary Engineering in Brazil, in order to obtain maximum utilization of what exists to establish a research sequence in a program attuned to current problems, and to obtain help from the authorities on all different levels.

Other laboratories and institutes in the area of San Paulo are concerned with problems of environmental sanitation, and could provide assistance in research programs.

**Physical Facilities**

3 laboratories of 100 sq. meters each -- external area of 5000 sq. meters. In University City there is a hydraulic laboratory, possibly to be expanded. Complete facilities in the Microbiological laboratory for bacteriology, by dilution and by membrane, as well as for plankton, including a section on virology.

Normal facilities, including spectrophotometry, for physical-chemical tests of water. Equipment for tests of coagulation and filtration.

Small pumps and hydro-pneumatic equipment, but no vertical shaft pumps, although there are large horizontal shaft pumps in the University's Hydraulic laboratory.

Necessary facilities for tests of B.O.D., and experimental test equipment for lateral digestion.

Gas Gauges, but no gas analysis (Orsat or Burrel).

Complete meteorological station, including an evaporometer. Limited equipment for hydrologic measurement, but includes non-registering pitometers which are tested in the hydraulic laboratory of the University.

Adequate facilities of energy, air, gas and vacuum, as well as glass materials. No wind tunnel, special equipment of fluid mechanics, oscillographs, converters or similar equipment, but same can be obtained in other departments of the University.
Physical Facilities (continued)

There is a photographic laboratory; and the University has mechanical soil and nuclear physics laboratories, as well as model shops in other departments, also a digital and analogical computer section.

Document reproduction facilities limited to multilith and mimeograph machines, but the University has offset machines and adequate bookbinding equipment.

STAFF COMMENT

The Faculty of Hygiene and Public Health at the University of Sao Paulo represents a potentially excellent scientific resource for conducting research in environmental sanitation. While only one full-time professor is indicated, many members of the faculty have had extensive experience and training in foreign countries, and have made significant contributions to the training of sanitary engineers in Brazil. It is discouraging to note that low salaries and excessively strict rules with regard to travel and contact with other universities are limiting the number of full-time professors. In fact, two excellent professors returned to full-time teaching only to give this up in a short time and go back on a part-time basis because of economic factors.

There are a goodly number of students matriculated through this University, and it is encouraging that at least one student is registered to begin his Ph.D. program this coming year. Two of the professors are also undertaking Ph.D. programs.

The physical facilities outlined in the report for doing research in environmental sanitation are better than average, and no doubt would be conducive to good work being performed, provided financial assistance could be obtained to support research projects. Presently, funds are provided by the State of Sao Paulo, and some from AID. With some full-time staff and training programs at the Master's and Doctorate levels, this University should be in a position to make a significant contribution to sanitary engineering research in Brazil.
University of Sao Paulo, Brazil

Polytechnic School
RESEARCH QUESTIONNAIRE

University of Sao Paulo, Brazil
Polytechnic School

The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

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Personnel:

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled?

No full-time workers in Environmental Health activities. Disciplines related to Env. Health are: General Hydraulics, Sanitation, Applied Hydraulics & Fluvial Hydraulics. There are 16 professors in these fields.

(2) How many of them are engaged in research?

One

(3) Of those who are not, have they had experience doing research?

One

(4) How many of the faculty have had training abroad?

Seven = General Hydraulics, 2; Sanitation, 2; Applied & Fluvial Hydraulics, 3.

Which countries?

(not specified)

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?

Fewer demands placed on research budget to ensure continuation of work being done; also higher salaries and less severe regulations with regards to means and facilities for travel, contact with other universities, etc.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

Hydrology; Flood control; Conduit Hydraulics.

Who are the key people in the program?

(not specified)

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

No.

Students:
Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

Normal courses are undergraduate, and 90 students/year matriculate in disciplines related to sanitation. Attendance at graduate courses, lasting from 6 mos. to a year, varies between 15 and 30 students. Graduate school offers certificate only -- no degree.

(2) Does the undergraduate or graduate program have a thesis requirement?

Undergraduate courses -- No. Graduate -- yes.

(3) Are any of the students now doing research?

Some research being done by candidates for positions of assistant professor or professor.

(4) Are there research fellowships available?

No.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

25,000 vols. in School library; Environmental Health section has only 50-200 vols. of modern books, with 300 more to be bought.

Professors and students are permitted to take out books only at the end of the afternoon, and these must be returned at the opening of class next day. Magazines are restricted to professors.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

Available laboratories -- 200 sq. meters, with physical-chemical teaching equipment.

Research facilities in Fluid Mechanics and Hydraulic Engineering are most complete in Brazil. Teaching area covers 1000 sq. meters, with 4000 sq. meters for models. There are also photo, soil mechanics and hydrology laboratories, as well as a shop for making models.

School has limited facilities for document reproduction.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

School is included in annual budget, which is not always provided. There will be a grant of $300,000 for the Hydraulic Research Center, and U.N. funds for hydraulic equipment and such resources in the University, part of which could be used in these activities.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

See answer to this question in Questionnaire covering Faculty of Hygiene and Public Health, University of Sao Paulo.

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

See comments in Questionnaire covering Faculty of Hygiene and Public Health, University of Sao Paulo.

STAFF COMMENT

This is a leading engineering school in Brazil. While there is no full-time staff in sanitary engineering, they do have one of the best hydraulics laboratories in the region. This should be exploited and put to good use with some research projects concerned with fluid mechanics and hydraulics. From this, a more diverse research effort may emerge. The staff is good, and includes some of the very competent faculty members from the Faculty of Hygiene, who spend time at both institutions. There is an area of 1000 square meters for teaching, and a 4000-square meter area for model work.
The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

Personnel:

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled?

44 = Medical Doctor 1 Chemists 3 Bacteriologists 2
Civil & Sanitary Engrns. 10 Pharmacists 11 Architect 1
Chemical Engrns. 12 Biologists 4

(2) How many of them are engaged in research?

7 = Biologists, 3; Bacteriologists, 2; Chemists, 2.

(3) Of those who are not, have they had experience doing research?

Nine

(4) How many of the faculty have had training abroad?

16

Which countries?

U.S.A., Holland, Spain, France, Italy, Portugal, Argentina, Peru, England.

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?

Better salaries.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

Water, waste waters (including industrial wastes), water pollution control, and air pollution.

Who are the key people in the program?

(Not specified)

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

These are presently permitted under the rules establishing the Institute, but no current arrangements are in effect other than through the UNDP/SF channels.

Students:

Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

88 full-time undergraduate engineering students in University of Guanabara, for whom the Institute conducts an introductory course in Sanitary Engineering.

(2) Does the undergraduate or graduate program have a thesis requirement?

No.

(3) Are any of the students now doing research?

No.

(4) Are there research fellowships available?

No.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

(a) Institute of Sanitary Engineering Library -- 470 vols.; 135 magazines and journals.

(b) University of Guanabara Engineering School Library -- 6000 vols.; 850 reprints and reports; 100 magazines.
**Physical Facilities:**

(1) To what extent are physical facilities available for doing research? Describe briefly.

Following space will be available after June 2/66: -- 968 sq. meters.

<table>
<thead>
<tr>
<th>Laboratory Type</th>
<th>Area (sq. meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical-Chemical labs.</td>
<td>407</td>
</tr>
<tr>
<td>Bacteriological labs.</td>
<td>198</td>
</tr>
<tr>
<td>Biological labs.</td>
<td>105</td>
</tr>
<tr>
<td>Training labs.</td>
<td>22</td>
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<tr>
<td>Hydraulics</td>
<td>44</td>
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<tr>
<td>Workshops</td>
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<td>Constant temperature rooms</td>
<td>20</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>236</td>
</tr>
</tbody>
</table>

**Financial Support:**

(1) From what sources is financial support derived for any ongoing research?

SURSAN Budget.

**Private and Government-Operated Laboratories** (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

(Not specified)

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

(None given)

STAFF COMMENT

The U.N. Special Fund has agreed to collaborate in the establishment of the Institute of Sanitary Engineering of SURSAN (Superintendency of Urban Development and Sanitation), a corporate unit of the Department of Public Works of the State of Guanabara. Special Fund allocation for a four-year development period, which started on July 13, 1965, is $467,700, with the Government contributing $1,247,870. The Institute will occupy 3000 square meters of floor space in the University of Guanabara building. This project intends to combine the existing and separate laboratories of water supply and sewage into a facility that will be equipped not only for service and research, but also for academic and special in-service training.

There are 44 full-time professional staff members (10 engineers) who will be engaged in research in water, waste water -- including industrial wastes, water pollution, and air pollution control. Since the first 4 years of this project will permit visits from foreign experts and exchange of personnel, there is an opportunity here to expose the faculty and students at the University to a research environment. If this project meets expectations, there should emerge an improved academic program and a potentially good research resource at this school.
Inter-Municipal Commission on
Water and Air Pollution Control

(CICPAA - Brazil)
Appendix A - RES 5/11

RESEARCH QUESTIONNAIRE

Inter-Municipal Commission on
Water and Air Pollution Control
(CICPAA - Brazil)

The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

Personnel:

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled? Auxiliary personnel, full-time
Six engineers
6 chemists (technicians)
1 bacteriologist
1 meteorologist

(2) How many of them are engaged in research? None

(3) Of those who are not, have they had experience doing research? One engineer

(4) How many of the faculty have had training abroad? One engineer

Which countries? Had 2 mos. training at Robert A. Taft Engineering Center in 1962. He is presently taking a post-graduate course in the field of Air and Water Pollution Control at the University of Pittsburgh.

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)? An expansion and intensification of the Inter-Municipal Commission on Water and Air Pollution Control programs, which would permit an increase in the number of staff members.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

Air and Water Pollution; other fields in Environmental Health, such as problems of waste disposal; industrial hygiene.

Who are the key people in the program?

(Not specified)

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

The personnel of CICPAA maintains continuous interchange with Government institutions and universities, as well as with specialized personnel in the field of sanitary engineering, on the national and international level.

Students:

Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

(2) Does the undergraduate or graduate program have a thesis requirement?

(3) Are any of the students now doing research?

(4) Are there research fellowships available?

CICPAA trains, within its capabilities, technical personnel from industry and technical schools.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

CICPAA is organizing a specialized library in subjects relating to water and air pollution, waste disposal, and industrial hygiene.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

Area presently utilized -- 500 sq. meters
Area available -- 600 sq. meters

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

Annual grants from the municipalities of Santo Andre, Sao Bernardo do Campo, Sao Caetano do Sul e de Maua. Occasional financial collaboration by the State Government for special projects, and voluntary collaboration of industry.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

(not specified)

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

We could do some applied research based on small projects utilizing the available personnel complemented, if necessary, by the existing equipment. However, for research of a higher level, tied to larger projects, the help of specialized foreign technicians and greater financial assistance would be necessary.

Taking into account the interrelationship of the various working segments of our organization, added to our facilities, we can state that there exists an adequate level of motivation for the performance of that particular type of activity.

There is a national policy for research. There are Governmental units working in research programs, however, we do not know whether these fall within the national program. To our way of thinking, the research programs within the national policy should have support within technical administrative and financial structures which are autonomous, with specific and permanent funds, which would be an incentive to the present researchers to stay in their work, and also be an incentive to new professionals to enter and stay in this field.

Faculty or School

An introductory course in air pollution is given to doctors in the health unit of the State -- Graduate course -- Certificate of Completion -- Short Course.

A course for industrial stokers (furnaces) -- Undergraduate course -- Certificate of Completion -- Short Course.

Laboratory equipment and accessories obtained from foreign sources -- considering the national limitations, it is possible to acquire some laboratory equipment and accessories.

Contracts with local and international organizations, with respect to research and teaching -- there is collaboration by the National Service of Industrial Apprentices for Stokers' Courses.
Physical Facilities: (Page 3)

Laboratory equipment for:
(a) Bacteriology by dilution;
(b) Bacteriology by membrane;
(c) Plankton -- none, but projected;
(d) Physical chemistry:
   pH; conductivity; total waste; stationary waste;
   organic material; solid waste; suspended matter;
   sedimentary waste; oils and greases; chloride and chromes;
(e) Sedimentation and coagulation testing -- no;
(f) Filtration testing -- no;
(g) Pumping equipment -- no;
(h) Hydraulic measuring equipment -- no;
(i) Chlorine equipment -- no;
(j) Oxygen requirements:
   chemical requirements for oxygen; immediate requirement
   for dissolved oxygen; biochemical requirement for oxygen;
   oxygen consumed by inorganic matter; oxygen consumed by
   organic matter;
(k) Gas analyzer;
(l) Glass materials;
(m) Other equipment:
   High-volume Samplers; Paper Taper Air Samplers; Sequential
   Samplers; Light Absorbsometer; Colorimetric Drager Detector
   for different gases and vapors; Colorimetric Detector for CO,
   Bf and F; Smokescopes; Anemograph; Thermo Hydrograph;
   Pluviometer; Vacuum Pumps; Wet-Test Meters; Flowmeters;
   Mufflers (for furnaces); Stoves; Kilns and Microscopic
   equipment;
(n) Air, gas, hot water, vacuum and electrical outlets;
(o) Hydrology equipment being obtained;
(p) Specialized hydraulic equipment -- no;
(q) Photographic laboratory -- none, but projected;
(r) Wind tunnel -- no;
(s) Special measuring and production equipment; oscillographs;
   converters; generators -- no.
(t) Other laboratories and facilities:
   Soil mechanics laboratory; preparation and production of
   models; nuclear physics; etc.; computers -- no.
(u) Printing and reproduction of documents - (Mimeograph) --
   production capacity -- 500,000 sheets/year.
   Offset equipment; original and negative offset;
   bookbinding -- none.
Caribbean - English Speaking
STAFF COMMENT

The opportunities for doing research in sanitary engineering in this area are limited. However, there is some promise, because of the extreme interest on the part of the faculty at the University of West Indies.

In Jamaica, the School of Public Health (not strictly a School of Public Health as used in U. S.), which is a part of the Ministry of Health, is primarily a focal point for training sanitary inspectors. Although the teaching resources are limited, courses are being offered in fresh-water biology and water pollution.

At the school in Trinidad, there is a 3-year Engineering program, with six Civil Engineering professors on the staff, with two on a full-time basis.

Funds are limited for the establishment of laboratory facilities, although a request is in the 1968 budget to improve this situation during the next five-year plan.
Institute of Occupational Health and Air Pollution

Chile
RESEARCH QUESTIONNAIRE

Institute of Occupational Health and Air Pollution
Chile

The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

Personnel:
Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled?

12 = 2 medical doctors
4 engineers
4 chemists
1 electronics man
1 technician

(2) How many of them are engaged in research?

All, but in a limited way

(3) Of those who are not, have they had experience doing research?

See (2) above

(4) How many of the faculty have had training abroad?

5 (the 2 doctors and 3 engineers)

Which countries?

U.S.A., Peru, England, Germany, France, Italy, Scandinavian countries, Russia, Yugoslavia, etc.

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?

Increase in the budget, and possibility of better pay.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

Occupational health and air pollution.

Who are the key people in the program?

The Director and Sub-Director of the Institute.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

No.

Students:

Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

15 graduate students, full-time.

(2) Does the undergraduate or graduate program have a thesis requirement?

No.

(3) Are any of the students now doing research?

No.

(4) Are there research fellowships available?

No.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program? Specialized library with approx. 220 books, 500 folders, 2000 slots available for different materials, and a collection of 73 magazines -- only begun in 1963, and constantly expanding. One also has access to the libraries of the Schools of Engineering, Medicine and Public Health of the University of Chile, those with which interchange is maintained and, of course, any other library in the country. There is a full-time librarian.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

The Institute occupies a building of 1500 sq. meters, of which 700 are dedicated to laboratories where research is or could be done.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

The Institute was begun with an important allotment from the U.N. Special Fund, with which it acquired part of its equipment. The salaries and operating expenses are taken care of by the National Health Service of Chile, which also finances the research going on at the present time. There is also a small allotment from the School of Health, University of Chile, with which this Institute collaborates.

The Institute also has a very small sum which consists of its own income from student tuition and from services occasionally rendered to private industry.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

See below

(2) An overall picture of: (a) Facilities and (b) Personnel.

See below

This part of the questionnaire seems to refer to the country as a whole, not just this Institute. The Institute is a Governmental institution, which has specialized laboratories in Occupational Health, Air Pollution, Radiological Protection, Biochemistry, and Work Physiology, involving those professionals mentioned above.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

The Institute desires to broaden its research program, and dedicates -- to research -- the meager time which is left after teaching activities and its other services are fulfilled. Additional personnel would be indispensable in order to be able to do research in a systematic way, but cannot be obtained because of very serious budgetary problems.

With regards to technical knowledge of the investigative process, some of the professionals working there have more or less broad experience in this connection, but they are the very ones who have the least amount of time to devote to such activities, because of their teaching and administrative responsibilities. If a more extensive research program is desired, it would be helpful to have an expert who could spend some months initiating and completing various projects, with the younger professionals of the Institute, thereby permitting them to gain experience and the confidence to move about in this field with greater assurance.

Finally, it should be mentioned once again that the Institute has been in operation less than 2 years; therefore it is to be expected that its activities in every respect will be broadened considerably later.
STAFF COMMENT

On June 7, 1963, a cooperative project agreement was signed by the Government of Chile, the U.N. Development Program, and WHO, creating the Institute of Occupational Health and Air Pollution Research, in Santiago.

The overall objective of the Institute is to contribute to the solution of the many problems of occupational health and air pollution which now exist in Chile. This will be accomplished through the conduct and promotion of scientific research; the preparation of professional personnel, both from Chile and other nations; and the provisions of technical consultation to industry, government, and private institutions. The project is of 5 years' duration, and is very closely integrated with the School of Public Health of the University of Chile.

Laboratory and field research has been accomplished in Pneumoconiosis, Toxicology (mercury, manganese and solvent poisoning), Work Physiology (work load, functional tests in pneumoconiosis), Radiation Protection (personnel dosimetry, Sr 90 in milk), and Air Pollution (city and country problems related to agriculture damage).
The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

**Personnel:**

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

1. How many full-time faculty members are there at the universities being sampled?
   None.

2. How many of them are engaged in research?
   None.

3. Of those who are not, have they had experience doing research?
   Two non-full time faculty members have had experience in research.

4. How many of the faculty have had training abroad?
   The same two in (3) above.

   Which countries?
   Mainly U.S.A., also England and Peru.

5. What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?
   An increase of physical facilities for research in the University.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

As there has been no research, no particular field has been developed. In near future, emphasis will be placed on water analysis.

Who are the key people in the program?

Investigator of Sanitary Engineering Division; an Assistant Student; and Assistant Personnel from the Pan American Sanitary Bureau.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

No.

Students:

Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

Nine in Sanitary Engineering programs. This means 9 students are in the last grade of a 6-year program on Civil Engineering, taking special courses on the subject during the sixth grade.

(2) Does the undergraduate or graduate program have a thesis requirement?

Yes.

(3) Are any of the students now doing research?

No.

(4) Are there research fellowships available?

Yes.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

About 100 different volumes on diverse areas of the specialty, and a large Central Library covering all branches of Engineering.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

Up to now, none.

Financial Support:

(1) From what sources is financial support derived for any ongoing research? From the University funds and Pan American Sanitary Bureau.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

A. --- "Instituto de Higiene del Trabajo" belonging to Servicio Nacional de Salud"
B. --- "Laboratorio de la Escuela de Salubridad de la Universidad de Chile."
C. --- "Laboratorio Central de la Dirección de Obras Sanitarias", belonging to Ministerio de Obras Publicas.

(2) An overall picture of: (a) Facilities and (b) Personnel.

(Not given)
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

There is great interest in doing research by the institutions and personnel working on laboratories, but unfortunately, due to economic reasons, there is a lack of trained personnel and there is no possibility of making full-scale program on research.

If financial support and other factors are favorable, we think that research can be undertaken by people working in the country, provided there is a foreign advisory.

There is no national policy on research.
The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

**Personnel:**

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

1. How many full-time faculty members are there at the universities being sampled?

   54 full-time professors, 8 of whom are working in Sanitary Engineering and Hydraulics.

2. How many of them are engaged in research?

   There are 17 professors working in the laboratories of the Faculty (Materials Testing, Sanitary Engineering and Hydraulics) where some research is conducted.

3. Of those who are not, have they had experience doing research?

   Five professors have had research experience.

4. How many of the faculty have had training abroad?

   37 professors.

   Which countries?

   U.S., England, Germany, France and Holland.

5. What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?

   The administrative functions which these personnel perform at present could be taken over by new personnel.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

At present, there is sufficient space for research in the Hydraulics laboratory, and it is considered one of the best in South America. Expansion of the Sanitary Engineering laboratory will be finished in July, 1966, and it will then have the necessary capacity for the forthcoming graduate courses.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

There are no research projects going on at the present time.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

(Not specified)

(2) An overall picture of: (a) Facilities and (b) Personnel.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

Hydraulics and water treatment.

Who are the key people in the program?

In hydraulics and Sanitary Engineering, the work is directed by two engineers.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

No.

Students:

Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

Presently, only Sanitary Engineering courses given are for undergraduate students in Civil Engineering. There are 45 students doing projects in Sanitary Engineering. See Note on Page A-38.

(2) Does the undergraduate or graduate program have a thesis requirement?

In undergraduate programs, projects must be completed under direction of the professors. No thesis is required. See Note on Page A-38.

(3) Are any of the students now doing research?

No.

(4) Are there research fellowships available?

At present, no. See Note on Page A-38.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

The Faculty has a library which is in the process of being enlarged to properly satisfy the needs of the graduate courses.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

(Not given)

Students: (Page 2)

Note re Items (1), (2) and (4)

Beginning next semester, graduate courses will begin in Sanitary Engineering with the help of the World Health Organization and the U. N. Special Fund. There will be approximately 20 students in the first graduate course.

A research project will probably be a graduation requirement of the courses which are planned.

It is hoped that, when the graduate programs get underway, some fellowships will be obtainable for research.

STAFF COMMENT

This Department has excellent potential for doing research in sanitary engineering, with its eight full-time faculty members, five of whom have had research experience. While very little research is going on now, they do have an excellent Hydraulics laboratory which, although already one of the best in South America, is now being expanded.
University of the Andes, Colombia

Faculty of Engineering
RESEARCH QUESTIONNAIRE

University of the Andes, Colombia
Faculty of Engineering

The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

Personnel:

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled?
   90, of whom 21 are in Engineering.

(2) How many of them are engaged in research?
   8 in Engineering; 22 others.

(3) Of those who are not, have they had experience doing research?
   8 in Engineering; 10 others.

(4) How many of the faculty have had training abroad?
   18 in Engineering; 60 others.

Which countries?
   U.S., England, Hungary, Germany, Spain, France.

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?
   Research facilities; better salaries; fringe benefits (housing and transportation); consulting practice.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

Hydraulics and Computer applications.

Who are the key people in the program?

Three professors with foreign training.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

School of Engineering will have following visiting professors:
(a) 6 during next 4 years, under grant from Ford Foundation;
(b) 2 during next 3 years, under program sponsored by Gov't. of Netherlands, on research in Hydraulics and Hydrology.

Exchange programs with several U.S. universities -- such as Illinois, M.I.T., Pittsburgh, Texas, etc. -- established several years ago.

Students:
Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

No students specifically in a Sanitary Engineering program at present. However, students in Civil Engineering are required to take compulsory course in Sanitary Engineering, and are offered second as an elective.

(2) Does the undergraduate or graduate program have a thesis requirement?

(3) Are any of the students now doing research?

(4) Are there research fellowships available?

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

These are being expanded through help of the O.P.S. and grant from Ford Foundation, and are expected to be quite satisfactory by end of 1966.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

IBM 650 Computer available; new, larger one will be available late in 1966 or early in 1967.

Large laboratory and research facilities will be available early in 1967, through loan from Inter-American Development Bank.

Research facilities in Hydraulics will be available by mid-1967, through Program of Technical Assistance from Netherlands Government.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

Ongoing research activities supported mainly through research contracts with Government agencies and partially by international organizations.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

(Not specified)

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

School of Engineering has the human resources and the will to increase research activities in specific fields, provided adequate financial support is secured. Research facilities will motivate interesting people to join Faculty of the School of Engineering.

STAFF COMMENT

This University enjoys a very excellent reputation as a university in Latin America. The report bears this out, in that there is a substantial full-time faculty in engineering, devoting some time to research. Also the caliber of staff is excellent, with some of the men receiving training in the United States at M.I.T. and the University of California. The potential for research in sanitary engineering at this University is good, even though the School of Engineering does not have students specifically enrolled in a sanitary engineering program. There are good capabilities for undertaking projects involving economics, hydraulics, and hydrology and, through cooperative Inter-American program with M.I.T., a computer center is available to those studying problems of the environment. However, like many others, they are experiencing difficulty in getting adequate financial support for research.
University del Valle, Colombia

School of Sanitary Engineering
The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

**Personnel:**

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

1. **How many full-time faculty members are there at the universities being sampled?**
   - Nine.

2. **How many of them are engaged in research?**
   - Four.

3. **Of those who are not, have they had experience doing research?**
   - Two.

4. **How many of the faculty have had training abroad?**
   - Eight.

   Which countries?
   - U.S., Holland, France, Puerto Rico, Switzerland.

5. **What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?**
   - Economic.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?
   Sanitary Chemistry (stream pollution, sewage, industrial wastes), Treatment Process (oxidation lagoons), Hydrology and Aquatic Biology.

Who are the key people in the program?
   Faculty members in charge of Sanitary Chemistry, Treatment Process, Aquatic Biology, and Environmental Sanitation.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?
   School has visiting professor from Rockefeller Foundation, whose assistance has been invaluable in organization and operation of the School. No formal student exchange program yet, as School has only been in existence 5 years so no group has yet completed studies. Offer has been received from Tulane University for such an arrangement.

Students:
   Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?
   No graduate students as yet. There are presently 100 students enrolled, distributed in 5 grades.

(2) Does the undergraduate or graduate program have a thesis requirement?
   Professional work has to be done, but no actual thesis required.

(3) Are any of the students now doing research?
   No; however, some have participated in former research activities. We hope to enroll fifth year students in future research programs.

(4) Are there research fellowships available?
   None at this time.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?
   Central library with about 600 books of Sanitary Engineering, organized with Dewey decimal system; 35 journals currently being received. Library also has good collection of technical books and journals in all other engineering fields.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

School has complete Sanitary Chemistry Laboratory with equipment that permits routine physical-chemical analysis and some other more specialized analyses. There are also Biology and Microbiology labs.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

Some research activities are included within the program of the International Center for Medical Research and Training (ICMRT) at University del Valle, which functions are supported by a grant awarded to Tulane University by National Institutes of Health, U.S. Public Health Service.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

No knowledge of any local private or Government-operated laboratory engaged in research.

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

(No reply given to this portion of Questionnaire)

STAFF COMMENT

This school has an excellent 6-year academic program and there are nine full-time faculty members in the School of Sanitary Engineering with four devoting some time to research. Two others on the staff have had research experience. It is significant that eight of the nine faculty members have had training abroad, which may be a factor in their having an active research program.

From the standpoint of technical assistance, the University is also fortunate in having a visiting professor from the Rockefeller Foundation who has been extremely helpful in organizing some of the activities at the school.

There are about 100 students taking sanitary engineering work, and some of them are participating in research activities. It is expected that the academic program will improve as more experience is gained. The School has been in existence only 5 years.

The School has a rather complete sanitary engineering laboratory, with equipment that permits routine physicochemical analysis. There are also biological and microbiological laboratories. They are in a position to undertake investigations in sanitary chemistry (stream pollution, sewage, industrial wastes), treatment processes (oxidation lagoons), hydrology, and aquatic biology.

Presently, some financial support for research is being obtained from the International Center for Medical Research and Training at the University. This group has a "paired grant" from the National Institutes of Health, which involves ICMRT and Tulane University. The Sanitary Engineering group could undertake more research if additional financial support were available.
A plan was presented to the U. N. Development Program to establish a Water Resources Institute within the University of Costa Rica. This facility will be a part of the Engineering School, and will provide assistance to national agencies in solving problems related to the development and use of hydrologic resources, and also will be used for teaching.

The program of research will include underground water for exploration - quality and quantity - with special emphasis in the areas where there is a scarcity of water. This work will be closely coordinated with the programs for supplying potable water of the National Service of Water Supply.

The physical facilities will include a sanitary engineering laboratory with personnel and equipment necessary to carry on laboratory tests of a chemical, physical, and biological nature. The laboratory will also fulfill a useful function in serving as a resource in the Engineering School for training of students and others engaged in control activities.
University of San Carlos, Guatemala

Regional School of Post-Graduate Studies in Sanitary Engineering
The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

**Personnel:**

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

1. How many full-time faculty members are there at the universities being sampled?
   - Six

2. How many of them are engaged in research?
   - Five in applied research.

3. Of those who are not, have they had experience doing research?
   - Some of the personnel have been involved, in a large or small way, with applied investigative work.

4. How many of the faculty have had training abroad?
   - All teaching personnel.

   Which countries?
   - U.S.A., Chile, France, Puerto Rico, Brazil.

5. What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?
   - Greater economic resources within the University. However, regional and national institutions are available to collaborate on the program, and it is expected that a greater level of collaboration will be effected in future, as well as greater private initiative.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis? For answer to this question, see Page A-52.

Who are the key people in the program? (not specified)

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries? Yes.

Students: Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there? Eight full-time graduates.

(2) Does the undergraduate or graduate program have a thesis requirement? Yes.

(3) Are any of the students now doing research? Only in a limited way, as a complement to their regular studies in the laboratory or on projects. It is hoped that more emphasis can later be placed on this.

(4) Are there research fellowships available? Not at present, but the School is interested in promoting fellowships and would like to have collaboration of national and international institutions.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program? The Engineering School has a well-administered and operated library, and as the Regional School is part of the Engineering Faculty, it is expected that the Sanitary Engineering Library will be formed as a part of the general one. At present, the library has approximately 9000 vols., duly classified, and a main objective of the school's faculty is to substantially increase the number of publications now available.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

See answer to this question on Page A-52.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

University of San Carlos has signed agreements with General Office of Public Works and Municipality of City of Guatemala, permitting the integration of the laboratories and personnel of these institutions with those which the Faculty of Engineering already had — each institution maintaining its financial support to the same ends.

Cooperative research program in oxidation lakes has also been initiated between the Regional School and the Office of Public Works.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

(Not specified)

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

(Not given)

Personnel: (From Page A-50)

(6) Emphasis of program is on fundamental aspects of potable water, water networks, waste disposition, including the general activities in the health and public health fields.

School has a consultant Central American Committee composed of representatives of all of the Central American universities, whose mission it is to make a periodic evaluation of the plans which are being put into effect, as well as an orientation which should be made for future studies.

Physical Facilities: (From Page A-51)

(1) At present: complete laboratories in chemistry, microbiology, fluid mechanics, and hydraulics. Also available are additional facilities of the Engineering Faculty in the fields of physics, construction materials, soil mechanics, photoelasticity, geology and electricity, as well as its Engineering Research Center, and a computer center with full-time personnel who work with the Regional School.

Under development: a laboratory on unitary processes to permit students to familiarize themselves with study of these processes as a complement to courses on the procedures of water treatment and water supply networks.

STAFF COMMENT

The Regional School of Sanitary Engineering represents a conjunctive effort of the five national universities, including Costa Rica, San Salvador, Honduras, Nicaragua and Guatemala, under the auspices of the Superior Central American University Council and the University of San Carlos in Guatemala. The objective of the Regional School is to provide advanced education in Sanitary Engineering, with sound scientific and technological base and a fundamental concept of long-range planning. Main emphasis will be placed on resources, directed towards the adaptation of the advances in technology and engineering methods to the cultural and economic conditions of the region.

Since this program started in 1966, it is difficult to predict whether the regional concept will help in furthering research in the Sanitary Engineering field. Certainly, the potential is here. Five of the full-time faculty members are working in applied research, and each of these has had advanced post-graduate studies outside the country. Also, five engineers are doing post-graduate work, supported by fellowships made available by PAHO.
STAFF COMMENT (Continued)

This University is receiving substantial support from AID through a grant to the University of North Carolina, to help in developing and planning of the basic programs.

Additional consultative services are being provided through the Central American Committee, composed of representatives of all the Central American Universities, whose mission it is to make a periodic evaluation of the plans which are being put into effect, as well as orientating future studies.

The physical facilities are good and, for the present, reasonable financial support is available. It is significant that some of this financial support is coming from Governmental agencies. The University of San Carlos has signed agreements with the General Office of Public Works, and with the Municipality of the City of Guatemala and the laboratory facilities of these Agencies are now a part of the University. A co-operative research program in oxidation ponds has been initiated between the Regional School and the Office of Public Works.
RESEARCH QUESTIONNAIRE

National Autonomous University of Mexico
Faculty of Sanitary Engineering

The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

**Personnel:**

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled?
   Four

(2) How many of them are engaged in research?
   Four

(3) Of those who are not, have they had experience doing research?
   Yes, on a limited scale, and purely for didactic purposes

(4) How many of the faculty have had training abroad?
   Eight
   Which countries?
   U.S.A., France

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?
   Most important is salary. Secondly, the possibility of working in applied research programs, according to needs of the country. This implies facilities, instrumentation, and team work.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

Special emphasis is on basic subjects taught: applied mathematics, hydraulics, water supply and treatment, chemistry and biology. Complementation of teaching by means of applied research is being emphasized.

Who are the key people in the program?

The four full-time professors.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

Yes, through collaboration of the Pan American Health Organization, a number of professors from the U.S.A. and a few Latin American countries have been teaching in short intensive courses offered by the University. Agreement signed with University of Texas, and one Mexican sanitary engineer is working for Ph.D. in Austin. Next year, one professor from University of Texas is expected to come to Mexico to teach and cooperate in research activities.

Students:

Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

Ten graduate; 538 undergraduate.

(2) Does the undergraduate or graduate program have a thesis requirement?

Yes, both, even though in the near future this requirement will be applicable to graduate students only.

(3) Are any of the students now doing research?

Yes, two.

(4) Are there research fellowships available?

Yes.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

Available library has approximately 100 modern books and 15 technical journals in Sanitary Engineering.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

Well-equipped Sanitary Engineering laboratory is available with area of 200 sq. meters. Outdoor space also available.

Hydraulics laboratory is cooperating in Sanitary Engineering research work; computing center is at disposal of Sanitary Engineering Department.

Classrooms, faculty offices, very complete printing section, projection equipment, etc. are part of facilities for Sanitary Engineering activities.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

University funds are supplemented by donations of the Secretaries of Hydraulic Resources and Public Health, and also by the Municipality (Federal District).

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

There are no private or government-operated laboratories doing research in sanitary engineering.

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

(No reply given to this portion of Questionnaire)

STAFF COMMENT

This is a promising university, with eight members on the staff, with two on a full-time basis and engaged in research. At least eight on the faculty have had training abroad. The school offers an undergraduate and graduate program, with at least ten full-time graduate students.

The University has a visiting faculty and student exchange arrangement with other universities. One such agreement is with the University of Texas, and one of the faculty members is working on a Ph.D. at this school.

The library is good, and they do have laboratory equipment, including the use of a computer center, along with 200 square meters of space available. There are some hydraulics research projects under way, and just recently PAHO approved and agreed to fund the following three research proposals:

(1) Criteria of Design of Stabilization Ponds
(2) Criteria for Design of Hydraulic Flocculator
(3) Study of Plastic Pipe for Water Systems.

Other financial support is limited. Presently they are receiving some support from the University, the Secretaries of Hydraulic Resources and Public Health, and from the Federal District. Also, a grant from the Ford Foundation will permit utilizing consultants on a short-term basis to assist in program development.

A comment accompanying both reports from Mexico is significant, and is quoted:

"Due to a chronic deficiency of funds, the Mexican universities have been unable to establish research activities on a permanent basis. The lack of trained personnel and available research facilities has created a serious problem: the University depends on funds from the Government and private agencies to sponsor research work of interest to these agencies, but these groups do not have confidence in the Universities to do satisfactory work, and are reluctant to provide the needed funds.

It is thus evident that, without the help of an unbiased group, it will be difficult for any Mexican University to receive the cooperation of Government agencies and of private enterprise in a way that will help develop research on a continuous and proficient basis."
University of Nuevo Leon, Mexico
Faculty of Sanitary Engineering
RESEARCH QUESTIONNAIRE

University of Nuevo Leon, Mexico
Faculty of Sanitary Engineering

The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

**Personnel:**

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled?
   Two.

(2) How many of them are engaged in research?
   Two.

(3) Of those who are not, have they had experience doing research?
   Yes, primarily with didactic objectives.

(4) How many of the faculty have had training abroad?
   One.

   Which countries?
   Colombia.

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?
   Most important factor would be salary. Secondly, the possibility of being able to work in applied research programs, according to needs of the country. This implies facilities, instrumentation, and team work.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?
Special emphasis on sanitary engineering activities in field of Public Health.
Course is offered in Industrial Wastes. Research work has been in progress in ground water flow and forecasting.

Who are the key people in the program?
Two professors, working full time - 70% teaching; 30% research.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?
No.

Students:
Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?
3 full-time graduate; 77 full-time undergraduate.

(2) Does the undergraduate or graduate program have a thesis requirement?
Yes, both.

(3) Are any of the students now doing research?
No.

(4) Are there research fellowships available?
No.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?
A Sanitary Engineering library is available, with some 60 books and 6 technical journals.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

Regularly equipped Sanitary Engineering laboratory is available, with area of 120 square meters. Classrooms, projection equipment, printing facilities and teaching aids are normally used.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

Small amount of money has been donated by a private institution.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

None available.

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

(No reply given to this portion of Questionnaire)

STAFF COMMENT

While only two full-time faculty members are indicated, there appears to be some potential for research at this institution, particularly since they do have a graduate training program. Both individuals are engaged in some research, particularly in the area of groundwater flow, meteorological (forecasting), industrial wastes, and water reuse. Of significance is the fact that both professors are full-time, devoting 70 percent of their time to teaching and 30 percent to research.

The Monterrey area of Mexico is highly industrialized and, because of limited water resources, research in water reuse is extremely important. With the capability for research in this area at the University there are the opportunities to get financial support from industrial organizations.

The school has 120 square meters of laboratory space and a good library. They could use additional funds, since those provided by the University are limited.
National University of Engineering, Peru

Faculty of Sanitary Engineering
RESEARCH QUESTIONNAIRE

National University of Engineering, Peru
Faculty of Sanitary Engineering

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While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

**Personnel:**

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled?

Seven

(2) How many of them are engaged in research?

Three

(3) Of those who are not, have they had experience doing research?

Two

(4) How many of the faculty have had training abroad?

Six

Which countries?

Not specified

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)?

Increase in faculty budget; establishment of research program; intensification of graduate program in order to bring faculty more into line with needs of the country.
Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis?

Supply; elimination of waste water; treatment and disposal of garbage.

Who are the key people in the program?

(Not specified)

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

Presently establishing professor exchange program with Faculty of Public Health, University of Sao Paulo, Brazil.

Students: Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?

Faculty does not have regular full-time graduate courses, but has given short courses in matters related to Sanitary Engineering, in collaboration with PAHO and AID. Full-time undergraduate students = 115.

(2) Does the undergraduate or graduate program have a thesis requirement?

Undergraduate courses – Yes. Any graduate courses which exist, according to regulations of National University of Engineering – Yes.

(3) Are any of the students now doing research?

Yes, in preparation of thesis.

(4) Are there research fellowships available?

No.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program?

Large lending service for home use; exchange of publications with foreign universities; Faculty library has file cards of Central Library of Engineering, whose books can be obtained on loan; graduate librarian is administrator.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

One laboratory equipped for physical-chemical water analyses; another for biological and bacteriological analyses; assistant staff; projectors; tape recorders; loudspeakers; mimeograph machines; etc.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

University budget given to Faculty for research program; grants for research from AID, University of North Carolina, Office of Sanitary Works of Ministry of Development, and the Special Service of Public Health.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

No private ones. Governmental are: Laboratories of Sanitary Engineering Faculty, National Engineering University; and of the Occupational Health Service.

(2) An overall picture of: (a) Facilities and (b) Personnel.

These laboratories are well situated and completely equipped for their present work. Assistant and administrative personnel are well trained and experienced in their fields.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

General policy of National Engineering University of Peru, especially Faculty of Sanitary Engineering, is to promote and facilitate research activities.

Faculty of Sanitary Engineering is anxious to receive financial and technical assistance for development of such activities.

Governmental agencies of Peru, which work on problems of potable water distribution and sewage elimination - such as Office of Sanitary Works of Ministry of Development, and the national program of Sanitary Engineering of the Special Service of Public Health - have signed agreements with Faculty of Sanitary Engineering for investigation of certain aspects connected with distribution of potable water.

STAFF COMMENT

The potential at this University appears good. It has a complete 5-year academic program and at least three professors with research experience, and each has had training in an institution outside the country, and thus may have been exposed to research methodology.

There is some ongoing research and no doubt this will be expanded and improved with assistance being rendered by the University of North Carolina on a grant from AID. There are two additional sources of support, which will tend to give the research program some stability - the Office of Sanitary Works of the Ministry of Development and the Special Service of Public Health. Significant, too, is that the general policy of the National Engineering University of Peru, especially the Faculty of Sanitary Engineering, is to promote and facilitate research activities.
Central University of Venezuela

Department of Civil Engineering
(Sanitary Engineering)
RESEARCH QUESTIONNAIRE

Central University of Venezuela
Department of Civil Engineering
(Sanitary Engineering)

The Pan American Health Organization has contracted with the Battelle Memorial Institute to assist in the preparation of a report on the environmental sanitation research potential in Latin America. This report will serve as a resource document during the meeting of the PAHO Advisory Committee on Medical Research, to be held in mid-June, 1966.

While the report will concern itself with environmental sanitation research broadly, emphasis will be on the role of sanitary engineers and related professional disciplines in research.

We would appreciate your answering the following questions, including any personal observations on the various countries with which you are familiar. Each of the questions is focused specifically on the field of Environmental Sanitation, and "Personnel" refers to Sanitary Engineering and related professional disciplines.

Personnel:

Since much of the research effort will have to be undertaken at academic institutions, the number of full-time faculty members in each institution is an important factor. Also, information on graduate programs is relevant, in that this generally is the level of academic training at which research is more likely to flourish.

(1) How many full-time faculty members are there at the universities being sampled?

Eight.

(2) How many of them are engaged in research?

Eight.

(3) Of those who are not, have they had experience doing research?


(4) How many of the faculty have had training abroad?

Four.

Which countries?

U. S. A., Belgium, France, Germany.

(5) What are the factors that would increase the number of full-time faculty members to consider full-time teaching (and potentially be available for research)? Research opportunities and physical facilities, the establishment of a postgraduate course, and to increase the budget of the University to pay for the new full-time faculty members.
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Personnel: (continued)

(6) In what areas of specialty (hydraulics, solid waste, industrial hygiene, etc.) do the institutions being sampled have particular capabilities and are placing special emphasis? The following research activities are presently being carried out: Cercaria Control Waste Water; Unit Process, with Emphasis on Activated Sludge; Stabilization Ponds; Air Pollution; Bench Scale Model Construction in Hydraulics. Others under consideration.

Who are the key people in the program?

One professor in charge of each project.

(7) Does the university have visiting faculty and student exchange arrangements with universities in foreign countries?

Yes, in a limited way, by means of the sanitary engineering education program being developed with assistance of WHO and UN Special Fund. This is a field in which the University may profit considerably if convenient arrangements are made. Particular interest has been shown by Univ. of California, which could be considered for such a program.

Students:
Reference is to students in sanitary engineering programs.

(1) How many full-time graduate and undergraduate students are there?
Graduate - none. In 1966, 5th year - 4 3rd year - 5
4th year - 6 2nd year - 5
10
10 = 20

(2) Does the undergraduate or graduate program have a thesis requirement?
Undergraduate - yes. Graduate program, at Master's level, does not require a thesis, but it will for the Doctor's degree.

(3) Are any of the students now doing research?
Yes, during the preparation of the thesis.

(4) Are there research fellowships available?
No.

Library Facilities:

(1) How extensive are library facilities available for faculty and students in the sanitary engineering program? University and Faculty of Engineering have good library facilities, but of a general nature. According to the sanitary engineering education program, a specific library in sanitary engineering is being organized. We are providing most of the basic books, but there is plenty of room for assistance in this area. One way in which assistance could be provided would be in obtaining back issues of journals related to sanitary engineering for, say, the last 10 years in order to catch up with the literature in this field.
Physical Facilities:

(1) To what extent are physical facilities available for doing research? Describe briefly.

Basic facilities are provided for laboratories in microbiology, chemistry, industrial hygiene and unit process. However, for research specialized equipment and supplies will be needed according to the type of research to be undertaken.

Financial Support:

(1) From what sources is financial support derived for any ongoing research?

The ongoing research activities are being substantially financed by the Central University of Venezuela. Some specific research activities are receiving contributions from the Ministry of Health and the National Institute of Waterworks.

Private and Government-Operated Laboratories (doing research in Sanitary Engineering)

Please list:

(1) Such laboratories.

None.

(2) An overall picture of: (a) Facilities and (b) Personnel.
From the answers to the above questions, would you please give us a brief summary of your opinion concerning the general climate or setting for doing research at the various institutions or laboratories; the degree of interest and motivation towards doing research; and whether there is the "know-how" to undertake research even if the setting, financial support and other factors are favorable. Is there a national policy on the support of research?

The people involved have the "know-how" in general lines, but they will profit very much from outside assistance, especially in regard to guidance, to choosing the subjects to be investigated, as well as with follow-up visits.

There is great interest in research on specific parameters applicable to this area, since they are using the ones established for other climates. They are also concerned with specific problems, such as the control of bilharzia.

**STAFF COMMENT**

A United Nations Special Fund project in Venezuela is making available funds to assist in the development of the academic programs and the potential for research at the Andres Bello Catholic University in Caracas; the University of Zulia in Maracaibo; the Los Andes University in Merida; and the Central University in Caracas. The plan of operations for which the supporting agreement was signed by the Government, the U.N.D.P., and the Organization, with the latter as executing agency, specifies that the Special Fund will contribute $736,400 and the Government $936,275 for a 4-year program, which starts operations on January 8, 1967. The Government's contribution will cover the provision of laboratory space and regular staff, and the U.N. Development program will provide laboratory equipment, fellowships, and employment of special consultants.

The four universities will provide basic courses in sanitary engineering for all Civil Engineering undergraduate students and will include: hydrology; hydraulics; sanitary science, with laboratory work in bacteriology and chemistry; and water supply and sewage.

Special attention will be given to Central University in developing its graduate program in sanitary engineering, with emphasis on research in sanitary chemistry and biology, radioactivity, air and water pollution control, and other problems of the environment.

According to estimates, approximately 500 students will annually receive training under this program. Provision has also been made for in-service training activities, which will utilize the facilities at the several sanitary engineering laboratories and the technical staff at the universities to give specialized instruction to employees of the Ministries of Health and Public Works and the National Institute of Sanitary Works.

From the standpoint of research, the Central University program offers the best opportunity for the development of investigative work in sanitary engineering in the foreseeable future, although the U.N.D.P. project should help improve the potential at the other schools.
APPENDIX B

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BIBLIOGRAPHY

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