Science and Brazilian Development

Report of the Third Workshop on Contribution of Science and Technology to Development

APRIL 7-11, 1969 RIO DE JANEIRO, BRAZIL

Conducted by
National Research Council of Brazil
(Conselho Nacional de Pesquisas)
In Cooperation with
Office of the Foreign Secretary
National Academy of Sciences

NATIONAL ACADEMY OF SCIENCES
Washington, D.C.

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This report records the issues discussed and the conclusions reached at the Third Brazil-U.S. Workshop on Contribution of Science and Technology to Development held in Rio de Janeiro, Brazil, April 7-11, 1969. It was compiled from reports of session chairmen and rapporteurs, as well as staff notes. The workshop forms part of a science cooperation program between the National Academy of Sciences - National Research Council and the Brazilian National Research Council (CNPq), under contract AID/csd-1122. The report will be presented to the Board on Science and Technology for International Development of the National Academy of Sciences and to the Agency for International Development and will be made available to interested institutions in Brazil. It is part of a continuing study of science organization and development in a number of countries.

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Third Brazil-U.S. Workshop on

CONTRIBUTION OF SCIENCE AND TECHNOLOGY TO DEVELOPMENT

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A G E N D A

Third
BRAZIL-U.S. WORKSHOP
on
CONTRIBUTION OF SCIENCE AND TECHNOLOGY TO DEVELOPMENT
April 7-11, 1969
Rio de Janeiro, Brazil

April 7 (Monday)

Session I 9:00 a.m.	Evolution and appreciation of NAS-CNPq program of cooperation - Dr. Antonio Moreira Couceiro Remarks - Dr. Harrison Brown
	Government's strategic plan for scientific and technological development - Dr. J. Paulo Velloso
	Appreciation and comments on the last NAS-CNPq meeting - Dr. Amadeu Cury
	Role of the National Bank for Economic Development (BNDE) in scientific and technological development - Dr. Graccho Costa Rodriques, Jr.
	Role of the CNPq in the last four years - Dr. Frota Moreira

AGRICULTURE

Session II 2:00 p.m.	Relationship of agricultural research institutes of the federal and state governments and the universities - Dr. Glauco Pinto Viegas
	Utilization of the results of agricultural research in Brazil - Dr. Otto L. Schrader
	Utilization of the results of agricultural and technological research - Dr. G. Edward Schuh
	Centers of excellence for graduate courses in agriculture - Dr. Ady Raul da Silva

Some suggestions for improving agricultural research in Brazil
- Dr. Roy Lovvorn

April 8 (Tuesday)

Session III
9:00 a.m.

Ministry of Agriculture program for developing agricultural research
- Dr. Ayrton Zanon

Report of the Brazil-U.S. Study Group on Agricultural Economics and comments
- Dr. Victor Pellegrini

Present status of rural economics research in Brazil
- Dr. G. Edward Schuh

Future activities of the joint study groups on Agricultural Research and Agricultural Economics

INDUSTRIAL RESEARCH

Session IV
2:00 p.m.

Report of the Brazil-U.S. Study Group on Industrial Research and comments
- Dr. Richard C. Jordan
- Dr. Pérsio de Souza Santos (report presented by Dr. Nelson Gutheil)

Industrial research in universities and research institutes
- Dr. Richard C. Jordan
- Dr. Alberto Coimbra
- Dr. Kurt Politzer

Challenges for the future
- Dr. Stefan H. Robock

Future activities of the joint study group on Industrial Research

CHEMISTRY

April 9 (Wednesday)

Session V
9:00 a.m.

Progress report of the Brazil-U.S. Study Group on Graduate Teaching and Research in Chemistry and comments
- Dr. Carl Djerassi
- Dr. Ernesto Tolmasquim

Participation of the University of São Paulo in the program
- Dr. Paschoal Senise

Participation of the Federal University of Rio de Janeiro in the program
- Dra. Eloisa Mano

Patent problems in Brazil and suggestions for further study
- Dr. Carl Djerassi

Participation of governmental and private institutions in the program
- Dr. Walter Mors
- Dr. Abrahão Iachan
- Dr. Antonio Seabra Moggi

Future activities of the joint study group on Chemistry

EARTH SCIENCES

Session VI
2:00 p.m.

Role of the National Department of Mineral Production (DNPM) in the development of mineral resources in Brazil
- Dr. Marcelo Tunes

Program of graduate studies in geology
- Dr. Rui Ribeiro Franco
- Dr. Max White
- Dr. William D. Johnston, Jr.

Geochemistry in Brazil
- Dr. Milton Formoso

Geophysics in Brazil
- Dr. Wendenlin Lotze

April 10 (Thursday)

Session VII
9:00 a.m.

Geochronology in Brazil
- Dr. Humberto Cordani

Geophysics - Guidelines for research and graduate studies
- Dr. Clarence R. Allen

Geochemistry - Guidelines for research and graduate studies
- Dr. Harrison Brown

Geochemical studies of soil formation in the tropics
- Dr. John A. Forman

Future activities of the joint study group on Earth Sciences

COMPUTER SCIENCES AND TRANSPORTATION

Session VIII
2:00 p.m.

Research in computer sciences in the Catholic University of Rio de Janeiro
- Dr. Olinto de Oliveira

Computer sciences in the Federal University of Rio de Janeiro
- Dr. Denis França Leite

Computer sciences in the University of São Paulo
- Dr. Waldemar Seltzer

Road Research
- Dr. Roberto D. Leuzinger

Future activities in computer sciences and transportation research

Importance of highway research in Brazil and activities of the Institute of Highway Research (IPR)
- Ing. Homero Henrique Rosa Rangel

April 11 (Friday)

Session IX
9:00 p.m.

Meeting of the Coordinating Committee of CNPq-NAS and the chairmen of the joint study groups

Preparation of report and recommendations for future programs

Summary Report and Recommendations of the Third Brazil-U.S. Workshop on Contribution of Science and Technology to Development

April 7-11, 1969
Rio de Janeiro, Brazil

The third in a continuing series of workshop meetings, co-sponsored by the Brazilian National Research Council (CNPq) and the U.S. National Academy of Sciences-National Research Council (NAS-NRC), was held in Rio de Janeiro, Brazil, April 7-11, 1969.

These binational meetings are convened for the purpose of bringing together representatives from the scientific community, government, and private institutions to discuss informally problems relating to science and economic development. More specifically, the participants in these meetings consider mechanisms for facilitating and accelerating scientific progress as well as using science and technology in the development process.

The initial workshop in this series was held in Itatiaia, Brazil, in April 1966. This meeting resulted in the formulation of specific recommendations for continuing joint Brazil-U.S. activity in several problem areas considered to be of significant priority. Subsequently, five Brazilian-U.S. study groups were formed to consider (1) industrial research, (2) norms, measurements, and testing, (3) agricultural research, (4) agricultural economics, and (5) mineral sciences.

The second workshop, held in Washington, D. C., February 5-9, 1968, focused attention on a review and evaluation of the direction and work of the existing joint study groups and a consideration of science policy formulation in Brazil and the United States. Discussions of Brazil's science policy were based on a review of the Five-Year Plan for Scientific and Technological Development (1968-1972), prepared for the President of Brazil by the Brazilian Research Council with the help of members of Brazil's scientific community in December 1967.

In addition to continuation of the joint study groups, initiated following the first workshop in Itatiaia, the second workshop recommended new cooperative efforts in the area of postgraduate training and research in key fields of chemistry and in the field of computer sciences.

The present workshop focused attention on an evaluation of the final reports of the various study groups and a consideration of mechanisms for implementation of the recommendations presented.

Chairmen Antonio Moreira Couceiro and Harrison Brown opened the workshop with remarks emphasizing the significant value of the cooperative program to their respective countries. Dr. Couceiro pointed to the work of the various joint study groups as concrete examples of the positive impact of such programs on government planning for the economic development of Brazil. At the same time, he further pointed out the importance of joint efforts beyond the borders of Brazil, for the continent as a whole. He pledged continued efforts on the part of the CNPq to achieve the objectives defined in the joint program, and expressed appreciation to the National Academy of Sciences for helping to establish the "foundations for scientific cooperation which will continue over many years, thus strengthening the bond of friendship between the researchers of our two countries, promoting progress and benefitting the continent."

Dr. Brown pointed to the strong bond between U.S. and Brazilian scientists, developed as a result of the mutual realization that science has an important role to play in the future development of the world. He emphasized the importance of the Brazil-U.S. program in setting an example for other programs of the NAS in other parts of the developing world, and credited the Brazilian Research Council for its wisdom in recognizing the importance of science in the development of higher education and in the development of the economy as a whole. Dr. Brown, noting the importance attached to this program by various leaders concerned with problems of economic development, conveyed their hopes for the success of this joint approach in Brazil and for its possible use in other parts of the developing world.

Following these opening remarks, the formal workshop program began with discussions by Brazilian governmental representatives on the various roles of their respective agencies in Brazil's scientific and technological development.

In the afternoon and in succeeding days, the workshop focussed on the specific joint program areas of agriculture, agricultural economics, industrial research, and postgraduate chemistry. Formal and informal reports were presented and discussed, with particular attention being given to the future activities of the study groups and mechanisms for implementation of their recommendations.

The workshop noted, with particular pleasure, the completion of the first phase of the work of the industrial research group (report published September 1968), and the significant progress made by the agricultural research and agricultural economics groups. The joint agricultural research study group convened a seminar in Brazil, in February 1969, on the subject of management of agricultural research laboratories. The agricultural economics group presented its formal report with recommendations to the workshop, a copy of which is included as Appendix II.

A progress report on the preparation for the program on postgraduate research in key fields of chemistry was presented by Professor Carl Djerassi. This report (see report of session V) outlined the plans for the development of eight cooperative research programs in the Federal University of Rio de Janeiro, the University of São Paulo, and the Center for Physics Research in Rio de Janeiro. Dr. Djerassi's report of the steps taken by the U.S. senior scientists and the postdoctoral students was received enthusiastically by the workshop and was greeted with a pledge by the CNPq to move the program ahead as quickly as possible. Dr. Djerassi emphasized the importance attached to this program by U.S. scientists and officials and pointed especially to the NAS recognition of its significance in the awarding of fellowships to the U.S. postdoctoral scientists (National Academy of Sciences Overseas Research Fellows), a precedent for the Academy.

Brazilian chemists outlined their preparations for the program and discussed the roles of the chemistry departments of the Federal University of Rio de Janeiro, the University of São Paulo, and the Center for Physics Research in Rio, and the CNPq in support of the program. All expressed willingness to move ahead rapidly in its development.

On a related subject, Dr. Carl Djerassi spoke on the subject of patent problems in Brazil and called attention to the need to investigate alternative solutions to Brazil's patent situation in accordance with its industrial development objectives. He recommended an international, as opposed to a bilateral, study of this problem in order to gain insight from the experiences of other countries who have found different solutions for their patent problems.

Two sessions were devoted to earth sciences, an area considered by the CNPq to be of vital importance in its development program. Although possible programs for geological research and teaching had been considered in previous workshops and a joint study group had been formed to focus on various aspects of geology, this particular workshop discussed in detail, for the first time, the fields of geochemistry and geophysics. Papers were presented by several Brazilians, outlining the current state of these fields in Brazil and the needs for future development. Dr. Clarence Allen, a new U.S. workshop participant, presented, at the request of the CNPq, some guidelines for research and graduate studies in geophysics. Dr. Harrison Brown made a similar presentation in the field of geochemistry. Both emphasized that their remarks were of a general nature as their specific knowledge of the status of these fields in Brazil was quite inadequate.

Papers on geochronology in Brazil, on geochemical studies of soil formation in the tropics, and on graduate studies in geology in general, were presented by Brazilian participants. A paper was presented by the Director of the Department of National Mineral Development (DNPM) on the role of this agency in the development of mineral resources.

Another area which received considerable attention was computer sciences. Presentations were made by Brazilian scientists on existing programs in the

Catholic University, the Federal University of Rio de Janeiro, and the University of São Paulo. Plans for an intensive two-week course in computer sciences to be given in Rio were presented by Dr. Jean-Paul Jacob, an observer for the CNPq. These plans resulted from an earlier visit to Brazil by Dr. Gilbert McCann and Dr. Jacob. Dr. McCann was appointed by the National Academy of Sciences to consider, with Brazilian colleagues, the feasibility and merit of establishing a joint program in the future. A brief informal report prepared following the meetings in Brazil has been submitted to the CNPq and the NAS for further study.

A paper prepared by Dr. Roberto D. Leuzinger of the status and needs of transportation research in Brazil was considered by the workshop in the light of possible joint Brazil-U.S. programs. Supplementing this paper was a presentation given by Mr. Homero Henrique Rosa Rangel, on the importance of highway research in Brazil and the activities of the Brazilian transportation agency in this regard. (Because these papers opened a new area for consideration by the workshop, they are appended as Appendices III and IV.)

The final session was devoted to summarizing the reports prepared by the session rapporteurs and outlining the continuing program for implementation of the recommendations. The workshop tentatively set October 1970 as the date for their next meeting.

Specific Recommendations

The workshop recommended that:

1. A joint study group be created to look further into the present situation of earth sciences in Brazil, specifically geochemistry and geophysics, with the hope that a program of joint activity might be developed in the future;

2. A broadly representative group be organized to consider in greater depth the problem of developing the field of computer sciences in Brazil;

3. A joint study group be appointed to consider in greater depth the present situation in teaching, research and the labor market in the transportation engineering sector;

4. The preparation for the eight cooperative research programs in key fields of chemistry be continued in the desire to move the program along as quickly as possible;

5. The workshop participants continue to give attention to possible mechanisms for implementation of the various recommendations made by the joint study groups.

SESSION II*

Brazil-U.S. Study Group
on
Agricultural Research

Brazilian Members	U.S. Members
Ady Raul da Silva (Chairman)	Roy L. Lovvorn (Chairman)
Glauco Pinto Viegas	R. K. Frevert
R. Meirelles de Miranda	H. Rex Thomas

PROGRESS REPORT

Following its meeting in Brazil during February 1969, the study group presented to the third workshop a report of the discussions held at this meeting, together with the recommendations of the group for further action.

It was recommended that:

1. An inventory be made of all agricultural research now in progress in Brazil including the personnel, facilities and institutions. This study would be made by a team of four people, two from U.S. and two from Brazil. One of the Americans, an expert on such matters, would come to Brazil within the next few months, for the purpose of planning and initiating the survey. His anticipated initial stay would be one month. A three-man survey team of the two Brazilians and one American would then visit every research location in the country, obtaining and evaluating the work being done. A field survey would require up to six months. The first American would then return for a two month period to summarize the data for publication. It is assumed that once the inventory is made it will be kept current through annual updating by the Brazilian staff.

2. Once the inventory is completed the Joint Brazil-U.S. Study Group will meet in the United States to examine the results and make plans for utilizing such information.

3. After the inventory is finished and the meeting of the study group has taken place it is proposed that a seminar be held in Brazil to inform the research administrators of its results and to discuss with them the recommendations of the group.

4. If the inventory and its interpretation is not completed by February 1970, it is suggested that a seminar be held in Brazil in the same month for discussion of the following subjects: research coordination; documentation and dissemination of the research results.

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*Session I: see Appendix

The study group further opened discussion on the utilization of the results of agricultural and technological research in Brazil; the Centers of Excellence in graduate courses in agriculture; suggestions for improving agricultural research in Brazil; and, the relationship of agricultural research institutes of the federal and state governments and the universities.

The highlights of this discussion are summarized below:

I. The Utilization of the Results of Agricultural and Technological Research

A. The role of research in agricultural development

1. First, researchers who attempted to evaluate the rate of return on investments in the production of new knowledge (research) discovered that the return was exceedingly high. The most notable of these studies dealt with the development of hybrid corn in the U.S. It showed that the rate of return to society of each dollar invested up through 1956 in the development of hybrid seed corn was on the order of 700 per cent. This was a fantastically high rate of return, particularly when rates of return on successful commercial ventures generally run between 15-35 per cent. This finding suddenly made it very clear that investments in science and technology, or more specifically in research were high-payoff investments, and not those in roads, dams, and other physical capital.

2. The conclusion reached from this series of important studies is that if a country desires a more rapid rate of economic development, it must invest in education and research. These are high-payoff investments which can best speed up the growth of the development process. The emphasis is still on capital, but the form of the capital is what matters. The countries should concentrate on the formation of human capital by investing in education, and on the formation of a store of knowledge by investing in research.

B. The evidence on rates of return to investments in agricultural research

1. Considerable research has been done in recent years to evaluate the rates of return to investments in agricultural research. Perhaps the first of these estimates was that made by Schultz in 1953, utilizing fairly simple procedures.* Basing his estimates of benefits on the value of agricultural inputs saved by the advances in technology from 1940 to 1950, and his estimates of costs on the public expenditures for research, Schultz estimated upper and lower rate of return to society to be 35 per cent, and the upper

* Schultz, T.W., The Economic Organization of Agriculture, (New York: McGraw-Hill), 1953.

rate to be 170 per cent. These estimates applied to the rate of return on all public expenditures on agricultural research in the U.S.

2. The rates of return for Mexico indicate that high rates of return are not an artifact of the U.S. economy, with its rapid rate of growth. The wheat research in Mexico, which is widely recognized as a successful program, has a rate of return even higher than obtained for hybrid corn in the U.S. When the rate of return on total agricultural research in Mexico is considered, the result is practically the same as that obtained in the U.S.

C. Some implications.

1. The input mix used in producing research is important.

2. There is an optimum size for a research organization.

3. Research is often complementary.

4. International Research Centers can have an impact on cost of local research.

D. Conclusion.

Recent studies show that research or the production of new knowledge is an important input in the process of economic development. Especially in the case of agriculture, the rate of return to investments in agricultural research is exceedingly high. Recognizing that research is an economic activity provides important guidelines on how to organize and implement. It is no longer appropriate to view research as an end in itself, or as a consumption good. It is an investment, and hard decisions and hard choices have to be made if society is to obtain the maximum rate of return from its investments.

II. Centers of Excellence in Graduate Courses in Agriculture

The status of graduate courses in agriculture and related fields was presented:

A. One hundred eighty-four degrees of Master of Science (with thesis) have been granted up to December 1968 in 19 fields, by the Rural University of Minas Gerais, Vicosa - 122; Rural Federal University of Rio de Janeiro, Itaguaí - Km. 47 - 14; University of São Paulo, College of Agriculture, Piracicaba - 36; Federal University of Rio Grande do Sul, Pôrto Alegre - 12.

B. There are 434 candidates for Master of Science, registered in 28 courses, at the following institutions:

-Rural University of Minas Gerais, Vicosa - 137
-Federal University of Minas Gerais - 9
-Federal Rural University of Rio de Janeiro - 45
-University of State of São Paulo, College of Agriculture - 155
-University of State of São Paulo, Veterinary College - 20
-Federal University of Rio Grande do Sul - 68

There are 12 candidates registered for the Doctor's degree at Federal Rural University of Rio de Janeiro in seven fields.

The three objectives of the program of the Brazilian National Research Council to stimulate the development of graduate centers in agriculture are:

1. To promote the established four Centers of Excellence including the more qualified institutions of the following states: Minas Gerais; Rio de Janeiro - Guanabara; São Paulo; and Rio Grande do Sul.

2. To help the Centers of Excellence become able to offer graduate courses to supply the needs of the country for professors and researchers;

3. Through the Centers of Excellence, to stimulate and help the development of new Centers of Excellence by preparing its personnel.

To accomplish these objectives the CNPq will use funds from its 5-year plan to grant 640 scholarship years for candidates to Master of Science degrees, and 180 scholarship years abroad for candidates to Doctor's degrees.

From a loan in negotiation with USAID, the CNPq is planning to apply US$1,500,000 to hire 31 professor/years for supplementing the staff of the institutions belonging to Centers of Excellence; to grant 68 scholarship/years to staff members of the Centers of Excellence; and to buy materials (US$150,000).

The loan will include besides the dollar value, new cruzeiro funds originated by the selling of surplus agriculture products, in agreement with the Public Law 480 of the United States of America.

The total amount to be applied is NCr$12,000,000 of which 10 per cent will be used for administration by the CNPq and the balance in the following amounts by the Centers of Excellence:

Centers of Excellence	Scholarships		Grants	Grants for Research
Minas Gerais	(80)	Ncr$ 800,000	600,000	1,100,000
Rio de Janeiro-(Guanabara)	(80)	800,000	500,000	1,100,000
São Paulo	(120)	1,200,000	800,000	1,500,000
Rio Grande do Sul	(80)	800,000	500,000	1,100,000
Total--	(360)	3,600,000	2,400,000	4,800,000

The policy of Centers of Excellence was justified and special emphasis was placed by the workshop on the need for the participation of the research institutes belonging to the federal and state governments for they carry extensive research programs and are supported by a large number of qualified personnel facilities, stations and funds which can supplement the universities.

III. Some Suggestions for Improving the Agricultural Research in Brazil

1. The public must be made aware of the returns from investments in agricultural research.

2. The researcher must have a philosophy of service to his fellow citizens and a genuine interest in developing the rural sector.

3. Brazil needs to systematically study its research program and to establish priorities based on its national needs.

4. Attention needs to be given to the role agricultural economics, as a discipline, can play in establishing priorities and in making the research more meaningful.

5. Far more attention needs to be given to scientific manpower training.

6. Flexibility is needed, especially at the national level, in recruiting personnel and in rewarding them on the basis of merit.

7. Brazil has the unique opportunity of pioneering in the development of effective relationships between agricultural research at the national and at the state level. The two systems must and can be complementary but it will require objectivity by all administrators and a determination by those responsible for decision making.

8. Research is not complete until the results are made available to those paying the bill.

IV. Relationship of Agricultural Research Institutes of the Federal and State Governments and the Universities

There are 19 agricultural colleges and 12 veterinarian schools in Brazil. Even though this appears to be a large number, they are located mostly along the coast where population is dense. The importance of a contact between research and teaching personnel where located at separate institutions should be stressed. Present cooperation appears to be mostly between individuals and not between institutions. Cited were references to agreements between secretaries of agriculture, universities and research institutes to make cooperation more effective. Mention was also made of the problem of salary differential between universities and research institutes, even within the same state. Other problems also arise because of the autonomy of universities, but even so, ways must be developed for utilizing full-time research people in the training of graduate students.

SESSION SUMMARY

The presentations of this session provided a perspective of current activities as well as a review of the development of agricultural research in Brazil. Reports were made on the work of the study group at its meeting in February 1969. Presented to the workshop were the discussions on the utilization of results of agricultural research centers, the development of Centers of Excellence for graduate studies in agriculture, and the priorities of agricultural research yet to be considered in accordance with the recommendations made by the study group. (These topics have been elaborated upon in the preceding progress report.)

Dr. Otto L. Schrader reported on the status of agricultural research in Brazil, noting particularly the efforts of the Ministry of Agriculture as the main organ for federal research. He commented that the public still lacks information on investment returns on research although research on fertilization and cultivation practices has been well utilized in various productive areas.

Dr. G. Edward Schuh commented on the high rate of investment returns for research concluding that investments in education and research provide the highest pay-off in the development process.

Dr. Ady Raul da Silva presented a paper on the status of graduate courses in agriculture. The objectives of the Brazilian National Research Council in their endeavor to stimulate the growth of graduate centers in agriculture were also set forth.

In view of the findings of the study group, Dr. Roy Lovvorn presented suggestions for improving agricultural research.

The relationship of the agricultural research institutes of the federal and state governments and the universities was discussed by Dr. Glauco Pinto Viegas. Dr. Viegas emphasized the importance of contact between research and teaching personnel when they are located at separate institutions insofar as present cooperation appears to be largely between individuals and not between institutions.

Dr. Ady Raul da Silva presented the recommendations of the joint study group on agricultural research, which were outlined at their February meeting.

Brazil-U.S. Study Group
on
Agricultural Economics

Brazilian Members	U.S. Members
Victor J. Pellegrini (Chairman)	G. Edward Schuh (Chairman)
Constantino Carneiro Fraga	D. Woods Thomas
Fernando Rocha	Lawrence W. Witt

PROGRESS REPORT

A formal report of the study group is appended as Appendix II.

SESSION SUMMARY

The formal report of the Brazil-U.S. Study Group on Agricultural Economics was presented to the workshop by Victor Pellegrini. It reviews the past activities of the study group; specifies the goals and strategies which have been delineated for developing the profession of agricultural economics in Brazil; summarizes the activities of the work group in January of 1969; and, outlines a proposed program for the coming year, which will concentrate in large part on attempting to strengthen the weaker programs of agricultural economics, and on strengthening the relationships between Brazilian institutions and strong centers of research on Brazil in the U.S.

The mode of analysis undertaken by the study group was reviewed further by the workshop participants. It was pointed out that the numerical goals had been determined by demand and supply projections made in the concern that the market would be flooded with M.S.-level agricultural economists.

The President of the Institute for Stimulating Research, São Paulo, called attention to the problem of absorbing well-trained technicians and stressed the need to improve teaching programs, insofar as it is not necessary to take 12 years to obtain a Ph.D.

Dr. Couceiro commented favorably on the report and indicated that the CNPq had resources to extend to the agricultural economics program. He added that he foresaw no problem in absorbing well-trained technicians, especially in the field of agricultural economics, nor was he concerned that some disciplines might become well advanced in relation to others.

Dr. Brown, noting the quality of the work, moved that the report be accepted and that steps be taken to implement the recommendations.

Two papers were also presented in this session: 1) "The Ministry of Agriculture Program for Developing Agricultural Research," by Ayrton Zanon, and 2) "An Evaluation of Research in Agricultural Economics in Brazil," by G. Edward Schuh.

Ministry of Agriculture Program

Dr. Zanon discussed the current organization of the Ministry of Agriculture in view of the recent administration reform. Two major changes have taken place: 1) the addition of two new regional institutes to provide a more ample geographic coverage; and 2) the decentralization of the process for determining priorities. Dr. Zanon discussed how priorities are being determined, noting that greater attention is now being given to this area of concern. Finally, he discussed the budget increase for operational expenses, which has helped to provide continuity to the program.

Discussion centered on the resources the Ministry of Agriculture had available for operational research programs. Dr. Fagundes commented on the tremendous progress made in the Ministry's research program in recent years, particularly in the area of inter-communication, and stressed the lack of trained people in the past. He questioned whether the two new institutes are fully operational, and more specifically, whether they are adequately staffed. Dr. Zanon indicated that the staffing process is a slow one, but that they are making progress.

Dr. Dacorso questioned whether a statement that only 5% of their budget went to research was correct. Dr. Zanon responded that it was, but clarified that this referred essentially to operating expenses and did not include the fixed salaries of the staff. Dr. Ady Raul da Silva, former Director of the Research Service, pointed out that if salaries were included this figure would be about 50%.

In response to Dr. Glauco Viegas' inquiry as to what measures were being taken to relate the programs of the Ministry with those of the universities and the state experiment stations, Dr. Zanon said that it was necessary for members of the state experiment stations and the extension service to participate in the determination of priorities and stressed that all efforts are being made to make the programs of the institutes local programs.

Dr. Zanon elaborated on the training program of the Ministry, pointing out that it includes the objective of attaining Ph.D.-level training.

Dr. Couceiro pointed out that the agricultural sector has been a major concern of the CNPq, especially in view of the high rate of population growth in Brazil and the problem of agrarian reform. He stressed the desire and willingness of the CNPq to collaborate with the Ministry of Agriculture, particularly in the training of personnel.

Evaluation of Research

Dr. Schuh summarized his paper on the evaluation of the status of agricultural economics research in Brazil. His report both reviews research facilities and priorities in Brazil and makes suggestions for redirecting research efforts in line with the problems facing future programs.

Dr. Djerassi observed that the essence of the report could apply to almost any technical field in Brazil. He also commented on the problem of developing Brazilian literature on agricultural economics and discussed means by which this literature might be made accessible to the international community. Finally, he stressed the need for collaboration among scientific groups and discussed the problem of salaries.

Dr. Robock expressed his concern with the emphasis being given to Ph.D. programs, and argued that such programs are too costly for Brazil. He also discussed the possibility of collaborative work between economists and agricultural economists in solving some of the problems mentioned in Dr. Schuh's paper.

Dr. Schuh agreed that, in the U.S., very little attempt is made to economize the students' time, agreeing with Dr. Robock that the "puberty rites" associated with U.S. programs were not necessary. He stressed the need for attaining a level of training equivalent to the Ph.D. programs of developed countries, although the form of training was not so important. With respect to the problem of collaboration, he pointed out that although efforts to increase collaboration among scientists were being made, the difficulties arising from the autonomy of schools and faculties, particularly those of agriculture which tend to be independent of university complexes, remain.

Finally, the projected activities of the study group, as outlined in the formal report, were presented to the workshop for comment.

Brazil-U.S. Study Group
on
Industrial Research

Brazilian Members	U.S. Members
Pérsio de Souza Santos (Chairman)	Richard C. Jordan (Chairman)
Abrahão Iachan	Arthur W. Weber
Antonio Seabra Moggi	Anthony Leeds
George S. de Moraes	Bertram D. Thomas
Juvenal Osorio Gomes	Douglas H. Graham
Nelson G. Gutheil	Werner Baer
Andre Toselo	Jesse Hobson
Fred W. Lacerda	William A. W. Krebs
Joaquim Francisco de Carvalho	Eugene P. Pfleider
Kurt Politzer	Robert W. Olson
Remolo Ciola	William Bollay

PROGRESS REPORT

The workshop participants addressed their attention to measures for implementation of the recommendations made in the final report of the industrial research study group, published in September 1968.

Many of the recommendations spelled out in the 1968 report have already been implemented, i.e.:

1. A new law concerning fiscal incentives will be issued.

2. Carteira de Comercio Exterior (CACEX) is studying the problem of controls and duties on the importation of research materials by institutions.

3. Graduate courses are to be accredited through the CNPq.

4. São Paulo Institute for Technological Research (IPT) is attempting reorganization along the lines of the proposed model research institute.

5. The IPT is organizing a Center of Technical Information.

6. Members of the Brazilian panel had participated in a special course on Industrial Research Management held by Arthur D. Little, Inc.

The interrelationship of industry, industrial research institutes and universities was explored in three different presentations. The strong need to increase university-industry dialogue and involvement was clearly evident from this discussion. Currently there is a lack of mutual understanding of the points of view of the two groups which may be caused by institutional and psychological factors which hamper its development. One of the real strengths of technology in the United States involves the very close relationship between the personnel of industry and universities and not necessarily in the research and problem-solving areas.

It was recommended:

1. That a conference be organized and held in Brazil at an early time to accelerate acceptance of the final report and its philosophies. This conference should involve a broad spectrum of Brazilian industrialists, together with a core group of the current panels, augmented by additional personnel of appropriate competence.

2. That managers of research organizations in Brazil should request through the CNPq and the U.S. National Academy of Sciences that U.S. specialists in industrial research be made available to further assist in the organizing and carrying out of industrial research management training in Brazil.

3. That procedures be developed by which administrators of industrial research organizations in Brazil may visit U.S. industrial research organizations to aid them in the development of insight into research management procedures.

4. That specialists in scientific-technical information and documentation visit U.S. centers of information and documentation in order to gain insight into modern methods of documentation, retrieval and dissemination.

5. That studies be carried out on desirable means of increasing dialogue and involvement between universities and industry and that this be prepared as a supplementary report.

6. That a study be made of the existing Brazilian and international patent legislation with a view toward optimizing both technology transfer and, in the longer range, encouragement of technological innovation in Brazil.

The workshop participants accepted the final report of the study group and projected future activities of additional task groups for implementation of the recommendations contained therein.

SESSION SUMMARY

This session opened with the presentation of the final report (published September 1968) of the Brazil-U.S. Study Group on Industrial Research, entitled "Industrial Research as a Factor in Economic Development," by Nelson Gutheil on behalf of Dr. Pérsio de Souza Santos, Chairman of the Brazilian Panel, and Dr. Richard C. Jordan, Chairman of the U.S. Panel. The report covers a wide range of areas involving government, industry, technical institutes and universities. Dr. Jordan noted that this was a Brazilian report, prepared in consultation with the U.S. Panel.

In the ensuing discussions, Dr. Couceiro, Dr. Gutheil, Dr. Politzer and others observed that measures had already been taken by the Brazilians to implement a number of the recommendations.

Dr. Politzer, Dr. Coimbra and Dr. Jordan made presentations concerning the interrelationship of industry, industrial research institutes and universities. Dr. Harrison Brown noted one of the real strengths of technology in the United States was the very close relationship existing between personnel of industry and that of universities, and not necessarily in the research and problem-solving areas.

Dr. Robock presented some "Challenges for the Future." He noted that resource limitations urged the selection of priorities within priorities. He emphasized the need for "selling" the report to industry in order to generate a broader base for the use of research personnel. Further, seminars for the managers of research managers, as well as for the research managers themselves, were deemed desirable. Dr. Couceiro commented on the necessity of holding special meetings, involving both scientists and industrialists in order to establish research priority programs and to expand the market for researchers.

Dr. Jordan was called upon to summarize the recommendations for implementation. He informed the groups that these measures were outlined in the letter of transmittal for the report to the CNPq and the NAS, prepared by Dr. Pérsio de Souza Santos and himself.

SESSION V

Brazil-U.S. Study Group
on
Graduate Teaching and Research in Chemistry

Brazilian Members	U.S. Members
Marcelo Moura Campos (Chairman)	Carl Djerassi (Chairman)
Bernardo Geisel	John D. Baldeschwieler
Eloisa Mano	Harry B. Gray
Simão Mathías	George S. Hammond
Manoel de Frota Moreira	Robert E. Ireland
Walter Mors	William S. Johnson
Claudio Costa Netto	Robert N. Kreidler
Paschoal Senise	Aron Kuppermann
Ernesto Tolmasquim	Charles G. Overberger
	Henry Taube

PROGRESS REPORT

According to the five-year science plan of the CNPq, the development in Brazil of graduate education at the doctoral level in chemistry has the highest priority. As summarized by Dr. Antonio Couceiro, the President of the CNPq, "the Achilles heel of Brazilian development is chemistry." This is so because chemical expertise and manpower is needed in programs dealing with agriculture, mineral resources, chemicals, plastics, and pharmaceutical industrial development, etc. At the second workshop held in February 1968 in Washington, it was decided to form a Brazil-U.S. Committee on Chemistry and its first meeting was held in Rio and São Paulo in August 1968. In September 1968 the American members met again in Palo Alto, California, and their report - addressed to the Foreign Secretary of the National Academy of Sciences - was brought personally to the CNPq in January 1969 by Miss Téllez and Professor Harry Gray (Caltech). This report outlined the commitments which the American members were prepared to undertake, provided certain financial and logistic support problems could be solved. At the present workshop, the implementation of this problem on the part of the Brazilian and American groups was outlined.

The key to the success of this program is that it is based on a person-to-person collaboration between a given Brazilian and American professor in a specified area of chemistry (inorganic, physical, synthetic

polymers, synthetic organic) either at the University of São Paulo or the Federal University of Rio de Janeiro. The American professors from the Departments of Chemistry of the California Institute of Technology, Stanford University, and the University of Michigan were prepared to undertake a five-year commitment to select postdoctoral research fellows from their laboratories who would work in the laboratory of the respective Brazilian professor with Brazilian graduate students and thus help in the organization of a first-class doctoral program through research, tutorship and participation in graduate courses and seminars. At least ten American postdoctoral fellows are envisaged as participating in any one year in this program, and it is hoped that within a short time at least twenty Brazilian graduate students (under fellowship support from the CNPq) would be involved in this doctoral training program. Finally, the National Academy of Sciences undertook the responsibility of finding financial resources to cover the travel of the American professors to Brazil for periodic short visits, the stipends and travel (including a three to four week orientation trip approximately three to six months prior to the final arrival of the fellow in Brazil) of the American postdoctoral fellows (to be given the unique and prestigious title of National Academy of Sciences Overseas Research Fellow), certain secretarial and publication costs, in addition to carrying the administrative responsibility of the American component of the program. Furthermore, the American group accepted the responsibility of assuring admission, when necessary, of Brazilian chemistry graduate students involved in this program as special students for periods of up to one academic year at Caltech, Stanford University, and the University of Michigan for special course training and/or preliminary research collaboration with the American postdoctoral fellow prior to the latter's departure for Brazil.

The Brazilian commitment of the CNPq covered the fellowships (including possible travel to the U.S.) of the Brazilian graduate students, the purchase of the necessary equipment and supplies for the research programs (as outlined in the January 1969 report of the U.S. Chemistry Group), and last, but certainly not least, the assurance that a procedure would evolve that would permit the very rapid customs clearance of equipment and chemical supplies that need to be imported from abroad. This is especially important to the synthetic organic chemistry and synthetic polymer chemistry programs where small packages of specialty chemical items will probably have to be ordered and imported <u>each week</u> during the entire course of the five-year program, since these needs cannot be anticipated sufficiently far in advance. The following outline combines the reports of the American and Brazilian groups in the form of a preliminary and as yet tentative time schedule.

1. Federal University of Rio de Janeiro

Several steps have already been taken to initiate the joint program between Professor E. Mano and Professor Charles Overberger of the University of Michigan. Dr. Gomes, a graduate of the University of Rio, who received his Ph.D degree in 1968 at the University of Pennsylvania - is currently serving as a postdoctoral fellow on a one-year CNPq fellowship at the University of Michigan for advanced training in synthetic polymer chemistry. He will return to Rio in the fall of 1969 to participate as a staff member in the graduate training program. At that time, a Brazilian graduate student, who has already been selected, will be sent to the University of Michigan as a special student, and in 1970, at the time of the Brazilian student's return from Michigan to Rio, he will presumably be accompanied by an American postdoctoral fellow selected by Professor Overberger. Furthermore, nine graduate students are already working with Professor Mano on master theses in organic polymer chemistry at Rio.

Meanwhile, it will be important to insure that the various equipment items required for the polymer program are ordered and installed in Professor Mano's laboratory. Furthermore , the same arrangements outlined below for the synthetic organic chemistry program in São Paulo about the ordering and importation of chemicals apply with equal urgency to this project. Professor Mano is establishing a specialized library in the polymer field with funds from the BND. A trip by Professor Overberger by late this spring or early this summer is strongly indicated in order to be sure that all logistic aspects of the cooperative program with Professor Mano are well in hand.

2. Centro Brasilero de Pesquisas Fisicas (CBPF), Rio

In view of the fact that the CBPF is the only institution in Rio which currently has underway advanced research programs in inorganic chemistry and in chemical physics, and most importantly already has equipment totaling in cost in excess of $200,000 which is needed for much of the inorganic and physical chemical graduate training, it was the unanimous opinion of the American subcommittee that at the present time the CBPF was the only site where such a graduate training program leading to the Ph.D. degree in inorganic and physical chemistry could be initiated in Rio. Professor J. Danon expressed willingness to house such a group at the CBPF, and arrangements have already been made with a rector of the Federal University of Rio that such work by Brazilian graduate students would be recognized for the Ph.D. degree by the University.

Professor Harry Gray (Caltech) has a postdoctoral fellow (Dr. Levenson) available who would be ready in late 1969. Professor Danon

believes that two Brazilians would probably be available by this time from his laboratory to work on a Ph.D. degree in inorganic chemistry in this collaborative program with Professor Gray. He felt that these two individuals were persons of sufficient preparation that an initial one-year trip to Caltech would not be required. He also mentioned the presence at the CBPF of Dr. J. Pearlman of the Brooklyn Polytechnic Institute who could participate in a program with Professor Gray on x-ray crystallography in the field of inorganic chemistry. An orientation trip by Dr. Levenson before this summer is strongly indicated in order to determine what additional equipment is needed for this program.

Professor George Hammond (Caltech) has a postdoctoral fellow (Dr. Mog) available in late 1969 for work on photochemistry and ESR spectroscopy. Since an ESR spectrometer is available at the CBPF, it will only be necessary to order the photochemical equipment, and this should be done promptly after Dr. Mog's orientation trip which should be organized in the near future. The question of Brazilian graduate students participating in this program can probably be solved in a very attractive manner. Specifically, Dr. Bruce Kover, a Ph.D. from Caltech, is currently on the staff of the School of Chemistry of the Federal University of Rio under a teaching and research appointment funded by the CNPq. He is extremely interested in participating in this program and has agreed to provide two potential graduate students from the School of Chemistry to participate in this joint program. Dr. Kover's participation would not only aid greatly in this program but would also represent a very attractive link between the CBPF and the School of Chemistry of the University of Rio.

Professor Henry Taube will have a postdoctoral fellow (Dr. Jones) available in the fall of 1970, and details of this program will be determined during this year. It would be extremely useful if one or two Brazilian graduate students could be selected who would come to Stanford in September 1969 or in early 1970 as special students. They could then return to Rio together with Dr. Jones in the fall of 1970 to start an active program, and efforts should be made to select such persons.

Professor John Baldeschwieler (Stanford) will have to discuss in detail with Professor Danon the manner in which work on perturbed correlations of γ-radiation in macromolecules can best be initiated, although he is prepared to start such a program promptly as conditions and personnel are available in Rio. Since Professor Danon will be in the States in May, a meeting should be scheduled at Caltech with Professors Gray, Hammond, Baldeschwieler, and Taube (together with their postdoctoral candidates) to discuss various logistic and instrumental

aspects of their joint programs.

Professor Aron Kuppermann (Caltech) who is currently on sabbatical leave at the Weizmann Institute in Israel has written that in connection with his projected collaborative program on electron scattering, he may have available a postdoctoral fellow (Dr. Wei) this fall. A detailed written proposal by Professors Kuppermann and Danon on the equipment needed and the time schedule involved, coupled with a prompt orientation trip by Dr. Wei is urgently needed if such a program is to start in 1969.

3. University of São Paulo

Professor Harry Gray's (Caltech) postdoctoral fellow (Dr. Flood) will be available in the fall of 1969, and one first-class graduate student at the University of Sao Paulo is already available for work with him in the collaborative Gray-Giesbrecht inorganic chemistry program. Most equipment for this work seems to be already available and an orientation trip by Dr. Flood should be instituted promptly.

Professor Henry Taube (Stanford) has an excellent postdoctoral candidate (Dr. Malin) available who could start as early as October 1969. If necessary, he could stay at Stanford University until the end of the summer 1970 and start in São Paulo in the fall of 1970, if this is preferable from the Brazilian standpoint, although it would be attractive if this program could be started in 1969. His research in inorganic chemistry involves especially the chemistry of very fast reactions (a field in which the 1967 Nobel prize in chemistry was awarded) and would require a "stop-flow" apparatus. This commercially available instrument (from Durrum Instruments Corporation in Palo Alto, California) costs approximately $14,000 and would have to be ordered. Fortunately, its delivery time is very short. The question of availability of Brazilian students for this program would have to be resolved promptly with Professor Taube. One possibility is to select one to two Brazilians who could come to Stanford in the fall of 1969 to work with Professor Taube and Dr. Malin for six to ten months and then return with Dr. Malin to São Paulo. The other possibility is to start this work in 1969 in São Paulo with Dr. Malin and one or two Brazilian students, provided that they can be found.

Professors William S. Johnson (Stanford) and Robert Ireland (Caltech) have already two postdoctoral candidates (Dr. Ronald in early 1970 and Dr. Campbell in late 1969) available for their collaborative program in synthetic organic chemistry with Professor Moura Campos. These postdoctoral candidates should undertake their orientation trip

before the summer of 1969 in order to determine what equipment and especially what chemicals need to be ordered. Furthermore, they should be instructed in the procedure to be used for the subsequent rapid importation of specialty chemicals. (A tentative arrangement has been made with Aldrich Chemical Company in Milwaukee, Wisconsin to deposit a dollar credit balance by the CNPq in the States so that chemicals can be ordered telegraphically by catalogue code number, and would then be shipped by air freight to Brazil. According to Dr. Couceiro, a sum of approximately $20,000 will be made available for such purposes, and arrangements are being made by the CNPq and the Brazilian Finance Ministry for rapid customs clearance procedures.) According to Professor Moura Campos, one Brazilian graduate student (Flavio Morsoletto) could come to Stanford in September 1969 and return with the first American postdoctoral fellow in February 1970. The second American postdoctoral fellow should arrive in São Paulo in April or May 1970, at which time additional Brazilian graduate students would be available for this program.

The collaboration between Professor Baldeschwieler (Stanford) and Professor Riveros on ion cyclotron resonance spectroscopy is progressing on schedule. Professor Riveros has already spent three months at Stanford under a CNPq grant, the ICR instrument has already been ordered by the CNPq for delivery in April 1970, and Dr. Blair from Stanford has already been selected for postdoctoral work in São Paulo starting in May of 1970. The best recent undergraduate from São Paulo has already been selected for this program. He could be sent to Stanford in February 1970, but it will be decided whether this is desirable in view of Dr. Blair's arrival in São Paulo in May of 1970. In addition, in 1970 Professor Baldeschwieler will send a Stanford electronic technician to São Paulo (salary to be paid by Stanford, per diem by São Paulo) to train a Brazilian electronic technician in the maintenance of ICR equipment.

The collaborative photochemistry program between Professor George Hammond (Caltech) and Dr. V. Toscano will proceed in the following manner. Dr. Toscano will, in any event, be in Michigan for several weeks in June and July of 1969, and provided the extra travel between Michigan and California can be secured for him, he could spend one to two weeks at Caltech to acquaint himself with the type of instrumentation that will have to be ordered for São Paulo. He will again return to Caltech for a three-month period (January to March 1970) to carry out some experimental photochemical work, and then initiate the collaborative program in São Paulo upon his return to São Paulo.

Finally, there exists a question of a collaborative program in physical chemistry in São Paulo involving Professor Kuppermann (Caltech). Professor R. A. Bonham of Indiana University in conjunction

with Professor S. Mathias of the University of São Paulo is proposing a five to ten-year program on electron, atomic, and molecular beam scattering at São Paulo, together with Dr. Peixoto, who just received his Ph.D. degree at Indiana University and who is now assistant professor at São Paulo. Professor Kuppermann is anxious to collaborate with them since this complements his cooperative program with Professor Danon in Rio. Furthermore, it would also represent added strength to the Baldeschwieler-Riveros project in São Paulo. Professor Kuppermann suggested, and the American subcommittee agreed, if the Mathias-Bonham proposal to the CNPq is approved, that the program be incorporated within the scope of the Brazil-U.S. Chemistry Program.

In that many logistic problems will need to be resolved in the near future, a full-time coordinator for the program has been assigned at the National Academy of Sciences in Washington and at the Conselho Nacional de Pesquisas in Rio de Janeiro.

Additional Reports Dealing with Chemistry

In addition to the detailed description of the Brazil-U.S. cooperative program on graduate education in chemistry, three related presentations were made by Drs. Iachan, Seabra Moggi and Professor Mors on the participation of government and private institutions in chemistry in Brazil.

Dr. Djerassi discussed the importance of the nature of the patent system as a incentive for industrial research. He pointed out that in spite of the new Brazilian patent law of 1967, many of its provisions are still very outmoded. Thus Brazil, together with the Dominican Republic and Poland, are the three countries that still adhere to the 1925 Hague Act, while all other 76 adherents to the International Patent Convention have adopted the 1934 London (24 countries) and especially the 1958 Lisbon (52 countries) revisions. Furthermore, in spite of the fact that Brazil has practically no patent examination system (presumably because of lack of qualified patent examiners) it probably has one of the slowest acting patent offices in the world. In some cases, applications filed in 1962 have not yet received the first patent office action, and such delays obviously have very serious consequences.

Invariably the more industrialized and technologically advanced a country is, the more sophisticated and stronger is its patent system. In fact, the tendency in all advanced, industrial nations is toward product as well as process patents. The U.S. was the first such country followed by Great Britain and now Germany. It is likely that the Scandinavian countries will follow reasonably soon.

It is recommended that a small conference be convened by the CNPq for the following purpose and with the following suggested composition:

1. Determine what areas (for instance chemicals, pharmaceuticals, electronic devices, designs, etc.) are particularly important to Brazilian industrial development.

2. Is it more important to facilitate compulsory licensing and easy copying of foreign patented inventions (in other words, a loose patent system), or to provide an incentive for local industrial research, Brazilian inventors and encouragement of entrepreneurship (in other words, a strong patent system)?

3. Can patents be used as incentives for local industrial research (for instance, longer patent life on patents emanating from research performed in Brazil as compared to research done elsewhere)?

4. Study the literature searching methods currently being developed in the U.S. Patent Office, and especially the computer-aided searches. In fact, consider computerization of many aspects of the Brazilian Patent Office so as to expedite patent action and reduce the enormous backlog.

5. Consider the possibility of developing a corps of "patent agents" (as distinct from patent lawyers) - a group which exists in the U.S. and whose training eliminates a lot of traditional legal training that is not germane to the prosecution or defense of patents. In that connection, explore the possibility of apprenticeships for a few young Brazilian technologically trained persons (this is much more important than formal legal training) in the U.S. Patent Office and in a few large international legal firms in the U.S.

6. Invite participants from countries such as the U.S. (strong patent system with strong examination), Canada (about to introduce a system of compulsory licensing), Germany (a recent European country to have introduced product patents), and Israel (a small country whose patent system has to encourage applicability of local inventions to international patent coverage for exports), and perhaps one of the Scandinavian countries.

Such a conference need not be burdened with legal problems, but rather determine a theoretical model which would best fit Brazil's present and rapidly changing technological development status and which would stimulate research of economic benefit to Brazil. Once this is determined, these recommendations can then be forwarded by the CNPq to the appropriate Brazilian Government circles for possible consideration and legislative implementation. In other words, the technological and economic benefits of a patent system should be considered first, and the legal aspects only subsequently.

SESSION SUMMARY

The workshop focused its attention during this session on the implementation of the Brazil-U.S. program for postgraduate research in chemistry. The key to the success of this program is that it is based on a person-to-person collaboration between a given Brazilian and American professor in a specified area of chemistry. The commitments and responsibilities of the NAS, the CNPq, and the individual Brazilian and American professors were outlined for discussion.

Professor Djerassi, chairman of the American chemistry group, outlined the progress of the selection of the American postdoctoral fellows and the approximate time when they would be available. This presentation and timetable were followed by an introductory summary by Professor Tolmasquim of the progress of the Brazilian group and detailed statements by Professors E. Mano, P. Senise, and J. Danon of the commitments at the Federal University of Rio, the University of São Paulo, and the Center for Physics Research in Rio.

A preliminary and as yet tentative time schedule was specified for the initiation of each collaborative program.

In addition to the detailed description of the Brazil-U.S. chemistry program, three related presentations were made by Drs. Iachan and Moggi and Professor Mors on the participation of government and private institutions in chemistry in Brazil.

Professor Djerassi discussed the importance of the nature of the patent system as an incentive for industrial research. He pointed out that in spite of the new Brazilian patent law of 1967, many of its provisions are still very outmoded. It was recommended that a small conference be convened by the CNPq to consider certain aspects of the patent problem and to determine a theoretical model for Brazil which would stimulate research of economic benefit. It is intended that the recommendations arising from such a conference would be forwarded by the CNPq to appropriate Brazilian Government circles for consideration and implementation.

Earth Sciences

PROGRESS REPORT

The workshop focused its attention on the activities of the Departamento Nacional da Produção Mineral (DNPM) and various university programs to stimulate research and teaching in the field of earth sciences.

The Ten-Year Plan, initiated in 1964, brought a new philosophy to the DNPM. This philosophy encompassed the various roles played by the agency, that of fiscalizing the mining activities and, through another division, carrying out the basic geological work in the country. The geological work is carried out through 30 Basic Projects dealing with particular problems related to specific commodities. Since 1964 a change of structure has taken place, and today there are six districts and thirty-two residences covering most of Brazil. The DNPM has expanded from six geologists in 1964 to two hundred and twenty and has even further plans for expansion. The shortage of funds has made it difficult to expand the work in line with the pace of the country's development. Projects have been financed not only by the Ministry of Mines and Energy but also by the Banco Nacional do Desenvolvimento Economico (BNDE), which finances specific projects, and a loan from the U.S. Government has made it possible to bring a geologist from the U.S. Geological Survey to Brazil and to send Brazilians to the U.S. for training. The fact that the President of the Republic signed a decree by which a royalty of five percent of the profit from oil produced on the continental shelf will be paid, half to the Ministry of Education and half to the DNPM, is recognized as a good sign for the development of research in the earth sciences in Brazil.

There are at present about 1,100 geologists in Brazil: 220 employed by the DNPM, 30 by Pétrobras, 60 by the National Committee for Nuclear Energy (CNEN), 60 by SUDENE, and the remaining employed by private industry.

The DNPM has a laboratory in Rio and is using geochemical exploration methods in several programs. The geophysics program is again being implemented by the DNPM which has contracted geophysicists who are giving short courses to a number of geologists in order to create a geophysical branch there.

The DNPM has contributed to the work done by the CNEN from the date i was started. With funds from the U.S. Government loan, the DNPM is bringing people to the CNEN. The DNPM is interested in

improving the quality of its geologists and is allowing some to take graduate courses in Brazil and abroad, as it has done in the past. The agreement with USAID provides for training of Brazilian geologists in the United States.

A brief review of geology teaching in Brazil (from the creation of the School of Mines at Ouro Prêto in 1876 to the stablishment of the CAGE program that started the Geology Schools) was presented to the workshop. The graduate programs were started in 1967 when the CNPq chose three centers: the Geology School of the Federal University of Rio Grande do Sul, the geology course of the University of São Paulo, and the geology course of the University of Rio de Janeiro. The three centers are now fully at work. The Federal University in Bahía wants to start graduate programs in geochemistry and geophysics. The need for professors was emphasized. The CNPq interest in graduate programs in Brazil was due to the American Geological Institute that brought university professors here in 1966. The job market for geologists has increased due to the new Mining Code. Since the use of geologists is necessary in all phases of exploration work, and as the number of exploration permits is increasing, the market is good. The BNDE is playing an important part in the graduate program as it is financing equipment and professors for the universities of Rio Grande do Sul and Rio de Janeiro. The Brazilian delegation was urged to attend the meeting in Peru to make sure that the Tectonic Map, the Metamorphic Map and the Metalogenic Map, published under the auspices of the DNPM and the CNPq, are printed in Brazil. With relation to the Upper Mantle Committee, the Carnegie Institution, the Office of Naval Research, and other agencies in the United States are willing to collaborate. Specifically, the Magnet project could have some flights made over Brazil if this is of interest to the UMC. The Coast and Geodetic Survey has US$8,000,000 for the station to be set up in Brasilia.

The recommendations of the DNPM and the U.S. Geological Survey (USGS) made at Itatiaia have been followed - that is, assistance was being given to the DNPM. This was achieved through a US$8.4 million dollar technical assistance loan program provided by AID with the USGS as the implementing agency with the collaboration of the U.S. Bureau of Mines. The program with the DNPM is a basic training program in field geology and techniques relating to mineral evaluaion, geologic mapping and report preparation, mining technology, ore dressing and mineral statistics.

A brief report on the activities and plans of the Federal University of Bahia showed that their program in geophysics will be developed on a graduate level based on geologists and physicists. They are studying the possibility of starting a research program in

mineral exploration using electrical, magnetometric, electromanetrometric, induced polarization methods and spectrometry; groundwater studies will also be made, as well as nuclear geophysics studies on the physical properties of rocks and on the propagation of electromagnetic waves.

It is very difficult to draw a line between basic and applied research in geophysics as methods and equipment are changing very rapidly.

It is felt the universities should teach the basic principles and ideas and let the private companies and the DNPM teach the application of these methods. In the United States no outstanding geophysics department has its foundation in applied geophysics; those that have chosen to concentrate on applied research only tend to wither and eventually die.

A good geophysics department depends on good understanding between geophysicists and geologists, on available computer facilities, and on a team, not a one-man, approach. The biggest problem in Brazil is the lack of trained personnel. It is therefore important that basic research be started if geophysics is to develop. Attention has been called to the fact that there are differences between the United States and Brazil and that, in Brazil, applied geophysics must precede any basic research, due to the need of practical results. The activities of the CNPq reflect the activities of the Brazilian scientific community and it usually receives complaints that the CNPq is financing applied research and not basic and vice versa. In the CNPq budget for 1969, funds have been set apart for the development of geophysics and geochemistry in Brazil.

A good physicist should have a background in physics or applied mathematics. The geochemist should be a chemist or physicist, not a geologist, as it is usually easier to teach geology to a chemist or physicist than chemistry or physcis to a geologist. The most important parameter is to have qualified researchers who can also be leaders, because without leaders, projects cannot be carried out.

A study of formation of soils under tropical conditions is being started by the Federal University of Rio de Janeiro. This program will allow the Geosciences Institute to equip a laboratory with X-ray, DTC, electronic microscope, electron microprobe, mass absorption spectrometer, optical spectrometers, etc. The program will study the geochemical cycle of major and minor elements under tropical weather conditions.

In view of the very different problems faced by programs in geology, geophysics and geochemistry, it was suggested that a joint working group be established to consider these problems in greater depth. Such a working group should comprise not more than ten people, including on the Brazilian side, one representative of the CNPq; one representative of the DNPM, and three representatives of the universities. The counterpart group might well include a representative of the USGS, a Canadian representative if this seems appropriate and several experts in the specific scientific disciplines under discussion. Hopefully, this working group can meet during the second half of 1969, so that initial steps can be taken to establish cooperative programs by 1970.

SESSION SUMMARY

Dr. Marcelo Tunes opened the session by presenting an historical review of the role of the Departamento Nacional da Produção Mineral (DNPM) in the development of Brazil. He elaborated on the philosophy, the projects, and the resources of the DNPM. Discussion followed with questions concerning personnel facilities, specific projects and cooperative programs of the DNPM.

Dr. Rui Ribeiro Franco presented a paper on graduate studies in the earth sciences in Brazil giving a review of geology teaching since the creation of the School of Mines in Ouro Prêto in 1876. It was noted that the demand for geologists is increasing and that both the CNPq and the BNDE are taking an active interest in graduate programs in geology.

Dr. Johnston commented on the preceding papers and urged that the Tectonic Map of South America, the Metamorphic Map, and the Metalogenic Map, which UNESCO would like to publish, be printed instead in Brazil. He further cited the cooperation of specific U.S. agencies on the Upper Mantle Project.

Dr. Max White reported that the recommendations made at Itatiaia for a cooperative program between the DNPM and the U.S. Geological Survey had been implemented by a U.S. technical assistance loan program to encourage basic training in field geology.

Dr. Milton Formoso of the Federal University of Rio Grande do Sul presented a paper on the present state of geochemistry in Brazil, dealing with problems in teaching, basic research, geochemical explorations, methodology, and future plans for the development of the field.

Dr. Wendenlin Franz Lotze of the Federal University of Rio de Janeiro followed with a report on the present state of geophysics in Brazil. He cited public and private projects related to both basic and applied geophysics.

Dr. Carlos Dias reported on the current and projected activities of the Federal University of Bahia which is pursuing a graduate-level program based on the training of geologists and physicists. Specific programs on mineral exploration and ground-water studies are being considered.

Further presentations were made by Dr. Cordani on the Geochronology Center of Research at the University of São Paulo and by Dr. Clarence Allen on the expansion of geophysics in U.S. universities. Dr. Allen expressed concern that Brazil lacks trained personnel in

the field and that it would be most important to first develop basic research programs. Dr. Dias contended that the need for practical results precludes priority emphasis on basic research. Further comment was made on the distinction between basic and applied research. Dr. Couceiro felt that, within Brazil, the university should concentrate on basic research while the DNPM should be concerned with applied programs.

Dr. Harrison Brown presented an historical review of the development of geochemistry, particularly within the U.S., and opened the question of graduate training.

Professor Adelaide Santos gave a short presentation of the activities and objectives of the Geochemistry Laboratory in Salvador, Bahia.

Dr. Forman informed the group that the Federal University of Rio de Janeiro is beginning a study of the formation soils under tropical conditions.

Giving particular attention to specific programs for the development of geosciences in Brazil, Dr. Brown suggested that the Brazil-U.S. chemistry program might serve as a working model, while Dr. Cordani made reference to the program for the geochronology laboratory in São Paulo, and Dr. Iraja described, for example, the proposed program between the Federal University of Rio Grande do Sul and Indiana University.

Dr. Couceiro asked Drs. Allen and Forman to consider the presentations and discussions of these sessions and to propose further steps to follow in the development of earth sciences in Brazil, with special reference to geophysics and geochemistry. Their proposals focused on the organization of a joint working group which would undertake the establishment of cooperative programs by 1970.

SESSION VIII

Computer Sciences

SESSION SUMMARY

This session consisted of several presentations on the activities of four Brazilian institutions currently in a position to consider programs in computer sciences.

Dr. Olinto de Oliveira opened the session by describing the activities of the Rio Data Center which he heads at the Catholic University of Rio de Janeiro. (Catholic University is credited with the first pioneer work in the field of computer sciences.) Dr. Oliveira briefly outlined the research which the Center had conducted in 1968. More than 1500 students took courses at the Center last year, both at the undergraduate and the graduate level. There are 13 academic appointments at the Center and a total of 33 on the full staff. The Center serves most of the university departments and is most intensively used by the Department of Physics. The Center has been concerned with developing their facilities, although there is insufficient personnel.

Dr. Denis França Leite presented a paper on "Computer Sciences in the Federal University of Rio de Janeiro" which gave a history of the beginnings of computer sciences in Brazil. Dr. Leite also described the activities of the Coordination of Postgraduate Engineering Programs (COPPE), created in 1965, and the activities of his own Department of Scientific Calculation (DCC) created under COPPE in 1966. The DCC offers courses at the M.S.-level in computer sciences under the program of electrical engineering and provides courses for professors and engineers of other universities. It also undertakes data processing of a scientific nature for government and private industry. In 1967, the DCC offered courses to about 900 students. The following year, the number was increased to 1200 of which some ten percent were from COPPE, sixty percent from the Federal University of Rio de Janeiro, and the rest from other universities and industry.

At the present time, Brazil has about 260 computers of which about 20 are in universities, the largest of which are the IBM 7044 at the Catholic University and the B-3500 at the University of São Paulo.

Dr. Leite felt that universities should develop computer sciences and should strive for an intensive effort "en masse," utilizing the centers already in existence in Rio and São Paulo. He suggested the formation of large computer centers which would be coordinated under a central organ.

Dr. Jean-Paul Jacob described an intensive two-week course being developed in computer science to be given in Rio for professors currently in computer centers and for other interersted persons. He requested CNPq sponsorship of this program.

Dr. Waldemar Setzer, head of the Computer Center at the Institute of Mathematics, briefly described the four computer centers at the University of São Paulo.

It was decided by the workshop to form a study group to consider further the potentials for development of computer science in Brazil.

Highway and Transportation Research

SESSION SUMMARY

The workshop opened discussion on the present situation of transportation research in Brazil by considering two presentations covering the status and needs of this sector (appended).

Dr. Roberto D. Leuzinger presented a paper on "Transportation Engineering in Brazil," (Appendix IV), which emphasized the great importance of transportation in the development of the country, particularly in its geographical integration. His comments centered on the coordination of graduate teaching and research. Dr. Leuzinger proposed the creation of a joint study group to consider in greater detail the present situation of university teaching, research, and the labor market in the transportation engineering sector. This proposal was accepted as a workshop recommendation.

In reply to inquiries regarding the omission of water transportation in his discussion, Dr. Leuzinger pointed out that the problems are so vast that it would be better to initially concentrate on a less-encompassing program.

Dr. Homero Henrique Rosa Rangel also presented a paper on "The Importance of Highway Research in Brazil and the Activities of the Institute of Highway Research (IPR)," (Appendix III), which outlined a number of items for further discussion.

APPENDICES

I. Opening Statement by Dr. Antônio Moreira Couceiro

Opening Statement by Dr. Harrison Brown

Remarks by Mr. William A. Ellis

II. Report of the Brazil-U.S. Study Group on Agricultural Economics

III. Discussion paper on Importance of Highway Research in Brazil and Activities of the Institute of Highway Research (IPR), by Dr. Homero Henrique Rosa Rangel

IV. Discussion paper on the Status and Needs of Transportation Research in Brazil by Dr. Roberto D. Leuzinger

OPENING STATEMENT
by
Dr. Antônio Moreira Couceiro
President
Brazilian National Research Council (CNPq)

As the third meeting of the workshop - consisting of men of science appointed by the U.S. National Academy of Sciences and the Brazilian National Research Council - begins its work, it is most satisfying to address best wishes for success to our American colleagues and to express the desire that they will be received with the cordiality and recognition they deserve because of the dedication with which they are helping us in the search for ways and means to speed up the scientific and technological development of Brazil.

It is now three years since we first discussed, at Itatiaia, the purposes and usefulness of a well-balanced program of scientific cooperation between our two countries. During this period of time, everything persuaded us to believe more firmly in the opportunity and urgency of accomplishing this objective, for we were convinced that scientific and technological development cannot be achieved through financial resources alone or merely on the basis of good will, when these are not accompanied by reliable orientation and profound awareness of the problems to be solved by the developing countries.

We also learned that any effort of technical or scientific assistance, given by a friendly nation, which is not preceded and accompanied by a growing and properly sustained effort by the country that receives the aid, is worth little and will not last.

We are aware that any program of aid, which we may receive, cannot and must not be considered a privilege but rather a pledge that we will work together with the sister nations of the continent, for the purpose of bestowing upon them the benefits which we receive.

It would be utopian to pretend that the world is made up of equally developed countries, that it is populated by a mankind all of whose elements have the same sum total of scientific knowledge and all of whose elements are equally skilled in converting this knowledge into social benefit. It would therefore be quite unfortunate if we were to fail to realize that everybody must prepare himself in order to make a better contribution to social progress, through the perfection of agricultural methods, through the better utilization of natural resources, and through constant renovation of industrial techniques and education.

Because we have thought along these lines, the understandings we entered into three years ago were not lost on the endless road of good intentions; it was because of this way of thinking that the study groups, appointed at Itatiaia, and thereafter, for the most part accomplished the tasks which had been assigned to them. And so we have today the human and material resources which can be directly mobilized for the execution of research projects and for training of new researchers. As a result of the visits made by the study groups, it was possible to draw up a list of deficiencies of the Brazilian scientific apparatus, and from this same mechanism sprang suggestions for alleviating and eliminating the weak points of the system in an orderly and efficient manner.

The conclusions of some of the study groups are already in the hands of the National Academy of Sciences and the National Research Council; others are being rewritten and two of them are about completed. These documents will be discussed throughout this meeting and I can assure you that the Council will do everything to start these discussions immediately.

I must admit that a number of events helped our initial objectives along and, thanks to them, the effort of the National Research Council may turn out to be more forceful; moreover, because of these events, the implementation of the development programs has assumed a preferential character, and the importance of the role which science is called upon to play in our time has been truly recognized.

Initially, we had the signing of the Declaration of Presidents by Brazil at Punta del Este, and faithful compliance with the pledges assumed there: the development of a scientific and technological development policy, the increase in budget allocations for research and for training of researchers; the adoption of measures aimed at retaining Brazilian scientists in our country and at promoting the return of those who have moved abroad.

In this way, we today have a five-year program, worked out by the National Research Council. It was also possible to raise the salaries to be offered to the most outstanding Brazilian researchers, and we obtained the material resources which would facilitate the return of scientists and engineers who are now abroad, as well as the acquisition of equipment that is indispensable to the continuation of the work now being done outside the country.

On the other hand, we have the recent University Education Reform which establishes a requirement calling for the completion of a postgraduate course as a condition for admission to a teaching position; this reform also calls for the combination of related disciplines in the form of basic institutes; this creates conditions promoting the institution of a "full-time" work system and represents

recognition of the urgent need for including conditions for scientific effort in the university environment. This recent reform has created a new climate which is conducive to an expansion of research and a revitalizing of teaching methods.

Even more eloquent, however, is the Strategic Development Plan worked out by the Ministry of Planning and General Coordination. This plan provides financial resources, for a three-year period, for the expansion of basic and applied research as well as industrial research.

Finally, measures of a fiscal nature, promoting scientific and technological development, are now under study.

As you can see, we have made some progress since our first meeting. We have held to our commitment, to our determination, and to our desire and we have much more confidence in the success of cooperation with United States' researchers. It is in this spirit that we attend this meeting.

The National Academy of Sciences and its scientists can be sure that we will do whatever is humanly possible in order, as quickly as possible, to achieve the objectives which may be selected at this meeting, and that we will spare no effort in order to repay the aid we receive by cooperating in the development of the other nations of the continent.

To all present, I would like to express the appreciation of the National Research Council in advance - so sure am I that, at the end of this meeting, we will have the foundations for scientific cooperation which will continue over many years, thus strengthening the bonds of friendship between the researchers of our two countries, promoting progress, and benefitting the continent.

OPENING STATEMENT
by
Dr. Harrison Brown
Foreign Secretary
U.S. National Academy of Sciences (NAS)

Friends and colleagues. Speaking for my American colleagues, it is indeed a very great pleasure for us to be back in Brazil again talking over important problems of mutual concern with our Brazilian colleagues. Our two groups of scientists are united by a very strong bond. That bond is a mutual realization that science has an important role to play in the future development of the world.

I believe that our joint Brazilian-American program of scientific cooperation is, in a very real sense, setting an example for cooperation and technical assistance in the world as a whole. I do not say these words lightly, and I would like to stress that it is in part because of the success of this joint program, that in Colombia in November of last year, a Science Development Fund was established within the Colombian Ministry of Education and a Science Policy Council was established which is going to be chaired by the President of Colombia. Further, in the same month of last year, a Peruvian Research Council was established and I can say, as a matter of fact, that one of the reasons it was established was because of the example shown by Brazil in establishing the Brazilian Research Council, recognizing the importance of science in the development of higher education, and in the development of the economy as a whole.

I believe that we can point with pride to a number of our joint achievements. Perhaps, the most important aspect of our effort is that we have learned how to work together. This is not a situation where people from one country come to another country to tell them what to do. For one thing, we can't because we don't know ourselves. But, in bringing members of the scientific-technical communities of Brazil, with their deep knowledge of the problems within their own country, together with members of the scientific-technical community of our country with our own special experiences, there results a combination of knowledge which is considerably greater than the sum - it is more like the product, I would say, of the totality of your knowledge and ours. And together, we are able to identify problems and point to ways and means for their solution.

I have had the opportunity of talking with a number of persons in many parts of the world concerning our joint program and I believe you ought to know that there are several aspects of it which are being watched very closely by scientists, economists, and members of the

technological community in many countries and in many organizations. There has been a tremendous demand, for example, for the joint report of the Brazil National Research Council and the U.S. National Academy of Sciences on Industrial Research - we have requests for this report from Asia, Africa, the Organization for Economic Cooperation and Development (OECD), and the United Nations. In a sense, that report is becoming a handbook on conditions for the establishment of industrial research activity in a developing country. Our joint chemistry program, which we are just in the midst of getting started, is being looked upon with a tremendous amount of interest. I attended a meeting two weeks ago and present were John Hannah, the new Administrator for the Agency for International Development and formerly President of Michigan State University, and Robert McNamara, who is now President of the World Bank. I described the chemistry program as it has evolved and both of them expressed excitement about it. Indeed, Mr. McNamara stated that he hoped very much that this could be a prototype for future activities between developing and more technologically advanced nations in the future. Mr. Hannah was particularly pleased that our own Agency for International Development was participating in this program as vigorously as it is. So our own interest in this program greatly transcends Brazilian development alone. If this approach works in Brazil, it can be made to work elsewhere.

I believe that our two groups can point with pride to our achievements; in a very real sense, we are jointly leading our fellow scientists and engineers in other parts of the world along a new kind of pathway of international cooperation. So we, Dr. Couceiro, are deeply grateful to you and your colleagues for giving us the opportunity of engaging in this experiment. Thank you very much.

REMARKS
by
Mr. William A. Ellis
Director, USAID/Rio

With Introduction
by
Dr. Harrison Brown
Chairman of Session

Colleagues. It is my pleasure to introduce the Director of the Rio de Janeiro Mission of the Agency for International Development. From the time I first met him, he has taken a very great personal interest in our science development program and in these joint workshops. He has recently indicated a great deal of interest, indeed, in the experiment we are attempting aimed at developing and strengthening research competence at the graduate level here in Rio de Janeiro and São Paulo. So, with a great deal of pleasure, I would like to introduce to you Mr. William Ellis.

Dr. Brown, Dr. Couceiro, Ladies and Gentlemen. I am not going to steal very much of your valuable time. I know your agenda is extremely crowded. I want to say first of all that my rather limited presence at the meeting is no indication of my degree of interest. I was called out the first morning of your meeting to deal with an insoluble problem - of soluble coffee. I don't know which category it's in - insoluble or soluble. What Dr. Brown has said is true about my interest, and I think of the attitude of the Agency for International Development in general. We started our friendship and our discussions in Indonesia; and we made remarkable progress there is spite of very serious political, technical, and economic handicaps. If you can do it there, there certainly is no reason why we - two countries and two scientific communities working together - cannot make this a model for cooperation throughout the world. I think you are well on the way to that already.

I understand that Peru is emulating the Brazilian experience. From our standpoint, it is a source of great pride to play a modest role in this effort - and we want that role to be modest. We think it is important that we stay as much in the background as possible. I do not think there is any need for us to do otherwise, for political reasons and for reasons of flexibility of the program and academic freedom. It is important and we want it that way. It is a source of pride for us because, quite frankly, through the NAS and its many contacts with universities and elsewhere in the intellectual community, we are able to obtain or be associated with the type of high-quality individual that we get from no other source. So even in our indirect and, we hope, inconspicuous role, it is a source of great pride to us to have Americans, of the caliber represented in this room, come to Brazil.

Now, with regard to our program objectives, whether it is your general discussions, your general workshop or your specific programs of cooperation such as chemistry (which I know is on your agenda today), I think it is not only important for its own sake - the contribution of research within that particular field - but it is important for the development of the entire educational structure of the country. I cannot conceive of a first-rate university system, or a first-rate undergraduate program in the basic sciences, unless you have some centers of excellence with superior programs at the graduate and postgraduate level. The same goes right down the line; unless you have superior undergraduate programs, this begins to have an adverse effect on your collegia, gymnasia, and so on. Quite frankly, the entire educational system of Brazil has many deficiencies, and this is one of them. This concept of excellence is not engrained in the system from top to bottom. Probably in terms of an economical approach, I think you have to start from the top and work down. In terms of the length of time for which you obtain a pay-off in educational or scientific investment, it is just common sense that the gestation period is shorter at the postgraduate level and higher educational levels than it is in primary education. That does not negate the importance of primary education, nor is it to say that society should look at its priorities from the economic standpoint. But the fact remains that the primary level pay-off is ten to fifteen years away, but the pay-off level of your discussion and cooperation is one year, and perhaps even a shorter time away in terms of results. I think that is all I have to say except to congratulate you again, Dr. Couceiro, for the progress you have made already and to let you know that any way in which we can be helpful, without getting in your way, we stand prepared to do so. Thank you very much.

APPENDIX II

Report of

The Joint Brazil-U.S. Study Group

on

Agricultural Economics

of the Brazil-U.S. Science Cooperation Program

Presented To

The National Research Council of Brazil

and

The National Academy of Sciences of the United States of America

Brazilian Members	U. S. Members
Victor J. Pellegrini, Chairman	G. Edward Schuh, Chairman
Constantino Carneiro Fraza	D. Woods Thomas
Fernando Rocha	Lawrence W. Witt

The Study Group on Agricultural Economics met in Rio de Janeiro during the week of February 24 to March 1, 1969. The meetings were held simultaneously with those of the Study Group on Agricultural Research, and involved both independent meetings and joint meetings with this latter group.

The objectives of the Study Group on Agricultural Economics, as determined in its first meeting in Rio de Janeiro, January 22-30, 1968, are as follows:

1. To suggest ways in which agricultural economics can be integrated with the physical and biological agricultural research,

2. To suggest ways in which economic analysis can be brought to bear in establishing research priorities on a continuing basis,

3. To suggest steps to be taken which will strengthen agricultural economics as a science and discipline in Brazil. Special emphasis is to be given to:

   a. Strengthening teaching programs in agricultural economics,
   b. Strengthening research in agricultural economics generally, but most specifically, that useful for policy purposes.

4. To suggest ways in which a permanent Council of Economic Advisors for Brazilian Agricultural Development can be established which will guide the development of the growing profession, advise on national agricultural policy, and advise on programs of international assistance to the agricultural sector of Brazil.

The first report of the Study Group, submitted to the Brazilian National Research Council and the U.S. National Academy of Sciences on January 30, 1968, was a first step in attaining these objectives. It included:

1. A brief evaluation of the status of agricultural economics in Brazil.

2. A discussion of Brazil's needs for economic and social analysis of the agricultural sector.

3. A specification of goals and strategies which might be followed to strengthen agricultural economics as a science, to maximize the contribution of agricultural economics to technical agricultural research, and to improve decision-making in the formulation of national economic policy. In outline form these goals and strategies were specified as follows:

a. The economic dimension of agricultural research needs to be given greater emphasis. Three recommendations were made to this end:

(1) That research in agricultural economics be considered an integral part of agricultural research.

(2) That agricultural economics be established as a permanent component of the six (now eight) regional Institutes that make up the Department of Agricultural Research and Experimentation (DPEA, the Ministry of Agriculture - now EPE, the Office of Research and Experimentation), and in other research institutions where viable.

More specifically:

(a) It is recommended that a team of at least three agricultural economists (with at least the M.S.) be placed in each of the regional Institutes and in other research centers where viable.

(b) It is recommended that a small advisory group of agricultural economists be established at the national decision-making and planning level to help in establishing priorities for biological and physical research.

b. The profession of agricultural economics needs to be further developed.

Minimal goals or targets for the next 5 years should be:

(1) To have 30-40 men with the Ph.D. degree or well along in their doctoral studies. A realistic target is to have some 20 completed Ph.D.'s working in the country by 1972.

(2) To have 250-300 men with the M.S. degree working in the country.

(3) To develop at least four strong regional centers or complexes in agricultural economics. Each of these should have a strong training component plus a strong research component through which economists are seeking to solve regional problems.

(4) The development of at least one viable Ph.D. - level training program in Brazil.

(5) To develop comprehensive research programs that are more than just the by-product of ongoing graduate programs.

c. Capacity for policy analysis and research must be expanded. Specific targets are:

(1) The development of at least one policy - research group for work at the national level.

(2) The development of four policy research groups that can influence regional economic policy.

d. A permanent advisory committee for agricultural economics should be established. It was proposed that this be the Joint U.S.-Brazil Study Group on Agricultural Economics of the Brazilian National Research Council and the U.S. National Academy of Sciences, and that this group be constituted as a permanent Joint Commission on Agricultural Economics with the following general responsibilities:

(1) to provide intellectual guidance and leadership to the development of the agricultural economics profession in Brazil,

(2) to assist in the creation of stronger and more viable internal programs of research and education in agricultural economics.

(3) to expand opportunities for professional interactions among Brazilian agricultural economists and their colleagues in the United States and other nations. It was decided that the immediate tasks before the Commission in the first year would be three-fold:

(a) Explore alternative ways in which a permanent Council of Economic Advisors could be established to advise on national agricultural policy and on programs of international assistance to the agricultural sector of Brazil. The possible structure, mechanics, organization, function and procedures of such an organization need to be examined.

(b) Devise ways in which agricultural economics could be strengthened and the recommendations of last year's report could be implemented.

(c) Identify ways in which continuous support could be provided to research for policy purposes.

During the period February 24-March 1, 1969, a series of meetings were held in Rio de Janeiro to further the work of the Study Group. This

series of meetings involved the following basic elements designed to implement the objectives spelled out above:

1. A workshop for Brazilian agricultural economists that consisted of the following:

   a. One half-day devoted to a discussion of the report prepared by the Study Group a year ago.

   b. One half-day devoted to a discussion of a monograph prepared by Dr. G. Edward Schuh titled Research on Agricultural Development in Brazil. This monograph was sponsored by the Agricultural Development Council, and is essentially an evaluation of research in agricultural economics in Brazil.

   c. One half-day devoted to a discussion of New Graduate Programs in Agricultural Economics, 1/ prepared by Victor Pellegrini and Lawrence Witt. This study was financed by the Ford Foundation, and is an evaluation of three new graduate programs in Brazil and a comparison with the new programs in Peru and Mexico and the experience of students trained in the U.S.

2. A meeting with national and international financial entities to explore possibilities of financial support for expansion of work in agricultural economics, and to communicate the results of last year's meeting.

3. The presentation of papers to the Workshop on Agricultural Research. These papers were designed to show the role that agricultural economics can and should play in agricultural research programs.

4. A meeting of the Study Group, together with other representatives, to establish program activities for the coming year.

Appendix Table 1 and 2 show an analysis of the research to date in agricultural economics in Brazil. Table 1 shows the distribution of the research effort by subject matter on a national scale, and Table 2 shows the regional distribution.

1/ This report is based on a larger study prepared by the authors for the Ford Foundation: Appraisal of Graduate Programs in Agricultural Economics and the Effectiveness of the Graduates in the Institutional Setting of Brazil, Mexico, and Peru. A limited number of copies are available on request.

Suggestions made by Schuh for redirecting the research effort in agricultural economics consist of the following:2/

1. That greater attention be given to developing balance in the several research programs;

2. That greater attention be given to the relevance of the research programs in order that the scarce research resources be used on current problems in the economy;

3. That efforts be made to shorten the institutional lag of having little or no research on the rapidly developing frontier areas;

4. That more attention be given to integrative studies which synthesize the results from previous studies;

5. That efforts be made to undertake more macro-type studies;

6. That more attention be given to understanding how the economic system works; and

7. That more attention be given to research of a hypothesis-testing nature as contrasted to descriptive studies.

Priority areas of research as determined by this report are as follows:

1. Policy research - especially on domestic agricultural policies

2. International trade

3. Land reform

4. The economics of water

5. Problems of the labor market

6. Adjustment problems

7. The identification of sources of agricultural growth

8. The economics of education and growth

9. Institutional changes, especially:

   a. Those which service the labor market

   b. Those which service the land market

2/ A copy of the monograph is available on request.

c. Those which provide the services of science and technology

d. Those which provide new modern inputs

10. The regional disparity problem.

Problems facing future research consist of:

1. The problem of manpower

2. The problem of communication

3. The problem of data

4. The development of a Brazilian literature

5. The need to be "economists of agriculture" and not "agricultural economists".

The Pellegrini-Witt report was based on field data collected in Brazil, Peru, and Mexico, and mail questionnaires sent to students and their professors in the U.S. Major points from this report are as follows: The three operating graduate centers have substantially increased the number of trained agricultural economists in Brazil. The degree status in Brazil in 1968 is estimated to be as follows:

Some formal post B.S. or B.A. training	60
Taking courses for M.S.	41
Courses for M.S. completed	53
Holding the M.S.	69
Candidate for the Ph.D.	7
Holding the Ph.D.	1
	231

These are impressive numbers compared with the handful with graduate training 10 years ago. Some 30 to 40 new masters degrees can be expected during each of the next few years.

The three graduate centers in Brazil, two similar centers in Peru and Mexico, and the experience of some 45 masters candidates in the United States were compared. The analysis is based on interviews with the graduates, their professors, their employers, and with schools and employers that do not yet participate in the training or use of the graduates. Some major strengths and weaknesses of the Brazilian programs and recommendations made by the authors are as follows:

Strengths:

1. An impressive number of students have been trained and are now practicing their profession.

2. The thesis research constitutes a significant part of the total agricultural economic research in Brazil, thus representing a significant expansion in this resource.

3. In partial contrast to students studying abroad, nearly all of the theses deal with Brazilian problems and Brazilian data.

4. The programs, in general, are increasing in quality, offer more electives, and are becoming better established.

5. With the system of financing established (i.e., the employers send students and pay salaries to cover most of the costs), a substantial number of agencies are participating.

6. The time required for the established programs compares favorably with that for students in the United States.

Weaknesses:

1. While each center can refuse entrance to poorly qualified candidates, they do not have many resources to attract the best candidates, except as the employer choses to support him.

2. There is some unevenness in the quality of teaching and content of the courses, but probably little more than among other larger established institutions.

3. A significant number of students, especially in the early years of each program, do not have much help in identifying their problem and carrying out their thesis research.

4. The resources to assist the student in doing his research, such as money for travel, subsistence and help in interviewing, and in statistical analysis often are quite limited. Though much already has been accomplished, more assistance is needed.

5. The thesis often deals with a narrow problem and in total does not give enough attention to some important Brazilian problems. In part, this stems from the desire for a small, manageable project which fulfills the training function.

Recommendations

1. Other states of Brazil and the national government can benefit greatly from the continuation of these training programs. Financial assistance will help raise the quality and relevance of the program. Many alternative ways are possible. For example, a state other than the three now supporting programs could finance a research project which a prospective graduate would do as his thesis. They could establish a fellowship for a student from their state. In any case, more ample and a wider range of financial support are desirable.

2. The study suggests that more exchange of staff should occur among these centers, so as to broaden the experience and stimulate the imagination of the teachers and their students.

3. Special efforts are needed to help upgrade the economics and agricultural economics taught in the other faculties of agriculture and interior schools of economics. The young faculty in these other schools should be drawn in one or more of these centers both in special faculty training workshops or as participants in the training programs.

4. From time to time, a student with special competence should be invited to take on a broader and important problem and spend a larger period of time completing his thesis. Special compensation and budgeting would assist such a program.

5. The thesis research needs to continue to increase in quality, and faculty time must be provided so that adequate consultation is available.

6. The integration of several theses into a broader research report and the publication of these and (probably somewhat rewritten) completed theses need to be given greater attention. This is an important way of attracting finances and proving that these programs are important.

Papers presented to the Workshop on Agricultural Research by members of the agricultural economics group were as follows:

1. "Technical Assistance: International and Bilateral", by D. Woods Thomas.

2. "Economic Criteria in the Choice of Research Priorities for Agricultural Research", by G. Edward Schuh.

3. "Economic Criteria in the Choice of Research Priorities for Agricultural Research", by Constantino Fraza.

4. "Relations of Agricultural Research to Economic and Sociological Research," by Lawrence Witt.

5. "Relations of Agricultural Research to Economic and Sociological Research," by Humberto Richter.

The presentation of these papers provided an excellent opportunity for interaction between the social scientists and the physical scientists. The objectives of the papers were designed primarily to indicate the contributions of agricultural economics in establishing research priorities, and to suggest ways in which technical scientists and social scientists could work more closely in producing useful research.

In the meeting with financial entities, one of the members present was the head of the agricultural sector in the Institute of Applied Economic Research (IPEA) Ministry of Planning and General Coordination. He indicated that IPEA was making research monies available for policy research, and indicated that a committee was needed to coordinate this work. He asked that the Study Group make suggestions to him, and he would implement them.

The Study Group recommended that the committee consist of representatives from the following institutions or organizations:

1. Institute of Applied Economic Research - IPEA - Ministry of Planning.

2. Technical Office of Agricultural Economics - ETEA - Ministry of Agriculture.

3. Department of Rural Studies, Secretariat of Agriculture - Minas Gerais.

4. Institute of Agricultural Economics, Secretariat of Agriculture - São Paulo.

5. Institute for Economic Study and Research - IEPE - Pôrto Alegre.

6. Bank of the Northeast - ETENE and DERUR.

7. Institute of Rural Economics - Rural University of Minas Gerais - Viçosa.

8. Department of Rural Social Studies - School of Agronomy - Piracicaba.

9. The Fundação Getulio Vargas.

10. The National Research Council.

These institutions represent the major entities involved in agricultural economic research, and provide a good geographic coverage.

It is proposed that this committee meet once a month with the following assignments:

1. To establish and suggest priorities for socio-economic research on the agricultural sector.

2. To evaluate research projects submitted to IPEA for financing.

3. To suggest research projects that are necessary to evaluate agricultural policy.

4. To stimulate and promote seminars, workshops, and publications as a means of stimulating inter-change among the research centers.

5. To respond to solicitations of governmental organs within its sphere of influence.

This committee can be a key vehicle for implementing some of the recommendations of the Study Group on a continuing basis.

Two major activities of the Study Group are planned for the coming year:

1. A study trip for some 10-12 representatives of the Schools of Agronomy which have "under-developed" programs in agricultural economics. The study trip would consist of the following:

   a. Participation in the meeting of SOBER in Piracicaba, July, 1969.

   b. A visit to the following institutions which have strong research and/or training programs:

      (1) Department of Rural Social Studies, School of Agronomy, Piracicaba.

      (2) Institute of Agricultural Economics, Secretariat of Agriculture, São Paulo.

      (3) Department of Agricultural Economics, Secretariat of Agriculture, Minas Gerais.

      (4) Institute of Rural Economics, Rural University of Minas Gerais, Viçosa.

   c. A trip to the U.S. to visit a number of strong academic departments and research centers.

   d. Participation in the meetings of the American Association of Agricultural Economists, August, 1969.

   e. A three-day debriefing period in Rio de Janeiro.

Funds for this trip will be solicited from USAID. The objective of this program is to upgrade the programs of these institutions which are falling further and further behind the stronger entities in Brazil. In selecting men for this trip emphasis should be given to identifying young, capable men who have the leadership potential to return to their home institutions and develop sound programs, as well as those who have the potential to benefit from advanced training.

2. A meeting of the Study Group in the United States approximately a year from now. The purpose of this meeting would be three-fold:

   a. To develop possible programs of intellectual inter-change with U.S. academic departments that have programs in Brazil.

   b. To study how policy research is done in the U.S.

   c. To visit non-academic institutions in the U.S. that have research programs in Brazil.

   d. To meet with financial institutions that might collaborate in implementing the recommendations of the Study Group.

Institutions which might be visited in implementing these objectives are as follows:

   a. University of Wisconsin, Purdue University, University of Arizona, Ohio State University, Vanderbilt University, and Michigan State University.

   b. The Department of Agricultural Economics of the USDA and the Staff of the Council of Economic Advisors, Washington, D. C.

   c. Foreign Divisions of the Economic Research Service and SRS, the training institute of the World Bank, Inter-American Development Bank, and USAID.

   d. The Ford Foundation, the Rockefeller Foundation, Agricultural Development Council, etc.

Visits to the Library Reference Service of the Library of Congress, the Brookings Institute, and the Census offices would also be useful.

Other recommendations of the Study Group are as follows:

1. That Dr. Fernando Rocha be appointed to the Study Group in place of Dr. Rui Miller Paiva, who is now working abroad. Dr. Rocha is Director of the Institute of Rural Economics of the Rural University of Minas Gerais.

2. That the National Research Council of Brazil appoint someone to be responsible for its programs in agricultural economics. This would assure continuity in program efforts.

Table 1. Distribution of Research Among Subjects and Regions, Brazil

	Classification	North	Northeast	Minas Gerais	Rio de Janeiro and Guanabara	Goias and Mato Grosso
1.	Land and water use		16	4		2
2.	Farm management and farm organization	2	12	64	2	7
3.	Agricultural finance		11	5		
4.	Supply and demand	2	29	13	5	
5.	Agricultural marketing		20	17	3	
6.	International agricultural trade		1			
7.	Rural life and organization	2	11	17		2
8.	Agricultural policy	2	15	1	1	
9.	Population and agricultural labor		4	2		1
10.	Values, attitudes, and motivations			4		
11.	Agricultural mechanization					
12.	Rural industry	1	3	3		
13.	Agricultural statistics and research methodology		3	1		
14.	Extension, education and innovation			15		
15.	Economics and agricultural development	1	28	3	3	7
16.	General background on agriculture, economy and people	2	9			1
	Total	12	162	149	14	20
	Per Cent	1.2	16.5	15.2	1.4	2.0
	Number of Studies	10	111	105	13	12

(CONTINUED)

Table 1. Distribution of Research Among Subjects and Regions, Brazil. (CONTINUED)

	Classification	São Paulo	Parana and Santa Catarina	Rio Grande do Sul	Others[a]	National[b]	Total	Per Cent
1.	Land and water use	9		7	4	39	81	82
2.	Farm management and farm organization	51	3	21	5	13	180	18.3
3.	Agricultural finance	4		3	1	8	32	3.2
4.	Supply and demand	43	1	8	6	104	211	21.3
5.	Agricultural marketing	29			5	32	106	10.8
6.	International agricultural trade	1				23	25	2.5
7.	Rural life and organization	6	1	3		9	51	5.2
8.	Agricultural policy			2		19	40	4.1
9.	Population and agricultural labor	5	1	1		17	31	3.2
10.	Values, attitudes, and motivations	1		5			10	1.0
11.	Agricultural mechanization	2				2	4	.4
12.	Rural industry	1				6	14	1.4
13.	Agricultural statistics and research methodology	4		2		3	13	1.3
14.	Extension, education and innovation	4	1	8		8	36	3.7
15.	Economics and agricultural development	6	4	4	2	65	123	12.5
16.	General background on agriculture, economy and people	1	1	2	1	9	26	2.6
	Total	167	12	66	24	357	983	100.0
	Per Cent	17.0	1.2	6.8	2.4	36.3	100.0	
	Number of Studies	119	9	41	16	263	699	

a/ Studies that covered areas other than those specified individually, but not of national scope. Tend to be either regional studies or studies in states not specified, such as Espirito Santo.

b/ Studies that are national in scope.

Table 2. Percentage Distribution of Research Among Subjects by Selected Geographic Coverage

	Classification	Northeast	Minas Gerais	São Paulo	Rio Grande do Sul	National
1.	Land and water use	9.9	2.7	5.4	10.6	10.9
2.	Farm management and farm organization	7.4	42.9	30.5	31.8	3.6
3.	Agricultural finance	6.8	3.4	2.4	4.5	2.2
4.	Supply and demand	17.9	8.7	25.7	12.1	29.1
5.	Agricultural marketing	12.3	11.4	17.4		9.0
6.	International agricultural trade	0.6		0.6		6.4
7.	Rural life and organization	6.8	11.4	3.6	4.5	2.5
8.	Agricultural policy	9.2	0.7		3.0	5.3
9.	Population and agricultural labor	2.5	1.4	3.0	1.5	4.8
10.	Values, attitudes and motivations		2.7	0.6	7.5	
11.	Agricultural mechanization			1.2		0.6
12.	Rural industry	1.8	2.1	0.6		1.8
13.	Agricultural statistics and research methodology	1.8	0.7	2.4	3.0	0.9
14.	Extension, education and innovation		10.1	2.4	12.1	2.2
15.	Economic and agricultural development	17.4	2.1	3.6	6.0	18.2
16.	General background on agriculture, economy and people	2.5		0.6	3.0	2.5
	Total	100.0	100.0	100.0	100.0	100.0

Importance of Highway Research in Brazil and Activities of the Institute of Highway Research (IPR)

by

Dr. Homero Henrique Rosa Rangel
Director, IPR

1. Importance of transportation in Brazil's social life and economic development.

1.1 Facilitate circulation of national power and wealth.

1.2 Conquest and integration of new and vast areas, facilitating the effective development of the country's interior.

1.3 New possibilities for investment and production.

1.4 New possibilities for the employment of skilled manpower.

1.5 Evidence of importance of this subject also from viewpoint of national security.

2. By continuing to advance along these lines, the Federal Government consistently devotes major attention and resources to transportation goals (see attached documentation).

2.1 Greater sense of integration of various transportation systems.

2.2 Overall and sector plans of major importance and volume.

2.3 Utilization -- in the field of transportation, alone -- of more than NCr $7.2 billion, representing more than 41% of the total provided for under the 1968-1970 "3-year investment plan" of the Federal Government.

2.4 Need for improving working methods through more studies and research so as to achieve greater productivity, raise technical standards, and, consequently, greater comfort, capacity, and safety and transportation activities performed.

3. Worldwide tendency and special Brazilian features of the highway transportation system.

3.1 Worldwide tendency toward increasing use of highways, even in developed countries which have excellent transportation systems, consequently requiring highways that meet increasingly higher technical standards.

3.2 Items 1.1 - 1.5, applied to the extensive and varied conditions of Brazil.

3.3 Consequently, the Federal Government alone will use more than NCr $5.2 billion for new highway investments under the above-mentioned "three-year investment plan" : this represents more than 72% (or almost 354 of the total) of investments in all transportation systems.

3.4 Accentuated Brazilian entrepreneurial /free-enterprise/ development of highway construction projects, enabling more than 1 million Brazilians to live on the wages paid out as the result of these highway programs.

3.5 Extraordinary development of Brazilian auto industry which, during the 12 years of its existence, has already won a place for itself among the top 10 of the world and which is responsible for the existence of more than 2/3 of the automotive vehicle fleet in Brazil.

3.6 A situation in which the highway system -- in Brazil -- alone is responsible for the transportation of more than 70% of all of the transport volume handled in Brazil, by all of the various transportation systems, together.

3.7 The most recent, numerous, and extensive economic studies reveal that the profit-cost ratio of our highway investments turns out to be most favorable in terms of the situation in Brazil.

3.8 This explains Brazil's recent classification among the five countries which, throughout the world, are making the greatest effort in terms of the technological development of their highway transportation system.

4. Institute of Highway Research (IPR).

4.1 The score of highway research institutions, similar to the IPR and existing throughout the developed part of the world.

4.2 The two tendencies: the HRB (Highway Research Board) in the United States and the RRL ("Road Research Laboratory") in Great Britain.

4.3 The creation of the IPR, in 1957, similar to the HRB and the advisability of retaining this similar mission in view of the special situation prevailing in Brazil.

4.4 Example of similar activities in the United States -- in national surveys made by the "International Road Federation" in collaboration with the HRB and the "Bureau of Public Roads" involving 5,000 highway research projects accomplished in 40 countries. In Brazil, this work was coordinated by the IPR (see the study that was prepared).

4.5 Objectives of IPR: coordinate, plan, carry out, stimulate, and disseminate studies and research of concern to highway traffic. These fundamental objectives include attempts to provide motivation, such as the attempt being made here now.

4.6 Organization and expansion of IPR throughout national territory (see table and organizational charts).

4.7 IPR operating procedure: essentially cooperative, similar to the HRB, featuring integration of efforts of highway agencies, technology institutes, as well as study centers and private industry and business.

4.8 Principal types of IPR activities:

-Study scholarships and assistance for studies and research:

-Specialized training courses in the Federal District and throughout the States of Brazil, featuring more than 200 courses offered by the IPR, aimed at the specialized skill development of more than 3,000 technicians in the following name specialties: paving, geology, traffic, electronic computation, nature conservation, highway administration, transportation economics, pre-stressed concrete, equipment maintenance, application of PERT/CPM system, topography, drafting and drawing, as well as laboratory technicians.

-Invitations to famous engineers -- both Brazilian and foreign -- to present new techniques;

-Promotion of and participation in symposia, congresses, and other technical meetings, in Brazil and abroad;

-Association and collaboration with similar agencies;

-Observation and study trips throughout the country and abroad;

-Development of special studies and promotion of competition on current topics;

-Preparation, printing and distribution of pertinent works, with more than 5,000 technical documents already put out by the IPR, totaling more than 1 million copies of technical publications distributed free of charge.

4.9 Principal achievements of IPR:

-"Symposia on highway research," such as annual and international meetings, attended by more than 2,000 engineers for the four symposia held so far; the HRB and the RRL were also represented on these occasions.

-Two "national seminars on highway engineering education," representing an attempt to discuss and submit solutions to the main problems in this important field of education, an effort which also resulted in the preparation of a new curriculum for highway-oriented disciplines;

-Stimulus for greater utilization of complete studies and consultation services in highway planning and construction projects;

-Observation and study trips throughout the country and abroad, with the participation of the USAID;

-More than 200 specialized training courses;

-Incentive for greater use of geology in highway studies;

-Study of new methods for determination of pavement dimensions;

-Study on maximum, per/axle limits for freight transported by highway;

-Study of characteristics of Brazilian asphalt;

-Study of new "highway project norms";

-Study on improvement of safety conditions of highways;

-Prizes awarded to most outstanding students in the field of highway engineering;

-Studies and research on pavement types best suited for the particular conditions prevailing on the highways in the Northeast and Amazonia;

-Survey of hundreds of Brazilian highway engineering students and researchers, conducted by the IPR for the first time in Brazil;

-Studies on the preparation of special construction manuals and basic construction work;

-Studies dealing with the use of aero-photo-geology.

4.10 This underscores the great effort being made by the IPR primarily in the area of specialized personnel for the purpose of overcoming the deficiency in highway engineering curricula and meeting the growing demands of the highway agencies which subsidize us.

4.11 Here -- as in the HRB -- our institute is financially supported by the National Research Council, by the DNER /the National Highway Department/, and by other highway agencies as well as private industry and business organizations, with the following overall participation since the establishment of IPR in 1957:

National Research Council	12.9%
DNER	49.7%
Other agencies	36.4%
Private industry	0.1%
Miscellaneous	0.9%

4.12 It is with great concern that we find that -- although Brazil is in the outstanding position mentioned earlier -- the resources earmarked for highway studies and research, to be handled through the IPR, are extremely small and amount to less than 0.09%, when compared to highway investments earmarked by the Federal Government for the above-mentioned three-year investment plan; this is considered insufficient to provide the necessary technological support for the intensive highway construction program. Even more serious than that is the result of a comparison with the combined figure for all of the country's highway plans (federal, state and municipal).

4.13 We can, to some extent, understand this insufficiency in terms of attention and resources to be devoted to these problems, against the background of our highway situation which is fascinating and which can be viewed predominately in executive terms, especially since it absorbs voluminous financial and material resources and a large number of highly-skilled workers drawing high pay; the situation, however, is quite complex since it involves numerous agencies interested in technological progress for highways, featuring such areas of diversified activity as the National Research Council, the IPR, the DNER, the state and municipal departments, the directorate of roads and transportation under the Ministry of the Army, SUDENE /Office of the Superintendent for the Development of the Northeast/, the SUDAM /Office of the Superintendent for the Development of Amazonia/, the SUDESUL /Office of the Superintendent for the Southern Region/, the schools of engineering, geology, economics, and chemistry, as well as technological institutes, private industry, and business organizations.

4.14 However, here, as in the United States and in the other countries which follow the orientation of the HRB, it is up to the highway research institutes -- affiliated with the various national research councils -- to discharge this responsibility for highway studies and research which must serve as a support for an intensive highway construction program.

4.15 It is, therefore, de jure and de facto up to the IPR to discharge this important responsibility, and we could not allow this opportunity to pass without alerting the illustrious authorities as to the gravity of the situation in an effort to persuade them to develop an increasing awareness of the problem and to display, therefore, greater and more decisive participation in the solution of the problem we face.

5. Suggestions for a program of cooperation.

5.1 Greater allocation of resources from the USAID and other financing agencies for highway study and research programs, including training courses and study trips.

5.2 Greater tie-in with the universities, for the purpose of developing highway engineering.

5.3 Greater facilities for an increase in the exchange of highway documentation, particularly through the national system of the HRB (using electronic computers) and the LNEC (the National Civil Engineering Laboratory in Lisbon).

5.4 Possibilities of financing for the numerous technical publications of IPR.

5.5 Better facilities for the allocation and utilization of electronic computers in highway construction projects and controls.

5.6 Better facilities for the utilization of geological services and studies in highway planning and construction projects, including photogeo-interpretation, studies of terrain features, gradients, and massifs, drainage studies, and studies on soils and other typical Brazilian materials.

5.7 Improved facilities for the development of the study of the characteristics of Brazilian asphalts, in view of the other conditions prevailing throughout the country.

5.8 Incentive for the development of economic studies concerning the field of transportation, especially highway transportation, so as to provide better conditions for highway planning and construction projects.

5.9 Better facilities for the development of safety conditions regarding persons, vehicles, and highways.

5.10 Better facilities for the study of Brazilian materials, especially those in the Northeast region and Amazonia, including a study of the types of pavement that would be best suited for these conditions.

5.11 Improved facilities for publicizing the great importance of the need for highway studies and research which represent the technical supporting structure that is indispensable to the executive development of highway programs, although this should not involve any unnecessary and unforeseeable risks, with all the frequently voluminous and irreparable losses resulting from this.

Transportation Engineering in Brazil

by
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INTRODUCTION

Brazil's continental dimensions and the differences that exist today in the level of development of the country's various regions, leave no doubt that transportation is of vital importance to the nation's geographic integration. The analysis of national indices of economic activity reveals the significance of transportation as a source of government income and expenditure, confirming that an efficient transportation system is a fundamental element to the progress and development of Brazil.

It is the purpose of this report to provide points for discussion during the third workshop on "The Contribution of Science and Technology to Development" by making a few comments on the present situation of Transportation Engineering in Brazil from the point of view of education, research and the necessary coordination between the university, the governmental agencies and industry with the aim of achieving better transportation for Brazil.

EDUCATION

Transportation Engineering education in Brazil was restricted, until very recently, to undergraduate and specialization courses that followed out-of-date curricula, were concerned almost exclusively with construction aspects and did not devote any effort to research. A few years ago some of the civil engineering undergraduate courses started offering an option in transportation which was a first attempt to a more comprehensive and modern approach, but the emphasis in construction still remains and no encouragement is given to research.

With the purpose of reducing this inbalance and creating conditions for the development of research in this field, the Graduate School of Engineering of the Federal University of Rio de Janeiro (COPPE-UFRJ) decided to open a new area of study in Transportation Engineering, starting in March 1969, offering programs that lead to the degree of Master of Science. The scope and description of the courses that constitute this area of study are listed in appendix 1.

The reaction of those who are acquainted with the problems of transportation engineering in Brazil and who have become familiar with this program has been invariably enthusiastic. However, there is some difficulty in finding Brazilian professors with the desired experience, probably because the existing courses and the professional environment do not provide adequate training. Consequently, it seems that unless we receive support of foreign professors to teach, at least the essential subjects, the newborn program will not survive.

It is also of great importance to define clearly the policy that should guide the organization of graduate programs in transportation not only to avoid uncontrolled proliferation of such programs but also to provide conditions for enrollment of students and for adequate utilization of their qualifications after completion of the program.

RESEARCH

Transportation Research has been almost non-existent. A recent bibliographic search on traffic engineering conducted by the Institute of Bibliography and Documentation (IBBD) could not find a single research report published by a Brazilian organization either public or private. An analysis of this situation probably will indicate the absence of graduate courses as one of the main causes of this deficiency.

It is also well known that government organizations that deal with transportation are not research oriented, and that, in fact, it is rather common to find in these organizations high officials who are even opposed to research.

Obviously, due to the predominant atmosphere in the government and in the University, the private sector could not find favorable conditions to develop research. The very few isolated professionals who show genuine interest in research soon become discouraged by the existing difficulties and completely abandon this type of activity.

Planning for the development of research in the field of Transportation Engineering should include a determination of the needs for research, a survey of the existing human and material capabilities, the identification of present deficiencies, the making of recommendations and the formulation of a realistic program to implement these recommendations.

COORDINATION

Until very recently, transportation planning and studies were almost entirely the responsibility of government agencies that did not encourage the participation of consultants in this type of work. The necessity of obtaining external financing for new projects has made it

necessary for the government to try to use private firms in the feasibility studies as required by the financial agencies.

The present large demand for these studies and the disastrous consequences of the utilization of improvised professionals can cause a sudden reversal in the basically healthy trend of encouraging the development of the private sector as a complement to the government activities in transportation planning and research. Graduate education is of special importance in the correction of the present situation due to its role as a source of qualified personnel particularly adequate to this type of activity.

It is possible to observe today a few isolated efforts which strive towards a better level in the treatment of problems related to transportation. Most of these efforts, however, do not last due to inadequate coordination among universities, government and industry.

It is opportune to mention the transportation studies contracted by the Executive Group for the Integration of Transportation Policy (CEIPOT) with foreign consulting firms that constitute, in the opinion of the International Bank for Reconstruction and Development, one of the largest transportation studies that have ever been contracted by a single entity. In order for these studies to yield the benefits that are being expected, it is of the utmost importance to provide organizations, both in the government and in the private sector, that can absorb and efficiently utilize the enormous amount of data that has been collected. If this is not accomplished in a relatively short time, the studies will soon be of little use except for their historical value. The University, and the Graduate School in particular, play a vital role in this context as a source of qualified personnel specially suitable for the activities of planning and research.

Any future action that may be taken to improve present conditions of transportation in Brazil, should consider the balanced participation of university, government and industry with the purpose of avoiding distortions like, for instance, the uncontrolled proliferation of graduate courses that can cause an imbalance different from the existing one today but which can be just as harmful.

CONCLUSIONS

- Transportation represents an essential element in the development and geographical integration of Brazil.

- COPPE's initiative creating an area of studies in Transportation Engineering on a graduate level is opportune and needs support in the form of foreign professors.

- It is necessary to create, particularly in the government, adequate incentives for graduate studies and research by improving present working

conditions of qualified professionals.

- It is of the utmost importance to guarantee balanced participation of the university, the governmental agencies and industry in the development of transportation. The formation of a study group to investigate the present situation of transportation research, its relationship with graduate education and existing working conditions and to make recommendations aiming at the coordinated improvement of these activities will represent a highly important contribution to the development of Brazil.

Appendix I

TRANSPORTATION ENGINEERING GRADUATE PROGRAM

INTRODUCTION TO TRANSPORTATION ENGINEERING. Operational and technological characteristics of the various transportation systems. Optimization in utilizing the different systems or combination of systems. Elements of planning and design. Data survey and demand studies.

CITY AND REGIONAL PLANNING FOR ENGINEERS. Objectives and scope of comprehensive planning of urban and rural areas. Basic concepts and theories of planning. Methods of analysis and design. Examples of regional and city comprehensive planning and its relationship with transportation engineering.

TRAFFIC ENGINEERING. Analysis of vehicular and human characteristics in traffic streams. Traffic and parking study methods, traffic control, traffic safety.

ADVANCED HIGHWAY PLANNING. Highway and traffic demand studies. Highway capacity. Urban highways. Geometric design, signs, marking and traffic safety.

FEASIBILITY ANALYSIS OF TRANSPORTATION SYSTEMS. Selection and justification of transportation projects criteria for choice of alternatives. Methods of studying financial, economic and technical aspects.

AIR TRANSPORT ENGINEERING. Civil Aviation. Characteristcs of civil transport aircraft. Airspace utilization. Navigational aids. Air Traffic control. The airport and the community. Airport site selection. Airport capacity. Airport design. Terminal facilities for STOL/VTOL aircraft.

The program of study described herein is intended to provide a starting point for further discussions on this matter. Present conditions indicate that a broader program including subjects such as railroads, maritime and river transport is not feasible at the moment. It is the University's intention to incorporate gradually these and other subjects so as to create a center of graduate studies that will offer opportunity

for research in all fields of transportation.

To supplement these programs of study, students can presently choose from several courses in civil, production and other types of engineering programs which are already well-established.

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