

# **SCIENCE AND BRAZILIAN DEVELOPMENT**

## **Report of a Workshop on Contribution of Science and Technology to Development**

*April 11-16, 1966*

*Itatiaia, Brazil*

### **PART I**

*Under the Auspices of*  
**The Brazilian National Research Council**  
*and*

**National Academy of Sciences—National Research Council**

*In Cooperation with*  
**Agency for International Development**

S C I E N C E   A N N D   B R A Z I L I A N   D E V E L O P M E N T

REPORT OF A WORKSHOP ON

CONTRIBUTION OF SCIENCE AND TECHNOLOGY TO DEVELOPMENT

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This report has been prepared by the Office of the Foreign Secretary, National Academy of Sciences-National Research Council, for the Latin American Bureau, Agency for International Development, Washington, D. C., under Contract No. AID/1a-125.

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of Science and Technology to Development

\*Separate Volume

# NATIONAL ACADEMY OF SCIENCES

2101 CONSTITUTION AVENUE  
WASHINGTON 25, D. C.

## Brazil-U.S. Workshop on CONTRIBUTION OF SCIENCE AND TECHNOLOGY TO DEVELOPMENT

Host: Conselho Nacional de Pesquisas  
Dates: April 11-16, 1966  
Place: Hotel Simon, Itatiaia, RJ, Brazil

### Brazilian Participants

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Rio de Janeiro, GB

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Representante do  
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Almirante Octacílio Cunha, Presidente  
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Rio de Janeiro, GB

### United States Participants

Dr. Harrison Brown  
Foreign Secretary  
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Dr. Carl Djerassi  
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University of Minnesota  
Minneapolis, Minnesota

Dr. Roy L. Lovvorn  
Director of Research  
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### Observers

USAID Mission Director  
Stuart Van Dyke  
(present at opening session)

USAID Deputy Mission Director  
William Ellis  
(present at opening session)

Mr. Thomas Hazard Jr.  
USAID/Washington

Dr. Andre Simonpietri  
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Dr. Rosson Cardwell  
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NATIONAL ACADEMY OF SCIENCES  
NATIONAL RESEARCH COUNCIL

2101 CONSTITUTION AVENUE, N.W., WASHINGTON, D. C. 20418

OFFICE OF THE FOREIGN SECRETARY

PROGRAM

Brazil-U.S. Workshop on  
CONTRIBUTION OF SCIENCE AND TECHNOLOGY TO DEVELOPMENT

April 11-16, 1966 Hotel Simon, Itatiaia, Brazil

Monday 4/11 PM Arrival  
Opening Session

Tuesday 4/12 AM Agriculture

Speaker: Dr. Glauco Pinto Viegas  
Chairman: Dr. Roy L. Lovvorn  
Secretary: Almirante Octacílio Cunha

PM Public Health

Speaker: Dr. Ernani Braga  
Chairman: Dr. Dieter Koch-Weser (Acting)  
Secretary: Dr. Franklin A. Neva

Wednesday 4/13 AM Assistance to Industry

Speaker: Dr. Sylvio Froes Abreu  
Chairman: Dr. Henrique Capper de Souza  
Secretary: Dr. Richard Jordan

PM Mineral Resources

Speaker: Dr. Annibal Alves Bastos  
Chairman: Dr. W. D. Johnston Jr.  
Secretary: Dr. Gerhard Jacob

Thursday 4/14 AM Geographic Integration

Speaker: Almirante Octacílio Cunha  
Chairman: Dr. Charles Wagley  
Secretary: Dr. Glauco Pinto Viegas

PM Visit to Itatiaia National Park and Museum

Brazil-U.S. Workshop Program

Friday 4/15 AM Development of Scientific and Technological  
Manpower

Speaker: Dr. Oscar Sala  
Chairman: Dr. Aristides A. Pacheco Leão  
Secretary: Dr. Stefan Robock

PM General Discussion and Recommendations

Chairman: Dr. Antonio Moreira Couceiro

Saturday 4/16 Departure for Rio with stops for lunch.

Draft Report on U.S.-Brazil Workshop  
on Contribution of Science and Technology to Development  
held in Itatiaia, Brazil April 11-16, 1966

A workshop entitled "The Contributions of Science and Technology to Development" was held in Itatiaia, Brazil April 11-16, 1966 under the joint sponsorship of the NAS-NRC/s Latin America Science Board\* and the Brazilian National Research Council, CNPq. This workshop brought together natural and social scientists, technologists and government planners to assess informally Brazil's scientific and technical resources both human and physical and to discuss means of mobilizing those resources toward economic development.

Background

The workshop arose out of discussions in the Latin America Science Board and in the Latin American Bureau of AID, regarding the value of a bi-national, rather than regional, approach to development problems in Latin America. Following a meeting of the Latin America Science Board in Rio in May, 1965, during which the workshop idea was explored further, Dr. Harrison Brown, Foreign Secretary of the U.S. National Academy of Sciences—National Research Council met with Dr. Antonio Moreira Couceiro, the President of the Conselho Nacional de Pesquisas (CNPq) to discuss the possibility of having joint workshops on the subject of science and development with the U.S. National Academy of Sciences and the Brazil CNPq alternating as hosts. These initial discussions led to more formal preparations conducted in August and December 1965 by Dr. Dieter Koch-Weser, Harvard University School of Public Health, the appointed U.S. workshop coordinator, and Dr. Walter Mors, the Brazilian coordinator.

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\*The LASB is supported under AID/Latin American Bureau contract, AID/la-125.

Details regarding agenda format and site were worked out during these meetings. Dr. Victor Rabinowitch and Miss Theresa Tellez, of the NAS-NRC/s Office of the Foreign Secretary's staff, were responsible for the U.S. staff effort both in the United States and prior to and during the workshop in Rio and Itatiaia, respectively.

U.S. participants were selected by the Executive Committee of the Latin America Science Board on the basis of suggestions made by the Board and others having knowledge of the Brazilian science scene. (See page ii for complete participant list.)

A formal AID/State Department briefing for all U.S. participants was held February 17, 1966 in Washington, D. C.

Background information on Brazilian universities, scientific and technological organizations, and foreign assistance projects in Brazil, was prepared by the Office of the Foreign Secretary staff and distributed to all participants prior to the workshop. (See Part III)

#### Workshop Structure

The workshop was divided into seven working sessions—six devoted to the discussion of specific scientific or technical problems or needs in relation to development—the seventh to a general summary of discussion of the workshop results and recommendations.

Chairmen and secretaries for each session were rotated between Brazilian and U.S. participants. Speakers were all Brazilian participants who were given responsibility for introducing the session topic either by summarizing their prepared paper or by impromptu remarks (see Part II).

The final report of each session was prepared by the secretary with the aid of the session chairman, the speaker and invited participants. This report took various forms depending on the wishes of the writing committee. In some cases a summary of the discussions was prepared; in other cases only a list of the conclusions or recommendations was prepared (see page 21). In order to preserve the informal nature of the meetings, no verbatim record of discussions was attempted.

The final session was devoted to the presentation of the six session reports with recommendations. As the recommendations fell into two distinct categories:

- a) recommendations of a purely internal nature, directed from Brazilians, to their various ministries and institutions; and
- b) recommendations for specific bi-national collaborative efforts in science, technology and development;

these two categories of recommendations were treated separately in the final session. The recommendations for U.S.-Brazilian collaborative efforts were prepared on the basis of the session reports by a special drafting committee consisting of the two delegation chairmen, Drs. Harrison Brown and Antonio Moreira Couceiro (Dr. Manoel da Frota Moreira substituted for Dr. Couceiro in his absence), the two workshop coordinators, and also Dr. Aristides A. Pacheco Leão.

There was one departure from the procedures outlined above and this was a proposal made by Dr. Carl Djerassi for encouraging basic research, particularly with industrial or technological implications, in Brazil. This proposal took the form of a document entitled "Comments by Carl Djerassi." By unanimous decision of the workshop participants, it was

decided to append Dr. Djerassi's comments to the reports of the workshop sessions. (See page 33)

Follow-up to Workshop Recommendations

U.S. and Brazilian efforts to implement the various recommendations noted on the pages which follow have already begun and it is planned that subsequent progress reports will be issued to indicate their status.

Support - Financial and Logistical

The Brazilian Research Council was host for the workshop, providing per diem allowances for all participants and making all of the necessary meeting arrangements. Translators and clerical help were also furnished insuring a smoothly running program.

The U.S. support for this workshop was provided by the Latin American Bureau of the Agency for International Development through a contract with the National Academy of Sciences. Additional assistance was lent by the Office of the Science Attaché, U.S. Embassy Brazil, and by the USAID Mission which furnished transportation, secretarial help and office equipment. Several representatives from the Mission and the U.S. Embassy attended as observers.

Reports of the discussions for the six sessions, together with the summary of recommendations for U.S.-Brazil collaborative programs, adopted on the final day, are contained in the following pages.

REPORT OF SESSION I - AGRICULTURE

Speaker: Dr. Glauco Pinto Viégas  
Chairman: Dr. Roy L. Lovvorn  
Secretary: Almirante Octacílio Cunha

1. Recognizing that agriculture, including forestry and fisheries, is basic to the continued economic development of Brazil, it is recommended that a joint Committee be established for the continued study of the opportunities of further U.S.-Brazilian collaboration in this field. The Committee should consist of three scientists from each country.

2. We recommend the creation of a group of six scientists, three each from the U.S. and Brazil to study the organization of agricultural research institutions, both state and national, and of ways of implementing coordination, means of eliminating obstacles and of other ways of getting better return from investments in research. Such a study group could draw from research organizations in other countries including the obtaining of consultants from Western Europe, Australia and New Zealand if necessary. Such a task force would be attached to the National Research Council.

3. We recommend the creation of a unit for studying methods of establishing priorities in agricultural research. It would be an economic research unit for an overall analysis of agricultural commodities in relation to nutrition and consumer demand, export opportunities and economic feasibility. The unit would consist of three U.S. scientists and three Brazilian scientists and would work with the Ministry of Planning and the Ministry of Agriculture.

4. Technical cooperation of Brazilian and U.S. agricultural institutions should be improved, aiming at the training of qualified technical personnel. Provisions should be made for the part-time continued use of U.S. scientists once they have returned to the U.S. campus.

5. Participant training as practiced by the USAID program has sent many Brazilian students abroad for study. This program needs to be liberalized by either Brazilian government or the U.S. government for the inclusion of expenses for the trainee's wife and children.

6. We recommend that the two countries promote a survey of cultivated forms of native plants of economic importance, such as cassava, peanuts, pineapple, cashew, grasses and legumes, establishing germplasm banks within research institutions where this material could be utilized for breeding purposes.

REPORT OF SESSION II - PUBLIC HEALTH

Speaker: Dr. Ernani Braga  
Chairman: Dr. Dieter Koch-Weser (Acting)  
Secretary: Dr. Franklin A. Neva

In the absence of Prof. Aragão, Dr. Koch-Weser served as Chairman.

Dr. Koch-Weser, in opening the session, encouraged a frank exchange of views. Unfortunately, no background paper in English was available, but Dr. Ernani Braga summarized the overall situation in the health field in Brazil to open the session.

Resumé of Dr. Braga's Comments

Dr. Braga's own previous associations illustrated earliest examples of U.S.-Brazilian cooperation: he worked with the Rockefeller Foundation, which began health work in Brazil as early as 1916, and also with SESP, a joint U.S.-Brazilian Public Health program. Dr. Braga then outlined the administrative history of Brazilian health services, including gains or losses in effectiveness of such services depending upon State or Federal control. The Federal government was attempting to correct some deficiencies that existed, for example, in the field of health statistics. It was pointed out that a very recent appraisal of the health situation in Brazil, done by the Ministry of Planning by Dr. Nelson Morais, contained much information applicable to the present discussion. Certain items from this report, "Preliminary Diagnosis of the Health Situation in Brazil," were mentioned, but the report was not available to the participants of the workshop. These included statistics on general and infant mortality, and life expectancy for different geographic regions of Brazil. Other aspects of health covered in this report, which Dr.

Braga wished to emphasize, were problems such as extension of some type of health services to remote regions of the country, and adequate provision of human resources, including auxiliary personnel, in the health field. A National Health Conference to be held next year would deal specifically with the subject of human resources for health; in this context it would help serve as the focus for international cooperative programs.

Dr. Koch-Weser opened the discussion by asking if the optimum conditions for cooperative programs could be defined more specifically. In reply, Braga used the Rockefeller Foundation's approach as an example -- namely, concentration on development of centers of excellence in Brazil, and training people to the limit of their capability locally before sending them abroad. There was considerable subsequent discussion on how the U.S. could help in training of health personnel. One example of an answer came from a survey indicating that Latin scientists preferred some program of cooperative work involving U.S. scientists and Latin Americans in Latin America, rather than simply more money or grants, or only sending more people abroad for advanced training. Dr. Djerassi felt that since U.S. senior scientists were more likely to go elsewhere than Latin America while on leave, or for foreign research experiences, it would be better to concentrate on young scientists in their early post-doctoral period to come to Latin America for an experience abroad. There was general agreement on the great need within academic institutions of the U.S. to make foreign experience prestigious, respectable, and rewarding. The general lack of knowledge in the U.S. of Latin American scientific facilities and literature, were cited as additional inhibiting factors.

Dr. Sala described the cooperative program in physics between the University of São Paulo and the University of Wisconsin, which is now in its fourth year, and is supported by the National Science Foundation from the U.S. and FAPESP from Brazil. This has primarily involved an exchange of post-graduate students, but has even included a U.S. student doing his doctoral work in Brazil. A question was raised as to whether research was really as important a contribution as teaching for a person from the U.S. to make if working in Brazil. A combined experience of teaching and research was felt to be necessary, and really inseparable, but active participation of Brazilians with the visiting scientist was essential in both activities.

Problems associated with cooperative and exchange programs were discussed further in a general sense -- not only in relation to health training. Dr. Lovvorn raised the question from his experience with AID contracts in agricultural work, as to whether one could not spend two to three years in Latin America and then continue work on the same problem, while still supported by the contract, while at his home institution. This might provide greater continuity of research on Latin American problems, and an eventual return of the person to the Latin American scene. Other mechanisms and factors to interest U.S. scientific people in Latin America were pointed out -- the role of the U.S. National Academy of Sciences in making known problems and places for research in Latin America, importance of careful choice of the place and conditions where research is to be done so that the initial experience is productive, and the necessity for chief administrative officers of both institutions involved to give genuine support to the project.

Dr. Harrison Brown asked if Dr. Braga could make some evaluation of the relative status of research in public health in contrast to other fields, such as agriculture. Dr. Braga, and Dr. Couceiro as well, admitted that biomedical research was relatively well off, and at least some sort of research facilities were distributed in all parts of the country. Biological research receives the largest allocation, by different fields, in the 1965-66 CNPq budget. Yet, Dr. Couceiro felt that there had been a deterioration in research in the public health field in the last ten years. In this connection, Dr. Koch-Weser objected to the implication that all bio-medical research is public health oriented; these are not at all synonymous. Furthermore, it was pointed out that one could frequently get support for basic bio-medical research in Brazil, whereas support for more applied health research, such as epidemiologic studies, was more difficult to obtain.

In view of the now well-recognized relationship of successful health programs leading to increases in population, Dr. Djerassi asked what Brazil was doing in the area of population control. Uncontrolled increase in population was felt to be a public health problem. Dr. Capper de Souza said that this was a matter of increasing preoccupation by many Brazilians because it threatened to nullify increases in economic productivity which were difficult enough to achieve. Dr. Couceiro stated that in his opinion population control should not be discussed in a session on public health. Dr. Braga observed that this matter was being approached in various ways by different Latin American countries and perhaps the problem was not as acute in Brazil as in some other countries.

The discussion period was concluded by Mr. Asper, who observed that he had hoped to see a clearer identification of the health problems considered of greatest importance for Brazilian economic and social development. He also noted that there had been no mention of the relationship of health problems to other fields, such as agriculture. The chairman acknowledged that this would have been desirable, but it was difficult to assess priorities in the absence of hard data on the current public health situation in Brazil.

In summary, even though the background documentation had not been provided for this particular session, it seemed clear that the important scientific and technological elements of public health in Brazil were embodied in the following points:

1. The role of health in overall social and economic development should be defined more clearly. This requires meaningful health statistics to define the magnitude of health problems and needs. Regardless of official or religious attitudes towards population growth, there are many health implications of this phenomenon which simply cannot be ignored. These implications include such basic requirements as necessary vital statistics, the capacity to predict future health manpower needs (numbers of doctors, nurses, medical schools, etc.), as well as any more direct attempts to deal with population growth that may develop with time. Thus, the economic aspects of health must be recognized.

2. Existing health resources must be utilized in the most efficient manner. Wherever possible, preventive and public health measures require emphasis since they can reduce the need for more expensive

curative health services. This also implies expansion of para- or auxiliary medical personnel at all levels.

3. It was recognized that research and training—and, as a matter of fact in most instances also service—in Public Health have to be considered and have to receive assistance together. The most critical shortage, as in almost any field in Brazil, is in manpower at all levels, from the Public Health Physician to the field technician in sanitation. Active U.S. cooperation in planning for the continuing improvement in Public Health in Brazil should result in:

- a) increasing the prestige of Public Health work, compared to private practice of medicine and basic science;
- b) the application of modern and specialized techniques on specific Brazilian Public Health problems. This would preferably be done by more and more U.S. scientists and public health workers cooperating in Brazil in research and training of personnel;
- c) increased knowledge and awareness of unique and excellent research opportunities in many aspects of Public Health in Brazil, which consequently would attract more U.S. scientists into such cooperation programs;
- d) strengthening local training facilities, which should be used to the limit of their capability, reserving the very expensive opportunities abroad only for highly specialized training not available in Brazil.

#### Recommendations

Based on the above considerations, the following suggestions are made for future U.S.-Brazil cooperation in the field of public health:

1. Statistical services related to health should be strengthened; this includes support of training.
2. Specific attempts should be made to increase participation of U.S. public health workers at all levels in research, training, and teaching activities in Brazil. For this purpose steps must be taken to:

- a) make international activity rewarding within the U.S. academic community both in terms of prestige and academic advancement;
- b) support plans presently being formulated by the Association of American Medical Schools to increase involvement of U.S. health science faculties in medical and public health education abroad;
- c) disseminate information regarding unique opportunities for research in Brazil.

3. Promote for Brazilians in the U.S. those specialized or unique training opportunities not available in Brazil.

4. The U.S. National Academy of Sciences--National Research Council should assist in securing, at request, needed technical assistance from U.S. institutions and agencies to Brazilian and U.S. health specialists engaged in collaborative activities.

REPORT OF SESSION III - ASSISTANCE TO INDUSTRY

Speaker: Dr. Sylvio Froes Abreu  
Chairman: Dr. Henrique Capper de Souza  
Secretary: Dr. Richard Jordan

The session, chaired by Dr. Henrique Capper Alves de Souza, was opened by Dr. Sylvio Froes Abreu who spoke on "Technology in Brazil at the Service of Industry and Government". This excellent paper discussed the impact of technology upon the modern world and provided a historical resume of technology in Brazil, stressing the beginning of the polytechnic schools in 1918, the first experimental station in 1921 and the rise and position of Institutes of Technology up to the present time. The differences were pointed out between the Institutes of Technology attached to universities for the purposes of offering specialized courses, graduate study and research for academic purposes and those not directly attached to universities for the purpose of rendering service to the general public, industry and government. The nature of the activities of eighteen different technical institutes in Brazil were reviewed. The author concluded by recommending that measures be taken to (a) augment the staffs of the institutes, particularly those servicing industry, to permit needed technical services not now available, to (b) carry out a survey to determine the equipment needs, and to (c) take measures to improve the salaries of staff.

Following this presentation, the discussion expanded into other facets of the industrial assistance problem. Dr. Jordan pointed out that in the last decade or so in the United States there had been a blending of the physical sciences, the engineering sciences and engineering insofar

as training was concerned, and that testing and application was largely accomplished by industrial research institutes and industry, and that basic physical and engineering research was the regime of both universities and industry. The establishing of science as a live and vital force in society is a major part of the problem of developing a strong economy based upon modern science and technology. In the U.S. the percentage of scientists and engineers employed by industry has risen to 73% with 15% employed by the government and the rest by universities. More than a third of the science and engineering doctorates are employed by industry.

Dr. Harrison Brown stressed that he did not believe a really viable research program could exist in a country without strong support from and through industry. However, there was much research in both Brazil and the U.S. that industry could not do. Examples were given of nuclear power and communications satellites. He suggested that in the case of Brazil industrial research will need to be subsidized in the immediate future, but that perhaps consideration should be given to doing some research by contract with industry. Certainly the national laboratories should not be abandoned, but industry must also hire and support scientists directly.

Dr. Oscar Sala commented that Dr. Brown had introduced a very important point since universities were now a sort of "ivory tower" and that full-time professors were forbidden to consult with industry. He suggested that perhaps a sort of National Bureau of Standards should be established and that currently such things as non-destructive testing were not available.

Dr. Roback suggested that there was a distinction between testing and research and that research was expensive and competent manpower short. He suggested that the research goals must be carefully defined in terms of the needs for the development of the Brazilian economy. Dr. Koch-Weser agreed that the critical problem of manpower was clear and that the need for research in industry added a new dimension. Dr. Froes Abreu further accented that the lack of personnel was a principal problem. It has been suggested that something like a National Bureau of Standards was very much needed and should be organized around the National Institute of Weights and Measures.

Dr. Capper de Souza stressed that consideration of contracting by government with industry for research should be given.

Dr. Helio Antonio Scarabotolo announced that a new Center for the Application of Science and Technology for Latin American Development may be formed and attached to the University of Sao Paulo. Funds would be supplied by the Brazilian Government, the Spanish Government, several of the Latin American countries and UNESCO. This Institute would contract with and cooperate with other countries and institutes and there would be no overlapping of activities.

Dr. Djerassi commented that in his experience Brazil was in a much better position to develop research than Mexico was ten years ago, but that right now there was virtually no value placed on the Ph.D. in Brazil. He felt that the problem must be solved and there must be an indigenous population of scientists and scientific positions if the economic potential of the country was to be properly developed. For example, the pharmaceutical

industry must support research. One country, India, has insisted that research in the pharmaceutical industry be done within its borders.

Dr. Capper de Souza indicated that industry has increased during the period 1947/61 9.6% each year and that the capital required for the development of industry is very great. New industry frequently applies to government, but industry should essentially develop through private initiative.

Dr. Simonpietri commented that much of the discussion so far was really related to Dr. Sala's paper, yet to be presented. To the list of items in Dr. Sala's paper another one could now be added--the relationship between the universities and industry. He suggested that a number of the points covered in this session's discussion could well form the basis for an excellent second meeting.

Dr. Brown suggested that the time had now come when constructive plans should be made for future activity and that perhaps two sub-groups be formed to meet between now and the next general meeting. These sub-groups should be concerned with (a) the problem of expansion of research, and (b) the development of Brazilian organizations which have the functions of the American National Bureau of Standards. As a result of Dr. Brown's suggestion, Drs. Capper de Souza, Froes Abreu, and Jordan met with Dr. Brown following the meeting and drafted the following recommendation:

1. The participants in the Workshop recognize the urgent need for the expansion of research programs aimed at solving the problems of Brazilian industries and the need for expansion of trained scientific manpower. The task of achieving an expansion of industrial research capability, which is commensurate with the need, is a large one. It involves consideration of financial and other incentives for industry

as well as for scientists and engineers. The task also involves relationships between universities, industry and government. In view of the importance and complexity of the problems, the workshop recommends the establishment of a joint sub-committee of the U.S.-Brazil group composed of about eight to ten persons from Brazil and an equal number from the United States to consider these problems in detail and to make recommendations for concerted action. The specialties of the group should embrace the major areas of industrial research and persons knowledgeable in economics, in government and in industrial administration should be included. The sub-committee should have a small, full-time professional staff, one from Brazil and one from the United States, with access to adequate secretarial services. Subject to securing financing, the group should have its first meeting in Brazil within the next six months and should be asked to submit its first recommendations within eighteen months.

2. The committee recommends that means be found to increase the numbers of specialists available through the existing Institutes of Technology in order to disseminate the results of research throughout the country and to create nuclei of technological research.

3. The participants in the workshop recognize the importance of the establishment of an expanded standards activity formed around the present Bureau of Weights and Measures as a nucleus.

In order to aid the long-range development of such an activity, it is recommended that a joint subcommittee of the U.S.-Brazil group be formed, composed of about three or four persons from Brazil and an equal number from the United States. This group could be staffed by the professional staff attached to the Subcommittee on Industrial Research.

Subject to securing adequate financing, it is proposed that this subcommittee hold its first meeting in Washington at the National Academy of Sciences within the next six months. It is also proposed that the subcommittee submit its final recommendations within the next eighteen months.

REPORT OF SESSION IV - MINERAL RESOURCES

Speaker: Dr. Annibal Alves Bastos  
Chairman: Dr. W. D. Johnston, Jr.  
Secretary: Dr. Gerhard Jacob

Recommendations

1. Undergraduate Teaching: The question having been raised whether the present enrollment of undergraduate students in geology should be continued or decreased, the conclusion was that it should be continued at the present scale. The justification was that in case the demand of geologists would decrease (which was not the feeling of the majority), automatically the number of students entering geological schools would decrease.

2. Practical Work in Geology: It was agreed that the "Departamento Nacional de Produção Mineral" (DNPM), as the national geological service, should continue to strengthen its personnel in order to undertake its growing responsibilities, not only for its own mineral work but also to provide the geological and related services required by other regional Brazilian organizations.

In Dr. Annibal Bastos' report it has been stated that about 5 foreign geologists should come to Brazil to collaborate with the DNPM.

A non-objected statement has been made that this number should be multiplied by two or three and portable equipment suitable for prospecting work from five to ten meters depth should be made available here in Brazil.

3. Post-graduate Work: It was generally agreed that in Brazil there are three major geological centers at the Universities in São Paulo,

Rio de Janeiro and Porto Alegre. The first one is already carrying on post-graduate work in some areas of geology whereas at the two latter centers such programs could be started soon if adequate support is given to them. This post-graduate work should aim the M.S. and/or Ph.D. degrees, meaning from two to five years work on a research thesis accompanied by high-level courses. To increase efficiency (in the case of São Paulo) and to start this work (in the other two cases), qualified experts in university geological research should come from the U.S. to Brazil, to spend relatively long periods of time (two or more years) at these three universities.

4. The Role of USAID: It was generally agreed that USAID should continue collaboration in the area of geology, by making available part of the funds necessary to pursue the work outlined in items 1, 2 and 3. The details of these collaborations should be worked out with DNPM, the "Conselho Nacional de Pesquisas" and the school of geology involved.

5. Employment Possibilities for Geologists: In connection with item 1 it was stressed that more possibilities for geological work should be created, not only by government and para-government organizations but also by private organizations and industries, thus creating new employments for geologists and consequently increasing geological surveys and covering other needs of the country.

6. Priorities in Exploitation of Minerals: The DNPM should be the organization which establishes priorities in exploitation of mineral findings in the country, and it is recommended that special attention should be given to lime and fertilizers due to the acute demand of these materials by Agriculture. It has also been stated without objection that prospection of nuclear minerals should be increased.

7. Methods of Prospection: Although the field work seems still to be the main way of prospection, more sophisticated methods should also be introduced, at least as accessorial methods to field work, and certainly in research programs at the universities.

REPORT OF SESSION V - GEOGRAPHIC INTEGRATION

Speaker: Almirante Octacílio Cunha  
Chairman: Dr. Charles Wagley  
Secretary: Dr. Glauco Pinto Viégas

Recognizing the great importance of the communication and transportation system for the economic development of the country, in view of their involvement in the political and social integration of the population, we recommend:

1. Special attention should be given to the studies relative to the organization and development of the conventional means of communication and the opportunity of utilizing new discoveries in the field of technology in this sector, such as fixed satellite, hydrofoil, micro-waves, etc.

2. The social, economic and cultural research of problems related to communication and transportation, such as internal migration, public health, education, urbanization, the assimilation of the imigrant and modifications in the social structure.

3. Special attention should be given to urban transportation and communication considering the rapid urbanization throughout the country.

4. The creation of a workshop formed by 4 specialists, 2 Americans and 2 Brazilians, for the continuation of the studies. Considering that such researchers require inter-disciplinary studies, these specialists should be able to count on the assistance of a staff in the different fields of science and technology, if necessary. For this aim, we recommend that the "Conselho Nacional de Pesquisas" and the National Academy of Sciences should take the necessary steps for its perfect coordination.

REPORT OF SESSION VI - DEVELOPMENT OF SCIENTIFIC AND  
TECHNOLOGICAL MANPOWER

Speaker: Dr. Oscar Sala  
Chairman: Dr. Aristides A. Pacheco Leão  
Secretary: Dr. Stefan Robock

Recommendations on the Training of Scientists:

1. That serious consideration should be given by Brazil to the problem of disparities between salaries of Brazilian and foreign scientists in attempting to implement programs for bringing foreign scientists to Brazil.

2. That more efficient use be made of post-graduate training centers now existing by bringing in foreign scientists to increase the capacity of the centers for training. An urgent need is to increase the experienced faculty in order to accommodate the rapidly growing enrollment of graduate students.

3. That several high priority cooperative programs between Brazilian and U.S. research groups should be given the opportunity and the means to maintain and expand their activities. The chemistry program mentioned by Dr. Djerassi and the cooperative program in physics between the University of São Paulo and the University of Wisconsin are examples of activities that may merit priority for continued and adequate support.

4. That programs be supported for facilitating bibliographic exchanges and the translation of scientific books and films.

5. That the financing of basic research should be expanded greatly in Brazil but in harmony with the capacity of scientists and research institutions to utilize efficiently such additional resources. At Brazil's present stage of development a goal of one percent of the Gross Domestic Product for scientific research and development might be a justifiable target.

6. That the financial resources for scientific research be enlarged through efforts to influence various governmental agencies such as Petrobras, the Superintendency for the Amazon, and private industry to undertake and finance scientific research.

7. That cooperation be extended to the planning work underway on manpower and higher education to ensure that the future need for scientists will be met.

SESSION VII - SUMMARY OF RECOMMENDATIONS FOR U.S.-BRAZIL  
COLLABORATIVE PROGRAMS

Chairman: Dr. Antonio Moreira Couceiro

I - AGRICULTURE

1. Recognizing that agriculture, including forestry and fisheries, is basic to the continued economic development of Brazil, it is recommended that a joint subcommittee be established as a working group for the continued study of the opportunities for further U.S.-Brazilian collaboration in this field. This working group should consist of 3 scientists from each country.

In addition this group should also study the organization of agricultural research institutions, both state and national, ways of implementing coordination, means of eliminating obstacles and other ways of getting better return from investments in research. Such a working group could draw from research organizations in other countries including the obtaining of consultants from Western Europe, Australia and New Zealand, if necessary. It would be attached to the "Conselho Nacional de Pesquisas."

2. We recommend the creation of an economic research unit for an overall analysis of agricultural commodities in relation to nutrition and consumer demand, export opportunities and economic feasibility, and establishment of priorities for research in these fields. The unit would consist of three U.S. scientists and three Brazilian scientists and would work with the Ministry of Planning and the Ministry of Agriculture.

3. Technical cooperation of Brazilian and U.S. agricultural institutions should aim at the training of qualified technical personnel on a continuing basis.

4. We recommend that the two countries promote a survey of cultivated forms of native plants of economic importance, such as cassava, peanuts, pineapple, cashew, grasses and legumes, establishing germplasm banks within research institutions where this material could be utilized for breeding purposes.

## II - PUBLIC HEALTH

The following suggestions are made for future U.S.-Brazil cooperation in the field of public health:

1. Statistical services related to health should be strengthened; this includes support of training. For this purpose the "Conselho Nacional de Pesquisas" and the National Academy of Sciences should each designate a scientist to jointly formulate recommendations for future action.

2. Specific attempts should be made to increase participation of U.S. public health workers at all levels in research, training, and teaching activities in Brazil. For this purpose steps should be taken to:

- a) make international activity rewarding within the U.S. academic community both in terms of prestige and academic advancement;
- b) support plans presently being formulated by the "Association of American Medical Schools" to increase involvement of U.S. health science faculties in medical and public health education abroad;
- c) create in the scientific community an awareness of the unique opportunities for research in Brazil.

3. Promote in the U.S. specialized training opportunities not available in Brazil.

4. The U.S. National Academy of Sciences--National Research Council should assist in securing, at request, needed technical assistance from U.S. health specialists engaged in collaborative activities.

5. The U.S. Brazil Committee on the Contribution of Science and Technology to Development should sponsor collaborative efforts in the investigation of specific Public Health problems in Brazil, such as Tuberculosis, Chagas Disease, Malnutrition and others.

### III - MINERAL RESOURCES

1. The joint U.S.-Brazil science, technology and development group should cooperate in every way possible to strengthen the "Departamento Nacional de Produção Mineral" (DNPM) so that it remains the outstanding geological group in Brazil and will be able to cope with the increasing demands placed upon it.

2. Under the auspices of the U.S.-Brazil science, technology and development group, several geologists should be brought to Brazil to work in the "Departamento Nacional de Produção Mineral" (DNPM), with the assurance that adequate equipment is provided.

3. Several U.S. research geologists should be brought to Brazil for two or more years to foster post-graduate training and research programs in the Universities of São Paulo, Rio de Janeiro, Porto Alegre and others when their programs reach the post-graduate level.

### IV - ASSISTANCE TO INDUSTRY

1. The participants in the workshop recognize the urgent need for the expansion of research programs aimed at solving the problems of

Brazilian industries and the need for expansion of trained scientific manpower. The task of achieving an expansion of industrial research capability, which is commensurate with the need, is a large one. It involves consideration of financial and other incentives for industry as well as for scientists and engineers. The task also involves relationships between universities, industry and government. In view of the importance and complexity of the problems, the workshop recommends the establishment of a joint subcommittee of the U.S.-Brazil Science, Technology and Development group composed of about eight to ten persons from Brazil and an equal number from the United States to consider these problems in detail and to make recommendations for concerted action. The specialties of the group should embrace the major areas of industrial research and persons knowledgeable in economics, in government and in industrial administration should be included. The subcommittee should have a small, full-time professional staff, one from Brazil and one from the United States, with access to adequate secretarial services. Subject to securing financing, the group should have its first meeting in Brazil within the next six months and should be asked to submit its final recommendations within eighteen months.

2. The participants of the workshop recognize the importance of the establishment of a Brazilian National Bureau of Standards.

In order to aid the long-range development of such a bureau of standards, it is recommended that a joint Subcommittee of the U.S.-Brazil Science, Technology and Development group be formed, composed of about three or four persons from Brazil and an equal number from the United States. This group could be staffed by the professional staff attached to the Subcommittee on Industrial Research.

Subject to securing adequate financing, it is proposed that this subcommittee hold its first meeting in Washington at the National Bureau of Standards and at the National Academy of Sciences within the next six months. It is also proposed that the subcommittee submit its final recommendations within the next eighteen months.

3. The committee recommends that means be found to increase the number of specialists available through the existing Institutes of Technology in order to disseminate the results of research throughout the country and to create nuclei of technological research on the subjects most urgently needed.

#### V - GEOGRAPHIC INTEGRATION

We recommend the:

1. Creation of a 6-member subcommittee consisting of three scientists each from Brazil and the United States to investigate the application of micro-wave communication, including educational television in Brazil;

2. Creation of a subcommittee to study the feasibility of new means of transportation on waterways;

3. Creation of a subcommittee to consider research of technical and social problems associated with transportation, communication and urbanization. This subcommittee should prepare information for presentation to the next U.S.-Brazil science, technology and development workshop.

#### VI - TRAINING OF SCIENTISTS AND TECHNOLOGISTS

1. Cooperative programs between Brazilian and U.S. research groups should be given the opportunity and the means to maintain and

expand their activities. The cooperative program in physics between the University of São Paulo and the University of Wisconsin is one example that may merit priority for continued and adequate support.

2. A subcommittee of two should be created to consider in more detail the illustrative program on the subject of "steroid chemistry" suggested by Dr. Djerassi and described in an appended report. The names of Dr. Mors and Dr. Djerassi are suggested for this subcommittee.

3. The joint U.S.-Brazil Science, Technology and Development group should facilitate bibliographic exchange and the translation of scientific books and films.

4. The joint U.S.-Brazil Science, Technology and Development group will make every effort to encourage the centers now existing by bringing in foreign scientists to increase the capacity of the centers for training and research.

5. The joint U.S.-Brazil Science, Technology and Development group should maintain liaison with the study now undertaken jointly by USAID and the "Ministerio de Educação e Cultura" on the evaluation of the Brazilian educational system. This liaison should pay particular attention to future scientific manpower needs of Brazil.

6. Specific attempts should be made to increase participation of U.S. scientists in research activities in Brazil, both to lead young Brazilian research groups and to join more advanced teams. It is also desirable to increase the program of post-doctoral training of young Brazilians in the United States.

For this purpose, steps should be taken to:

- a) make international activity rewarding within the U.S. academic community, both in terms of prestige and academic advancement;

- b) create in the scientific community of the U.S. an awareness of the unique opportunities for research in Brazil;
- c) increase the number of post-doctoral fellowships to permit young Americans to spend, after their Ph.D. or M.D., one or more years in Brazil.

Comments by Carl Djerassi

The following proposal is made as a result of Dr. Sala's talk and should only be used for illustrative purposes. We would like to accept the argument that basic research, preferably with industrial or technological implications, either in industry or outside, must be encouraged in Brazil. For this to be done, three factors are essential: 1) Personnel; 2) Subject matter; and 3) Physical location. I propose to discuss the subject within these three definitions. .

Research personnel

For the type of research which I have in mind, it is not sufficient to employ technicians or individuals who simply completed the equivalent of a bachelor or master's degree training, but rather it is indispensable that one has available adequately trained individuals beyond the post-doctorate level, who dedicate themselves to full-time research with some ancillary advanced teaching. In the beginning it may be necessary to import specialists in certain of the areas, but the ultimate plan must be to have available largely Brazilian personnel. This, in turn, means either to attract existing Brazilian specialists who, for instance, may be currently abroad, or to encourage young Brazilians to follow research careers. An indispensable component of such an attraction is a financial one. It is essential that they are paid a very adequate salary which, within limits, is competitive with what an expert could get elsewhere outside of Brazil, and it also is important that such research positions carry status. I see no way of taking care of both these requirements within the context of presently existing Brazilian organizations which support research, namely, the government and the universities. I say

this for the following reasons: In the United States a chemist or physicist or biologist who has just received his Ph.D., would have very little difficulty in getting immediately a research position, paying an annual salary of 10 to 12,000 dollars. Since the cost of living in the major cities of Brazil is quite high, it is pointless to consider anything below 7,000 dollars per annum as a minimum compensation for such a scientist. In addition, provisions would have to be made to adjust such salary with respect to inflationary pressures. Such salaries, obviously, cannot be paid by an existing Brazilian government or university institution without upsetting their complete salary structure. As a concrete example I would like to offer a young and capable Brazilian chemist, who came to the United States nearly 4 years ago to get his Ph.D. degree in chemistry at Stanford University. He returned to Brazil two months ago, and the best that could be offered to him financially was a research fellowship from the Conselho Nacional de Pesquisas in the amount of \$240/month. The same individual would have had no difficulties in securing a very attractive position in the United States with a monthly salary of approximately \$1,000. Brazil must recognize that it will have to face this type of international competition for its outstanding scientists and that only independent, wealthy Brazilians could really afford to return to their own country under such circumstances. At present this Brazilian chemist has to commute nearly two hours to and from the university laboratory, since he cannot afford a car, nor is he able to pay the rent which apartments in the vicinity of the university command.

I would like to suggest, therefore, that in order to solve this problem immediately, Brazil follow the French or Soviet system of having

an independent agency, directly responsible to the President of the Republic, finance research positions and perhaps even operate research laboratories. For instance the French Research Council (CNRS) has a variety of career positions, such as Maitre de Recherche and Maitre de Conférence. These positions carry a salary as well as status, and while the individual is an employee of the CNRS, the actual position may be held in a variety of different laboratories, including all of the universities. I see no reason why Brazil cannot institute such a program immediately, since it will thus be possible to offer appropriate salaries and full-time permanent positions (without having to interfere with the existing personnel and salary policies of government institutions or universities) to the few Brazilian scientists who would deserve them and, at the same time, offer a major attraction to promising young students to work for the doctor degree so as to become eligible for such positions. At present, except for a beginning in São Paulo, there is no financial incentive in Brazil for any individual working for a doctor degree, and this is part of the reason why so few individuals pursue such study outside of medicine.

Subject matter

Obvious priorities have to be established with respect to the type of basic research that Brazil can afford to institute and which would have an important impact on the country's economy as well as its research capability. It is, therefore, necessary to find a Brazilian component and yet, at the same time, to select a field which would be internationally recognized, both in terms of quality and in importance. This is so because the type of scientist that one would ultimately like

to attract to such positions would be one to whom recognition by his international peers in the same field would be quite important, and who would be able to publish his results in international research journals. I would like to give an example of a type of research activity which might satisfy these criteria, but I want to emphasize that this is given purely for illustrative purposes and is done only because I happen to be familiar with this particular field.

As a starting point I would like to take the remark of Dr. Glauco Pinto Viégas that Brazil has a substantial sisal industry and the observation that one of the useless by-products of sisal processing, namely the liquid derived from the leaves, contains a glycoside of hecogenin. Hecogenin is one of the few steroid raw materials which is currently being used industrially in Europe for the manufacture of many steroid hormones, especially cortisone and other anti-inflammatory hormones. I would suggest that a chemical group be set up which would repeat the published procedure of isolating on a commercial scale hecogenin from sisal wastes and to establish on a government subsidy a small plant for the industrial production of cortico-steroids. Fortunately, from the same raw material (hecogenin) one can also make all of the other steroid products which are used in medicine, such as the male and female sex hormones, oral contraceptives, ect. If this is accomplished, Brazil may be in a position to take care locally of most of its steroid requirements, which at the present time are filled exclusively by importation. This may well have to be a subsidized endeavor in the beginning, but the important part to remember is that there will be present immediately an industrial and economic rationale for performing research in this field. The indispensable requirement for performing steroid chemical research is the availability of substantial amounts of steroid raw materials and

intermediates, and these are usually only available in or near a steroid industry. It is not surprising, therefore, that the only countries in the world in which steroid chemical research is performed are those which have a steroid industry, and with the exception of Mexico, all of them are highly developed nations. An additional advantage of setting up such a steroid industry is that a nucleus of fairly advanced chemical operators would also have to be trained, and these could subsequently be used for other manufacture of sophisticated pharmaceuticals. Indeed it would be very surprising if the personnel required for the operation of such a plant would then not also take the initiative to undertake the production of other synthetic drugs, since nearly all of them involve easier chemical steps as compared to steroids.

Having available a source of steroid raw materials, it is then possible to perform with appropriate personnel advanced basic chemical research in the steroid field. To a large extent, this type of research, which in the international chemical research community carries a high prestige factor, involves chemical modifications of existing structures known to confer important biological activity or the isolation and structure proof of novel, naturally occurring steroids with biological potential. (A natural extension of such research, for which there already exists a capable nucleus in Brazil, is the general area of the chemistry of Brazilian natural products of plant and maritime origin.) In order to exploit fully such chemical research, it is indispensable to set up, at the same time, a biological research group which can evaluate pharmacologically and biochemically the properties of newly synthesized steroids. Once this work is done, the next stage is the clinical and veterinary evaluation of these results, and this in turn requires intimate research collaboration with clinical and veterinary groups. The latter

application is a fairly recent one and has enormous potential. A simple example is the recent work in the States and in Australia on the use of estrus synchronization of cattle and sheep. It is, for instance, possible with certain steroids, to bring all of the cows in one herd of cattle into estrus at the same time and to perform very efficiently artificial insemination in one or two days. Alternately, one can stagger cattle production by bringing cows into heat at appropriate intervals through the use of such steroids. Another application is to take sheep which are usually sterile during half a year and make them fertile during their infertile period. In other words, it is possible to have two crops of lambs per year where hitherto only one was feasible. These are only a few of the veterinary applications of steroids. An even more exciting one which dates only from last year, is the observation that a number of insect hormones are chemically of the steroid type. This opens spectacular opportunities for insect control, because it may be possible for the first time to create an insecticide for which no resistance can be developed and which at the same time would be harmless to plants or animals.

In summary, by stimulating chemical research in one area for which a native Brazilian raw material exists, and which can also be employed industrially for existing products, one stimulates original research in pharmacology, human medicine, veterinary medicine and in the insect field. This is a type of pay-off which one would like to derive from establishing research in one area, and I suggest that when other research topics are considered, this multiplication factor be taken into serious consideration.

I would also like to point out that if any significant discoveries are made in this type of chemical research, suitable international patent protection could assure the initially subsidized industry a very profitable return and eventually complete economic independence. Indeed one may go much further and predict that the entire subsequent Brazilian research effort in this field could eventually be paid out of the earnings of this industry. Also, it is quite likely that at some intermediate stage private investors may be encouraged to take over such a developing industry and to continue its growth under private auspices.

#### Physical location

The physical location of newly formed basic research groups outside of industry could be handled in a manner similar to that employed by the British Medical Research Council. This council has established research units (which it finances both in terms of personnel and other expenses) in research areas for which the council sees a specific need. Usually they do not build independent institutes, but rather establish these units within certain universities, but with semi-autonomous status. These units may range in size from a few individuals to as large a group as the molecular biology unit at Cambridge University, which includes several Nobel prize winners.