

VOLUME I

Report and
Recommendations

Second Peru-U. S. Workshop on Science and Technology in Economic Development

El Bosque, Peru

November 20-24, 1967

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This report records the topics discussed and the conclusions reached at the Second Peru-U.S. Workshop on Science and Technology in Economic Development held outside Lima, Peru, November 20-24, 1967. It is compiled from reports of session chairmen and rapporteurs, as well as staff notes. The workshop is part of a science cooperation program between the National Academy of Sciences and the Academia Nacional de Ciencias of Peru, under contract AID/csd 1122. The report will be presented to the Science Organization Development Board of the National Academy of Sciences and to the Agency for International Development and will be made available to interested institutions in Peru. It is part of a continuing program and study of science organization and development in a number of countries.

Report of the

SECOND PERU - U.S.

WORKSHOP ON SCIENCE AND TECHNOLOGY IN ECONOMIC DEVELOPMENT

El Bosque, Peru
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Office of the Foreign Secretary
National Academy of Sciences
"

In Cooperation with the
Peruvian National Academy of Sciences

NATIONAL ACADEMY OF SCIENCES
Washington, D. C.

1968

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in Volume II.

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A G E N D A

Monday, November 20

Opening Session

3:00-6:00 p.m.

Opening Addresses
Adoption of Agenda

Session I

Organization of Scientific and Technological Research (Report of Developments since First Workshop)

Chairman: Dr. José Tola
Speakers: General Angel Valdivia
Dr. Harrison Brown
Rapporteurs: Dr. Milner B. Schaefer
Ing. Isafas Flit

Tuesday, November 21

9:00-12:30 p.m.

Session II

Science in Secondary Education

Chairman: Dr. George Waggoner
Speakers: Dr. Víctor Latorre
Dr. Sidney Grant
Rapporteurs: Dr. Norman Moore
Dr. Holger Valqui

3:00-6:00 p.m.

Remarks by Ing. Víctor Ramírez, Observer
from Mexico

Session III

Science in Higher Education

Chairman: Dr. Mauricio San Martín
Speakers: Dr. Holger Valqui
Dr. Alberto Escobar
Dr. Harrison Brown
Rapporteurs: Dr. A. McGehee Harvey
Dr. Carlos Monge C.

Wednesday, November 22

9:00-12:30 p.m.

Session IV

Research: Responsibilities of Government
and Industry

Chairman: Ing. Mario Samamé Boggio
Ing. Alberto Giesecke
Ing. Jorge Grieve
Dr. Milner B. Schaefer
Rapporteurs: Dr. Víctor Benavides
Dr. William Bollay

3:00-6:00 p.m.

Session V

Peruvian Needs for Professional Scientific
Manpower

Chairman: Mr. William Lawless
Speakers: Ing. Mario Samamé Boggio
Dr. Norman Moore
Dr. José Tola
Rapporteurs: Dr. George Waggoner
Dr. Antonio Bacigalupo

9:00-10:30 p.m.

Seminar on Nuclear Agro-Industrial Complexes

Presentation by Dr. Harrison Brown

Thursday, November 23

9:00-12:30 p.m.

Panel Meetings (Panels 1 through 4)

Panel 1: Secondary Education

Dr. George Waggoner (Chairman)
Dr. Harrison Brown
Ing. Isafas Flit
Dr. Víctor Latorre

Panel 2: Higher Education

Dr. Mauricio San Martín (Chairman)
Dr. Carl Bauman
Dr. William Bollay
Dr. Carlos Monge C.
Dr. Holger Valqui

Thursday, November 23 (continued)

Panel 3: Research: Responsibilities of
Government and Industry

Cmdte. Eduardo Barragán (Chairman)
Dr. Víctor Benavides
Ing. Alberto Giesecke
Ing. José Lizárraga
Dr. Norman Moore
Dr. Milner B. Schaefer
General Angel Valdivia

Panel 4: Peruvian Needs for Professional
Scientific Manpower

Mr. William Lawless (Chairman)
Dr. Antonio Bacigalupo
Dr. A. McGehee Harvey
Ing. Mario Samamé Boggio
Dr. José Tola

Special Peruvian Subcommittee

General Angel Valdivia (Chairman)
Dr. Antonio Bacigalupo
Cmdte. Eduardo Barragán
Dr. Víctor Benavides
Dr. Andrés Kalnay
Ing. José Lizárraga

3:00-6:00 p.m.

Preparation of Panel Reports

Evening

Panel 5: Peru-U.S. Cooperative Program

Dr. Harrison Brown
Dr. José Tola
Ing. Alberto Giesecke
Dr. George Waggoner

Friday, November 24

9:00-12:30 p.m.

Session VI

Panel Reports

Chairman: Dr. José Tola

2:30-3:30 p.m.

Session VII

Findings and Recommendations

Chairman: Dr. Harrison Brown

Background Information and Summary Report

The second in a continuing series of NAS-sponsored science workshop meetings, supported by AID, was held outside Lima, November 20-24, 1967. These binational meetings bring together scientists and government representatives of the United States and Peru to discuss informally the development of an organizational structure and policy necessary to accelerate scientific and technological progress essential for Peruvian development.

The initial workshop meeting* held in Paracas, Peru, April 17-22, 1966, resulted in the informal grouping of Peruvian scientists, calling themselves the Paracas Group, to develop plans for the establishment of a Peruvian national research council and to strengthen the Peruvian National Academy of Sciences. The past year has seen some activity in support of these objectives. The establishment of a research council, although not yet a reality primarily because of political reasons, has nonetheless moved along, with considerable progress being made in the preparation of basic documents defining the council's eventual structure and plan of activities. It is believed that a Peruvian national research council will provide scientists greater strength and unity of purpose which will be essential if they are to assume the role of bringing science to

*The proceedings are contained in the Report of a Workshop on the Role of Science and Technology in Peruvian Economic Development. National Academy of Sciences, 1966.

bear on problems of vital national concern. A description of the various efforts to create a Peruvian national research council is contained in the document prepared by Peruvians entitled, "Organization of Scientific Research," which appears in Volume II. This document also includes the proposed plan of UNESCO on the organization of Peruvian scientific research which was considered by a committee of the Paracas group. The document entitled "A Methodological Approach to Scientific and Technological Planning," prepared by an OAS staff member, was made available to participants.

This workshop brought together eight U.S. participants, sixteen Peruvian participants, and approximately sixteen observers representing Peruvian universities, government and industry. The presence of an observer from Mexico was valuable. His account of Mexico's experience in the development of its scientific resources was particularly relevant to the discussions. About ten observers from the USAID Mission and the U.S. Embassy staff, including Mr. Donald Finberg, Assistant Director for Program of the USAID Mission, also attended. Ambassador John Wesley Jones attended part of the meeting and expressed his continued interest in this joint U.S.-Peruvian activity.

An evening seminar on nuclear agro-industrial complexes presented by Dr. Harrison Brown was well attended by workshop participants and invited guests with a special interest in the topic, including the Chairman of the Peruvian Commission on Atomic Energy. Papers prepared by Alvin Weinberg, Director of Oak Ridge National Laboratory, and his associates, and the report of the World Food Panel were distributed as background for this seminar.

The topics discussed at the workshop centered on the identification of bases for a national science policy, with special emphasis on the essential requirements of economic development, from the standpoint of Peru's immediate and more distant future.

The discussions were particularly timely in view of the great interest in science generated by the recent meeting of American Presidents at Punta del Este. The Presidents' Declaration states in part that:

"Latin America will share in the benefits of current scientific and technological progress so as to reduce the widening gap between it and highly industrialized nations in the areas of production techniques of living conditions. National scientific and technological programs will be developed and strengthened and a regional program will be started; multinational institutes for advanced training and research will be established; existing institutes of this kind in Latin America will at the same time be strengthened and contributions will be made to the exchange and advancement of technological knowledge."

Papers presented to the plenary sessions of the workshop by Peruvian scientists were in the following areas:

Organization of Scientific and Technological Research
Science in Secondary Education
Science in Higher Education
Research: Responsibilities of Government and Industry
Peruvian Needs for Professional Scientific Manpower.

These papers stimulated active plenary discussion, which was continued in small, specialized panels. The latter afforded a greater opportunity for consideration of specific points prior to the formulation of concrete recommendations. A special committee singled out recommendations which required priority attention, and these were adopted as such by the workshop participants.

The recommendations fall into two distinct categories: (1) those that must be implemented by the Peruvians themselves; and (2) those that lend themselves to implementation through cooperative effort.

Two of those in the latter category merit special attention. The first is that of creating a joint Peruvian-U.S. commission to study the present state of Peru's scientific and technical manpower base and to formulate a plan to satisfy Peruvian requirements in these areas over the next ten years. This study is especially necessary if Peru is to make meaningful plans for its future development. (See recommendations of Panel 1).

The second recommendation concerns the establishment of a Peruvian Association for the Advancement of Science which would bring together in one organization all Peruvians interested in science and technology, whatever their level of scientific accomplishment and activity. (See recommendation of special Peruvian panel). It is expected such an organization would stimulate increased interest and lead to a greater national awareness of the importance of scientific support and involvement. Provisional draft statutes were submitted at the workshop meeting. These were subsequently revised and are appended to this report.*

Particularly noteworthy at this workshop was the evidence of Peruvian enthusiasm for moving ahead as quickly as possible in the

*Subsequent to the meeting at El Bosque, the U.S. National Academy of Sciences arranged, with AID support, for the visit of one of the Peruvian organizers to consult with the American Association for the Advancement of Science, Science Service, and other organizations in Washington, D. C.

attainment of their objectives. The strong sense of purpose exhibited on this occasion gives reassurance that real progress can be achieved in a common effort to improve and mobilize scientific and technical resources for economic development. Moreover, the increased participation, which includes not only the more established scientists, but also their younger colleagues, who represent a broad range of disciplines, will help assure continued interest and participation in this and related programs.

In conclusion, the participants noted "the value of establishing and maintaining effective working relationships between the scientists of our two countries and working together in the analysis and solution of problems relating science and economic development," and recommended that "the Peru-United States workshops on science and economic development, so successful in the initial meetings, be continued." The participants agreed that a workshop meeting to evaluate progress and to elaborate new mechanisms for continued joint activity should be held next year. It was agreed that in the meantime, efforts ought to be directed toward implementing recommendations singled out by Panel 5 and agreed to by all participants as deserving of immediate attention. These are:

1. Continuation of efforts toward the establishment of a Peruvian National Research Council.
2. Establishment of a cooperative Peru-U.S. Commission to formulate a plan for highly qualified scientific manpower.
3. Initiation of a survey by the Inter-University Council to determine present activities in current pure and applied research.

4. Establishment of the Peruvian Association for the Advancement of Science.
5. Initiation of a study of science curricula in secondary schools by means of a commission sponsored by the National Academy of Sciences of Peru.
6. Initiation of a study by the Inter-University Council of university admission examinations.
7. Implementation in a faculty of education of a program to improve the scientific preparation of science teachers in secondary education in coordination with a faculty of science.

Session I

ORGANIZATION OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH

Chairman: Dr. José Tola Rapporteurs: Dr. Milner B. Schaefer
Ing. Isafas Flit

Dr. Tola reported on developments since the first workshop. The Paracas Group, which consists of some 20 advisors, has been reconstituted as a subcommittee of the reorganized National Academy of Sciences. Suggested statutes for a National Research Council, prepared by a Paracas Group panel and revised at a joint meeting at the U.S. National Academy of Sciences, form the basis of the "Draft Law to Establish a National Research Council," which appears as Appendix I of the Valdivia subcommittee report, "Organization of Scientific Research." At the request of the Minister of Education, a UNESCO consultant has prepared detailed recommendations for a Peruvian science policy structure, a preliminary draft of which appears as Appendix II of the Valdivia report. These recommendations are being extensively revised and are expected to correspond closely to those of the Paracas Group.

Dr. Brown reviewed recent developments. He believes there is a growing awareness in the United States of the need for a long-time scale for solutions to problems of social and economic development. The limitation is not so much funds as it is competent people, so that the time scale is determined by the time required to educate people up to the highest levels of scientific competence. He noted the changing attitudes reflected at Punta del Este concerning

the importance of science and technology in development, and the need to translate this attitude into action. He also mentioned discussions he and Dr. Tola held with President Belaúnde since the first workshop. Dr. Brown emphasized the importance of establishing the National Research Council as a mechanism for channeling Peruvian Government funds for research and development, and expressed the hope that the group might identify specific projects which might be undertaken by the research council when it is created.

General Valdivia read the report "Organization of Scientific Investigation," calling attention to the Appendices.

The report contains recommendations for the formation of three entities concerned with science and technology: the reorganized National Academy of Sciences, a National Research Council, and an Association for the Advancement of Science. The latter is to include persons from all sectors of the public interested in science and technology and their role in national life. The Association should be developed in the private sector. It was noted that only the National Research Council requires legislation to establish it. The reorganization of the Academy of Sciences is already under way.

There was also considerable discussion of the nature of the proposed Association for the Advancement of Science. It was generally agreed that it should be open to a large sector of the public, but there were some differences of opinion as to how closely related it should be to the National Academy of Sciences, although all agreed that the Academy should, in any case, have a leading role

in its development.

Several suggestions concerning specifics of the proposed law establishing the National Research Council were discussed. These included: whether the universities should be specifically represented, perhaps through a representative nominated by the Inter-University Council; the need for having members specifically concerned with marine resources, and with terrestrial natural resources other than agriculture.

There was some difference of opinion on the immediate steps to be taken in helping to bring about the establishment of the National Research Council. Some members of the Peruvian group felt that it should await receipt of the final recommendations of UNESCO by the Minister of Education, who has the responsibility for drafting the legislation, after which the group could offer criticism, if appropriate. However, it was felt that the UNESCO suggestions contained in the preliminary draft, in Appendix II of the Valdivia report, call for an organization that is altogether too complex. Nevertheless, hope was expressed that the final UNESCO recommendations for a governmental scientific body would be in accordance with those of the Paracas Group. Others felt that there should be more immediate action not only on this matter but on others, because of the pressing needs of the country, and the fact that decisions are being made rapidly, without the desired scientific inputs. Because of this it was agreed that the Peruvian group should, in any case, be working on a specific proposal and a course of action, since the UNESCO report might be long delayed, and there

is need to take action quite soon.

The Chairman proposed that the following was required:

- (1) Approval of the basic principles regarding the National Research Council, as expressed in the draft of Appendix I of the report.
- (2) Recommendations for development of a specific project for the National Research Council (details of the draft law).
- (3) Recommendations for the establishment of an Association for the Advancement of Science.

After further discussion, this was generally agreed to, and Ing. Giesecke specifically proposed the formation of a panel of the Peru group to work on a plan of action for implementing the National Research Council. The Chairman appointed a panel consisting of: General Valdivia, Dr. Bacigalupo, Dr. Lizárraga, and Dr. Benavides.

- A. That the universities attempt to influence the quality and the orientation of the academic plans and curricula of secondary education.
 - B. That they likewise attempt to influence the training of secondary school teachers. In those cases where the universities themselves are responsible for this training, they should be concerned about orienting it more toward the needs of the prospective teachers.
 - C. That they encourage and accept plans for the coordination of the national educational systems, whether it be through coordinating bodies or through a unification of the whole system which would guarantee the necessary interrelation between the different levels of education.
4. It is recognized that the application of the suggested measures implies long-range solutions and does not help alleviate the urgent problems of today. It is therefore suggested that temporary solutions be sought and put into effect. Among these, for example, is the expedient of refresher courses for highschool graduates, which some universities have adopted."

Dr. Víctor Latorre noted in his paper, "Secondary Education in Peru," that while Peru will soon be faced with an oversupply of secondary school teachers, the majority are unqualified to fulfill their principal function: to teach the students "to think and to do." Science instructors are largely innocent of any real understanding of science; consequently, instruction is based on rote memorization of facts, and laboratory experimentation is not included in the curriculum.

Inadequate training of normal school teachers is accentuated by lack of communication between these teachers and the universities. Forward-looking teachers should be allowed to study in universities without taking the full curriculum. To further aid in such communication a bulletin published by the scientific community,

built around the theme of the importance of science and laboratory experiments in secondary schools, would be of help.

There was agreement that summer institutes and the Regional School for Mathematics have filled an important role both for training and retraining teachers in the sciences. Such facilities encourage further study by teachers after graduation—presently too rarely done.

Night schools for secondary school students who must work during the daytime are also recommended, as was the encouragement of extracurricular scientific activities by both students and teachers.

There is a strong trend toward more students selecting education programs and fewer selecting science and technical programs, as they leave secondary school. This trend is caused by several factors: (a) the ease of passing the education entrance examination; (b) the large number of education schools available; (c) their location close to the students' homes, making it easier financially to attend education schools; (d) the security offered by the law which guarantees some income for all normal school graduates; (e) the lack of vocational selectivity demanded by the education course; (f) the possibility of studying on a part-time basis; and (g) the lack of intermediate technical schools for training people to the technician level.

To combat the trend it was suggested that there be fewer education courses and more science courses offered, both types of courses to be at a higher level, in order to challenge bright

students equally in both areas.

A further complicating problem is the fact that 50 percent of first-year engineering school students must repeat the first year's work, leaving even fewer openings for new science students in existing schools.

The need for a shift from education to scientific or engineering careers was emphasized by the forecast that within a few years there will be an oversupply of secondary school teachers trained to present standards. Fewer and better secondary school teachers are needed. Correction of this situation would release budgetary funds for support of the scientific and intermediate technical training.

The importance of developing scientists interested in education, rather than educators interested in science, was emphasized, though it was recognized this can be achieved only on a long-term basis and via university training, the ultimate goal being a requirement that science teachers in high school be science majors in the university. Any short-term solution is only a palliative, not a cure.

The serious problem of teaching students "how to think" and "how to do" was discussed, and the possibility of student construction of laboratory teaching materials was presented as a partial solution, since economic sources for laboratory materials are scarce. The experience itself is educational, and rudimentary experiments are often very effective. The possibility of construction of such laboratory materials by people in or associated with

universities was discussed, but caution was expressed that use of universities directly as workshops can be overdone.

Satellite TV with adequate power, to be used with inexpensive receiving antennas, was suggested as a new approach to massive secondary education. The system would use multiple language channels and cover a whole continent. The ultimate cost per student could be remarkably low with such a system.

The question was raised as to the possibility of creating a few secondary and normal schools of exceptional quality inside or outside the public school system, both as pilot schools to lead the way for the rest of the school system, and as places where exceptionally trained teachers would find satisfaction in teaching and in being efficiently used.

It would be appropriate that directors of scientific summer institutes for secondary and normal school teachers make the selection of teachers for such pilot schools. The political and economic problems which would be involved were discussed at length and appeared to be formidable.

Session III

SCIENCE IN HIGHER EDUCATION

Chairman: Dr. Mauricio San Martín Rapporteurs: Dr. A. McGehee Harvey
Dr. Carlos Monge C.

The session opened with a summary by Ing. Ramírez of the current status of Mexican plans and accomplishments in the area of science and technology. These efforts have led to a significant increase in the gross national product of the country, and a significantly higher per capita income. This growth has not been entirely balanced, particularly in the trade area. One important need which Ing. Ramírez emphasized was mass education, especially the training of technicians in all fields. Among the means employed to meet these needs are: (1) integral planning for education at all levels, and (2) the development and strengthening of research. It has been estimated that the number of new professors needed in the next five years is 27,000, and in the succeeding five years, 20,000. A central planning office has been created for a training program which is well integrated with the governing bodies of the universities. A special effort is being made to foster doctorate and post-doctorate training.

The National Bank of Mexico developed a credit plan to help those sent abroad for training. The areas of study for trainees abroad are related to the priority needs in Mexico. Special groups in various institutions have been created for special training and research in key areas, including physics, mathematics, the biological sciences, and the social sciences. A framework for a national

research council has been developed. Integrated programs have avoided duplication and waste in research and training, e.g., between the Polytechnic Institute and the universities. A program was instituted to inform the public of the importance of research, by relating it to the increase in the gross national product of the country. This has resulted in wide-spread emphasis on, and effective accomplishments in, education and research related to the important needs of the country.

Dr. Valqui presented a paper on science in higher education in Peru. The following is a summary of the main points of his presentation.

- Research is a fundamental activity in the university. Without it, the university is only a collection of ideas and methods which represent the vast experience of more developed centers.
- The percentage of the total budget devoted to research in most Peruvian universities is extremely small.
- Our educational system should emphasize the scientific method. The cultivation of our capacity to critically analyze information, our capacity to be original, and our scientific honesty should be increased.
- In referring to primary and secondary education, the professor should not limit himself to the teaching of a certain discipline. He should also use the discipline as a pretext for developing the scientific aptitude of students.
- The student should become more and more independent of his professor, by developing his own scientific capacity. The professor will then have more time to devote to his own academic activities. This is critical at the university level where the need to acquire new knowledge, and the needs for research, demand a large part of the professor's time.
- Peru has a very limited scientific tradition. It is not conscious of the fact that science is an indispensable

tool in the development of the country. There is a marked tendency to believe that basic sciences are only useful in training for professions like medicine, engineering, etc., and that they are not important in themselves.

- Our professors believe that there is no need for continuing their studies, once they have obtained their titles. They read only the texts that they are supposed to teach.
- Appointments for many full-time professors are made on the assumption that they are only needed for teaching. As a result of this, universities have increased the number of students but the quality of teaching has remained stationary.
- There is a general feeling inside the universities against research. Many professors are afraid of working in a field which does not give immediate practical results and this will eventually result in a minority of individuals who are qualified for this activity.
- The full-time system (tiempo completo) is of advantage for the ones who are interested in research. The exclusive dedication (exclusive full-time) is not accepted at present by most universities due to the large amount of money needed to cover the professors' salaries.
- The entrance examination of the universities, with their fixed questionnaires, are an invitation to students to continue the bad studying habits they have acquired in primary and secondary schools.
- The frustrated student develops a resentment against science. Physics and mathematics, he is told, are exact sciences; but they are taught by means of confusing verbalism which makes the students doubt the veracity of the statements.
- There is general agreement that all these defects and limitations should be corrected. The evolution of the new system should grow out of the good nuclei which already exists in some universities.
- It is important that the professors who will be involved in the planning and development of the new scientific education systems have time to do their research. Otherwise they will eventually turn against their own ideals.

--A national advertising campaign in favor of science is needed. National scientific contests should be encouraged. The summer courses for school teachers should be expanded. Modern means of teaching like radio, TV, and others should be utilized.

Dr. San Martín commented that the figures given in the document of Dr. Valqui concerning the percent of the National University budgets devoted to research were underestimated. Some full-time professors are devoting essentially all of their time to research but what does not show is the sizable input into research of the greater number of part-time professors.

Dr. Monge supplied additional information in regard to this by pointing out that in Cayetano Heredia, 40 percent of the budget was devoted to research. He documented this effectively. For example, in high altitude biology there are 30 investigators covering a wide variety of fields, including population control, endocrinology, endemic goiter, and cardiology.

Dr. Bacigalupo, who also felt that the paper of Dr. Valqui gave too pessimistic a view, described the extensive research programs at the Agrarian University that are directed at important areas such as agronomy, social problems, economics, and nutrition. He felt that the important work going on at his university was apparently better known outside of Peru than it is by other scientists in the country. He emphasized that their programs have been well supported by government and industry in Peru, as well as by foreign agencies. He stated that the Government of Peru calls on them for advice and comment on plans, but does not always follow the advice. He stressed the fact that a National Academy of Sciences

would be of great help. He emphasized that their research has had important practical results, e.g., in increasing corn production and added that an atmosphere where good research is being done has an important impact on the quality of the teaching program.

Dr. Escobar pointed out that it is important to concentrate not only on the natural sciences but also on the humanities and social sciences, in which scientific activity is also of fundamental importance. If the problem of training and research in the natural sciences is to be solved, it must be in the broader context. If one looks at the problems of an underdeveloped country in this broader context and plans effective solutions for the overall situation, the problems in the area of science and technology will be more soundly resolved.

Dr. Kalnay also took an optimistic view, and described the dynamic leadership in the Engineering University. There are talented, well-trained scientists there who have the right objectives and an enthusiastic approach.

Dr. Benavides commented that Dr. Valqui had made a true estimate of the serious problems which exist in regard to science and science training. He pointed out that in geology and mining there is no research going on, in spite of the fact that over 50 percent of the gross national product comes from mining. There are some bright spots which provide hope, as Drs. Monge and Bacigalupo had indicated. However, there is a serious problem when major resources in education do not recognize the importance of science and technology in development, and when promotions are considered, professors

are judged not on their research accomplishments but on seniority alone.

Capt. Freyre referred to the important accomplishments of the Institute of the Sea, and stressed the importance of studying marine resources from nutritional and other points of view. He stressed the fact that a whole new activity has been created as a career—the sea sciences—and that the university should recognize this and structure proper means of training people for this important scientific area.

Dr. San Martín commented that the discussion had emphasized the fact that more effective communication was needed at all levels in regard to the research going on in Peru, and stated that an inventory was being made.

Dr. Brown gave an excellent summary of his conclusions concerning the future development of science and engineering in Peru and of the scientific spirit necessary for progress, based on his five visits to this country. He pointed out that the richer countries have reached a stage of development in science and engineering at which there is a positive feedback loop, whereby through proper application of technology, wealth is proliferating wealth. The danger with respect to the poorer countries is the development of a negative feedback loop whereby poverty begets poverty. The reason is the one-sided application of technology, ignoring science and research. He stressed that the problem of development is not limited by capital alone. Capital investment is important, but it cannot be spent properly unless there are trained people to use it

effectively. One must create the research base locally for solving problems. They cannot be solved overseas.

He next addressed himself to the needs as a function of time in the development of science and engineering, particularly with reference to the universities. He believes that the long-time needs for trained persons in science and engineering will be great. In the next ten years, fewer than 100 to 200 Ph.D.'s in the natural sciences alone would be grossly inadequate for university needs. The needs in the social sciences will be equally great.

The population will double in 25 years, with 650,000 students in the university systems, of which 150,000 will be specializing in science and engineering. Assuming a ratio of 40 students to each full-time staff member which is essential the need 25 years hence is for 4,000 full-time faculty with Ph.D.'s or the equivalent. When one adds to this the needs of industrial laboratories, government departments, agricultural stations, normal schools, etc., the figure is truly great. Peru cannot possibly meet the needs 25 years hence, but with great help from the outside may do it in 35 to 40 years. This shows the difficulty and the time scale, which would mean doubling the number of Ph.D.'s every four years—a breath-taking problem.

The steps to be taken must be drastic and include:

- (1) A realistic appraisal of the needs for technical manpower to attain the development goals.
- (2) Long-term plans for the development of Ph.D.'s at the university level.

- (3) Responsibility for the research and analysis necessary for effective plans for research and development in Peru.

This can be done in two stages: (1) plans for the next 10 years and (2) less concrete plans for the next 25 years. No plan dealing with these critical problems can be developed without a major input from the scientific and technological community, which has been almost negligible up to the present time.

If science and engineering are going to be increased in quality as well as quantity, research competence must be developed. At the graduate level, one cannot get good teaching without research competence. Government mechanisms are needed for financing research in the university system and in government laboratories, and for stimulating industry to develop high-quality research programs.

Students must be exposed to research, shown that problems can be solved and that support of research is an integral part of the overall support needed to maintain a viable society. Research is necessary to produce scientists and engineers of high quality.

Finally, Dr. Brown stressed that quality is more important than quantity. There is only a "world science" and Peruvian scientists must be judged by world standards. Thus, Peruvian scientists must place themselves in the position of being self-critical and of exposing themselves to world criticism. Scientists at all levels, and particularly the young developing scientists should be exposed to the criticism of the world scientific community. Plans for travel must be included in the budget for research, therefore.

Dr. Monge expressed agreement with Dr. Brown's remarks. He emphasized that one must build on the strengths that already exist

in order to insure quality. In developing new fields, one must not deprive the ones already in existence which are doing sound and effective research on important problems.

Dr. Schaefer felt that the needs forecasted in the biological area were underestimated, particularly those of greatest importance in relation to the key problems in Peru (agriculture, marine sciences, health, etc.).

Dr. Grant inquired if the terms basic and applied research are useful. He asked Dr. Brown if he was speaking of quality in regard to pure sciences.

Dr. Brown replied that the vast bulk of research and development should be aimed at the problems of the country in terms of individual effort and of the budget for research. At the same time, if one is going to have a viable academic community with effective teaching and research training, and develop good faculties, many should have freedom to do what is of interest to them, without reference to its potential application. As much of this should be done as possible, without eating too much into the budget and manpower resources for the key problems.

Dr. Moore added that in the USA 90 percent of the research in the universities, as well as in government and industry, is applied.

Dr. Grant asked if training was different for basic as opposed to applied research.

There was agreement that there was little difference.

Dr. Tola had the fear that if only 10 percent of the effort in an underdeveloped country was given to basic research, it would

suffer and not perhaps be viable.

Dr. Brown stated that if applied research is developed properly and related to effective accomplishments, 10 percent would put Dr. Tola in clover.

Quality is equally important in applied research. Universities in the United States convinced government and industry that they could contribute greatly to the economy by research in applied fields, and that a good measure of basic research was used to sustain applied research and development over the long term.

It was suggested that mining—an important resource—could be used as a good example in trying to sell industry and government on the necessity of supporting research and research training in the universities.

Session IV

RESEARCH: RESPONSIBILITIES OF GOVERNMENT AND INDUSTRY

Chairman: Ing. Mario Samamé B. Rapporteurs: Dr. Víctor Benavides
Dr. William Bollay

Following Ing. Giesecke's presentation of his paper, "Responsibilities of Government in Research," the research philosophies and activities of a number of Peruvian government research institutions were described.

Cmdte. Barragán described the philosophy of the Peruvian Office of Naval Research: To encourage scientific research which is either of direct interest to the Navy or for the country at large. Examples:

- (1) Study of the installation of a subcritical nuclear reactor.
- (2) Feasibility study on harnessing of solar energy.
- (3) Problems of navigation and propulsion at high altitudes such as Lake Titicaca.
- (4) Effect of high altitude on diesel engines.

The Navy Research Office is authorized to invest 10 percent of its budget in basic research.

Ing. Lizárraga indicated that Government research groups suffer because of economic difficulties, heightened by the recent devaluation. This is resulting in a "brain drain" to other organizations. Even though it is difficult to establish the figures of government spending on research and development, it is not impossible to do so, and it is urgent to obtain these for planning purposes.

Captain Freyre described the Consejo de Investigación (founded in 1954 to study the sperm whale), the Fisheries Service of the Ministry of Agriculture (in charge of "inland waters"), and the Instituto del Mar. He referred to cooperative projects with the Universidad Agraria (anchovies as protein sources), San Marcos University, and the Corporación de Fertilizantes.

General Valdivia expressed the interest of the Armed Forces in research and development. The military does not pretend to have research groups, but channels its projects to existing institutions either with the Government or universities.

Ing. Vaccari described the objectives and organization of the SIPA (Servicio de Investigación y Promoción Agraria), indicating that it receives donations and grants. It suffers from loss of manpower to other activities.

Dr. Bacigalupo recommended that planning of research should be done via a National Research Council and that industry participation in research and development should be encouraged.

Dr. Bollyay stated that the suggestion to establish a "think group" has great merit, and described the process through which one such group studied the problems of a stationary communications satellite for educational purposes. The group found out that such a satellite could make possible the relay of programs to every village, and that it could be put in operation in less than ten years. The main factor facing this system is not the hardware but the programs. The cost for such an educational TV system, including program preparation, satellite and launch system, and 200,000 school

receiving systems is about \$19 million per year for ten years. Dr. Bollay recommended that government and industry cooperate with interdisciplinary university teams of faculty and graduate students in the formulation of critical national problems and the syntheses of technological solutions. For example, in the United States such a "system engineering project" has been concerned with the use of stationary communication satellites for educational purposes.

Dr. Valqui noted that the work carried out by Government research groups represents the application of techniques developed in more advanced countries. This work would be far more efficient if it were supported by basic research carried out by Peruvians.

Cmdte. Barragán recommended that:

- (1) Research be organized at the national level.
- (2) Institutions be created with adequate environment.

Dr. Latorre stated that the mission of the University is to carry out research. He indicated that it is possible to reverse the "brain drain." At the University of Engineering, for instance, there are 15 foreign professors, largely in physics.

Dr. Monge stated that there is the need to learn how to perform research, and that this should be done with the resources that we have at hand. In effect, it was necessary to bring into the country the Philosophy of Science.

Dr. Schaefer discussed the roles of government and industry in scientific research. In the United States, pure or basic research is supported by the National Science Foundation. Some basic research is also sponsored by other government organizations which are mission

oriented, provided the subject of the basic research leads to a better understanding in the subject of the mission. Examples of problem-oriented research were the Manhattan Project (development of nuclear bomb) and seawater desalinization. From the standpoint of the government sponsors they support only problem-oriented research; but from the standpoint of the scientist performing the research, it is basic or pure research, however.

The primary function of industry is to produce a profit. Thus, industry can only support research which leads to new understanding that will generate new products, so that the costs can be recovered. Also, industry needs patents—a preferential lease or exclusive rights—in order to justify research expenditures. United States industry has actually interpreted its charter very liberally, and has also supported at universities considerable basic research not directly related to industry's problems. Furthermore, industrial associations sometimes support research which benefits all of the industry, e.g., the fishing industry has supported much of the research at the Instituto del Mar.

The primary reason for government support of research is to advance the general welfare of all the people, such as in medicine or public health, transportation, agricultural research, etc. It may be carried out in government laboratories. However, most government-sponsored research is carried out by industry, universities, and non-profit foundations.

If research is carried out in government laboratories, then the government must pay competitive salaries, to avoid losing their

best men. There is, however, an internal brain drain from government to industry and to the universities.

It was recommended that general planning of research involving the government, the university and industry be carried out.

Ing. Grieve stated that the function of industrial research is to obtain greater development through the application, discovery or innovation of new technology. However, he stressed the importance of aligning needs with the objectives of the country. He indicated that, for instance, the application of new technology was not always advisable, because it could cause unemployment. This requires national planning. He also stated that it is imperative to investigate human realities in a technological framework.

Dr. Brown indicated that it is important that government and industry also develop research competence. In the United States, the land-grant college system was established about 100 years ago, and much money has been invested in agricultural research over this period. This research has been spectacularly successful.

One economist has said that the return on investment of agricultural research in the United States for that 100 years has averaged 100 percent per year. Only in the last 30 years has industry made major research expenditures, resulting in larger returns on investment.

The university research programs could not have been carried out without the support of government and industry. Conversely, industry realizes that the university is its main source of manpower. The Cal Tech "University Associates" were described. Each one

contributes \$20,000 per year for general purposes. In return, they get closer to the university, can see the results before they are published.

The United States government invests even more heavily in universities than industry does. Peru is in a situation like that of the United States before World War II. The government invests in agriculture research, but not yet in other areas.

Industry has a role to play. Dr. Brown mentioned the example of the creation of the Chemistry Department at the University of Mexico, under the auspices of a chemical corporation. Extractive industries should be encouraged to assume similar responsibilities. He suggested that the Academy of Sciences and other groups ought to develop ways and means to persuade industry to help university research.

Dr. Schaefer indicated that in the United States there has been a fruitful collaboration between government and industry. In the Department of the Interior, for instance, an office for water research was established 12 years ago. It has funds for grants and contracts. As a result of this effort, the cost of water has come down from \$4.00 to \$0.20 per 1,000 gallons. Now there is no doubt but that desalted water will be utilized, and the next step will be to carry the costs to \$0.10 per 1,000 gallons. It is a field in which the government and industry can get together to look into the problem.

Dr. Bacigalupo stated the need of the university to enlist the help of industry. This is something that requires some effort and

initiative on the part of the university. Also, the university should aid industry and try to help towards the solution of its problems.

Dr. San Martín indicated that the problem of the university and industry is one of a lack of communications. For this reason, the Inter-University Council and the Sociedad Nacional de Industrias will have a round table conference in the next few months.

Mr. Lawless said that in United States industry the conviction exists that research contributes to its success even though it is very difficult to measure the direct pay-off of research. Industry depends upon the university for manpower and for training research. He suggested that Peru's industry people need to acquire the conviction that university research programs will benefit them.

Dr. Valqui cautioned that there are dangers in accepting aid from industry because of the strings attached. Industry would try to get services at low cost and great savings.

Ing. Grieve indicated that research cannot escape the economic framework of the country, and that if some work could be carried out at the university more economically, it is of benefit to the country. He also suggested that incentives be created for industry to share in the development and use of common industrial research centers.

Dr. Moore stated that industry-university relations are complex and require considerable development. He recalled that previous discussion papers had indicated that after three years of high school, students usually abandon scientific education, unless

they intend to become engineers or MD's. He showed concern regarding the status of social science research, and indicated that there ought to be increased concern in the government for the humanities; without them the venture is hopeless.

Captain Freyre indicated that the fishing industry does not impose conditions on its support to the Instituto del Mar and that any other segment of industry would do the same. In fact, it was the Sociedad Nacional de Pesquería which motivated an approach to the university.

Dr. Valqui insisted that industry would try to obtain services, but not help towards broader studies.

Dr. Bauman explained the mechanism by which U.S. universities receive grants and contracts and assume complete control of the research and publication of results.

Dr. Monge indicated that to continue importing technology is a form of colonialism.

Dr. Benavides indicated that the bulk of industry in Peru is extractive; that the products (\$800 millions per year) are international commodities sold under competitive prices; that industry has requirements of technical, scientific and research personnel of the highest calibre and that the universities cannot fill the industrial requirements. Therefore, industry has had to bring foreign personnel for critical positions and to engage in extensive educational programs, from on-the-job training to scientific training, and even to the establishment of formal programs of study abroad, leading to a minimum of an MS level of education. Research

and development groups in industry, as for instance in the fields of metallurgy and geochemistry, are staffed largely by foreign personnel.

Ing. Samané noted that the great majority of technical personnel working in industry are Peruvian and trained in Peruvian universities.

Ing. Grieve and Dr. Bollay submitted the following recommendation for the creation of an industrial research laboratory. This was discussed but not adopted:

The real pay-off from research and development comes from an application to the problems of business and industry. Thus industrial research and development including mission-oriented applied research should probably represent 90 percent of the total research and development effort.

Much of this industrial research and development will be carried out in industry. In addition, there is a need for an industrial research laboratory which can serve the needs of the many smaller companies which cannot afford a permanent research laboratory of their own. Such an industrial research laboratory can also perform many standardization tests for the government to assure that the products of Peruvian industry will conform to world standards so that Peru can compete in price and quality with other industrial nations. It is suggested that a one percent tax on "industrial income" be applied for the support of such an industrial research laboratory.

The industrial research laboratory would perform other service functions for Peruvian industry such as assisting in the development of new products, provide testing services, and provide consulting services in order to raise the efficiency of production.

The industrial research laboratory should be located close to a good engineering school so as to facilitate the part-time research by faculty and students. It should, however, be organizationally independent. It might benefit by having a cooperative relation with a strong United States industrial research laboratory similar to that between the Battelle Laboratory in Frankfurt (Germany), and Battelle in the United States.

Session V

PERUVIAN NEEDS FOR PROFESSIONAL SCIENTIFIC MANPOWER

Chairman: Mr. William Lawless Rapporteurs: Dr. George R. Waggoner
Dr. Antonio Bacigalupo

Ing. Mario Samané presented the highlights of manpower projections contained in the paper, "Peru's Human Resources Requirements for the Sciences," which he prepared together with Dr. San Martín, Dr. Latorre and others.

Dr. Moore commented upon the need for vast increases in number and quality of researchers, pointing out also the need for adequate support of scientists by technicians. He stressed particularly the need of involving government and the private sector in the planning, in order that there be full communication and understanding of the needs of the scientific community. He emphasized the importance not only of formulating good plans but also of "selling" these plans to the national community.

Dr. Tola presented a plan for the development of scientific manpower through the cooperation of the National Academy of Sciences of Peru and the National Academy of Sciences of the United States ("Program for Training Peruvian Scientists," Vol. II). There was vigorous discussion of the various ways in which the problem of the shortage of scientific manpower might be solved. There was a consensus concerning the need for full and detailed studies of the shortage and of methods of meeting it. It was agreed that Panel 4 should explore further all the possibilities opened up by Dr. Tola's

interesting presentation. The possibility of a close cooperation between the national academies of Peru and the United States was very well received.

PANEL 1 - SECONDARY EDUCATION

Recommendations

We assume that the human element is the most important in the improvement of science in Peru. On the basis of this fundamental assumption, the following recommendations are made:

1. The National Academy of Sciences of Peru should concern itself with science curricula in the secondary schools. This is a proper concern of the Academy because the Academy represents the Peruvian scientific community—whether university, governmental or private. The Academy should concern itself with science in the secondary schools, because over the long run, the future scientists of the country have their first contact with the scientific disciplines in the secondary schools.

Specifically, the Academy, in consultation and collaboration with the Ministry of Education, should conduct an intensive study of science curricula in the secondary schools, including the problem of laboratory experimentation and facilities. We urge the Ministry to support such a study.

2. The Inter-University Council should make a careful study of the admissions examinations with particular reference to new curricula that may be developed in the sciences. The Inter-University Council should make this study in cooperation with the National Academy of Sciences of Peru. (See recommendation 6, Panel 2).
3. The separation between science and the humanities in the last years of the secondary schools should be eliminated. In the interest of attracting good students to science, the third year of secondary school is too early for this fundamental choice of vocation. We recognize that there is already an overloaded curriculum in the secondary school as a result of the encyclopedic approach to education. In view of the "new school's" principal goal—to teach the student to think—we believe a careful selection of materials, rather than an encyclopedic approach, will make possible a balanced and unified new curriculum.

4. The creation of a pilot experimental secondary school in which one of the principal objectives would be to offer modern and effective courses in mathematics and science. This school should be public and responsible to the Ministry of Education. The students should be admitted on the basis of high motivation and talent. The school should possess the best of modern teaching and laboratory equipment. It is expected that the students who graduate from this school will go on to be scientists or teachers of science.
5. The Paracas Group believes that eventually all secondary school teachers of science and mathematics should have university training. We believe that the strong faculties of sciences must cooperate with faculties of education and with normal schools. We further believe good faculties of education should strengthen their programs for the preparation of science teachers and should make the maximum use of the best talent in other universities. For example, the teachers in the summer institutes sponsored by the Ministry might well be involved in this suggested program.
6. The serious problem of overproduction of secondary school teachers should be studied, as a matter of immediate concern. It is evident that a few good faculties and normal schools should be consolidated; this implies the discontinuation of the weaker institutions.

Dr. George Waggoner (Chairman)
 Dr. Harrison Brown
 Ing. Isafas Flit
 Dr. Víctor Latorre

PANEL 2 - HIGHER EDUCATION

Recommendations

For Peruvian Action

1. Encourage departmental organization to make possible stronger academic departments, particularly in the basic sciences. Offer different levels of science programs depending upon the needs of the professional schools.
2. Recommend the establishment of general or basic study programs in Peruvian universities.

3. Undertake a survey of research and development in Peru by a questionnaire to be sent out from the planning office of the Inter-University Council. This survey would cover:
 - a. Who is doing research and development.
 - b. Where—university, government, or industry.
 - c. Subject of research.
 - d. Physical facilities.
 - e. Financial support.
4. Encourage each university to set its own goals—toward establishment of specialized centers of excellence. Agree on certain inter-university graduate programs so that as much advanced education as possible can be performed in Peruvian universities. This would involve encouragement of exchange of credits among the universities so that students can take specialized courses at various universities.
5. Encourage alternative possibilities for a student including:
 - a. Technician training for a terminal program of two or three years of study.
 - b. Undergraduate engineering and science education more appropriate for students preparing themselves for a professional career.
 - c. Masters degree for those students who are interested in research and development careers in industry or government.
 - d. Ph.D. degree for those students aiming principally at a research career.
6. Encourage aptitude and general intelligence testing in the university entrance examinations—rather than present testing of memorized facts. (See recommendation 2, Panel 1).
7. Encourage research and project laboratories for use of students to develop their research attitude and problem-solving capabilities.
8. Encourage study of a foreign language as part of the scientific curriculum toward a degree. A thorough understanding of at least one foreign language is essential in order to follow the world's technical literature.
9. Encourage professional activities such as seminars, research projects, participation in industrial and governmental

consulting. Encourage continuing studies by staff to keep up-to-date in their field.

For United States Action

1. Encourage cooperation of United States professional societies in selecting appropriate centers for training of Peruvian students in the United States. Training centers should include private and industrial research institutions as well as universities.
2. Encourage improved advisory services to Peruvian students in the United States to assure that they work on problems related to their country's development. This would help eliminate the brain drain.
3. Encourage financial support from appropriate governmental and private sources for the training of scientists at all levels.

Peruvian-United States Cooperation

1. Encourage U.S.-Peru cooperation between specific faculties on a continuing basis by exchange of staff, students, cooperation on projects, seminars, and exchange of information.
2. Concentrate particularly on cooperation in building up at least a few strong graduate programs in Peru.
3. Encourage participation of energetic young U.S. professors who are teaching new courses of importance to Peru's economy by offering one-month concentrated courses to university professors during the July-August vacation period, with continuing exchanges of course material and annual follow-up visits to give continuity to these programs.
4. Encourage cooperation on project laboratories and system engineering projects, with particular emphasis on projects of importance to Peru's economy. Offer recognition (prizes, fellowships, etc.) for exceptionally good solutions.
5. Encourage U. S. studies by small teams of Peruvian students who have already been motivated to concentrate their studies in an area of specialized interest to Peru. This might include interdisciplinary teams.

U.S. study might include university work as well as internship training at research or industrial organizations.

6. Encourage careful planning of Peru's requirements and needs for highly trained technical manpower. The joint U.S.-Peru group to study this matter should include representation from the institutions which will be using these highly trained technical people such as universities, government and industry. (See recommendation 2, Panel 4).
7. Encourage the establishment of research fellowships and make their existence widely known.

Dr. Mauricio San Martín (Chairman)
 Dr. Carl Bauman
 Dr. William Bollay
 Dr. Carlos Monge C.
 Dr. Holger Valqui

PANEL 3 - RESEARCH: GOVERNMENT AND INDUSTRY RESPONSIBILITIES

Recommendations

GENERAL

In order to accelerate the social and economic development of the country there is an urgent need for the government, industry and the scientific community to develop, support, coordinate and conduct joint programs of technological and scientific research. This is a permanent task which should be undertaken by the proposed National Research Council.

SPECIFIC

Until such an organization is established, some preliminary studies should be carried out. The Panel suggests the following:

For Peruvian Action

1. The establishment of an Ad Hoc Committee (Government, Industry and the Scientific Community) with the following objectives:

- a. To identify the more important areas where applied research and development are needed, indicating their respective priorities.
 - b. To determine how the corresponding research and development projects or areas should be allocated among universities and industrial and governmental research institutions.
 - c. To determine the means of supporting these research and development efforts.
2. The strengthening of research and development programs and institutes in the universities with the objective of promoting the establishment and improvement of the nation's small, medium and large industries.
 3. The undertaking of a survey within government, industry and universities designed to determine quantitatively (in terms of percentage of the GNP) and qualitatively, the amount and quality of the research now being done in these three areas of the economy. (See recommendation 3 for the Peruvian group, Panel 2).
 4. The establishment of an Ad Hoc Committee (Government, Industry and the Scientific Community) to study the need, possibilities and feasibility of establishing one or more Agro-Industrial-Marine Nuclear Complexes on our coast. This committee could include U.S. representatives later on.

Peruvian - U.S. Cooperation

1. The establishment of a joint Peru-U.S. Committee of the respective Academies of Sciences to look into the problem of gathering, coordinating and standardizing basic national statistical data especially in meteorology, hydrology and geophysics. This group would have, among others, the following responsibilities.
 - a. To identify current problems such as lack of coordination, data not yet collected, and others.
 - b. To make recommendations as to how these problems could be solved. Our panel suggests that the National Office for Evaluation of Natural Resources (ONERN) be charged with the responsibility of implementing the Peruvian commitment.
2. The establishment of a joint Peru-U.S. group to study the need, possibilities and feasibility of establishing a stationary satellite education and communications program for specific uses in the country.

3. The establishment of a joint Peru-U.S. group to study the need, suitability and feasibility of setting up a National Data Processing Center based on modern digital computer facilities as well as to provide technical advice to those organizations in our country which want to make efficient use of, or set up, their own computing facilities.

Cmdte. Eduardo Barragán (Chairman)
 Dr. Víctor Benavides
 Ing. Alberto Giesecke
 Ing. José Lizárraga
 Dr. Norman Moore
 Dr. Milner B. Schaefer
 General Angel Valdivia

**PANEL 4 - PERUVIAN REQUIREMENTS OF HUMAN RESOURCES
 FOR PROFESSIONAL SCIENTIFIC MANPOWER**

Recommendations

Panel 4 recommends that the Peru-U.S. workshop on the role of science and technology in the economic development of Peru adopt the following:

1. A declaration that in order to carry forth Peru's economic and social development, there is urgent need to establish a national program to train scientists adequately qualified to carry out original research and capable of teaching and conducting research in universities and research centers, both public and private.
2. The establishment of a joint Peru-U.S. commission by the Peruvian Academy of Sciences and the U.S. Academy of Sciences for the purpose of formulating the afore-mentioned plan, keeping in mind the national development plan and in accordance with the following guidelines:
 - a. The committee will be constituted by 5 Peruvian scientists designated by the Peruvian Academy of Sciences and 5 U.S. scientists designated by the U.S. National Academy of Sciences. In addition the group should include a representative from the Peruvian government, a representative from the Inter-University Council and a representative from industry.
 - b. The commission's work goals will be:

- i. To study all aspects of the problem related to the present situation and to the possibilities for future development taking into consideration the following points: (a) human resources; (b) material resources; and (c) scientific research.

The study should take into account the proposal presented at this meeting "A Program for the Training of Peruvian Scientists."

- ii. To establish the economic requirements, on an annual basis, necessary to carry out the plan over a period of ten years, giving the specific number of scientists which should be trained, the particular fields of specialization, and the investments required for the categories mentioned in the previous paragraph.
 - iii. To propose a program for financing the plan considering both internal and external sources.
- c. The joint commission should be provided with a joint full-time professional secretariat plus necessary secretarial support.
 - d. The commission's report should be presented to the two Academies within a period of 12 months from the time the commission is established.
3. A recommendation to the Peruvian Government that it give moral and financial support to the National Academy of Sciences of Peru for the constitution and operation of the commission.
 4. A recommendation to international assistance agencies and foundations that they lend economic assistance in order to carry out the work of the commission, recognizing that this work will be intimately related to Peruvian economic development and, therefore, to Latin American development.

Mr. William Lawless (Chairman)
 Dr. Antonio Bacigalupo
 Dr. A. McGehee Harvey
 Ing. Mario Samamé Boggio
 Dr. José Tola

PANEL 5 - UNITED STATES—PERU COOPERATIVE PROGRAMS

Recommendations

Panel 5 recommends that the second U.S.-Peru Workshop on Science and Technology in Economic Development subscribe to the recommendations made by Panels 1, 2, 3, and 4, as well as to those made by the Special Peruvian Panel. Recognizing, however, that limitations of resources will restrict the projects which can be undertaken effectively during the next few months, we urge that special priority be given the following seven projects during the next year:

1. Continuation of efforts toward the establishment of a Peruvian National Research Council. (Special Group Report).
2. Establishment of a cooperative Peru-U.S. Commission to formulate a plan for highly qualified scientific manpower. (Panel 4, recommendation 2).
3. Initiation of a survey by the Inter-University Council to determine present activities in current pure and applied research. (Panel 2, recommendation 3, for Peruvian Action).
4. Establishment of the Peruvian Association for the Advancement of Science. (Special Group Report).
5. Initiation of a study of science curricula in secondary schools by means of a commission sponsored by the National Academy of Sciences of Peru. (Panel 1, recommendation 1).
6. Initiation of a study by the Inter-University Council of university admission examinations. (Panel 1, recommendation 2).
7. Implementation in a faculty of education of a program to improve the scientific preparation of science teachers in secondary education in coordination with a faculty of science. (Panel 1, recommendation 5).

In addition, Panel 5 suggests that the participants at this meeting unanimously recommend that financial support be found for

the National Academy of Sciences of Peru on a continuing basis in order that it might undertake projects such as those recommended above. In our opinion, if the Academy is to work effectively, it needs modest facilities and a small permanent staff.

Finally, recognizing the value of establishing and maintaining effective working relationships between scientists of our two countries and of working together in the analysis and solution of problems relating science and economic development, we recommend that the Peru-U.S. workshops on science and economic development, so successful in the initial meeting, be continued. Specifically, we recommend that a meeting to evaluate our progress and to elaborate new mechanisms for our continued joint activity be held next year.

Dr. José Tola
Dr. Harrison Brown
Ing. Alberto Giesecke
Dr. George Waggoner

VI. REPORT OF THE SPECIAL GROUP ON THE ORGANIZATION OF SCIENTIFIC
AND TECHNOLOGICAL RESEARCH

A. Recommendations

1. Mobilization of the scientific community and all persons interested in the advancement of science by creating a Peruvian Association for the Advancement of Science. The creation of this institution should take place during the present meeting.
2. The National Academy of Sciences of Peru and the Peruvian Association for the Advancement of Science should jointly approach the appropriate political authority or authorities who would be concerned with the legal aspects of the creation of a National Research Council, formulated on the basis of the proposed legislation (ante-projecto) elaborated by the Paracas Group.

B. Implementation of the Recommendations

1. The creation of a Peruvian Association for the Advancement of Science will take place through a Founding Board of Directors which will be named during the present session, working with the guidance provided by Provisional Statutes which the group has drafted. Dr. Antonio Bacigalupo will submit suggestions of persons which should constitute the Founding Board of Directors.
2. The Group believes that the legal creation of a National Research Council should be executed by means of a Presidential decree which should be sought by a committee composed of the following persons: Dr. Víctor Benavides C., Ing. José Lizárraga, Dr. Andrés Kalnay, Cmdte. Eduardo Barragán, and General Angel Valdivia.

**PROVISIONAL STATUTES
PERUVIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE**

TITLE I

Name, Domicile and Objectives

Article 1

The Peruvian Association for the Advancement of Science (APAC) is hereby constituted as an institution of public law, with legal headquarters in the city of Lima and branches as appropriate in other locations throughout the country.

Article 2

The objectives of the Peruvian Association for the Advancement of Science are to promote and disseminate science, technology and scientific knowledge in Peru. Toward this end, it shall:

- (a) Bring together scientists and individuals who utilize science and technology or are interested in their advancement in our country.
- (b) Promote better understanding of scientific and technical methods among the general public.
- (c) Promote the continuous improvement of scientific education in the country at the primary, secondary and university levels.
- (d) Stimulate young people's interest and dedication to science and technology.
- (e) Sponsor the training of Peruvian scientists.
- (f) Promote better utilization of science for the welfare and security of the country.
- (g) Stimulate the work of scientists in Peru.
- (h) Encourage improved cooperation among scientists in the same or different fields.

TITLE II
Membership

Article 3

Any individual or institution interested in the advancement of science who submits a written application to the President of the Association as perscribed by these Statutes, may become a member of the Association. The membership will consist of the following categories:

- (a) **Active Scientific Members.** Individuals with a university degree who are engaged professionally or academically in scientific activities or are working actively in the development of science in the country, who have been recommended by two other active scientific members.
- (b) **Active Non-Scientific Members.** Individuals dedicated to, related to, or interested in scientific activity.
- (c) **Affiliated Associations.** National or foreign institutions wishing to join APAC and assist in achieving its objectives.
- (d) **Students.** Full-time students in secondary schools or universities.
- (e) **Honorary Members.** Individuals who have made a meritorious contribution to scientific research or the promotion of research, in the country or abroad.
- (f) **Corresponding Members.** Peruvian or foreign scientists, not residing in the country, who are outstanding in any field of science.
- (g) **Life Members.** Individuals who have been active scientific members for a period of thirty years.
- (h) **Individual Patron.** Individuals wishing to provide significant financial support to the Association.
- (i) **Corporate Patron.** Institutions or organizations wishing to provide significant financial support to the Association.

Article 4

Honorary or corresponding membership shall be effective upon the approval of the Council, following recommendation by the Board of Directors. Membership in other categories shall be effective upon the approval of the Board of Directors.

Article 5

It is the obligation of the members to adhere to these statutes and the decisions of the Board of Directors and the Council, to honor the Association and to contribute to the fulfillment of its objectives with the means at their disposal.

Article 6

Members are entitled to use the premises, library, and other facilities, as prescribed by the Board of Directors, to participate in meetings and programs organized by the Association, and to enjoy all other benefits derived from achievement of the Association's objectives.

TITLE III

Finances

Article 7

Members are required to pay their annual dues in advance. These dues may be modified by the Council at the recommendation of the Board of Directors.

Article 8

Unjustified failure to meet payment of dues for one year will be cause for suspending membership rights in the Association.

Article 9

All donations or allocations from the Government or private entities shall become the property of the Association.

TITLE IV

Administration of the Association

Article 10

The Association shall be governed by the following entities:

- (a) The Directive Council
- (b) The Board of Directors
- (c) The Assembly

TITLE V
The Directive Council

Article 11

The Directive Council is the Association's highest executive body. It is constituted by the chairmen of each of the Sections and Chapters of APAC and its affiliated branches throughout the nation.

Article 12

The Directive Council shall meet each year on June 30 for the following purposes:

- (a) To elect, from among its members, the President, Vice-President, and Secretary of the Council, who will hold the same positions on the Board of Directors.
- (b) To elect the remaining members of the Board of Directors for the ensuing period.
- (c) To discuss and approve or disapprove the Annual Report and Financial Statement submitted by the outgoing Board of Directors.
- (d) To discuss the work accomplished by the Associations and the projects in progress.
- (e) To approve and amend the Statutes.
- (f) To discuss organizational matters.
- (g) To establish regular and special dues.
- (h) To approve the membership of honorary and corresponding members recommended by the Board of Directors.
- (i) To attend to matters concerning the Association's property.
- (j) To resolve matters not foreseen in the Statutes.

Article 13

Special meetings may be convened by the Directive Council whenever considered necessary by the President of the Council, or upon the written request of at least thirty percent of its members, specifying the purpose of the meeting.

Article 14

One-half plus one of the total membership of the Council of the Association shall constitute a quorum.

TITLE VI

The Board of Directors

Article 15

The Association shall be officially represented by the Board of Directors, which shall be composed of a President, a Vice-President, a Secretary, a Treasurer, and three Board members, one of whom shall be the past President.

Article 16

The Association's Organizing Group shall constitute the Founding Board of Directors and shall serve for one year, at the end of which, the Directive Council shall elect the succeeding Board of Directors.

Article 17

The responsibilities and powers of the Founding Board of Directors are:

- (a) To recommend to the Government, in cooperation with the National Academy of Sciences, the creation of a National Research Council and offer its advice for this purpose.
- (b) To carry out necessary actions for the organization of the Association.
- (c) To direct the actions of the Association for maximum achievement of its objectives, constituting Commissions as required.
- (d) To formulate the definitive Statutes and By-Laws of the Association.
- (e) To approve admission of new members.
- (f) To establish the number and names of the Sections.
- (g) To approve the expenditures of the Association.

- (h) To appoint and remove administrative officers as may be necessary and determine their salaries.
- (i) To designate new members to fill positions vacated on the Board.
- (j) To maintain and foster scientific exchange with similar foreign institutions.
- (k) To promote and/or authorize the establishment of APAC branches in various areas of the country.
- (l) To account for income, expenditures and financial progress to the succeeding Board of Directors.

Article 18

Members of the Board of Directors must be Peruvian, active scientific members of the Association, and up-to-date in payment of membership dues.

Article 19

A meeting of the Board of Directors shall be official with the presence of four members, one of whom shall be its President.

Article 20

The decisions of the Board of Directors shall be taken by majority vote; in the event of a tie, the President shall cast the deciding vote.

Article 21

The Board of Directors shall be elected by the Council of APAC, through ballots mailed to all Council members well in advance. An absolute majority vote is necessary for election.

Article 22

The members of the Board of Directors may be reelected consecutively only once.

Article 23

The Board of Directors shall be convened at least every thirty days by the President or at the request of three of its members.

Article 24

An officer of the Board of Directors missing three consecutive or five alternate meetings without notice or just cause shall be relieved of his duties.

Article 25

In the event an office is left vacant, the Council shall elect a successor.

Article 26

The Association shall be officially represented by the President of the Board of Directors or, in his absence, by the Vice-President.

TITLE VII

The Assembly

Article 27

All members of the Association shall convene once a year in a General Assembly for the purpose of:

- (a) Hearing the Annual Report.
- (b) Learning the plans of the Association as outlined by the Council and the Board of Directors.
- (c) Awarding honorary titles and distinctions to individuals who have served the Association effectively.

Article 28

The Assembly shall hold special meetings whenever necessary to take decisions on matters beyond the purview of the Council, at the request of the Council or at least thirty percent of the active scientific members.

TITLE VIII
The Officers of the Association

The President

Article 29

The President of the Association must have been an active scientific member for three years. This provision is applicable after the Association has been in existence four years.

Article 30

The President shall represent the Association officially and legally and shall have the following responsibilities:

- (a) He shall convene and preside over meetings of the Assembly, the Council, and the Board of Directors.
- (b) He shall conduct the meetings, announce election results, and shall cast the deciding vote whenever there is a tie.
- (c) He shall implement the decisions taken at meetings of the Assembly, the Council, and the Board of Directors, as well as the Annual Report and Financial Statement for his term of office.
- (d) He shall attend or send a representative to the meetings of the Sections and Chapters when so requested.

The Vice President

Article 31

The Vice-President must be an active scientific member. The Vice-President shall replace the President in his functions, in the event of a vacancy or impediment.

Article 32

The Vice-President shall collaborate with the President in conducting the activities of the Association.

The Secretary

Article 33

The Secretary must be an active scientific member.

Article 34

The Secretary shall have the following responsibilities:

- (a) To keep the records of all meetings, publish the reports thereof, and handle all correspondence.
- (b) To call the meetings of the Assembly, the Council, and the Board of Directors.
- (c) To countersign any document jointly with the President.
- (d) To inform the Council and the Board of Directors on the status of proposed members and proposing members.
- (e) To notify members regarding their appointment as such, enclosing the part of the Statutes pertinent to their responsibilities.
- (f) To report to the Council and the Board of Directors regarding the activities of the members.
- (g) To handle the correspondence of the Office of the President.

Article 35

Upon termination of his term, the Secretary shall deliver all books and files in his charge to his successor, and advise him for a period of thirty days after the new appointments are effective.

The Treasurer**Article 36**

The Treasurer must be an active scientific member. He shall perform the following duties:

- (a) Prepare the budget of the Association.
- (b) Manage the accounts of the Association.
- (c) Authorize the issuance of receipts, signing them and ensuring that they are made good.
- (d) Open accounts with banks or savings associations and sign checks jointly with the President.

- (e) Collect dues and other regular or special incoming funds.
- (f) Report on the financial status of the Association when so requested by the Board of Directors.
- (g) Keep current the record of membership dues.
- (h) Receive all inventoried books and records placed in his charge and deliver same to his successor, and advise the latter for a period of thirty days after the new appointments are effective.

TITLE IX

Sections and Chapters

Article 37

The work of the Association shall be conducted through its Sections and Chapters, which shall promote studies in the different fields of science. Sections shall be responsible for the Association's basic activities and Chapters shall support the activities of the Sections.

Article 38

The Board of Directors shall be responsible for proposing the establishment of new Sections and Chapters of the Council.

Article 39

The activities of each Section and Chapter shall be managed by a Board of Directors consisting of a Chairman, a Secretary, and two other Directors.

Article 40

The Board of Directors of each Section shall be elected by secret ballot of the active scientific members of the Section before June 30 of each year.

Article 41

The Board of Directors of each Chapter shall be elected by secret ballot of its active scientific members before June 30 of each year.

Article 42

The Board of Directors elected for the Sections and Chapters shall take office on June 30 of each year, before the regular meeting of the Council.

Article 43

Any member of the Association may be associated with one or more Sections or Chapters, but shall indicate the Section or Chapter wherein he shall be a voting member.

Article 44

The Chairmen of the Chapters and Sections shall be members of the APAC Council.

Article 45

The Boards of Directors of the Sections and Chapters may establish working committees as deemed appropriate for conducting the specific work needed.

TITLE X

The Executive Director

Article 46

The Executive Director shall be responsible for conducting activities related to the financial and administrative operation of the Association, as designated by the Board of Directors. He shall be appointed by the Board of Directors, on the recommendation of its President.

Article 47

The Executive Director shall have the following responsibilities:

- (a) To conduct the financial and administrative operations of the Association as assigned to him by the Board of Directors.
- (b) To supervise the work of the Association's personnel.
- (c) To propose to the Board of Directors measures for the most efficient financial and administrative operation of the organization.

TITLE XI
Temporary Articles

Article 48

The Association shall have the following Sections initially:

- Oceanography and Fisheries
- Social Sciences
- Mathematics, Physics and Astronomy
- Chemistry and Pharmacy
- Geology and Geography (Water Resources, Cartography, Geodesy)
- Animal Sciences (Animal Husbandry, Veterinary Medicine)
- Biology (Botany, Zoology, Animal and Plant Physiology, Microbiology, Ecology)
- Economics and Political Science
- Engineering and Architecture
- Medical Sciences, Odontology and Nutrition
- Industry (Mining, Petroleum, Transportation and Energy)
- Education and Communications
- Philosophy, History and Humanities

Article 49

The Association shall have the following Chapters initially:

- Journalism and Editorials
- Religion
- Armed Forces
- Banking
- Commerce
- Law
- Radio and Television

Article 50

Membership dues: Entrance fees and annual dues shall be as follows:

(a) Active Scientific and Non-Scientific Members:

Entrance fees	S/. 100.00
Annual dues	" 250.00

(b) Students

They do not pay entrance fees	
Annual dues	" 100.00

(c) **Affiliated Associations:**

Entrance fees S/. 1,000.00
Annual dues " 500.00

(d) **Individual Patrons:**

Minimum annual dues " 5,000.00
or single contribution. " 50,000.00

(e) **Corporate Patrons:**

Minimum annual dues " 15,000.00
or single contribution. " 150,000.00

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Papers Contributed by Peruvians

I. ORGANIZATION OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH

Organization of Scientific Research
Paracas Group Committee

II. SCIENCE IN SECONDARY EDUCATION

Secondary Education in Peru
V́ctor Latorre

III. SCIENCE IN HIGHER EDUCATION

Science in Higher Education
Holger Valqui

IV. RESPONSIBILITIES OF GOVERNMENT AND INDUSTRY IN RESEARCH

Scientific and Technological Research in the Armed Forces
Julio Bailetti

Organization of the Office of Research and Development,
Peruvian Navy
Eduardo Barragán

Report on Program V - Forestry Research
Flavio Bazán

Center of Educational Research of the Ministry of Public
Education

Diagnosis of Scientific and Technological Research in Peru:
Public Health
Carlos Collazos

Report on Marine Sciences
Alfredo Freyre

Responsibilities of Industry in Research
Jorge Grieve

Responsibilities of Government in Research
Alberto Giesecke

Diagnosis of Scientific and Technological Research in Peru:
National Institute for Industrial Promotion (INPI)
José Lizárraga

National Office of Natural Resources Evaluation
José Lizárraga

The Social Sciences in Peru
Héctor Martínez

Report on Agricultural Research in Peru
Federico Vaccari

V. PERUVIAN NEEDS FOR PROFESSIONAL SCIENTIFIC MANPOWER

Peru's Human Resources Requirements for the Sciences
Paracas Group Committee

Training Program for Peruvian Scientists
José Tola



