FINAL REPORT

BRAZIL - U.S. CHEMISTRY PROGRAM

October 1969 - December 1976

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Introduction and Summary

In October 1969, the National Research Council of Brazil (CNPq) and the U.S. National Academy of Sciences (NAS) initiated an experimental program in postgraduate research and teaching in chemistry in Brazil. The main purpose of the program was to determine whether the growth of advanced research and teaching in chemistry in Brazil could be accelerated through collaborative projects between Brazilian and U.S. chemists. A second purpose was to explore the feasibility of involving eminent U.S. scientists on a part-time basis and younger Ph.D.s full time in a long-term development program.

The program operated as follows: senior Brazilian chemists chose U.S. colleagues with whom they wished to establish a productive cooperative research program based on compatibility of interests and availability of graduate students, instrumentation, and laboratory space. Since it was impossible to attract top-level U.S. senior chemists (who have continuing research programs with large groups of senior colleagues and students at their home institutions) to move to Brazil for long periods, young American Ph.D. chemists (usually from the laboratory of the senior U.S. professor) were selected by the U.S. and Brazilian scientists for assignment to Brazilian universities for two to three years. Their positions in Brazil were equivalent to those of assistant professors in the United States; they conducted specific research projects with Brazilian graduate

students and taught courses in their research area. The senior U.S. professors participated in each project through semiannual visits to Brazil and through continuing communication with their Brazilian counterparts and with the young Americans for whom they were also responsible.

Another aspect of the program was the emphasis placed on training Brazilian doctoral candidates in Brazil, rather than abroad. The reason for this was twofold: 1) in order to train first-class Ph.D.s, the Brazilian institutions needed to modernize their laboratories and equipment; and 2) these upgraded facilities would be conducive to keeping trained Brazilians in Brazil by offering them good research facilities.

The program was truly cooperative. The collaboration included both professors and institutions. The CNPq committed itself to provide fellowships to Brazilian students, purchase necessary equipment and supplies, modernize laboratory facilities, hire a full-time program coordinator, and find a continuous procedure to expedite importation of small amounts of chemicals not available in Brazil. The NAS accepted the responsibility of finding financial resources to cover the travel of NAS professors to Brazil for short visits; stipends and travel for the Fellows (including a three- to four-week orientation trip, approximately six months prior to relocation to Brazil, and scientific meetings in the United States); Portuguese language training in the United States; publication charges for papers written by the NAS Fellows; and salary for a full-time coordinator and secretarial assistance.

After seven years of operation (ending in 1976), the program resulted in the establishment of research groups now in full operation in the following fields:

° At the University of São Paulo in electron scattering, ion cyclotron resonance, photochemistry, organic and inorganic synthesis, and electro-analytical chemistry.

° At the Federal University of Rio de Janeiro in polymers, photochemistry, X-ray crystallography, and biochemistry.

To date, these groups have published over 100 papers in international journals, and twenty-three more have been accepted for publication. Two books have been published, ten papers have been submitted for publication, and twenty-seven papers are in preparation. Program participants have so far been awarded fifty M.S. degrees and sixteen Ph.D.s; one hundred M.S. candidates and thirty Ph.D. candidates are enrolled. The program has also provided substantial assistance to other Brazilian research groups not directly participating in the program in Rio and São Paulo.

Information on activities of the research groups in São Paulo and Rio associated with the CNPq/NAS Joint Program in Chemistry

Period: September 1969 through October 1976

Present Head of Group	Beginning date of group	Location	Degrees Granted		Scientific Personnel Throughout Including Present Members	Papers Published		Papers Presented at Meetings	
			M.Sc.	Ph.D.		National Journals	International Journals	National	International
Ricardo Bicca de Alencastro	9/75	UFRJ	3	—	5	—	2	2	—
Ernesto Giesbrecht	9/69	USP	1	1	7	1	18	30	3
Bruce Kover	9/69	UFRJ	5	3	20	—	—	2	4
Eloisa Biasotto Mano[a]	9/69	UFRJ	27	—	50	5	17	19	6
Eduardo de Almeida Neves	3/73	USP	2	3	13	—	8	20	—
Anita F. Panek	9/74	UFRJ	—	—	15	—	—	1	10
Eduardo M. A. Peixoto	9/69	USP	—	—	11	1	17	25	1
Nicola Petragnani	9 69	USP	11	2	20	1	14	40	4
Vicente Toscano	9/70	USP	—	4	10	—	6	21	1
José Riveros	9/69	USP	1	3	8	3	17	15	5
	TOTAL		50	18	159	11	99	175	34

[a]This group also obtained two patents.

In Retrospect

The timing of the beginning of the chemistry program was a vital factor. The key ingredients for a successful venture of this type were already firmly in place in Brazil: the Brazilian economy was booming; the reorganization of the university structure in Brazil was already decreed; a well structured CNPq/CAPES (Ministry of Education) postgraduate program was already under way; the need to increase investments substantially in science and technology was widely recognized at the highest levels of the Brazilian Government; and the relationship between the CNPq and the NAS had progressed to the point that open and frank discussions could be held regarding the feasibility of the program. In addition, many Brazilians were aware of the necessity of increasing the status and prestige of scientists and engineers in Brazil. The ground was thus well prepared for many necessary changes, such as: increasing Brazilian professors' salaries; increasing Brazilian student fellowships; and more flexible control over the use of research funds.

Furthermore, the U.S. Agency for International Development (USAID) in Brazil advocated the use of science and technology in its programs of assistance to Brazil, and its Mission Director, Mr. William Ellis, encouraged and supported the relationship between the CNPq and the NAS. The USAID Mission sought and made possible a special contractual arrangement with the NAS and CNPq, which allowed the two scientific

institutions to operate the chemistry program without USAID administrative involvement in day-to-day activities.

Many U.S. science organizations and Brazilian agencies such as the Brazilian Ministry of education (CAPES), Federal University of Rio de Janeiro's Postgraduate Program, Brazilian National Development Bank (BND), and the Fund for Special Studies and Projects (FINEP), contributed substantially to the program. In the University of São Paulo, the State's Foundation for the Support of Science (FAPESP) played a decisive role by providing funds not only for a large number of student fellowships but also by equipping a mechanic and electronic shop, purchasing instruments and accessories for the electron, atomic, and molecular beam-scattering laboratory and covering general support for administrative functions. Contributions critical to the initiation and success of the program were received from the U.S. National Science Foundation, the Alfred P. Sloan Foundation, the Atlantic-Richfield Foundation, the Anderson Foundation, the E. I. du Pont de Nemours & Company Incorporated, and the Atlantic Petroleum Company of Brazil.

Brazilian officials in Washington facilitated progress in a number of important ways, including issuing special visas for the NAS Fellows and assisting in transferring materials to Brazil.

The achievements of the program are summarized in the following recommendations of the November 1976 Joint Meeting. A fuller account is provided in the Final Report by U.S. Panel, June 1976 (Appendix iii).

Recommendations of the Joint Meeting of the CNPq/NAS Program in Chemistry Held in São Paulo in November 1976

1. The several projects of the program, after an investment of about 1.5 million dollars on the part of the CNPq and of 1.1 million dollars on the part of American sources, are fully functional with a total of about 100 graduate students and researchers actively engaged in their scientific and technological investigations. To protect the capital and efforts already invested and to produce the desired result of training of personnel at a level of international competence of the highest caliber it is essential that this research should continue. We therefore emphatically recommend that the CNPq should furnish to the different projects, for this new phase of those activities, annual funding for the upkeep of the research on the same order of magnitude of that which was allotted in 1976. This represents a minimum additional investment necessary to protect the initial investment, guarantee a satisfactory yield, and avoid the waste that could result if these funds were not made available. This recommendation is based on the principles adopted during the July 1976 meeting in Rio de Janeiro by the "Consulting Committee" of the cooperative CNPq/NAS program and approved by the Scientific Advisory Board of the CNPq.

2. The interaction between scientists at a national and international level is vital to the performance of research, and strong

scientific bonds were established during the lifetime of the present program. We recommend that resources be allocated for the continuation of this interaction in the form of bilateral visits of researchers for the program. The American professors who participated in the CNPq/NAS program have already expressed (during their March 1976 meeting in Pasadena, California) their firm support for this recommendation and have made themselves available for this interchange.

3. It is still too early to assess the total impact of the program on the Brazilian scene. This assessment can better be done two or three years from now, when the current activities will reach their optimal yield. Such an assessment should indicate that the relatively small amount of resources recommended above should have a very large cost-effectiveness, as a result of the high return on the resources invested. We recommend that an assessment of this kind be made.

4. In some of the projects, conditions may exist to permit a partial funding of their work through specific bilateral agreements with foreign agencies, which could reduce the Brazilian cost of these programs. We recommend that the pursuit of such agreements be encouraged.

Appendix i

Current List of Brazilian and NAS Panelists

Brazilian Panelists

Rio de Janeiro

Professora Eloisa Mano (Chairman), Instituto de Macromoléculas Universidade Federal do Rio de Janeiro

Professor Ricardo Bicca de Alencastro, Director, Instituto de Química, Universidade Federal do Rio de Janeiro

Professor W. Bruce Kover, Instituto de Química, Universidade Federal do Rio de Janeiro

Dr. Manoel da Frota Moreira, Consultoria Científica, Conselho Nacional de Desenvolvimento Cientifico e Tecnologico

Professor Walter B. Mors, Centro de Pesquisas de Produtos Naturais, Universidade Federal do Rio de Janeiro

Professora Anita Panek, Departmento de Bioquímica, Instituto de Química, Universidade Federal do Rio de Janeiro

Professor Peter Rudolf Seidl, Seçao de Química, Instituto Militar de Engenharia

Dr. David Tabak, Instituto de Macromoléculas, Universidade Federal do Rio de Janeiro

São Paulo

Professor Paschoal Senise (chairman), Instituto de Química, Universidade de São Paulo

Professor Ernesto Giesbrecht, Instituto de Química, Universidade de São Paulo

Professor Simão Mathias, Instituto de Química, Universidade de São Paulo

Professor Eduardo Neves, Instituto de Química, Universidade de São Paulo

Professor Eduardo M. A. Peixoto, Instituto de Química, Universidade de São Paulo

Professor Nicola Petragnani, Instituto de Química, Universidade de São Paulo

Professor José Riveros, Instituto de Química, Universidade de São Paulo

Professor Vicente G. Toscano, Instituto de Química, Universidade de São Paulo

Brazilian Program Coordinator

Dr. Attila Alberto Jancso, Bilateral Cooperation Coordinator, Conselho Nacional de Desenvolvimento Cientifico e Tecnologico

NAS Panelists

Professor Aron Kuppermann (Chairman), Division of Chemistry and Chemical Engineering, California Institute of Technology

Professor Fred C. Anson, Division of Chemistry and Chemical Engineering, California Institute of Technology

Professor John D. Baldeschwieler, Division of Chemistry and Chemical Engineering, California Institute of Technology

Professor Russell A. Bonham, Department of Chemistry, Indiana University

Professor Michel Boudart, Department of Chemical Engineering, Stanford University

Professor Harry B. Gray, Department of Chemistry, California Institute of Technology

Professor William S. Johnson, Department of Chemistry, Stanford University

Mr. Robert N. Kreidler, Executive Vice President, Alfred P. Sloan Foundation

Professor James A. Marshall, Department of Chemistry, Northwestern University

Dr. George S. Menger-Hammond, Merrill College, University of California at Santa Cruz

Professor Charles G. Overberger, Vice President for Research, The University of Michigan

Professor Sten Samson, Department of Chemistry, California Institute of Technology

Professor Henry Taube, Department of Chemistry, Stanford University

Professor Ernest Wenkert, Department of Chemistry, Rice University

NAS Program Coordinator

Mr. B. K. Wesley Copeland, Board on Science and Technology for International Development, Commission on International Relations, National Academy of Sciences

Appendix ii

List of U.S. Panelists - 1969-1976

Professor Fred C. Anson, Division of Chemistry and Chemical Engineering, California Institute of Technology
September 1974--76

Professor John D. Baldeschwieler, Division of Chemistry and Chemical Engineering, California Institute of Technology
1969--76

Professor Russell A. Bonham, Department of Chemistry, Indiana University
April 1970--76

Professor Michel Boudart, Department of Chemical Engineering, Stanford University
December 1971--76

Professor Carl Djerassi, Department of Chemistry, Stanford University
1969 - Dec. 1975; Chairman 1969-72.

Professor Harry B. Gray, Department of Chemistry, California Institute of Technology
1969--76

Professor Robert E. Ireland, Department of Chemistry, California Institute of Technology
1969 - March 1975

Professor William S. Johnson, Department of Chemistry, Stanford University
1969--76

Mr. Robert N. Kreidler, Executive Vice President, Alfred P. Sloan Foundation
1969--76

Professor Aron Kuppermann, Division of Chemistry and Chemical Engineering, California Institute of Technology
1969-76; Chairman 1973-76.

Professor James A. Marshall, Department of Chemistry, Northwestern University
December 1971--76

Professor George S. Menger-Hammond, Merrill College, University of California at Santa Cruz, and Foreign Secretary, National Academy of Sciences
1969--76

Professor Charles G. Overberger, Vice President for Research, The University of Michigan
1969--76

Professor Sten Samson, Department of Chemistry, California Institute of Technology
March 1975--76

Professor Henry Taube, Department of Chemistry, Stanford University
1969--76

Professor Ernest Wenkert, Department of Chemistry, Rice University
September 1975--76

Appendix iii

Final Report by U.S. Panel, June 1976

1. Background

In 1965 some members of the U.S. National Academy of Sciences (NAS) Latin America Science Board (LASB) met in Brazil with representatives of the CNPq (at that time the Conselho Nacional de Pesquisas, which has since been restructured into the Conselho Nacional de Desenvolvimento Cientifico e Tecnologico while retaining the CNPq acronym) to discuss possible areas of cooperation. As a result of this meeting the first of a series of CNPq/NAS workshops was organized on the Contribution of Science and Technology to Development, held in Brazil in April 1966. The second workshop occurred in Washington, D. C. in February 1968 to review joint study programs initiated during the first workshop and to hold a panel discussion on U.S. and Brazilian science policies. In this discussion, chemistry was identified as an area requiring improvement. Dr. Antonio Couceiro, then President of the CNPq, characterized chemistry as the Achilles heel of Brazilian scientific development. Its importance for physics, geology, biology, medicine, agriculture and for industrial development was emphasized. This led to a recommendation for the establishment of a joint CNPq/NAS Committee on Chemistry in Brazil and Dr. Couceiro asked Dr. Carl Djerassi, Professor of Organic Chemistry at Stanford University and Chairman of the LASB,

to help organize such a committee. Djerassi put forward the basic premise that a program sponsored by a committee of this kind should aim at the implantation of areas of chemical graduate education and research at sufficiently high levels to produce scientists whose professional qualifications could match those in the advanced world. This principle received general support and it was jointly decided that to maximize the chances of success, this new program should be located in places which had reasonably sound undergraduate programs in chemistry and had already taken some steps towards the establishment of graduate programs. It was jointly decided that the Universidade de São Paulo (USP) and the Universidade Federal do Rio de Janeiro (UFRJ) most closely satisfied those criteria. Furthermore, those areas of chemistry in which the needs were greatest were identified by the Brazilians and a list of possible American participants was prepared by them. It is important to stress that not only the request for cooperation and the choice of areas of cooperation were done by the Brazilians, but even the list of potential American participants, based on scientific reputation, was prepared by them, in consultation with Djerassi. This amounted to a strong mandate and was instrumental in helping him convince his American colleagues to join the program.

2. Basic Concept

The problem of how to rapidly implant or improve a graduate education and research capability in a developing country is not an easy one to solve. Several approaches have been tried at different times and places in the past. A common one has been to establish an extensive

fellowship program for the graduate training abroad of scientists. By itself, this approach has usually resulted in disappointing failures. The individuals thereby trained, upon returning home, would find the local conditions inadequate for the utilization of their training, and felt powerless to change by themselves the local organizational structure and working conditions. A second approach has been to invite visiting foreign professors to help implant new programs and a new scientific spirit. This requires extensive periods of stay, of several years, of the foreign participants away from their own country and professional activities, something which most highly active scientists find very undesirable if not unacceptable. This mechanism introduces a bias against the participation by the most prominent and qualified individuals. A third concept was proposed by Djerassi, which could overcome these difficulties. The highest quality foreign professors would be invited to participate in a collective program by implanting research groups in the country in question. This they would do with the help of young Ph.D.s of their choice, whom they would either have trained or with whom they would have strongly interacted. These Ph.D.s would go to the developing ocuntry for a period of several years and implant the research program somewhat as a junior faculty member would do in the United States, and would also initiate the teaching of graduate courses. The senior foreign professor would maintain strong ties with the new program by a few visits per year to the host country and would help maintain the continuity of the program at the time of replacement of the resident young American by another one. As an integral and essential part of this concept, for each component of such a project

in the host country, there should be the participation of a senior professor of that country who would be strongly committed to it and willing to give it the administrative and, where appropriate, scientific support essential for a successful implantation of this new area of research. Djerassi had arrived at this concept as a result of extensive prior experience in Mexico and Brazil, and the CNPq agreed to adopt it in the joint venture in chemistry being contemplated.

It was envisaged that approximately five new research groups at USP and another five at UFRJ would be established, and that they would last for a period of between five and ten years. With one American Ph.D., one Brazilian professor, and several graduate students per group, there would be a total of about 30 people involved in the overall program in each one of these two locations. It was hoped that this would constitute a critical mass, and that after five to ten years the corresponding laboratories would be well established and enough Brazilian Ph.D.s would have been trained to permit a natural continuation of the research efforts and a withdrawal of the American participation.

3. Implementation

The plans, as formulated, involved joint sponsorship by the NAS and the CNPq and bilateral funding. Such funding, for a period of five years was secured. The total U.S. expenditures to date were approximately $1.1 million and came mainly from the Agency for International Development, with additional contributions from the Alfred P. Sloan Foundation, the National Science Foundation, the E. I. du Pont de Nemours & Company, Incorporated, the Anderson Foundation, the Atlantic-Richfield Foundation and the Atlantic Petroleum Company of Brazil. The contributions from private sources were extremely useful as they

constituted in part seed money which helped catalyze the availability of the large amounts of Federal Funds. Furthermore, the flexibility in their use constituted an important asset. The U.S. funds were used mainly to pay the salaries and travel expenses of the American Ph.D.s who received the title of NAS Overseas Research Fellows, and for the expenses associated with the visits to Brazil of the senior American participants and other visiting foreign lecturers. Our guess of the Brazilian cost is approximately $1.5 million used mainly to purchase capital equipment and research materials and supplies.

Djerassi and Dr. Manoel da Frota Moreira, Scientific Director of the CNPq, organized a meeting for August 1968 in Rio and São Paulo. It included the following American professors, who were potential participants in the cooperative program: John D. Baldeschwieler, Carl Djerassi, William S. Johnson, and Henry Taube of Stanford; Harry B. Gray, George S. Hammond, Robert E. Ireland, and Aron Kuppermann of Caltech, and Charles G. Overberger of the University of Michigan. In addition, Dr. Victor Rabinowitch of the NAS and Robert N. Kreidler of the Alfred P. Sloan Foundation participated in this meeting. The Brazilian representation at the meeting was: Professors Marcelo Moura Campos, Bernardo Geisel, Eloisa B. Mano, Simão Mathias, Walter Mors, Claudio Costa Neto, Paschoal Americo Senise and Ernesto Tolmasquim. After their return to the United States, the American contingent held a meeting at Stanford and a unanimous decision was reached to initiate the cooperative venture in the fall of 1969 with Djerassi as chairman of the U.S. panel. Joint programs were established in Rio in Inorganic Chemistry, Photochemistry, and Polymer Chemistry and in São Paulo in Synthetic Organic Chemistry,

Inorganic Chemistry, Photochemistry, and Physical Chemistry. The American panel was later joined by Professors Fred C. Anson and Sten Samson of Caltech, Russell Bonham of Indiana University, James A. Marshall of Northwestern University, and Ernest Wenkert of Rice University. Professors Eloisa Biasotto Mano and Paschoal Senise were the Brazilian Chairman for the programs in Rio and São Paulo, respectively.

A joint meeting of the American and Brazilian participants of the program was held in Rio in November 1973, four years after its inception. By then, the President of the CNPq was General Arthur Mascarenhas Façanha and its Scientific Director continued to be Dr. Manoel da Frota Moreira. Both continued to give competent, enthusiastic and vigorous support to the program. An assessment of the progress up to that time was made, and it was jointly decided that a two-year extension beyond the initial five-year schedule was needed to fulfill its objectives. It turned out not to be possible to get significant additional funding for that augmented period from American sources, and as a result the CNPq, now under the presidency of João Dion de Melo Teles, agreed to accept responsibility for all those expenditures which it legally could, and which amounted to about 95 percent of the additional cost of the last two years of the program. This commitment can be considered as a measure of the Brazilian interest in the venture and in its success. The chairmanship of the American panel was assumed in early 1973 by Aron Kuppermann. The NAS program coordinator since the program's inception was Mr. B. K. Wesley Copeland.

4. Overview of Accomplishments

A brief overview of the accomplishments of each project follows. Not all research programs were initiated simultaneously and this should be taken into account when comparing their achievements.

4.1. Inorganic Chemistry, São Paulo

The senior participants were Professors Henry Taube (Stanford) and Ernesto Giesbrecht (USP) and the American Fellows were Drs. John Malin (70-73) and Edward Dockal (73-75). This project is an ideal model since it satisfied all of the criteria deemed desirable for its potential success and therefore for the testing of the Djerassi concept. Professor Giesbrecht gave the program very strong administrative support. Six graduate students are being or have been trained in it; one obtained a Ph.D. and one an M.Sc. A third completed all the requirements for her Ph.D. degree but died in an accident before the final defense of her finished thesis. The other three students are Ph.D. candidates. New areas of research on the kinetics and mechanism of reactions of compounds of cobalt, ruthenium, vanadium, osmium, and iron were established, using a wide variety of modern experimental techniques. From this work, 12 publications in international journals have resulted so far. A graduate course on Mechanisms of Inorganic Reactions in Solution was taught twice by Dr. Malin in Portuguese, to about 20 students each time. The first Brazilian Ph.D. emerging from this program, Dr. Henrique Toma, is now a member of the academic staff of the USP and is unofficially guiding the research of new graduate students. At present, there are no American Fellows in this project, things are running well, and the goal of self-sufficiency for the Brazilians has been attained in six years in this instance. Furthermore, there is appreciable interaction between Henrique Toma and Eduardo Neves (see section 4.6), which is a highly desirable kind of byproduct of the program.

4.2. Ion-Cyclotron Resonance Mass Spectrometry (Physical Chemistry) São Paulo

The senior participants were Professors John D. Baldeschwieler (initially from Stanford and now at Caltech) and José Riveros (USP), and the American Fellows were Drs. Larry (Blair (70-71) and Patrick Jones (71-73). Seven graduate students joined the group, two of whom have obtained their degrees and become assistant professors (at USP) and one who has obtained an M.Sc. and is continuing work for the Ph.D. Of the other four, three are Ph.D. candidates and one has given up. Thirteen publications on the work of this group, on ion-molecule reactions done with a sophisticated Varian ion-cyclotron-resonance mass spectrometer, have appeared in international journals. The role of the American Fellows, although useful, was not central to the success of this program. Although Dr. Riveros, a young, high-quality, Harvard-trained Ph.D., took the leadership in establishing this program from its initiation, the role of the American Fellows was important in establishing the basic research objectives of the program.

4.3. Photochemistry, São Paulo

The senior participants were Professors George S. Hammond (initially from Caltech and later at the University of California at Santa Cruz and Foreign Secretary of the NAS) and Vicente Toscano (USP) and the American Fellows were Drs. Richard Weiss (71-74) and Frank Quina (75-77). Nine graduate students have participated in this program, one of whom obtained her Ph.D. while six of the others are still working towards their degrees. This project was slow in starting, due to the initial unavailability of a senior Brazilian partner. Studies in organic photochemistry were initiated, and six publications have since appeared in international journals. Due

to its late start, the project is not yet self sufficient, depending on the active participation of an American Fellow.

4.4. Synthetic Organic Chemistry, São Paulo

The senior participants were Professors William S. Johnson (Stanford), Robert Ireland (Caltech)*, James A. Marshall (Northwestern), Marcelo Moura Campos (USP) and Nicola Petragnani (USP), and the NAS Fellows were Drs. Simon Campbell (69-72), Robert Ronald (70-72), Thomas Meteyer (72-74), and Timothy Brocksom (72-75). Sixteen graduate students have been involved with this program, of whom one has obtained a Ph.D., another eleven an M.Sc., and the others are working towards a graduate degree. Three of the people who obtained an M.Sc. are continuing towards a Ph.D. An appropriate research laboratory was set up and equipped. Six papers have appeared in international journals. Dr. Brocksom, the NAS Fellow, settled permanently in Brazil which should help the project acquire continuity and self-sufficiency.

4.5. Atomic and Molecular Dynamics (Physical Chemistry), São Paulo

The senior participants were Professors Russell Bonham (Indiana University), Aron Kuppermann (Caltech), Simão Mathias (USP), and Eduardo M. A. Peixoto (USP). Professor Peixoto is a young man who obtained his Ph.D. at Indiana University with Professor Bonham, and it was deemed unnecesary and even undesirable to arrange for an NAS Fellow to join this group. Six graduate students are being trained in it, none of whom have received graduate degrees as yet. Seven publications have appeared in international journals. It was decided by the senior participants to undertake the construction, in São Paulo, of an electron scattering apparatus. This was done in order to assess the feasibility of building, in Brazil, modern experimental equipment, something essential for the development of new

*Professor Ernest Wenkert (Rice University) succeeded Professor Ireland.

areas of physico-chemical research. This slowed down the progress of the project, but it eventually was successful. This group now has the capability of designing, constucting, and operating sophisticated instrumentation. It has attained self-sufficiency and continuity.

4.6. Electroanalytical Chemistry, São Paulo

This is the most recent São Paulo project. It was started in early 1973 with Professors Fred Anson (Caltech) and Eduardo de Almeida Neves (USP) as senior participants. Professor Neves, prior to that, had spent one and a half years in Professor Anson's laboratory at Caltech and this resulted in a close cooperation between the two, obviating the necessity of an NAS Fellow. Eight graduate students have been involved in the work of this project, two of whom, who had been graduate students since 1971, have obtained degrees (one Ph.D. and one M.Sc.). A good electroanalytical laboratory has been developed and six papers have appeared in international journals. In spite of its youth, this program has already attained self-sufficiency and continuity.

4.7. Photochemistry, Rio

The senior participants were Professors George Hammond (Caltech and the University of California, Santa Cruz) and W. Bruce Kover (UFRJ), and the NAS Fellows were Drs. David Mog (70-73) and David E. Nicodem (72-75). Seven graduate students have been involved in this program, of whom one has obtained a Ph.D. and one an M.Sc. In addition, nine undergraduate students are presently doing research in the group. The infrastructure at the UFRJ made the establishment of this research group rather difficult and slow. However, it was accomplished, and a functioning organic photochemistry lab in Rio does exist. It has not yet generated any publications in international journals, but these should be forthcoming. It is,

however, training Brazilian graduate students, and would not have been established in the absence of the cooperative program. Its continuity and self-sufficiency are, however, not yet established.

4.8. Inorganic Chemistry - X-ray Crystallography (Rio)

The senior participants were Professors Harry Gray (Caltech), Henry Taube (Stanford), Sten Samson (Caltech), Jacques Danon (CBPF), Vicente Gentil (UFRJ), and Aida Espinola (UFRJ), and the NAS Fellows were Drs. Michael Flood (69-73), Diane Gutterman (70-72), and Ray Harrigan (70-72). The project lacked from the beginning an interested senior Brazilian participant associated with the UFRJ. The project was terminated in 1973, but some positive results were obtained. As a consequence of considerable personal initiative and tact Harrigan was able to initiate a small program in inorganic photochemistry involving two students. After his return to the United States he completed one of the projects begun in Brazil and the results have been published. One student obtained an M.Sc., an automatic x-ray diffractometer was acquired and recently made operational due to the strong efforts of Dr. Sten Samson (Caltech), a student was trained at Caltech to operate it, and a young Brazilian professor, Ricardo Bicca de Alencastro (UFRJ), is setting up a program for its utilization. At Caltech Drs. Gretchen and Neil Mandel have put the computer software programs in operation, which gives the project the ability to solve x-ray structures of small molecules.

4.9. Polymer Chemistry, Rio

The senior participants were Professors Charles Overberger (Michigan) and Eloisa B. Mano (UFRJ), and the NAS Fellow was Dr. Robert F. Tarvin (72-74). In addition, two young Brazilians, Drs. Ailton de Souza Gomes,

and David Tabak, who obtained their Ph.D.s in the United States, participated actively in the project. A new polymer chemistry laboratory, designated NUMA (Nucleo Macromolécular) was established. About 30 graduate students have been or are associated with it, and 17 have obtained M.Sc. degrees. Currently there are seven Ph.D. candidates in the program. Six of the M.Sc. graduates have been hired by PETROBRAS; three of the others returned to their original institutes. Technological research in the group involves today 34 industrial projects completed or under way, some of which have no sponsors. About nineteen publications have appeared or are in press in international journals. It has become a major operation and a new building to house it is being constructed at the UFRJ campus on Fundão Island. The NAS Fellow played a small role in its development, mainly because a scientifically active and interested senior Brazilian was involved and needed only the material and intellectual support to proceed.

4.10. Biochemistry, Rio

This is the most recent project in the chemistry program, having started less than a year ago. The senior Brazilian scientist was Dr. Anita F. Panek (UFRJ). Dr. James R. Mattoon (Johns Hopkins University) was the senior U.S. scientist/NAS Fellow (75-77). Projects involving porphyrin biochemistry and mitochondria and a study of the biosynthesis of citrochrome oxidase have been initiated. Six graduate students are working in the group. This project gives signs of vigor and rapid development.

4.11. Other Activities

One of the byproducts of the program has been to establish an interaction among Professor Michel Boudart and PETROBRAS, IME, Professor

Claudio Costa Neto, and Professor Ricardo Bicca de Alencastro. As a result of these several interactions, a program in heterogeneous catalysis seems to be taking shape in Rio, although not under the umbrella of the CNPq/NAS program.

5. Discussion

The NAS/CNPq cooperative program for the development of graduate research and education in chemistry at the Universidade de São Paulo and the Universidade Federal do Rio de Janeiro was strongly based on the Djerassi concept. According to it, a number of groups are set up consisting of the following elements: (a) a scientifically active, high-quality foreign professor; a young, high-quality NAS Fellow whose Ph.D. was obtained under that professor or who has strongly interacted with him; (c) a senior local professor, preferably active scientifically, very interested in the future of the project, and capable and willing to give strong administrative (and, when appropriate, scientific) support to the NAS Fellow, even at a significant cost in time and effort; and (d) a number of graduate students who are the primary target of the graduate training program, and who spend full time doing research and taking graduate courses. Enough such groups should exist at any one time to create a critical mass capable of maintaining enthusiasm, an interactive and progressive scientific environment, and forward momentum. Periodic visits by the senior foreign professors and other visiting lecturers should occur in order to increase interaction with the international scientific community.

The present NAS/CNPq program has thoroughly tested this concept, verified the basic validity of its premises, located some of its weak

points, and indicated ways to improve it in future programs. The conclusions are given below.

a) The Senior Foreign Professor. He plays a vital role in the program and in ascertaining its continuity. He must maintain an active and continuous interest in the project which manifests itself not only through frequent visits to the host country but also through fairly constant correspondence with his colleagues in the developing country (the Fellow and local professor) on scientific and administrative matters.

b) The Young NAS Fellow. The existence of this Fellow is essential when there is no local scientist trained, available, and willing to play a personal and direct role in getting the new program implanted. The Fellow must be highly qualified scientifically and very adaptable personally. He must derive satisfaction in contributing to the progress of a developing country and realize that his own rate of scientific progress is apt to be significantly slowed down. He must be able and willing to become rapidly fluent in a foreign language and to adapt to different cultural attitudes and backgrounds. He should preferably be single, but, if married, his wife should have similar adaptability qualities. It is also essential that the Fellow should either have received his doctoral training under the foreign professor or have spent enough time thereafter in the latter's laboratory in order to be able and willing to carry on a research program of mutual interest. Without this characteristic it is difficult for a strong scientific interaction to be maintained among the two and, when the time comes for the Fellow to be replaced by another one, to maintain scientific

continuity. He must nevertheless be given a high degree of autonomy in the conduct of the scientific affairs of his research group and be permitted to organize and to teach graduate courses. Last, but not least, it is extremely important that the choice of the Fellow be made jointly by the foreign and local senior professors. A weakness of the concept is the difficulty of ascertaining scientific continuity of the ongoing research projects upon changeover from one Fellow to another.

c) The Senior Local Professor. This individual plays an essential role in the success of the program. There is an added advantage if he is scientifically active in parallel research projects of his own, which will be strengthened as a result of the implantation of the interaction with the cooperative project being established. Even if not active scientifically, he must be interested in the success of the program to a sufficient degree to devote the time necessary to help the NAS Fellow overcome whatever administrative or bureaucratic barriers that are apt to appear in his pathway. He must also be sufficiently well established at his local university to be effective in this role. Under certain circumstances, the NAS Fellow and the senior local professor may be combined into a single individual, as has happened in the two physical chemistry projects in São Paulo. In both cases, the Brazilian participant was a young, U.S.-trained Ph.D. They had not yet established research groups or projects of their own, but were willing and able to do so, and were very receptive to and interested in a cooperative venture which would furnish them with the necessary means to accomplish their goals.

Such a situation has both advantages and disadvantages, and its departure from the NAS Fellow model must be recognized and handled appropriately. First, there is a diminished role and need for a NAS Fellow as a participant in the group organized by the young local scientist. Such a Fellow may have to play a less autonomous role and may in fact be in direct conflict with his local counterpart in terms of competition for prestige, graduate students, equipment, and financial resources. Under these circumstances, NAS Fellows should not participate in such individual programs, but instead the young local scientist should be given equivalent support by the collective program, both in terms of resources and scientific interaction with the foreign professor. An inherent difficulty appears under these conditions. The young Brazilians were, in this case, not well established and therefore less able to handle local bureaucratic problems. To alleviate such a difficulty it is important that the local chairman of the program take special pains to help such participants. It was extremely fortunate for the program that in this instance a chairman of this caliber did indeed exist in the form of Professor Paschoal Senise. As a result, both of those physical chemistry projects succeeded. A similar situation existed in Rio, involving a senior rather than a junior Brazilian scientist, Professor Eloisa B. Mano, an extremely energetic and dedicated person. She was already a full professor, well-established, and ready and eager to start a polymer chemistry project. She was also the chairman of the CNPq/NAS program for Rio. In her case, the project would have succeeded even without a NAS Fellow. Therefore, the concept of a NAS Fellow must be generalized to take into account such variations. It is actually very advantageous for the host country to encourage cases of this type, since

the scientists involved are local and will remain in the host country. To inject a NAS Fellow who will eventually be replaced by somebody local is an unnecessarily long route under these special circumstances. Avoiding NAS Fellows in these cases also circumvents the problem of securing scientific continuity upon replacement of one Fellow by another.

d) Graduate Students. It is centrally important that special efforts be made to rapidly recruit high quality graduate students into a cooperative venture of this kind, since they are the central target of the program. In addition, without them the initiation process is much slower and less rewarding. It should be kept in mind that there may be a strong competition with industry for good students, making it difficult for the latter to complete their graduate studies before being lured away by a high-paying job.

The degree of success of each of the projects of the program correlated strikingly well with the degree of fulfillment of the above criteria. In addition to these comments on the basic concept of the program, the following remarks should be made.

1. Rapid importation of chemicals and small equipment replacement parts is a vital ingredient for success. Despite numerous attempts, this problem was only temporarily solved via a special mechanism involving the Brazilian Embassy in Washington, the Brazilian Air Force, and the good offices of the National Academy of Sciences. When the program ends in December 1976, this mechanism is likely to become unavailable and it is very important that means be found by the Brazilians to solve this serious problem.

2. Basic support facilities, including machine, electronic, and glassblowing shops, stockrooms, and secretarial and other administrative backup help are important and should be explicitly discussed at the inception of any new venture of this kind.

3. The concept that in addition to the initial capital investment there are systematic maintenance and upgrading costs associated with modern research equipment was a difficult one to introduce. Similarly, the concept that there are significant costs of expendables and supplies associated with the day-to-day operation of any research group, with the cost per capita being approximately constant within a group as the size of the group increases, was also difficult to introduce. Finally, the frequency at which funds for such costs were received by the various projects was not constant and interfered appreciably with the orderly operation and planning of the several groups. In any future venture, the importance of these points must be stressed and specific commitments on both sides made to avoid the problems resulting from the lack of realization of their significance.

4. It should be ascertained that the salary commitments to NAS Fellows be met promptly since they are entirely dependent on these funds for their financial solvency and do not have a local extended family to resort to at times of financial crisis. The problems associated with their visas and importation of personal belongings should also be tackled at the early stages of discussion of new programs to avoid an unnecessary and excessive diversion of the Fellow's efforts away from his scientific responsibilities.

5. The role of visiting lecturers,* and the other participating foreign professors, is an important one in establishing scientific intercourse with the international scientific community. Equally important is the travel abroad of young local scientists to international meetings and for visits to other laboratories, after they have reached a level of training which makes these travels profitable. In addition, stimulating travel within the host country by the young local scientists to speak about their research project and results is also highly desirable.

6. As local students complete their graduate or postdoctoral training and become ready to initiate research groups of their own, they should receive support from the host country's research support organizations. This might take the form, for example, of allowing them to transfer specialized research equipment which they have used to their new location and giving the means to the senior local professor with whom they have worked to replace this equipment with a more up-to-date version of it or with different kinds of equipment if he wishes to change the direction of his research. In other cases the recent graduates should be given funds to build or to acquire their equipment.

7. After the program terminates in December 1976, there will still be many students in the "pipeline". They will need continued support, not only in the form of stipends but also in the form of research support. It should be realized that a large investment by the CNPq has been made in setting up the various research groups, and that it is essential that these groups continue to be supported for this investment not to be lost.

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*See Appendix iv.

8. The problem of finding adequate jobs for the returning NAS Fellows is a serious one and deserves special attention. It is highly desirable for funds to be available for them to spend up to one year in the laboratory of the senior foreign professor with whom they had been associated. From this location they can effectively institute a search for jobs with the professor's aid. We have found that it was very difficult for the NAS Fellows to find positions in the United States while based in Brazil. In several cases, only after they had been back for many months did they find such positions.

9. On occasion, misunderstanding and sometimes delay of the work occured because American participants, both professors and Fellows, did not understand the different structure of the two Brazilian universities and the support system of the country. This kind of problem is probably unavoidable because a foreigner can never really learn entirely the characteristics of the institutions of another country without long study. These problems may be minimized by recognizing their inevitability and anticipating the need for ad hoc adaptive procedures.

10. An interesting byproduct of programs of this type is that they tend to catalyze an evolution in the administration of scientific research in the country concerned as well as in the foreign agencies involved in international programs. This tends to facilitate future research efforts of a national or international character.

Appendix iv

Visiting Lecturers - September 1971-June 1976

A new element, visiting lectures by eminent U.S. chemists not in the bilateral program, was added to the program the latter part of 1971. The five major objectives of these visits were:

1. To increase the numbers and points of contact between Brazil and the United States;

2. To broaden the knowledge and interest of program participants, Brazilian students, and others at the universities in areas other than their own discipline;

3. To decrease the feeling of scientific isolation among the scientists in the program in Brazil;

4. To provide up-to-date information on research in a particular discipline; and

5. To provide information that may give guidance to the future administration of the program.

Lecturer/Affiliation/Date of Visit

Dr. Herbert Morawetz, Polytechnic Institute of Brooklyn, September 21-23, 1971

Dr. Dale Margerum, Purdue University, July 23 - 6 August, 1972

*Dr. Sten Samson, California Institute of Technology, October 15 - November 3, 1972

Dr. Hermann F. Wellenstein, Indiana University, December 6 - 20, 1972

*Subsequently became a senior U.S. scientist in a program project.

Dr. John Stille, University of Iowa, March 9 - 24, 1973

Dr. Vincent McKoy, California Institute of Technology, March 23 - April 2, 1973

Dr. Stephen Berry, University of Chicago, April 19 - May 6, 1973

Dr. George H. Buchi, Massachusetts Institute of Technology, June 11 - 15, 1973

*Dr. Fred Anson, California Institute of Technology, October 21 - 31, 1973

Dr. Harry Morrison, Purdue University, November 20 - 27, 1973

Dr. William Dauben, University of California at Berkeley, November 28 - December 5, 1973

Dr. Paul J. Kropp, University of North Carolina at Chapel Hill, December 3 - 8, 1973

**Dr. John M. Malin, University of Missouri, May 14 - 28, 1974

Dr. Eugene E. van Tamelen, Stanford University, September 15 - 21, 1974

**Dr. John M. Malin, University of Missouri, September 1975

Dr. Angelo Lamola, Bell Laboratories (New Jersey), November 10 - 21, 1975

Dr. Roger S. Porter, University of Massachusetts, November 15 - 22, 1975

Dr. Neil Mandel, California Institute of Technology, May - June 1976

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*Subsequently became a senior U.S. scientist in a program project.

**Formerly a NAS Overseas Research Fellow.

Appendix v

List of Publications

Blair, Larry K.; Paulo Celso Isolani; and José M. Riveros. 1973. Formation, reactivity, and relative stability of clustered alkoxide ions by ion cyclotron resonance spectroscopy. Journal of the American Chemical Society. 95:1057-1060.

Bonham, R. A. 1974. Coupling to the elastic channel in electron impact spectroscopy: a simple second born model and its application to excitation of the 6^1P_1 state of mercury and to the excitation of molecules. Journal of Electron Spectroscopy and Related Phenomena. 3:85-106.

Bonham, R. A. 1974. On the convergence of the method of moments for obtaining vibrational averages. Ciência e Cultura. 26:19:884-887.

Bonham, Russell A., and Eduardo M. A. Peixoto. 1972. Intramolecular multiple scattering in gas-phase electron diffraction: some model calculations. Journal of Chemical Physics. 56:5:2377-2384.

Brauman, J. I.; José M. Riveros; and Larry K. Blair. 1971. Gas-phase basicities of amines. Journal of the American Chemical Society. 93:3914.

Briscese, Sonia Maria J., and José M. Riveros. 1975. Gas phase nucleophilic reactions of aromatic systems. Journal of the American Chemical Society. 97:1:230-231.

Briscese, S. M. J.; L. K. Blair; and J. M. Riveros. 1974. Fluoride affinity of simple carbonium ions. Anais da Academia Brasileira de Ciências. 45:no prelo.

Brocksom, Timothy J.; Rui Rodrigues; and Nicola Petragnani. 1974. Ester enolates: a new preparation of malonates, phosphonoacetates, α-selenyl and sulfinyl esters. Journal of Organic Chemistry. 39:2114-2116.

Brocksom, Timothy J.; Nicola Petragnani; Rui Rodrigues; and H. La Scala Teixeira. 1975. Ester enolates II. The preparation of di- and tetra-substituted succinate esters. Synthesis. 396.

Campbell, Simon F.; M. G. Constantino; Timothy J. Brocksom; and Nicola Petragnani. 1975. An approach to the synthesis of bakkenolide A. Synthetic Communications. 5:5.

Campbell, Simon Fraser; Romero, J. R.; Petragnani, N.; Brocksom. T. J. 1976. An approach to the generation of a new reactive intermediate: 4,5-dehydrocycloheptatriene. Ciência e Cultura. 28:11:1337-1341.

Chum, Helena Li; E. R. Dockal; and T. Rabokai. 1975. Electrochemistry of organometallic compounds. I. Cyclic voltammetry of organo-cobaloximes in aqueous acid solutions. Journal of Electroanalytical Chemistry. 63:197-205.

Coelho, Augusto Liete. 1973. Sintese e caracterizacao dos haletos de diacidobis(etilenodiamina)osmio(III). Unpublished Masters thesis, Universidade de São Paulo.

da Silva, Roberto T.; Vicente G. Toscano; and Richard G. Weiss. 1973. Photolysis of triphenyl-phosphinebenzoylmethylene. Chemical Communications. The Chemical Society. 16:567-568.

de Souza Gomes, Ailton, and Odyr do Couto Filho. 1972. Studies on the cationic polymerization of indene initiated by methyl ethyl ketone peroxide in liquid sulfur dioxide. Polymer Letters. 10:725-729.

do Couto Filho, Odyr, and Ailton de Souza Gomes. 1971. Cationic polymerization of indene by methyl ethyl peroxide in liquid sulfur dioxide. Polymer Letters. 10:891-894.

Drücker, Carmela Stachy; Vicente G. Toscano; and Richard G. Weiss. 1973. A general method for the determination of steric effects during collisional energy transfer. The partial photoresoltution of penta-2,3-diene. Journal of the American Chemical Society. 95:6482-6484.

Faigle, J. F. G.; P. C. Isolani; and J. M. Riveros. 1976. The gas phase reaction of F^- and CH^- with alkyl formates. Journal of the American Chemical Society. 98:8:2049-2052.

Faljoni, A.; K. Zinner; and Richard G. Weiss. 1974. An attempt to influence the decay modes of 1,2-diphenylcyclopropane excited states with optically active solvents. Tetrahedron Letters. No. 13, 1127-1130.

Figueiredo, A. M., and Ailton de Souza Gomes. 1973. Synthesis of 6,7-benzo-2-azabicyclo [3.2.0] heptan-3-one. Organic Preparations and Procedures International. 5:1:13-15.

Hildebrandt, Richard L., and Eduardo M. A. Peixoto. 1972. Structure of maleic anhydride determined by gas-phase electron diffraction. Journal of Molecular Structure. 12:31-37.

Isolani, P. C., and J. M. Riveros. 1975. Energy requirements for the indirect formation of cluster ions in the gas phase: the ion-molecule reaction of negative ions with esters of formic acid. Chem. Phys. Letters. 33:361.

Isolani, Paulo C.; José M. Riveros; and Peter W. Tiedemann. 1973. Gas phase proton affinities of carbonyl compounds by ion cyclotron resonance spectroscopy. Journal of the Chemical Society, Faraday Transactions. II:69:1023-1027.

Malin, John M., and Rex E. Shepherd. 1972. The aqueous pyrazine-nickel (II) complex. Journal of Inorganic & Nuclear Chemistry. 34:10: 3203-3207.

Malin, John M., and Henrique E. Toma. 1971. Cinetica e mecanismo de reação entre os ions aquopenta-ammineruthenium(II) e n-methyl-pyranzinio. Ciência e Cultura. Suplemento 23:69.

Malin, John M., and Henrique E. Toma. 1971. Mechanismos de substituição no ion bromo-pentammincobalto(III). Ciência e Cultura. Suplemento 23:65.

Mano, Eloisa B. and Roberto Riva de Almeida. 1970. A convenient technique for determination of reactivity ratios. Journal of Polymer Science. Part A-1, 8:2713-2716.

Mano, Eloisa B., and Roberto Riva de Almeida. 1971. Determinação de razões de reatividade de pares poliméricos utilizando computador. Rev. Bras. Tecnologia. 2:121.

Mano, Eloisa B., and Luíz Antonio Alves. Oxidative polimerization of aromatic hydrocarbons - a study of kinetics and mechanism. Journal of Polymer Science. Part A-1, 10:655-671.

Mano, Eloisa B.; Odyr do Couto Filho: Walter D. Vilar; and Ailton de Souza Gomes. 1971. Grafting of chlorinated polyindene with methyl methacrylate. Journal of Polymer Science. A-1, 9:821.

Mano, Eloisa B. 1973. Observações sobre a evasão de estudantes no Instituto de Química da Universidade Federal do Rio de Janeiro durante os oito primeiros ano de implantação da pos-graducao. Revista Latino American de Educacion.

Mano, Eloisa B., and Leni Akcelrud Durão. 1973. Review of laboratory methods for the preparation of polymer films. Journal of Chemical Education. 50:228-232.

Mano, Eloisa B.; Walter Dias Vilar; Odyr do Couto Filho; and Ailton de Souza Gomes. 1971. Cloração de poli-indeno. Rev. Bras. Technologia. 2:27.

Mano, Eloisa B., and Fernanda M. B. Coutinho. 1975. Grafting on polyamides. Advances in Polymer Science. 19:97-116.

Marcondes, Maria Eunice R.; Vicente G. Toscano; and Richard G. Weiss. 1974. A linear free energy relationship between σ-values and rate constants for fluorescence quenching of substituted anthracenes by triphenylphosphine. Tetrahedron Letters. No. 46, 4053-4054.

Marcondes, Maria Eunice R.; Vicente G. Toscano; and Richard G. Weiss. 1975. A change in mechanism during fluroescence quenching of substituted anthracenes by triphenylphosphine. Journal of the American Chemical Society. 97:4485-4490.

Martin, Patrick H. S., Danny L. Yeager and Vincent McKoy. 1974. Oscillator strengths for the $X^1\Sigma^+ - A^1\Pi$ system in Ch^+ from the equations of motion method. Chem. Phys. Letters. 25:184.

McIver, Jr., R. T.; J. A. Scott; and José M. Riveros. The effect of solvation on the intrinsic relative acidity of methanol and ethanol. Journal of the American Chemical Society. 95:2706-2708.

Nogueira, J. C.; A. G. Ayrosa; G. G. B. de Souza; and Eduardo M. A. Peixoto. 1973. Mecanismo de posicionamento ortec 3701B modificado para medidas de alta precisao. Ciência e Cultura. 25:116.

Overberger, C. G.; T. Yoshimura; A. Ohnishi; and A. S. Gomes. 1970. Synthesis of inherently dissymmetric polyamides. Journal of Polymer Science. Part A-1, 8:2275-2291.

Overberger, C. G.; A. Ohnishi; and A. S. Gomes. 1971. Optical properties of inherently dissymmetric polyamides. Journal of Polymer Science, Part A-1, 9:1139-1151.

Peixoto, Eduardo M. A. 1969. Determinação de densidade electronica em átomos e moleculas por meio de difração de eletrons. Ciência e Cultura. 21:199.

Peixoto, Eduardo M. A. 1972. Estutura do amidrido moleico determinada por difração de eletrons em fase gasosa. Ciência e Cultura. 24:81.

Peixoto, E. M. A.; J. C. Nogueira; A. G. Ayrosa; and G. G. B. de Souza. 1973. A technique for high precision angular displacement using a modified ortec 3701B position mechanisms. Rev. Sci. Instrum. 44:1782.

Peixoto, E. M. A. 1974. Tese para obtenção de Livre Docente, Instituto de Química, Universidade de São Paulo.

Peixoto E. M. A.; Lee Mu-Tao; and J. C. Nogueira. 1975. A new theoretical model for scattering of electrons by molecules, I-hydrogen molecule. Ciência e Cultura. 27:772.

Peixoto, E. M. A., and J. C. Nogueira. 1976. Total relative cross section for 500 eV and 1 keV electrons scattered by nitrogen (N_2). Physical Review Abstracts. 13:4:1352-1357.

Pereira, Mercedes S., and John M. Malin. 1974. The ligand pentaammine (pyrazine)ruthenium(II). Aqueous complexes of nickel(II), copper(II), and zinc(II). Inorganic Chemistry. 13:386-389.

Petragnani, Nicola; Libardo Tores Castellanos; Kenneth J. Wynne; and William Maxwell. 1973. New anionic species of tellurium(IV). Journal of Organometallic Chemistry. 55:295-307.

Reeves, L. W.; J. M. Riveros; R. A. Spragg; and J. A. Vanin. 1973. A study of ^{15}N formamide oriented in a lyotropic nematic phase. Molecular Physics. 25:9.

Riveros, J. M. 1970. Determinação da basicidade relativa das aminas por ressonância ciclotrônica de ions. Tese de Livre-Docência, Instituto de Química, Universidade de São Paulo.

Riveros, J. M. 1970. Isotopic effect and temperature dependence of the ESR spectrum of the methyl radical. Anais da Academia Brasileira de Ciências. 42:181.

Riveros, J. M. 1974. Formation and relative stability of negative ion clusters by ion cyclotron resonance spectroscopy. Advances in Mass Spectrometry. 6:277-282.

Riveros, José M.; Antonio Celso Breda; and Larry K. Blair. 1973. Formation and relative stability of chloride ion clusters in the gas phase by ion cyclotron resonance spectroscopy. Journal of the Chemical Society. 95:4066-4067.

Riveros, José M.; Peter W. Tiedemann; and A. Celso Breda. 1973. Formation of $XeCl^-$ in the gas phase. Chemical Physics Letters. 20:4: 345-346.

Riveros, José M., and Peter W. Tiedemann. 1972. Gas-phase kinetic protonation site of formamide. Anais da Academia Brasileira de Ciências. 44:413.

Ronald, Robert C. 1973. A new method for methyleneation of butyrolacetones. Tetrahedron Letters. 3831.

Scroggin, D. G.; J. M. Riveros; and E. B. Wilson. 1974. The microwave spectrum and rotational isomerism of ethyl nitrate. Journal of Chem. Phys. 60:1376.

Takashima, K., and J. M. Riveros. 1976. Gas phase nucleophilic reactions in 1,1-difluorethylene. Canadian Journal of Chemistry. 54:11:1839-1840.

Takashima, K., and J. M. Riveros. 1976. The determination of molecular ionization cross sections in an ICR spectrometer. Anais da Academia Brasileira de Ciências. 48:1:33-36.

Tarvin, Robert F. 1973. Liquid crystals and polymerizations. Sociedade Brasileira para o Progresso da Ciência. 25:126.

Tarvin, Robert F. 1973. Polymerization of alkyl vinyl ether by dichlorodicyanobenzoquinone. Sociedade Brasileira para o Progresso da Ciência. 25:27.

Tarvin, Robert F., and F. W. Neetzow. 1973. Unsymmetrical liquid crystalline esters. Journal of the Chemical Society, Chem. Communications. 396-397.

Tiedemann, Peter W.; Paulo Celso Isolani; and José M. Riveros. 1973. Gas-phase proton affinities of carbonyl compounds. Journal of the Chemical Society, Faraday Transactions II. No. prelo.

Tiedemann, P. W., and J. M. Riveros. 1974. Ion-molecule reactions of acids and esters with alcohols: gas phase analogs of acidic esterification processes. Journal of the American Chemical Society. 96:185.

Tiedemann, Peter W., and José M. Riveros. 1973. Mechanism of ionic self-acylation in the gas phase. Journal of the American Chemical Society. 95:3140-3144.

Toma, Henrique E., and John M. Malin. 1972. Evidence for an unusual association between two cations in aqueous solution. Journal of the American Chemical Society. 94:4039-4040.

Toma, Henrique E., and John M. Malin. 1973. Kinetics of formation and stability constants of some pentacyanoferrate(II) complexes of aromatic nitrogen heterocycles. Inorganic Chemistry. 12:2080-2083.

Toma, Henrique E., and John M. Malin. 1974. Dissociation kinetics of pentacyanoiron(II) complexes of ammonia and methalamine. Inorganic Chemistry. 13:1772-1774.

Toma, Henrique E., and John M. Malin. 1973. A spectrophotometer cell stopper for syringe transfer. Journal of Chemical Education. 50:272.

Toma, Henrique E., and John M. Malin. 1973. Properties and reactivity of some pentacyanoferrate(II) complexes of aromatic nitrogen heterocycles. Inorganic Chemistry. 12:5:1039-1045.

Toma, Henrique E., and John M. Malin. 1975. The hydrate-carbonyl equilibrium in the complex pentacyano(4-formylpyridine)iron(II) and kinetics of some related electron exchange reactions. Journal of the American Chemical Society. 97:2:288-293.

Toma, Henrique E.; John M. Malin; and Ernesto Giesbrecht. 1973. The ion pentacyano(dimethyl sulfoxide)ferrate(II): synthesis, characterization and substitution kinetics in aqueous solution. Inorganic Chemistry. 12:2084-2089.

Toma, Henrique E.; John M. Malin; and Ernesto Giesbrecht. 1973. The kinetics of oxidative substitution in bromopentaamminecobalt (III) ion by chlorine, hypochlorous and hypobromous acids. Inorg. Chim. Acta. 7:423.

Toma, H.; E. Giesbrecht; and J. M. Malin. 1976. Quantitative spectrophotometric determination of small amounts of dissolved carbon monoxide-cyanide and sulfoxides in aqueous solutions. Academia Brasileira de Ciências Rio de Janeiro Anais. 28:1:41-46.

Toscano, Vicente G., and Carmela Drücker. 1973. Ciência e Cultura. 23:52.

Yoshida, Massoyoshi, and Richard G. Weiss. 1975. The photodecomposition and photoracemization of methyl (+)-o-methylmandelate. Tetrehedron Letters. 31:1801-1805.

Books Published

Bonham, R. A., and M. Fink. 1974. High Energy Electron Scattering. New York: Van Nostrand Reinhold Company.

Mano, E. B., ed. 1975. Proceedings of the International Symposium on Macromolecules. Amsterdam: Elsevier Scientific Publishing Company.

Book Accepted for Publication

Tarvin, R. F.; F. W. Neetzow; M. M. Jacob; and E. A. V. Roland. 1974. Liquid Crystalline Polymerizations.

Manuscripts Accepted for Publication

Brocksom, Timothy J.; Mauricio G. Constantino; and Helena M. C. Ferraz. Synthesis of spiro-β-methylene-γ-butyrolactones. Synthetic Communications. Accepted for Publication.

Costa-Carvalho, V. L. A.; A. D. Panek; and J. R. Mattoon. Effects of carbon source and genetic modification of phosphoglucomutase on trehalose metabolism in Saccharomyces cerevisiae. Accepted for publication.

Marcondes, Maria Eunice R.; Vicente G. Toscano; and Richard G. Weiss. Florescence quenching of anthracenes by N,N,-Dimethylaniline. A comparison with quenching by triphenylphosphine. Journal of Photochemistry. Accepted for publication.

Marcondes, Maria Eunice R.; Vicente G. Toscano; and Richard G. Weiss. Florescence quenching of substituted anthracenes by tris(pentafluorophenyl)phosphine. Journal of Photochemistry. Accepted for publication.

Martin, Patrick H. S.; W. H. Henneker; and Vincent McKoy. Dipole properties of atoms and molecules in the random phase approximation. Journal of Chem. Phys. Accepted for publication.

Martin, Patrick H. S.; W. H. Henneker; and Vincent McKoy. Second-order optical properties and van der Vaals coefficients of atoms and molecules in the random phase approximation. Chem. Phys. Letters. Accepted for publication.

Mattoon, J. R.; J. C. Beck; E. Carvajal; and D. R. Malamud. Genetic modification of mitochondrial membranes including ADP-ATP carrier and δ-aminolevulinic acid. Methods in Enzymology, Biomembranes. Part D. Fleischer, S. and Packer, L. (eds.). New York: Academic Press. Accepted for publication.

Mattoon, J. R.; D. R. Malamud; A. Brunner; G. Braz; E. Carvajal; W. E. Lancashire; and A. D. Panek. Regulation of heme formation and cytochrome biosynthesis in normal and mutant yeast. Accepted for publication.

Nicodem, D. E.; M. L. P. F. Cabral; and J. C. N. Ferreira. The use of 0.15 M potassium ferrioxalate as a chemical actionometer. Molecular Photochemistry. Accepted for publication.

Panek, Anita D., and James R. Mattoon. Regulation of energy metabolism in Saccharomyces cerevisiae, relationships between catabolite repression, trehalose synthesis, and mitochondrial development. Archives of Biochemistry and Biophysics. Accepted for publication.

Panek, A. D.; A. L. Sampaio; G. C. Braz; and J. R. Mattoon. Biochemistry and genetics of yeast, pure and applied aspects. Bacila, M.; Horecker, B.; and Stoppani, A. O. M. (eds.). New York: Academic Press. Accepted for publication.

Panek, A. D.; A. L. Sampaio, G. C. Braz; and J. R. Mattoon. Regulation of energy metabolism in yeast. Relationships between carbohydrate reserves, catabolite repression and maltose utilization. Accepted for publication.

Peixoto, E. M. A. A new relation between internuclear distances and atomic number. Ciência e Cultura. Accepted for publication.

Peixoto, Eduardo M. A.; Ione Iga; Lee Mu-Tao; and J. C. Nogueira. The half molecule mode. II--complete and quantitative description of electron scattering by $H_2(^1\Sigma^+g)$ from 100 eV to 40 KeV. Ciência e Cultura. Accepted for publication.

Petragnani, N.; T. J. Brocksom; A. R. Gato. An approach to the synthesis of C_{18} triunsaturated fatty acids. Farmaco, Ed. Sci. Accepted for publication.

Petratnani, N.; T. Brocksom; and A. Moro. 2-Formyl-1, 4-benzodioxane; preparation and reactivity. Farmaco, Ed. Sci. Accepted for publication.

Quina, F. H. and D. G. Whitten. Photochemical reactions in organized monolayer assemblies IV. Photodimerization, photoisomerization and excimer formation with surfactant olefins and dienes in monolayer assemblies, crystals and micelles. Journal of the American Chemical Society. Accepted for publication.

Quina, F. H.; Z. Hamlet; and F. A. Carroll. Biomolecular decay routes in the singlet quenching of naphthalene by chloroacetonitrile. Journal of the American Chemical Society. Accepted for publication.

Quina, F. H. and V. G. Toscano. Photophenomena in surfactant media. Quenching of a water-soluble fluorescence probe by iodide ion in micellar solutions of sodium dodecyl sulfate. Journal of Physical Chemistry. Accepted for publication.

Takashima, K. and J. M. Riveros. The determination of molecular ionization cross sections in an ICR spectrometer. Anais da Academia Brasileira de Ciências. Accepted for publication.

Tarvin. R. F.; F. W. Neetzow; M. M. Jacob; and E. A. V. Roland. Liquid crystalline polymerizations. International Journal of Polymeric Materials. Accepted for publication.

Toscano, Vicente G., and F. H. Quina. Influence of self-quenching of the benezene triplet state of estimates of naphthalene $T_2 \rightsquigarrow T_1$ interval conversion rates. Chem. Phys. Letters. Accepted for publication.

Valle, Any Bernstein Freitas; Anita D. Panek; and James R. Mattoon. Colorimetric determination of succinic acid using yeast succinate dehydrogenase. Accepted for publication.

Manuscripts Submitted for Publication

Abakerli, R. B.; V. G. Toscano; and F. H. Quina. 1976. Photophenomena in surfactant media. Estimation of free monomeric surfactant as a function of total surfactant concentration. Journal of the American Chemical Society. Submitted for publication.

Bonham, R. A., and H. F. Wellenstein. 1973. The quantum mechanical first born binary encounter theory of electron impact ionization and the theoretical cross section differential with respect to scattered solid angle and energy loss in helium. Submitted for publication.

de Almeida, Maria Lucia Cardoso; Frank H. Quina; and Fernando C. Reinach. 1976. An inexpensive method for photographing oscilliscope traces. Submitted for publication.

Dunlop, Mario S.; Vyvyan D. Maio; and Ailton de Souza Gomes. Copolymerization of indene with acrylo-nitrile, methyl methacrylate and maleic anhydride in the presence of $ZnCl_2$. Journal of Polymer Science. Submitted for publication.

Espinola, Aida. 1971. Ememtos-traços em óleo de xisto. Communicações do 1.° Simpósio Brasileiro de Xisto. Submitted for publication.

Malin, John M., and Rex E. Shepherd. The ions aquopenta-ammineruthenium (II) and n-methylpyrazinium: evidence for intermediate formation in the substitution reaction. Journal of the American Chemical Society. Submitted for publication.

Martin, P. H. S.; T. N. Rescigno; V. McKoy; and W. H. Henneker. 1974. Photoionization cross sections for H_2 in the random phase approximation with a square-integrable basis. Chem. Phys. Letters. Submitted for publication.

Nicodem, D. E.; R. V. Brito; and R. Marchiori. Photoenol bromination. The Journal of the Chemical Society, Chemical Communications. Submitted for publication.

Politi, M.; I. M. Cuccovia; H. Chaimovich; M. L. C. de Almeida; J. B. S. Bonilha; and F. H. Quina. Effect of hexadecyl trimethyl ammonium bromide on the hydrolysis of N-Alkyl-4-Cyanopyridinium ions. Tetrahedron Letters. Submitted for publication.

Tarvin, Robert F. 1974. Unsymmetrical liquid crystalline esters: smetic and nematic phenyl benzoates. Submitted for publication.

Manuscripts in Preparation

Abakerli, R. B.; V. G. Toscano; and F. H. Quina. Photophenomena in surfactant media. A fluoroescent probe study of the solubilization of N,N-Dimethylaniline in dilute aqueous cetyltrimethylammonium bromide. Manuscript in preparation.

Bittencourt, H. M. S.; F. H. Quina; and H. Chaimovich. Fluorescence studies of acid phosphatase. Topography and absence of gross salt. Induced conformational changes. Manuscript in preparation.

Brocksom, Timothy J., and M. G. Constantino. The synthesis of a β methylene γ-lactone. Manuscript in preparation.

Brocksom, Timothy J., and J. T. Terreira. The synthesis of a δ methylene-γ-lactone. Manuscript in preparation.

Chaimovich, H.; F. H. Quina; J. Escabi; and J. H. Fendler. Nanosecond time-resolved fluorescence study of pyrene in aqueous micelles. A study of the migration of substrates from the core to the interphase. Manuscript in preparation.

Coelho, Augusto L., and John M. Malin. Synthesis of trans-dichlorobis (ethylenediamine) osmium (II) chloride. Manuscript in preparation.

da Silva, Roberto R.; Frank H. Quina; Vicente G. Toscano; and Richard G. Weiss. Mechanism of the photolysis of 3,5-cyclohexadiene-1-one-2-(triphenyl)phosphorane. Manuscript in preparation.

de Souza, G. G. B.; E. M. A. Peixoto; and M. C. A. Santos. A high resolution Möllenstedt analyzer for medium (500 eV - 3 keV) electrons. Manuscript in preparation.

Harrigan, Raymond W.; George S. Hammond; and Harry B. Gray. Photochemistry of titanium cyclopentadienyls. Manuscript in preparation.

Jones, Patrick R. Inelastic, low energy, electron-scattering. Manuscript in preparation.

Jones, Patrick R. Ion-molecule reactions of $GeHx^+$. Manuscript in preparation.

Jose, Sonia M.; Larry K. Blair; and José M. Riveros. Fluoride affinity of simple carbonium ions. Manuscript in preparation.

Marcondes, Maria Eunice R.; Vicente G. Toscano; and Richard G. Weiss. Further observations on the quenching mechanisms of anthracene singlets by phosphines and amines. Manuscript in preparation.

Peixoto, E. M. A.; J. C. Nogueira; Lee Mu-Tao; and Ione Iga. A new study of H_2 by electron scattering using a new scattering model (100 eV-40 keV). Manuscript in preparation.

Peixoto, E. M. A., and L. Mu-Tao. An exact solution of the e-H_2 scattering using Glauber approximation and a new scattering model. Manuscript in preparation.

Peixoto, E. M. A., and J. C. Nogueira. A study of the total and inelastic cross section for collision of 1000 eV and 500 eV electrons by argon. Manuscript in preparation.

Peixoto, E. M. A. and G. G. B. de Souza. Small angle study of the elastic differential cross section of electrons by Ar from 500 eV - 3 keV. Manuscript in preparation.

Peixoto, E. M. A. and Ione Iga. Gas phase molecular structure of dioxadiene by electron diffraction. Manuscript in preparation.

Peixoto E. M. A.; Ione Iga; and L. Mu-Tao. 1975. Gas phase electron diffraction and molecular structure of cyclic peroxides. Manuscript in preparation.

Peixoto, E. M. A.; L. Mu-Tao; and J. C. Nogueira. Determination of the molecular structure of CCl_4 by medium (1 keV) electrons: an investigation of the multiple scattering. Manuscript in preparation.

Peixoto, E. M. A. A new rack for scientific instruments (patent required). Manuscript in preparation.

Peixoto, E. M. A., and J. C. Nogueira. Total differntial cross sections for 500 eV and 1 keV electrons scattered by N_2 in electronic and atomic collisions. Manuscript in preparation.

Peixoto, E. M. A.; Lee Mu-Tao; I. Iga. Espalhamento de elétrons de 40 keV por N_2 em fase gasosa--determinação de estrutura molecular. Manuscript in preparation.

Petragnani, Nicola, and Libardo Tores Castellanos. Asymmetric tellurides. Manuscript in preparation.

Petragnani, N.; L. T. Castellanos; K. Y. Wynne; and D. J. Williams. Tetraorganylphosphonium salts of dihaloorganyltellurates(II) and dihaloorganylselenates(II). Manuscript in preparation.

Riveros, José; Peter W. Tiedemann; and Antonio Celso Breda. Observation of $XeCl^-$ by ion cyclotron resonance. Manuscript in preparation.

Sanioto, D. L.; F. H. Quina; and S. Schreier. Carcinogenic and non-carcinogenic hydrocarbons in lipid membranes. A fluorescence study. Manuscript in preparation.