Research in Environmental Health

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Pan American Sanitary Bureau, Regional Office of the World Health Organization
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# RESEARCH IN ENVIRONMENTAL HEALTH

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RESEARCH IN ENVIRONMENTAL HEALTH*

Introduction

Reference is made to the Report of the First Meeting of the PAHO Advisory Committee on Medical Research and to certain observations and recommendations made by the Committee in its section on Environmental Health, from which the following is quoted:

"In developing economical 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 meet 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 and such stations should be associated with technical institutions offering technological programs."

The Committee further observed that due to the local nature of environmental health hazards

"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 skill."

These Committee observations and recommendations have given guidance and direction to studies that have been undertaken during the past year.

The present report on research in environmental health, if limited to an account of work actually underway, would be misleading in that it would fail to recognize significant progress in the development of the idea of providing research service through national environmental health

*Prepared for the Second Meeting of the PAHO Advisory Committee on Medical Research, 17-21 June 1963, by the PAHO consultant in Environmental Health, Earnest Boyce, Professor Emeritus, School of Public Health, University of Michigan, Ann Arbor, Michigan.
centers or institutes. Since making his report last year, the consultant in environmental health, has worked with health authorities, departments of public works, colleges of engineering, and others concerned with environmental health and sanitary engineering problems in twelve Latin American countries.*

Water Supply and Sewerage

In all of these countries, persons concerned with problems of environmental health, and in particular with problems of water supply and sewerage, have evidenced a real interest in research investigations that could be conducted by a sanitary engineering institute, associated with an academic institution.

The interest in research and development studies in water supply and sewerage services has been greatly stimulated by the high priority given these services by PAHO and supported by the policies of the Alliance for Progress and by the several funding agencies. It represents a realization on the part of engineers charged with the responsibility of design, construction and operation of these utility services, that much needed design information is not available, and that there is an urgent need to develop information sources, equipped and staffed, that can provide these data.

There is also a growing realization that the technical design information, developed for use in other countries with different climatic and economic conditions should be restudied and adapted to meet special

*Mexico, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panamá, Venezuela, Trinidad, Brazil, Argentina and Chile.
Latin American needs - and that sanitary engineering institutes could be very effective in meeting this need.

The organizational pattern of the proposed sanitary engineering institutes being considered for possible development in several Latin American countries recognizes the importance of combining in one facility the functions of sanitary engineering education and training, environmental health research and sanitary laboratory service for the several national agencies concerned with public water supply and sewerage problems.

There is a general appreciation of the importance of providing a qualified, full-time, and dedicated institute staff of sanitary chemists, biologists, and engineers to produce an effective program in research and development. The overhead operating cost of an institute that combines these several closely inter-related functions can thus be kept to a minimum and the services of a qualified staff be utilized to a maximum.

UN Special Fund or foundation support is being requested to provide training grants, laboratory equipment, libraries, and special technical consultants to the universities that will be the sponsoring agencies in the several countries. Unilateral contracts between the universities and the national service agencies in need of institute research and service will provide the basis for the joint support of the non-academic portion of the institute's program. Several countries now have well-defined plans for establishing these sanitary engineering institutes or research facilities.

Venezuela has applied to the UN Special Fund for a grant that would be made available through the Ministry of Education for sanitary engineering laboratories and other research facilities at each of four universities
where sanitary engineering is taught. One Venezuelan university proposes to establish a sanitary engineering experiment station and a program of inservice instruction for engineering employees, both with the cooperation of the National Sanitary Public Works Authority.

The National University of Bogotá, Colombia, has approval of a grant of $604,000 from UN Special Fund to be used for strengthening the educational program in the College of Engineering - to include special staff and facilities for sanitary engineering.

Plans have been completed by SURNAN (the Sanitary Public Works Agency of the State of Guanabara, Brazil, the former Federal District) for establishing a sanitary engineering institute in cooperation with the College of Engineering, University of Guanabara. This institute, to be located in the College of Engineering, would occupy 3,000 square meters of floor space and would provide laboratory facilities for the routine biological and chemical control tests required by SURNAN's operations and also provide facilities for research and teaching.

Similar Sanitary Engineering Research and Service Institutes are being considered by the University of São 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 São Paulo and also by the University of Buenos Aires, School of Sanitary Engineering, Faculty of Engineering, with the cooperation and assistance of the National Sanitary Public Works Authority of Argentina.

Studies are being made by the Planning Division of the Ministry of Public Works of Chile for 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 CORFO (Corporación de Fomento de la Producción). Studies of possible national institutes of sanitary engineering have been made in Mexico and in each of the five Central American Countries, in Panama and in Trinidad. It is hoped, that with the interest that is being shown, at least some of these proposed projects will go forward during the coming year.

In a few instances, some concern has been expressed by engineering educators that despite the magnitude of the environmental health problems confronting the people of Latin America, a lack of appreciation of a need for qualified sanitary engineers could result in their having limited employment opportunities. However this concern hardly appears to be justified in view of the present demand for well qualified sanitary engineers and a growing appreciation of the need to find workable solutions for the many emerging problems in environmental control for public protection.

Others who have observed the problems of environmental health in Latin America have been concerned that this suddenly awakened interest in sanitary engineering research - as regards water resource development and sanitary drainage - centers mainly in the several agencies and authorities of national governments directly involved with engineering design, construction and utility operation. While there has been tacit support for these water supply and sanitary drainage projects on the part of public health ministries, there may be some lack of interest in, and appreciation for, a program that is of great public health significance.

Despite statements made by medical directors of public health in Latin American countries that their major health problems are those of
environmental control and that engineering skill and judgment are necessary and needed for their economical solution, this phase of public health work has not been developed as it must be if disease prevention through environmental control is to be a parallel public health objective along with the care and curing of the sick.

While sections and departments of sanitary engineering do exist in most, if not all ministries of public health, their functional use appears to be somewhat limited and less effective than would be indicated by the magnitude of the field.

The failure of sanitary engineers in public health ministries to provide the needed degree of professional engineering leadership and guidance in matters of environmental health may stem in part from a lack of basic public health law and regulation defining their duties and responsibilities and perhaps in part from a failure to recognize the value of the supporting service that can be provided by a staff of competent sanitary engineers functioning as an integral part of the public health team, and concerned with environmental health problems. The Consultant in Environmental Health, though not qualified to analyse or evaluate public health administrative patterns or policy, suggests that it would be unfortunate, if the interest in sanitary engineering research and development, stimulated in the several public works agencies directly concerned with the development of public water supplies and sanitary drainage, should be limited to agencies that do not have as their major responsibility the protection of the public health. The safety of a public water supply is not insured by its construction alone. It will require the repeated inspection, and engineering verification of its satisfactory operation (including chemical and biological testing) to insure the
sanitary quality of the water supplied to the public.

With the belief that public health agencies and national ministries should provide public leadership in all aspects of environmental health, and that sanitary engineering research and development should be applied in the solution of the many public health problems associated with man's physical environment, the Consultant in Environmental Health suggests that a research study might be made here of the organizational structure of national public health agencies to determine the most effective way to stimulate and strengthen that portion of the general public health program that is concerned with the control of factors in man's physical environment that adversely affect health.

It is significant to note the recommendations made by the Task Force on Health at the Ministerial Level, meeting in Washington 15-20 April 1963, and the statement in these recommendations that

"Among health programs, the highest priority should be given to environmental sanitation, and, within this field, to water supply and sewage disposal systems in urban and rural areas of Latin America".

These recommendations also state that "It is recommended that environmental sanitation units be given sufficient authority to permit them to exercise their proper advisory functions within the ministry of health, and also those of coordination and supervision of all governmental bodies that are also responsible for such works".

The recommendations on environmental sanitation of the Task Force are of interest in connection with this report and are included in Appendix B.

Occupational Health

While the problems of potable water supply and sanitary drainage will always be of major concern in any program of environmental control
for the protection of public health, there are other problems of environ-
mental health associated with industrial development and urbanizations
that need public health attention. For example, there are many public
health hazards associated with industrial working conditions in Latin
America. While social legislation may provide compensation for physical
damage and loss of earning power, the loss of the productive effort of a
skilled worker is an economic loss that must be added to the cost of com-
pensation, and to industry's financial overhead. Progressive social legis-
lation, with its humanitarian concern for the economic support of the
incapacitated worker, requires as its counterpart measure an increase in
the control measures that can be applied in the industrial working environ-
ment to protect the worker from the need for compensation.

Progress in the development of certain industries may well be depend-
dent on public health programs designed to protect the industrial worker
from his special environmental health hazards. This is evidenced by the
policies of agencies making industrial development loans and the emphasis
that these agencies place on the danger of economic loss if safe working
conditions are not provided through the environmental controls of indus-
trial hygiene technology.

The magnitude of the industrial hygiene problems of Latin America
is indicated by the 110,000 metal miners in Chile who are exposed to
silicosis and by the 20 per cent miner disability due to silicosis in the
tin mines of Bolivia. The effectiveness of public health control measures
is evidenced by the reduction of the silicosis rate, among the miners of
Peru from 13 per cent in 1950 to the present 5 per cent rate.

The work of the Institute of Occupational Health in Lima, Peru,
represents an outstanding development in this area of environmental health work. Under the Director, Dr. Ramón Vallenas, and operating as an independent but coordinated agency of the Ministry of Public Health in Peru, while supported by the mining industry through a 1.8 per cent payroll charge - the medical and scientific staff of this institute are demonstrating the economic soundness of a program of prevention rather than cure and/or compensation. Through supplemental research contracts this institute has extended its studies to include toxicological investigations of pesticides.

A similar industrial hygiene institute is being planned for Santiago, Chile, to be known as the Institute of Occupational Health and Air Pollution Research. A UN Special Fund contribution of $404,000 has been approved. The Government's counterpart contribution is $493,652. This institute will be a part of the National Health Service of the Ministry of Public Health of Chile and will have a special Advisory Committee Representing Industrial Management, Organized Labor, The National Development Corporation for Production, The Social Security Service, the University of Chile and the Medical and Engineering Professions.

The countries that have, or are in the process of developing programs in industrial hygiene are: Argentina, Bolivia, Brazil, Chile, Colombia, El Salvador, Mexico, Peru, Uruguay, and Venezuela.

It is of interest to record that a First Latin American Seminar on Occupational Health is being planned, under the sponsorship of PAHO, to meet in March 1964 at São Paulo, Brazil. The local sponsor is the Industrial Social Service Institute of São Paulo.

Thus, a start has been made in this important area of environmental
health, namely, to develop a disease prevention program through the control of adverse factors in the environment. The logic and economic soundness of preventive measures have been demonstrated.

Much credit is due to the PAHO Regional Advisor in Industrial Hygiene, John J. Bloomfield, for his years of educational and promotional work in Latin America. Formerly located in Lima, Peru, and now in Santiago, Chile, he has contributed much to the development of the two Institutes in this field.

Food Sanitation

Little can be added to the report made to the PAHO/ACMR last year with regard to research and progress in the better sanitary protection of food stuffs and the development of controls that are needed to keep food from becoming a source of infection. It is an area of environmental health where curative measures rather than the preventive measures of environmental control are still the major source of health protection, and where the understanding and cooperation of individuals requires an educational program approach.

Rural Sanitation

The importance of safe water supply for the rural population has received deserved attention in many countries: Ministries of Health are cooperating with Ministries of Public Works to provide safe water supplies in small rural communities where the economic level requires that improvements be financed from sources outside the community. Limited budgets have stimulated water supply development changes in the interest
of economy. The cost of well construction in Southern Chile, for example, has been reduced by new construction methods developed in the field.

Sanitary engineers in the National Health Service of Mexico have developed well-planned manuals of rural housing, water supply and sewage disposal. These should be regarded as examples only, and an indication of a growing interest on the part of health authorities in the preventive approach to public health.

Comments from PAHO Zone Offices

In order that this report might cover information from the field on needs for research in environmental health, PAHO requested its Zone Offices to supply such data. Observations and comments received so far are summarized in Appendix A.
APPENDIX A

Field Notes and Comments by PAHO Zone Offices on Environmental Health Research Activities and Needs

I. Argentina, Chile, Paraguay and Uruguay

Argentina

The School of Sanitary Engineering of the University of Buenos Aires has a full-time professor specialized in industrial hygiene who is studying the possibility of starting a research program in this field, in collaboration with the National Institute of Industrial Technology (INTI).

The Faculty of Engineering and the School of Sanitary Engineering of the University of Buenos Aires are interested in obtaining the assistance of PAHO and the UN Special Fund, to carry out a research program in environmental sanitation.

Chile

It should be pointed out that the creation of the Institute of Occupational Health and Atmospheric Contamination in Santiago, Chile, is now a fact, thanks to the collaboration of the United Nations Special Fund, and in the near future there will be a possibility of carrying out research in these specific fields.

General

Among the research needs that should be emphasized are those related to standards and techniques for the design of plants for treatment of sewage and industrial wastes. The majority of the countries have been using standards of other nations which in many cases do not reflect the prevailing conditions and needs of the country concerned.
In several countries, particularly in Argentina, the selection of the source of water supplies is extremely important because there is a shortage of surface waters, within possible catchment limits. It is imperative that the possibilities of capturing subsurface water by technical methods be explored. We therefore believe there is a broad field of research in the exploitation of subterranean water and the treatment to which it should be subjected to eliminate certain chemical substances (demineralization) that reduce its potability. Methods for feedback of subterranean layers would also be an important activity in this field.

Small communities are not in a position to finance the treatment of sewage, and it is therefore necessary to adopt economical systems to avoid the progressive contamination of water courses. We believe that in Latin America there has been little or no experience with simple treatment methods, such as oxidation ponds and ditches. Research could also be directed toward the utilization of sewage wastes subjected to this type of treatment, for the irrigation of arid zones which have a high potential for agricultural production.

As previously mentioned, industrial hygiene is a virgin field and initial research could be aimed at assessing the magnitude of the problem in this area.

The first step for initiating research programs in a country is to have competent professionals available and financial means with which to pay personnel and install laboratories. We believe that the first stage should be carried out at the level of the educational institutions, which in the future would promote research activities in other governmental and private agencies.
Experience has shown that sufficient stimulus has not yet been given to induce the governments to appoint sanitary engineers to key positions, and that for budgetary reasons these are replaced by civil engineers who have had some experience in the sanitary engineering field.

The schools of engineering have not awakened the students' interest in specializing in sanitary engineering. We would suggest that PAHO make an effort to study ways of establishing closer relations with the engineering schools so as to keep them aware of the importance of sanitary engineering in countries' plans for social and economic development.

II. Bolivia and Ecuador

Bolivia

It is evident that investigation of local conditions which aid in the transmission of certain diseases is important in the work of the field offices of PAHO. Although it is known how these diseases are transmitted and how to control them basically by means of sanitary engineering techniques, it is necessary to acquire more technical knowledge in order to decrease the costs of engineering programs, especially in the poorer and more undeveloped countries.

If the engineers project works which are beyond the economic capacity of the country, these are bound to fail. There is a need to improve conditions in relation to collection, transportation and sanitary disposal of refuse. The outdoors refuse and excreta in certain zones create a proliferation of flies and it is possible that this situation is one of the causes of the high urban infant mortality rate. An investigation which would reveal the percentage of flies that carry the germs of enteric diseases is suggested as a research study.
Another aspect which is important in order to decrease costs, is to have more precise data in relation to the survival of bacteria in land and water. This would be of great help in the introduction of simple and economical methods of purification of sewer wastes or in establishing rules with respect to the use of polluted water for irrigation purposes, since almost all the water courses near the towns are affected by sewer discharge. It has been found that lagoons, even in cloudy zones, can receive a larger amount of organic matter by surface unit and have a shorter period of retention, with the consequent economical advantage.

Ecuador

Water

The major problem here from the public health viewpoint is that of water. It is necessary to study the following points:

1. Locating water sources, especially ground water sources.
2. Production of coagulants, using minerals or plants of the country.
3. Obtaining water disinfectants using local raw materials.
4. Economical equipment made with home made material for water processing especially in rural communities.
5. Equipment for drilling wells and home made pumps for wells that are not deep; the same applies for chemical feeders.

Housing

Studying designs and the maximum use of construction materials for economical rural houses which will provide the following:

1. Rodent proof (There are many places affected by plague in this territory).
2. Installation of hot water, using cheap materials, especially in regions with cold climates, thus making bathing facilities more attractive and helping in the control of epidemic typhus.
Garbage

In view that the utilization of garbage for agricultural purposes is widely practiced in the Andean region, it is convenient to investigate the means by which garbage can be transformed in an economical manner without being an attraction for insects and rodents.

Water Pollution

In view that the problem of contamination of streams and rivers is growing every day, due to the disposal of sewage and liquid residue of incipient industries, it is important to install laboratories for investigation of water pollution and require the necessity of previous treatment before discharge.

III. Brazil

A quotation from "Research in Environmental Health" of the Report of the First Meeting of the PAHO Advisory Committee on Medical Research, page 53, is as follows:

"While it is important in Latin America, as well as elsewhere, that there be adequate support for basic research in the sciences that provide the foundation for environmental health practice, it is also important and perhaps more urgent to support research that will reduce the gap between what is known to be scientifically true and the possible application of this knowledge in the solution of the many environmental health problems that confront the peoples of Latin America."

This quotation is followed by the following comment from the PAHO Zone Office in Rio de Janeiro:

"We agree enthusiastically with this point of view because we do not see many possibilities for the countries of Latin America to embark by themselves in basic or pure research, while applied research programs are already in operation in several countries, and of course in Brazil, in connection with particular environmental conditions and/or well defined problems to be studied and solved within a comparatively short time, as demanded by rapid urbanization and industrialization."
Research activities in the state of Guanabara

1. Studies of pollution of the Guanabara Bay and bathing beaches of Rio de Janeiro. These include the so called drift-cards operation, eddy diffusion determinations and bacterial decline, in connection with the design of future submarine sewage outfalls. Carried out by SURSAN and with definite programs to continue for several years.

2. Sanitary survey of the Paraiba-Pirai Rivers Basin, with special consideration of sewage and industrial wastes discharges of Volta Redonda. Carried out by the Water Pollution Control Division of the Sanitary Engineering Institute of SURSAN.

3. Survey of the conditions of potability of the water supplied to the city of Rio de Janeiro. Carried out by the Division of Laboratories of the Institute.

Research activities in the state of São Paulo

1. Research studies of the extended oxidation process (oxidation ditches) for sewage treatment of small communities. This includes interchange of information with the TNO (Research Institute) of Holland for the design of a pilot plant in the state of São Paulo. The Faculty of Hygiene and Public Health is negotiating with the Municipality of São Bernardo do Campo for financing the construction of the pilot plant.

2. Study of plastic pipes (PVC and Polyethylene) for water distribution systems with respect to water quality, particularly taste and odor. Conducted by the Faculty of Hygiene and Public Health, University of São Paulo.
3. Sewage stabilization ponds at São José dos Campos. Operated under agreement between the Paraiba River Valley Service (Department of water and electric power), SESP Foundation and the Municipality of São José dos Campos.

4. Ground water resources investigation in the Jacarei - São José dos Campos area. In execution by the Paraiba River Valley Service, under agreement with the Geographic and Geologic Institute. Financed by the Research Fund of the state of São Paulo.

5. Sanitary survey of the Paraiba River Valley, by the Paraiba River Valley Service.

6. Exploration and study of new sources of water supply for metropolitan São Paulo. Carried out by CEPA, Special Commission for Water Supply Planning, formed out of DAE (Water and Sewage Department) engineers and representatives of DAEE, the Light and Power Co., the Water Division of the Ministry of Mines and Power (Federal Government), and the Professor of Sanitary Engineering of the Faculty of Hygiene and Public Health.

7. Sanitary survey of the Billings Reservoir. Carried out by the DAE.

8. Sanitary survey of Tamanduatei, Tietê and Pinheiros rivers. Carried out by the DAE.

9. Survey of Brazilian experience with well drilling equipment, screens and pumps, and research relative to the adaptability of these equipment and materials to the needs of the country. In execution by the Faculty of Hygiene and Public Health, and a special consultant under agreement signed by the University of São Paulo, SESP Foundation and USAID. The first part of the report, covering ten states, five of them in the
northeastern region of the country, is available. The second part is in preparation.

10. Air pollution studies in the metropolitan area of São Paulo, particularly in four municipalities of the industrial area. For execution by a special Inter-municipal Commission with collaboration of UNTA and PAHO (Agreement to be signed).

Research activities in the state of Rio Grande do Sul

1. Water fluoridation and experimentation on the use of fluor-spar available in the state of Santa Catarina. A program in operation by the Water Fluoridation Commission of the Secretary of Public Works.

2. Survey of water pollution problems, by the Water Pollution Control Council for the State, under the Secretary of Public Works.

Research activities in the state of Minas Gerais

1. Radioactivity research. Carried out by the Institute for radio-activity research, established by agreement between the School of Engineering, University of Minas Gerais and the National Research Council of Brazil.

As far as research work in the field of occupational health is concerned, nothing can be reported. There is only routine work done by SESI, Special Service for Industrial Safety, in São Paulo.

The major environmental health research needs in Brazil, in our opinion, are water pollution, air pollution, industrial wastes treatment, procedures and techniques for the analysis of water, sewage, industrial wastes and air. One way of implementing this research would be the establishment of Sanitary Engineering Institutes in close collaboration with the Universities and the governmental agencies responsible for the solution of environmental health problems.
IV. Venezuela and Trinidad

Venezuela

There have been no recent investigations in the field of sanitation which can be considered important.

The following investigation needs can be pointed out:
1. Removal of iron from underground water in small water supplies.
2. Behavior and persistence of schistosoma in sewage and in contaminated waters.
3. The use of highly toxic pesticides for agricultural purposes.

In order to implement these investigations, the University could be used and the work could also be coordinated with the Ministry of Public Health and INOS (Instituto Nacional de Obras Sanitarias), as they have a special interest in these problems.

In order to arouse interest in the investigation activity in the various environmental sanitation areas, it is suggested that this be done through the universities by providing them with the necessary equipment and perhaps, at the beginning, with consultants who can orient these activities.

Trinidad

The only research is that of ground water studies in Barbados. The work by Dr. H. Tullstrom, UN Technical Assistance Board, is mainly in connection with determining the total amount of ground water which could safely be extracted, percolation rates through some of the coral formations and the use of sloping tunnels and wells into the coral beds for absorption of storm and waste water.

Research needs include a method for control of insects breeding
in pit latrines and design data for rural sanitation structures suitable for use in islands of the West Indies.

Comments of the PAHO Consultant in Environmental Health: Note should be made of the publication during the year of two Spanish language textbooks on Water Supplies and Water Treatment, one prepared by Prof. Gustavo Rivas Mijares of Central University, Caracas, Venezuela, and one by Eng. Francisco Unda Opazo, Chief Engineer, National Health Service, Santiago, Chile.
APPENDIX B

TASK FORCE ON HEALTH AT THE MINISTERIAL LEVEL*
Washington, D.C., 15 - 20 April 1963

A.6 Environmental Sanitation

1. Among health programs the highest priority should be given to environmental sanitation and, within this field, to water supply and sewage disposal systems in urban and rural areas of Latin America. This priority should be reflected in the programs of national development, particularly as regards the allocation of funds and the establishment of the agencies necessary to achieve the objectives set forth in the Charter of Punta del Este.

2. Programs for the construction of water supply and sewage disposal systems should be intensified to the maximum in urban areas; they should be self-financing through the requirement of rational water rates and should be well organized and administered. The ministries of public health should stimulate and coordinate their activities with those of other national or local agencies in charge of urban water supply and sewage disposal services.

3. In order to fulfill the objective of the Charter of Punta del Este in rural areas, the Pan American Health Organization should study the possibility of establishing a Special Fund which could be designated

for rural welfare to be financed by contributions from the countries themselves, from the Alliance for Progress, and other international agencies.

This Fund would make it possible for governments to draw up and carry out environmental sanitation projects, with the cooperation of organized communities, priority being given to water supply projects.

The ministries of health will be those responsible for the programming and execution of rural sanitation courses.

They could lend or assign organized communities the necessary amounts for such works. It is estimated that with a suitable installment system a high percentage of the capital outlay could be recovered and used as a rotating fund that could benefit other communities.

4. Rural environmental sanitation programs should be initiated in areas where there is the greatest concentration of population and where the system could serve groups of houses. When the economic condition of the community permits it would be possible to carry the water lines into the houses; the ministries of health could be responsible for the domiciliary connections.

5. It is recommended that environmental sanitation units be given sufficient authority to permit them to exercise their proper advisory functions within the ministry of health, and also those of coordination and supervision of all governmental bodies that are also responsible for such works.
6. The ministries of health should take an active part in the planning and execution of housing programs sponsored by the governments, especially those that are developed in rural areas and, in the matter of the construction or improvement of housing, should encourage self-help efforts and the development of cooperatives to achieve this objective.

7. The ministries of health should intensify occupational health programs as well as those for the control of water and air pollution. Special attention should be given to the protection of the health of the agricultural worker, particularly to the danger inherent in modern agricultural practice. Industrialization programs should include industrial safety and health measures.

8. It is suggested that international banking agencies, include in their loan contracts to public or private enterprises, a clause making it an obligation to take measures to reduce work hazards in accordance with the legislation of each country. It is requested that the Pan American Sanitary Bureau undertake the pertinent negotiations.

9. The urgent need for training of professional and sub-professional personnel in the field of environmental sanitation is recognized to be of the utmost importance. It is recommended that the international agencies award the largest possible number of fellowships for this purpose and collaborate in the training of experts in the countries.