

PD - AAT - 591
45005

APPLIED SCIENCE AND TECHNOLOGY RESEARCH IN EGYPT
Quarterly Report No. 19 - Phase II
April-June 1986

Final Project Report

Contract Number NEB-0016-C-00-1058-00
Project Number 263-0016

Report Prepared by:

Board on Science and Technology for International Development
Office of International Affairs
National Academy of Sciences/National Research Council
Washington, D.C.
June 1986

CONTENTS

	Page
I. Introduction	1
II. Achievements	3
● S&T Policy and Management	6
● Demonstration Projects	8
● R&D Projects	9
III. Fact Finding and Study Opportunities	12
IV. Lessons and Assessment	17
● Summary, end-of-project report entitled, "Applied Science and Technology: an Egyptian-American Cooperative Program" (1977-1986)	17
● Summary and Conclusions, 1983 Program Evaluation Report, Board on Science and Technology for International Development	18
V. Bibliography	20
VI. Annexes	
● Annex A: Fact-Finding and Study Visits	22
● Annex B: R&D Management Workshop Participants, Denver Research Institute	57
● Annex C: Institutions Visited	60

INTRODUCTION

In March 1977, the Governments of Egypt and the United States signed a cooperative agreement known as the Applied Science and Technology Research Program designed to build stronger links among scientists and institutions in the two countries and to address priority problems of Egyptian socioeconomic development. Four major objectives were to be emphasized:

1. Changing Egyptian institutional and attitudinal perspectives on applied research and development (R&D) by giving greater attention to multidisciplinary and multi-institutional approaches to R&D.
2. Strengthening ties between Egyptian research institutions and end-users in agriculture, industry and the service sectors.
3. Developing more effective R&D management and evaluation systems in R&D institutions.
4. Providing modern equipment and instrumentation facilities and building an up-to-date science and technology information system in Egypt.

Overall responsibility for the program was assigned to the U.S. Agency for International Development (AID) and to the Egyptian Academy of Scientific Research and Technology (ASRT) by the two governments. Assistance in the major elements of the program was provided through contracts with: (a) the U.S. National Academy of Sciences/National Research Council (NAS/NRC) for program policy planning and oversight, and for technical assistance to specific applied R&D activities; (b) the University of Wisconsin at Madison and the U.S. National Institutes of Health for the purchase of scientific equipment, and for strengthening institutional capacities for the maintenance and repair (M&R) of scientific instrumentation and equipment; (c) the Georgia Institute of Technology for the design and implementation of an S & T information network; and (d) the U.S. National Bureau of Standards for strengthening Egyptian institutions responsible for industrial standards and measurements.

Individual projects within the Applied Science and Technology Research Program are covered in detailed reports in English to AID and in Arabic to the Government of Egypt. A summary report entitled "Applied Science and Technology: An Egyptian-American Cooperative Program (1977-1986)" has also been written and is available from the ASRT in Cairo or the NAS/NRC in Washington, D.C.

This is the final report by NAS/NRC to the U.S. AID Mission in Cairo. As an end-of-project statement it summarizes achievements and lessons learned in the Applied Science and Technology Research Program, AID Contract NEB-0016-C-00-1058-00. It also contains a chapter on

fact-finding and study opportunities made available to Egyptian scientists during the 8-year Program. Activities concerning procurement, maintenance and repair of scientific equipment, the Scientific and Technical Information project, and the project on industrial standards are given in separate reports by the individual contractors cited in "b", "c", and "d" above.

II

ACHIEVEMENTS

The National Academy of Sciences/National Research Council (NAS/NRC) responsibilities in the Applied Science and Technology Research Program included:

- Cooperation with the Academy of Scientific Research and Technology (ASRT) in S&T policy planning and management systems through the creation of a high-level program advisory committee (Joint Consultative Committee - JCC), projects in R&D management training and strengthening of management systems, and a series of national seminars on S&T policy measures to support Egyptian national development planning.

- Technical assistance for 3 multi-disciplinary, multi-institutional demonstration projects linked to high priority national development goals. (Food security - the More and Better Food Project; Energy - Biogas Technology for Rural Areas; and Land use - Technical and Socioeconomic Evaluation of Irrigation Systems in the New Lands of Egypt.)

- Technical assistance for 6 multidisciplinary R&D projects targeted to specific end-user needs. These projects were: (a) Evaluation of Egyptian Phosphate Ores, (b) Improving the Process of Wool Scouring and Wool Wax Recovery in Textiles, (c) Corrosion Causes and Control, (d) Red Sea Fisheries, (e) Investigation and Evaluation of Egyptian Bentonite Clays For Industrial Applications, and (f) Preparation of Selected Pharmaceutical Chemicals.

To highlight some of the main achievements arising from ASRT-NAS/NRC program elements, the following may be cited:

- The National Research Centre (NRC) in the More and Better Food and the Biogas Technology projects successfully adopted the multidisciplinary, multi-institutional approach to the problems involved. NRC mobilized resources from 13 of its own laboratories and from 8 other institutions to address priority questions in plant and animal production, nutrition, health, and energy. In this process, over 400 researchers were involved. The food program, begun in 3 demonstration villages, was later expanded to parts of 7 governorates with a total area of 130,000 feddans cultivated by more than 90,000 farmers.

- The NRC and the Central Metallurgical Research and Development Institute (CMRDI) successfully collaborated with end users in the industrial sector including the fertilizer, textile, pharmaceutical, and clay minerals industries. In textiles a wool scouring process was developed, tested, and installed at the Misr Beida Dyers Company. The process nets approximately \$650,000 per year in savings with an R&D

investment of approximately \$350,000. CMRDI generated 9 contracts to assist the Egyptian fertilizer industry on the basis of demonstrated results from the phosphate ores project alone.

- The R&D management training project created a cadre of approximately 12 Egyptian trainers from the 58 who went to the United States for training in R&D management principles. These 12, in turn, were responsible for nearly 700 Egyptians being trained in R&D management in Egypt. NRC now regularly offers introductory courses in R&D management to 50-100 scientists per year from the Centre, from research institutions affiliated with ASRT or belonging to Ministries, and from universities.

- The NRC team that was responsible for the biogas technology project has already expanded its activities to the important problem of urban and industrial waste water disposal, recycle, and use. Similarly, the CMRDI team responsible for the phosphate ores project formed the core of the group for the bentonite clays project. These are illustrations of the adaptability of the human and institutional resources to meet important industrial and environmental problems of Egypt as they arise. Local experts are now more frequently called upon rather than solely relying upon foreign consultants.

- The Joint Consultative Committee (JCC) mechanism provided an effective means to utilize high-level scientific and managerial experience on a bilateral basis over the 8-year period of the Applied Science and Technology Research Program to oversee the complex set of projects and activities. JCC members were high level S&T managers from universities, government and industry including university presidents, former directors of research of large corporations, a former Egyptian prime minister and a former science advisor to an American President. In addition to program and policy oversight they stimulated Egyptian planning initiatives on a broad range of science and technology policy issues.

Program inputs managed by NAS/NRC included:

- Pro bono advisory services of the JCC members, technical panels, and individual specialists 1,160 person days
- Consultants (paid) 600 person days
- Fact finding and study opportunities for Egyptians, principally in the United States (See Chapter III) 4,100 person days
- NAS/NRC staff in Egypt (Resident advisors) 64 person months
- NAS/NRC staff in the United States 430 person months

The NAS/NRC budget for the Applied Science and Technology Research Program was:

	<u>US\$</u> <u>millions</u>	<u>Egyptian Pounds</u> <u>millions</u>
Phase I (1978-81)	1.36	0.28
Phase II (1982-86)	2.46	0.55
	3.82	0.83

Total in US\$ equivalent (US\$1.00=LE0.83) = \$4.82

A summary of the projects, their goals, benefits and constraints is given in Figures 1, 2 and 3 on the pages which follow.

Figure 1

Applied Science and Technology Research Program

S&T Policy Planning and Management

<u>Project</u>	<u>Goals</u>	<u>Benefits/Positive Points</u>	<u>Constraints/Negative Points</u>
1.			
Joint Consultative Committee	Overall Policy Planning	Catalyzed Program Activities.	JCC often placed in a role dealing with secondary issues.
	Issue Formulation	Resolved issues among participating sponsors and contractors. Raised issues to higher levels of decision making.	Advisor vs management roles never completely clarified. Exposure to individual projects often too brief.
2.			
NAS/NRC Resident Director in Cairo	Coordinator of U.S. inputs Resource person at all program levels	Developed good rapport at most levels of mgt.	Language barrier for non-Arabic speaker.
		Assisted JCC in catalyzing projects.	Expensive to maintain U.S. national in Cairo.
		Good link to U.S. scientific and technical community.	Experience in R&D policy analysis underutilized.
3.			
R&D Mgt. Project	Train cadre in principles of R&D mgt. Institutionalize mgt. changes in ASRT and NRC	Over 700 Egyptians participated in training	Inability to create "career path" for R&D managers.
		Ongoing R&D mgt training at NRC.	
		Catalyzed interest in R&D mgt principles in ASRT institutions.	Institutionalization of new mgt systems moved slowly than planned.
		Affected mgt. of many projects.	

4.

S&T Policy

Institute series of S&T policy analyses

Catalyzed awareness of S&T policy planning function.

Failed to achieve more rigorous S&T policy planning & analytical procedures.

Professionalize process of S&T analysis

Instituted ongoing S&T policy planning activity in some ministries

Figure 2

Applied Science and Technology Research Program

Demonstration Projects

<u>Project</u>	<u>End User</u>	<u>Net Benefits/Positive Points</u>	<u>Constraints/Negative Points</u>
1.			
More and Better Food	Farmer/villages	Management by strong steering committee with considerable flexibility.	Project extension role of NRC still not clarified.
	Public Sector agriculture		
	Private sector agriculture	NRC recruited over 400 research personnel in more than 10 specialties to work closely at village and governorate levels.	Incentive payment system for future project requires study.
		Improvement in the income, welfare and nutritional status of village participants.	
		Adoption of achievements for national campaigns on (corn, peanut, poultry) 150,000 feddans.	
		Private sector introduced to NRC role in R&D.	
2.			
Biogas Technology	Farmers, and village communities	Prototype design and installment of digestors. (Family, community, and industrial sizes).	Economics of biogas systems for rural users requires construction subsidy.
	Private sector	Well organized internal project management system that allowed effective use of a foreign advisory panel and a strong reporting system.	Operational life of small digester designs not proved.
		1984 International Biogas Conference gave high recognition to Egypt effort.	

3.

Evaluation of Irrigation Systems for New Lands Nation at large

ASRT-AID sharing of project costs (initial 18 months only)

Level of effort modest in relation to priority for new lands development.

Emphasis on socio-economic as well as technological parameters.

Figure 3

Applied Science and Technology Research Program

R&D PROJECTS

<u>Project</u>	<u>End-User</u>	<u>Net Benefits/Positive Points</u>	<u>Constraints/Negative Points</u>
1.			
Evaluation of Egyptian Phosphate Ores	Egyptian Phosphate Fertilizer Industry	Developed technology for low-grade ore beneficiation. Experienced R&D team recognized by Egyptian fertilizer industry for consultancy and development studies. Contracts with industry based on achievements. Upgraded laboratory and pilot plant facilities.	Low demand for phosphates in world market.
2.			
Corrosion in petroleum refineries	Egyptian Petroleum Refinery (Suez)	Upgrading laboratory facility to state-of-the art. Recognition of importance of marketing function.	Principal surface science equipment requires M&R with high cost foreign inputs. Lack of trained personnel to operate instrument to optimum level.
3.			
Wool Scouring and Wool Wax Recovery	Misr Beida Dyers Co.	Specifically targeted to a production need. Achieved success in product quality, cost, and reduction of wastes. Project opened the way for further collaboration with industry.	

4.

Egyptian bentonite clays for industry

Six industrial firms that use bentonites

Discovery of high-grade bentonite deposit along Cairo Alexandria road.

Economic results not assured therefore commercial development of local bentonites uncertain.

Land reclamation projects

Upgraded pilot plant of CMRDI.

5.

Preparation of pharmaceutical chemicals

Pharmaceutical industry

Steering committee with industry facilitated broad cooperation and links

Industry commitment to produce products not assured.

Upgraded laboratory facilities at NRC.

6.

Development of Red Sea Fisheries

Egyptian consumers in general

Information on fishery resources, Foul Bay area of the Red Sea.

Goals too diffuse; resulted in academic rather than end-user focus.

III

FACT FINDING AND STUDY OPPORTUNITIES

In the belief that first-hand observation and face-to-face discussions with U.S. and foreign counterparts are the most effective way to transfer relevant experiences, more than 170 Egyptian scientists and engineers were provided the opportunity for study and orientation travel to the U.S. and other countries by the Applied Science and Technology Program. Through meetings with scientists and engineers in universities, government agencies, research institutes, and industrial firms as well as through hands-on experiences in laboratories and on production lines, the Egyptians expanded their understanding of state-of-the-art technologies and current R&D management methods. In addition, these visits laid the groundwork for the establishment of useful networks of communication and potential avenues of cooperation with experts in a wide range of disciplines.

Fact-finding and study visits for participants were structured to meet the specialized needs of the R&D and demonstration projects. Itineraries were developed according to specific requests from the Egyptians, in conjunction with recommendations from U.S. advisors and consultants as to the most relevant and useful contacts to be made. The Egypt Program staff in Washington identified, through its network of S&T contacts, additional appropriate individuals and institutions that would enhance the visitor's itinerary.

Fact-Finding Visits

The typical fact-finding visit was of three weeks duration, with one- or two-day stops scheduled at a variety of organizations. In some cases, participation in an international or regional technical conference was included, thereby permitting even wider interaction with the scientific community. The Egyptians visited laboratories, field sites, production lines, and research libraries. The successful outcome of the study travel component of the Applied Science and Technology Research Program could not have been accomplished without the voluntary and willing cooperation of the host institutions.

Fact-finding trips naturally varied in duration and number of organizations visited; however, to illustrate the scope of a typical fact-finding visit, the 1981 travel of two food technologists from the More and Better Food project is cited as an example. The Egyptians (from the NRC Laboratory of Food Technology and from the El-Nasr Company for Preserved Foods) were primarily interested in studying industrial practices in canning, freezing, and dehydration, including quality control and maintenance of food sanitation standards, and

observing modern techniques as practiced in the U.S. food industry. Their three-week program began with a four-day seminar on food process control at the University of Wisconsin Food Science Department. Following this, visits were made to university food technology departments and food processing plants in California, Washington, Michigan, and New York. Their itinerary included the Institute for Food Science and Technology, University of Washington, Seattle; the University of California at Davis; California State Polytechnic University; the University of Rhode Island; and Michigan State University. Industry visits included the Grande Cheese Co., Brownsville, Wisconsin; Crescent Foods, Seattle, Washington; Sea Pro Inc., Seattle, Washington; Safeway Distribution Center, Bellevue, Washington; Nalley's Inc., Tacoma, Washington; Factory of Innovative Foods, South San Francisco, California; Ed Hirschberg Freeze Drying Co., South San Francisco, California; Foremost-Gentry Factory, Gilroy, California; Compack Foods, King City, California; Carnation Research Center, Van Nuys, California; Hunt-Wesson Research Center, Fullerton, California; Gerber Products Co., Fremont, Michigan; Continental Baking Co., Rye, N.Y.; and General Foods Co. Central Research Department, Tarrytown, N.Y.

In a few cases, the most relevant R&D experiences and industrial applications were to be found in countries other than the U.S. The biogas project team, in particular, benefited from the opportunity to make on-site visits to countries that had field experiments and sizable biogas programs adapted to local needs. In 1979 a 5-member multidisciplinary team participated in a 4-week fact-finding tour of the People's Republic of China (PRC), Thailand, and India to make a first-hand, comprehensive survey of the current state-of-the-art of biogas technology in those countries and to become acquainted with the impact of the various technical, social, and economic factors involved. The group observed the techniques used for construction, operation, and management of biogas plants in rural areas; surveyed the biogas R&D programs in research institutes; and evaluated the potential applicability of the observed technology to Egyptian rural areas. Their itinerary was arranged by the Chinese Academy of Sciences, the Indian Ministry of Agriculture, and the Economic and Social Commission for Asia and the Pacific (ESCAP) in Thailand.

In 1981 and 1983, two additional studies were made of Asian biogas technology applications and extension. The project principal investigator participated in a national biogas seminar in India, followed by visits to operational biogas installations in India, the Philippines, and the PRC; the senior chemical engineer for the project attended a conference on evaluation of biomethanation systems in Bangkok, visited large-scale, commercial biogas units in India, reviewed biogas experience in rural areas of the Philippines and Korea, and assessed new developments in renewable energy strategies in the PRC.

A further comparison of the adaptation of biogas technology in developing countries was made in 1983 in Brazil by the head of the biogas project's engineering group. His program was organized by Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA), noted for its extensive R&D program on the conversion of crop residues and animal wastes into biogas. Field visits were made to biogas projects in the states of Minas Gerais, Sao Paulo, and Goias.

These visits constituted an important aspect of the technology transfer and adaptation effort of the biogas technology design group. Project staff were able to observe at first hand biogas digester designs, their operating characteristics, and ways in which on-the-scene problems were solved. Equally important were insights gained on the social acceptability and economic feasibility of the systems and on village-level training needs for maintenance and normal operation of the various systems.

Access to skills and experience outside the U.S. was also provided to other projects as well:

- The head of the NRC's Marketing and Technoeconomics Office met with officials of Turkey's Scientific and Research Council (TUBITAK) in Ankara and Istanbul to review that institution's successful industrial extension operations as a possible model for the expansion of the NRC's marketing capabilities.
- In order to determine the adaptability of these techniques to Egyptian industry, the co-principal investigators for the Wool Wax Project studied the most advanced technologies in wool processing at factories in Yorkshire, England, where these processes were adapted to large-scale textile operations. As a result of their study, the decision was made to adapt the process that is embodied in equipment manufactured by the Alfa Laval Company in Sweden. Before installation of the equipment at the Misr Beida Dyers Company plant near Alexandria, 3 Egyptians completed a 2-week training program at the Alfa Laval facilities in Sweden and France on operation and maintenance procedures.
- A group of scientists from the Pharmaceutical Chemicals R&D Project traveled to India with expenses shared by the NRC and the Indian Council of Scientific and Industrial Research. To enable industry representation in the group, the Applied Science and Technology Research Program funded the travel of the head of the production division of the El-Nasr Pharmaceutical Chemicals Co., the principal end-user of the technology being adapted by the NRC group. Visits were made to pharmaceutical research and production centers in both private and public sectors in Ahmedabad, Baroda, Bombay, Hyderabad, and Delhi. The Indian experience in pilot plant and scale-up procedures provided a useful comparison to procedures in pharmaceutical operations in the United States.

Study Visits

Study visits involved intensive two- or three-week programs at a single institution, either in a regularly scheduled course of study or in a program specifically tailored to meet the requirements of the visitor. For example, seven Egyptians enrolled in the Battelle Memorial Institute International Program in Productive R&D Management; one Egyptian studied at MIT's summer course on Management of Research, Development, and Technology-based Innovation; and two Egyptians completed courses on R&D contracting and program evaluation sponsored by the U.S. Office of Personnel Management and the U.S. General Services Administration. University short courses completed by Egyptian project personnel included "Plant Propagation Through Tissue Culture" at the University of California/Riverside and "Technology of Pesticide Analysis" at the University of California/Davis. Two of the Corrosion Project engineers spent two weeks at the Perkin-Elmer Corporation (Eden Prairie, Minnesota) introductory training course on operation of the sophisticated Electron Spectroscopy for Chemical Analysis (ESCA) equipment purchased by the program for the NRC Corrosion Laboratory. Two Egyptians from the Biogas Project attended courses at Perkin-Elmer (Norwalk, Connecticut) on atomic spectroscopy and gas chromatography. Reflecting the Program's primary emphasis on strengthening the management of R&D, the Denver Research Institute's series of courses on R&D management had a total of 47 Egyptian participants, the largest group of trainees under the program.

Some of the intensive study programs at a single institution were specifically designed for individual Egyptian project staff members. Native Plants Inc., Salt Lake City, Utah, arranged a two-week in-depth survey of arid land crop production for three researchers from the New Crops for Arid Lands Project. A series of training visits for the Phosphate Project staff was organized by the International Fertilizer Development Center, Muscle Shoals, Alabama, covering such areas as pilot plant scale ore beneficiation, wet chemical processing, and fertilizer granulation technology. To augment the Perkin-Elmer introductory ESCA training course mentioned above, follow-up hands-on ESCA training was provided by the University of Minnesota's Department of Chemical Engineering and Materials Science and by the Battelle Pacific Northwest Laboratories for two week periods at each institution.

In a few cases, the program was fortunate in having specially tailored study programs arranged and supported by institutions on a pro bono basis. The most noteworthy example of this involved a total of 9 researchers from the Pharmaceuticals Chemicals Project. Three leading U.S. pharmaceutical manufacturers organized a series of intensive, in-plant study and observation programs, which included supervised opportunities to participate in both design and decision sessions and conferences.

In addition to work on scale-up techniques and principles and on pilot plant operation, the Egyptians (6 from the NRC and 3 from the El Nasr Pharmaceutical Chemicals Co.) investigated (a) pilot plant and production quality control, sanitation, and maintenance of yield; (b) plant hazards and safety; (c) pharmaceutical regulations and consumer safety laws; (d) environmental aspects of pharmaceuticals production; and (e) waste disposal and management. The Upjohn Company (Kalamazoo, Michigan) contributed personnel and facilities for a total of 26 days training; Ciba-Geigy Corporation (Summit, New Jersey) 15 days; and Merck Sharpe and Dohme Research Laboratories (Rahway, New Jersey) 10 days. Specialized orientation visits were also made available by Smith, Klein & French Laboratories (Swedeland, Pennsylvania), Hoechst-Roussel Pharmaceuticals, Inc. (Somerville, New Jersey), and Sterling-Winthrop Research Institute (Rensselaer, New York) in areas such as quality control product assurance, product safety and packaging. This study/orientation travel involved subject matter and scale of operation (pilot plant and production levels) that are available only from industry. Although no precise dollar value can be given to the generous cooperation of the U.S. industries, a conservative estimate based upon time input of professional and support personnel would be \$50,000.

Several additional specialized study programs were offered on a pro bono basis. The NAS/NRC advisor to the Corrosion Project planned and supervised a 3-week course at the Amoco Research Center (Standard Oil Co.-Indiana), Naperville, Illinois. The program focussed on corrosion monitoring techniques and procedures for refinery failure analysis. Thirteen Amoco experts worked with the Egyptian principal investigator in the company's laboratories and nearby refinery. For the NRC geologist working on the Bentonite Project, the NAS/NRC project advisor provided the facilities of his laboratory at the Department of Geology, Indiana University, Bloomington, Indiana, for one week. The Egyptian researcher worked with university scientists on X-ray diffraction methods for structural analyses of clay minerals, using samples brought from Egypt. These analyses, essential for economic assessment studies, could not have been readily accomplished at the NRC laboratory. On two occasions, a member of the More & Better Food staff was invited by the U.S. Food Drug and Administration to spend a total of 8 weeks in its Biopharmaceutics Laboratory in Washington. Advanced analytical and instrumental techniques for examining complex molecules were studied, as well as in vivo methodologies for quantitative determination of drugs from biological fluids. This work was central to the nutrition-based studies of the project.

The number of fact-finding and study visits undertaken for each project is shown in Figure 4. A complete list of the visits is given in Annex A. The number of U.S. organizations involved is indicated in Figure 5. A list of institutions visited and meetings attended by Egyptian participants is provided in Annex B.

APPLIED SCIENCE S&T RESEARCH PROGRAM

FACT FINDING & STUDY VISITS

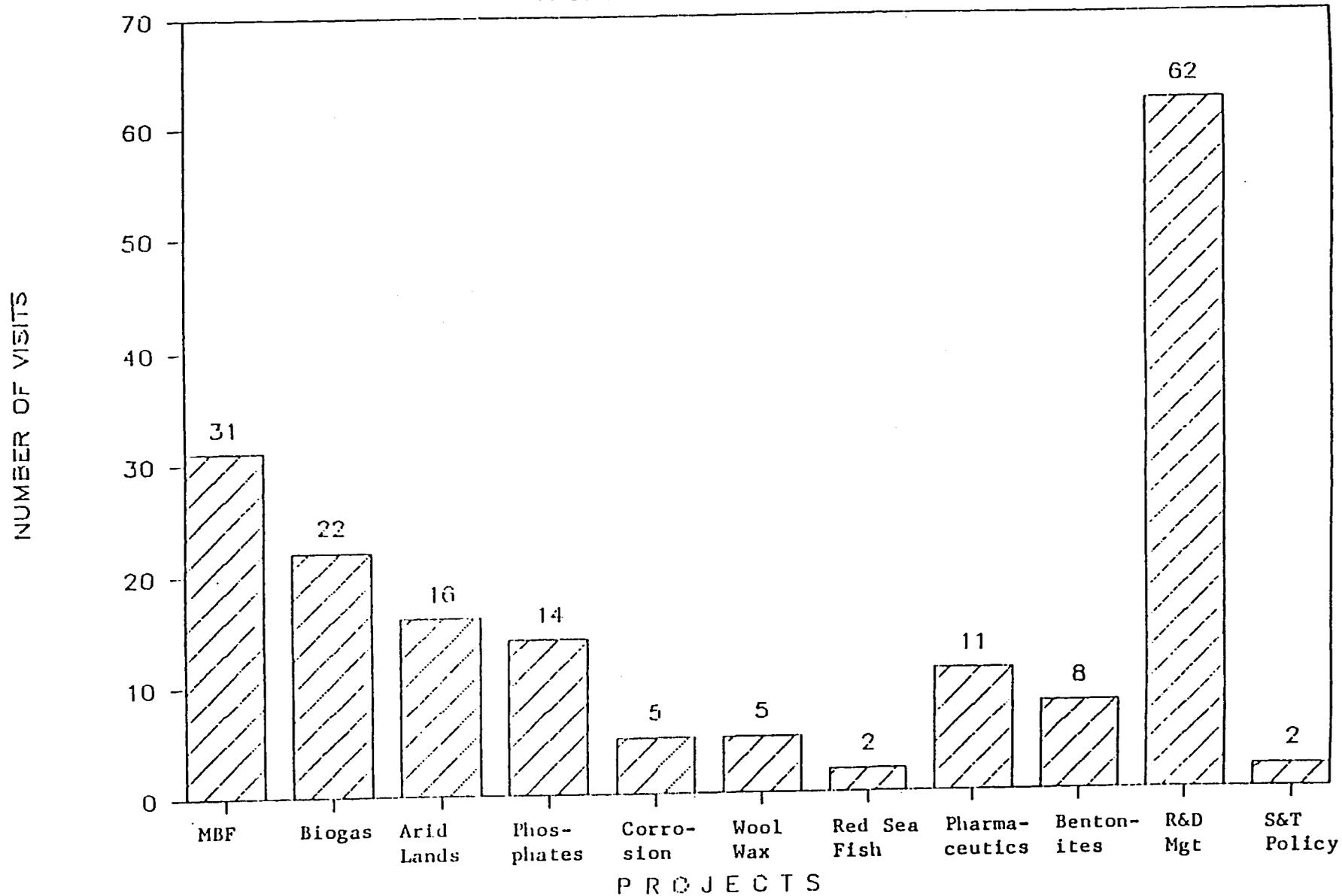


Figure 4

low

APPLIED S & T RESEARCH PROGRAM

NUMBER OF ORGANIZATIONS VISITED BY EGYPTIANS

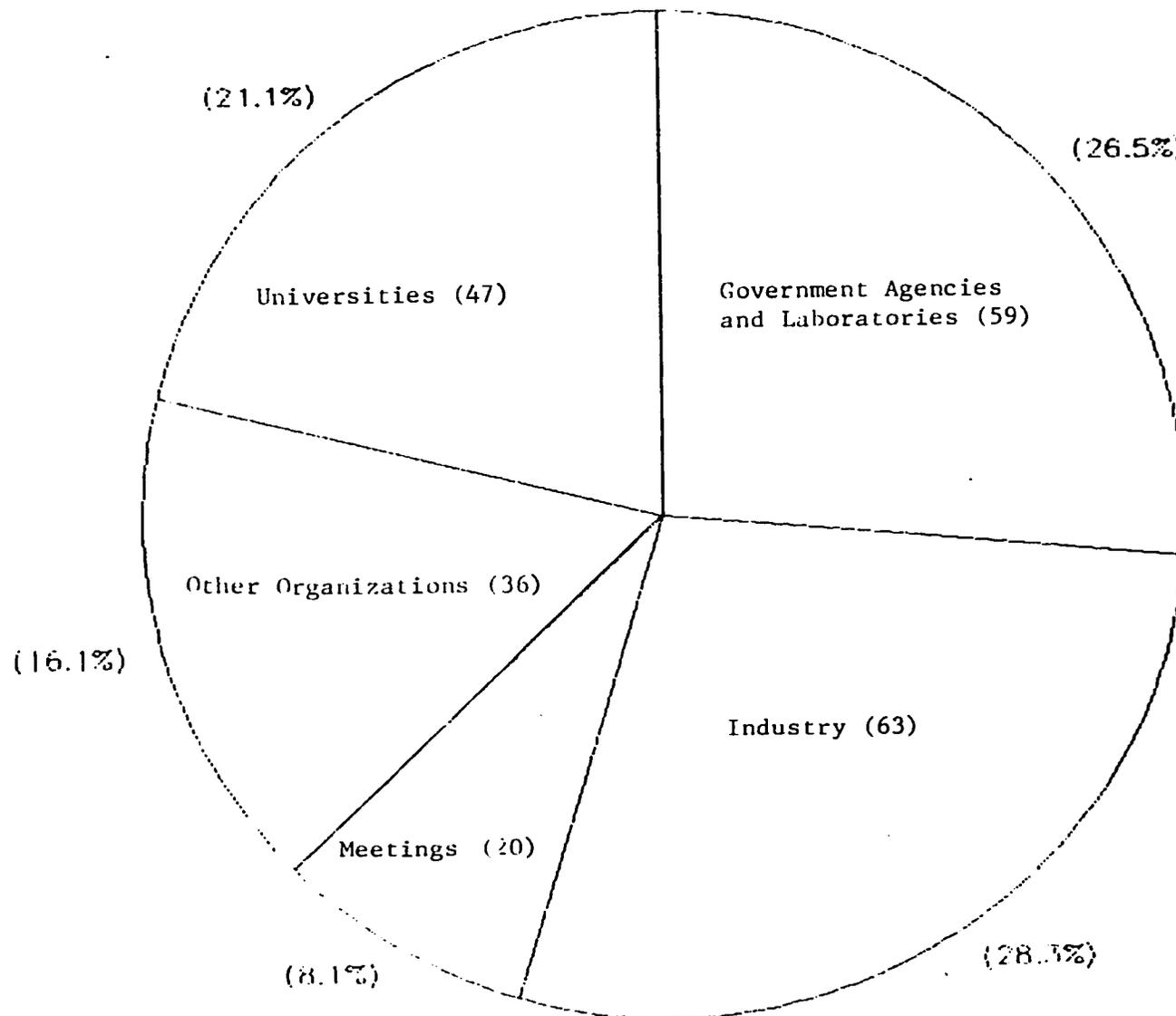


Figure 5

160

IV

LESSONS AND ASSESSMENT

To recapitulate the activities and accomplishments of the Applied Science and Technology Research Program, two reports provide a useful assessment of the program's operations and the lessons learned. Following is a summary of the principal findings of each report:

A. Applied Science and Technology: An Egyptian-American Cooperative Program (1977-1986) (10)

Lessons that can be learned from the experiences and achievements of the program include:

1. S&T for Egyptian national development can be effectively mobilized through the multidisciplinary team approach to problem solving.
2. Socioeconomic aspects must be included in the design and implementation of development projects.
3. Attention to R&D management skills at all project and program levels in laboratories and institutes pays big dividends. The incorporation of R&D management principles is essential for successful multi-disciplinary, multi-institutional S&T endeavors.
4. There is a growing role for a modern, strong, and well-coordinated S&T information system in Egypt that is linked to worldwide networks. (The nucleus of an S&T information system was established in the Applied Science and Technology Research Program.)
5. A versatile and efficient system for equipment maintenance and repair is an essential underpinning for science and technology. (The initiation of a maintenance and repair system is another accomplishment of the Program.)
6. Solutions to problems in the agricultural and industrial sectors are best achieved when the end-users and R&D institutes form strong, active partnerships. Research institutes can cultivate these partnerships by organizing their consultancy, advisory, and research services with market-oriented management.
7. Coordination among R&D institutes dealing with related activities is clearly important. Otherwise, time and resources are wasted. As an example, some 46 Egyptian institutes, belonging to 6 national agencies, are engaged in food, agriculture, and nutrition research and lack coordinating mechanisms.
8. The Applied Science and Technology Research Program demonstrated to Egyptian scientists, many of whom are somewhat isolated from the larger scientific community, that they can contribute and compete successfully. At the same time, the program underscored the extent to which S&T increasingly relies on international cooperation and communication.

B. A Review of BOSTID's Participation in the Applied Science and Technology Research Program, Egypt 1978-1983. (6)

Note: This evaluation was concerned with the policy and planning role, and the management aspects of the NAS/NRC delivery of technical assistance in the Applied Science and Technology Research Program. It was not an assessment of the individual projects nor of their impact upon the Egyptian national development process.

1. The overall effect of the NAS/NRC effort has been positive. Although the program is small in the context of Egyptian-U.S. technical assistance efforts, the program received the attention of scientific, educational, and political leaders in Egypt. It attracted talented people to serve on the JCC, on advisory panels, and as consultants. Considerable numbers of Egyptian scientists and engineers were given opportunities for advanced training, specialized study, and interaction with U.S. leaders in technical fields and in R&D management.

2. The cooperative effort between NAS/NRC and the ASRT should be viewed primarily in institution building terms. Considered in this light, the 8-year period of the program, although relatively long in AID terms, was short in terms of structural changes upon R&D institutions in Egypt, the relationships of institutions to one another, and market aspects of R&D. Nevertheless, positive steps have been taken both in the ASRT and the NRC to strengthen management for applied R&D and for extension of service to the agricultural and industrial end-users.

Perhaps the major deterrent to more rapid changes and to transfer of technologies in the program are the cultural factors involved. Egyptian and American approaches both to process and to organization are different, reflecting customs and patterns which are the product of their individual social and political histories, human and natural resources. Given these circumstances, scientific and technical cooperation between the two different systems is time-dependent. Although changes in institutional structures are evident, substantial challenges remain which could usefully be addressed to effect further institution building.

3. Egypt offers special aspects and opportunities for S&T cooperation which can reinforce the resources that NAS/NRC can bring to a program. Among these are:

- Relatively large numbers of sophisticated scientists and engineers available for projects in S&T for developments
- The positive attitude toward change and outreach for U.S. technical and managerial assistance exhibited by the leadership of the Egyptian S&T community.

- The prestige of the Egyptian scientific community and its role in social and political issues, including its influence on education and attitudes toward modernization.
- A complex institutional and organizational infrastructure for S&T, which can inhibit as well as catalyze efforts for cooperation.
- A policy of cooperation between the Governments of Egypt and of the U.S., which encourages working together in S&T for Egyptian development.

4. The Applied Science and Technology Research Program demonstrated that the NAS/NRC through BOSTID could deliver significant resources to the "S&T for development" process in Egypt and provide opportunities for broad U.S.-Egyptian cooperation. Significant mechanisms and resources of the NAS/NRC are:

- Broad access to the U.S. scientific and technical community in universities, government, and private industry.
- Oversight of the Board on Science and Technology for International Development with its wide-ranging experience in many aspects of S&T for development.
- Adaptability of NAS/NRC to special needs of the program in Egypt. Examples were the excellence of the U.S. panel of the Joint Consultative Committee, the positive impact made by the resident program specialists, the large numbers of specialized and highly qualified technical panelists and advisors, and the specially tailored training opportunities in the U.S. for Egyptian scientists.
- Continuity in effort over the life of the program. In general, the advisory panels and experts who served on a pro bono basis as well as the program staff remained and worked for the 8 year life of the project.

V

BIBLIOGRAPHY

1. Symposium on Science Policy Planning and Workshop on the Management and Planning of Research, Cairo, Egypt, April 30-May 8, 1975. Board on Science and Technology for International Development, NAS/NRC, Washington, D.C., U.S.A., 1976.
2. Egyptian Development and the Potential Role of Science and Technology. Report prepared for U.S. AID, Research Triangle Cooperation, North Carolina June 1976.
3. Report of a Discussion Meeting on the Theme "Towards a Joint Strategy for U.S.-Egyptian Cooperation in Science and Technology", Airlie House, Virginia, March 30-31, 1985. Informal report for U.S. AID, ASRT, and NAS/NRC reference purposes including the following discussion papers:
 - U.S.-Egyptian Scientific Cooperation: A Synthesis of Selected Evaluation Reports 1980-1984.
 - El-Nockrashy, A.S. The Applied Science and Technology Program: Analytical Examination of Some Achievements and Management Experience.
 - Davenport, J. The Applied Science and Technology Research Program: A Discussion of Lessons Learned and Experience Gained in a Technical Cooperation Program supported by ASRT and AID, 1978-1985.
 - Joint Consultative Committee. Statement on Airlie House Meeting, 30-31 March 1985.
 - U.S. AID/Egypt S&T Strategy Statement, March 5, 1985.
4. Lyman, Princeton; Pollack, Herman; Nelson, Courtney; and Gotsch, Carl. U.S. Cooperation with Egypt in Science and Technology. U.S. AID, Cairo, Egypt, April 1980.
5. Stone, C.A.; Kehr, A; Luykx, N.; and Marion, J. Evaluation Report: Applied Science and Technology Research AID/Cairo Project 263-0016, May 6, 1980.
6. Krebs, W. and Smuckler, R. A Review of BOSTID's Participation in the Applied Science and Technology Research Program, Egypt: 1978-1983. Board on Science and Technology for International Development, NAS/NRC, September 16, 1983.

7. Project Evaluation: Applied Science and Technology Research Project 263-0016. U.S. AID/Egypt, Cairo. December 1983.
8. Applied Science and Technology Research in Egypt. Quarterly Reports 1 through 18, Phase II, October 1981 through March 1986. Reports prepared by NAS/NRC Staff, Board on Science and Technology for International Development, for U.S. AID, Project 263-0016 under Contract NEB-0016-C-00-1058-00, Washington, D.C., U.S.A.
9. El Nockrashy, A.S.; Galal, Osman; and Davenport, J. More and Better Food: A Demonstration Project. Report issued by National Academy Press for the ASRT and NAS/NRC Applied Science and Technology Research Program, Washington, D.C., U.S.A. Expected publication date: 30 June 1986.
10. El Nockrashy, A.S. and Davenport, J. Applied Science and Technology: An Egyptian-American Cooperative Program (1977-1986). Report issued by National Academy Press for the ASRT and NAS/NRC Applied Science and Technology Research Program, Washington, D.C., U.S.A. Expected publication date: 30 June 1986.

ANNEX A

FACT-FINDING AND STUDY VISITS

January 1, 1978, through June 30, 1986

- More and Better Food
- Biogas Technology
- New Crops for Arid and Semi-arid Zones
- Phosphate Ores and Fertilizer
- Corrosion Causes and Control
- Wool Scouring and Wool Wax
- Development of Red Sea Fisheries
- Selected Pharmaceutical Chemicals
- Egyptian Bentonites
- R&D Management Systems
- S&T Policy Measures

FACT-FINDING AND STUDY VISITS
January 1, 1978, through June 30, 1986

MORE AND BETTER FOOD (MBF)

<u>DATE</u>	<u>NAME</u>	<u>PURPOSE</u>	<u>PLACE VISITED</u>
Nov.29-Dec.19, 1979	Fakhria Taha Researcher, Fats & Oils Laboratory, NRC	Color fixation and nutrient qualities of cottonseed oil	USDA Southern Regional Research Laboratory, New Orleans, Louisiana Food Protein R&D Center, Texas A&M University, College Station, Texas Plains Cooperative Oil Mill, Lubbock, TX Ranchers Oil Co., Fresno, California Cargill Co., Minneapolis, Minn.
May 15-June 8, 1980	Abdel-Hamid Talaat Higazi Head, Botany Laboratory NRC	Crop production, weed control, crop rotation, photo- synthesis, plant physiology	University of California, Davis University of Arizona, Tucson University of Florida, Gainesville USDA Agricultural Research Center, Beltsville, Maryland Cornell University, Ithaca, N.Y.
June 4-26, 1980	El-Sayed Mohamed Hegazi Professor of Food Sciences, Dept. of Nutrition & Food Sciences, NRC Ibrahim D. Rifaat Head, Food Technology and Dairy Research Laboratories NRC	Institute of Food Tech- nologists annual meeting Food industry R&D needs	New Orleans, Louisiana University of Wisconsin, Madison Del Monte Research Center, Walnut Creek, California University of California, Davis Carnation Research Corp., Van Nuys, California Utah State University, Logan, Utah Food Protein R&D Center, Texas A&M University, College Station, Texas

DATE	NAME	PURPOSE	PLACE VISITED
June 8-26, 1980	Sabry Riad Morcos Head, Dept. of Nutrition and Food Sciences, NRC	Protein-rich food mixtures for infants and children	Food & Drug Administration, Div. of Nutrition, Washington, D.C. Gerber Products, Co., Fremont, Michigan University of California, Berkeley University of California, Davis Carnation Research Corp., Van Nuys, California
June 15-29, 1980	Fayez S. Hanna Head, Soils and Water Use Laboratory, NRC	Soil survey methodology, soil conservation techniques, irrigation and drainage methods	USDA Soil Conservation Service, Washington and Phoenix, Ariz. U.S. Salinity Laboratory, Riverside, California University of California, Berkeley University of Arizona, Tucson U.S. Water Conservation Laboratory, Phoenix, Arizona
June 23-July 12, 1980	Mohamed El Beltagy Assoc. Professor Botany Dept., NRC	Vegetable crop production	USDA Agricultural Research Center, Beltsville, Maryland Texas A&M University, College Station University of California, Riverside University of California, Davis Cornell University, Ithaca, New York
Aug. 10-22, 1980	Zebaa Motagally Assoc. Professor of Animal Nutrition, NRC	Use of green fodder and agricultural by-products for animal feed	USDA Agricultural Research Center, Beltsville, Maryland Michigan State University, East Lansing University of Nebraska, Lincoln University of Minnesota, St. Paul University of Wisconsin, Madison

DATE	NAME	PURPOSE	PLACE VISITED
Sept. 8-26, 1980	Onsi Metwalli Professor of Nutritional Biochemistry, NRC	Micro-methods for estimating nutrients in biological fluids, biological evaluation of foodstuffs used on experimental animals, nutritional survey methodology	Food & Drug Administration, Division of Nutrition, Washington, D.C. USDA Human Nutrition Center, Beltsville, Md., and Grand Forks, N.D. Natl Institutes of Health, Bethesda, MD: Center for Research for Mothers & Children Natl Institute for Arthritis, Meta- bolism & Digestive Diseases Natl Institute of Allergy and Infectious Diseases Univ. of North Carolina, Chapel Hill USDA Northern Regional Research Center, Peoria, Illinois MIT Dept. of Nutrition and Food Science, Cambridge
Sept. 8-26, 1980	H. Abdel-Rahman Salama Chairman, Pest Control and Plant Protection Laboratory, NRC	Integrated pest management, field trials, extension activities	USDA Science & Education Administration Hyattsville, Maryland USDA Insects Attractants Laboratory and Insects Affecting Man & Animals Lab, Gainesville, Florida University of Florida, Gainesville USDA Agricultural Research & Education Center, Quincy, Florida USDA Western Cotton Research Lab., Phoenix, Arizona University of Arizona, Tucson USDA Cotton Insects Research Lab., College Station, Texas Texas A&M Univ., College Station
Oct.30-Nov.19, 1980	Mahmoud Nawito Head, Division of Animal Resources, NRC	Animal infertility, artificial insemination	USDA Animal Science Institute, Beltsville, Maryland Michigan State Univ., East Lansing University of Wisconsin, Madison Iowa State University, Ames Natl Animal Disease Center, Ames, Iowa Cornell University, Ithaca, N.Y. Eastern Artificial Insemination Cooperative, Ithaca, N.Y.

DATE	NAME	PURPOSE	PLACE VISITED
Jan.8-Feb.4, 1981	Zeinab H. Ahmed Director, Food Canning Development Centre El Nasr Co. for Preserved Foods Sayed A. Salem Professor, Food Science Food Technology Lab, NRC	Food processing and quality control	Wisconsin Better Process Control School, Univ. of Wisconsin, Madison Grande Cheese Co., Brownsville, Wis. University of California, Davis Factory of Innovative Foods, South San Francisco, California Ed Hirschberg Freeze Drying Co., South San Francisco, California Foremost-Gentry Factory, Gilroy, Calif. Central Valley Water Project, Los Banos, California Compack Foods Co., King City, Calif. California Polytechnic State Univ., San Luis Obispo Carnation Research Center, Van Nuys, California Hunt-Wesson Research Center, Fullerton, California Institute for Food Science & Technology Univ. of Washington, Seattle Michigan State University, East Lansing Gerber Products Co., Fremont, Michigan Continental Baking Co., Rye, N.Y. General Foods Co., Tarrytown, N.Y. Nutrition Foundation, N.Y., N.Y.
June 7-10, 1981	El Sayed M. Hegazi* Professor, Food Science Dept. of Nutrition and Food Sciences, NRC	Institute of Food Technologists annual meeting	Atlanta, Georgia
Aug. 8-29, 1981	Osman Galal Head, Child Health Lab. NRC	XX International Congress on Nutrition Visits re nutritional aspects of MBF	San Diego, California Tulane University, Dept. of Nutrition New Orleans, Louisiana University of Oklahoma, Pediatric Dept., Oklahoma City, Oklahoma Cornell University, Ithaca Program on Policies for S&T for Development Division of Nutritional Sciences Tufts University, Medford, Mass.

*Travel provided by non-program funds

DATE	NAME	PURPOSE	PLACE VISITED
Jan. 14-30, 1982	Ahmed F. El-Sherif Professor, Soils Dept., NRC	Soil fertility	NAS, Washington, D.C. USDA, Beltsville, Maryland University of Arizona, Tucson University of California, Riverside Colorado State University, Fort Collins USDA Agricultural Research Service Tifton, Georgia
May 13-June 2, 1982	Sohair I. Salem Research Professor, Child Health Laboratory, NRC	Fetal malnutrition, atomic absorption techniques for human hair analysis	Pediatrics Dept., Univ. of Oklahoma USDA Human Nutr. Lab, Grand Forks, M.D. Dept. of Nutrition and Food Science, MIT
July 14-Aug. 7, 1982	Nabih I. Ashour Professor of Crop Physiology, NRC	Plant physiology, field production of maize, soybeans, sunflower, peanuts	University of Georgia facilities in Athens, Griffin and Tifton USDA Agricultural Research Center, Beltsville, Md. North Dakota State University, Fargo University of Illinois, Urbana
July 8-14, 1982	Ali A. S. Ramadan Assoc. Professor of Food Technology, NRC Sohair A. El-Nockrashy Assoc. Professor of Dairy Science, NRC	Course on "Technology of Pesticide Analysis"	University of California, Davis

DATE	NAME	PURPOSE	PLACE VISITED
July 5-Aug.16, 1983	Sylvia K. El Arini Professor of Biochemistry, NRC	Advanced analytical and instrumental techniques for studying complex molecules (guest scientist)	Food & Drug Administration, Biopharmaceutics Lab, Washington
May 9-31, 1984	Aly Zein El Abedein Head, Dept. of Community Medicine & Rural Health, NRC	Measuring nutritional impacts of agricultural innovation	Univ. of Arizona, Dept. of Family and Community Medicine, Tucson
March 3-6, 1985	Osman Galal* Head, Child Health Lab, NRC Director, Nutrition Inst.	Base line data studies and women in development activities	Univ. of Arizona, Dept. of Family and Community Medicine, Tucson
April 24-May 12, 1985	Zebaa Motagally Assoc. Professor of Animal Nutrition, NRC	2nd Conference of Assoc. for Women in Development; training of women in cottage dairy production	Washington, D.C. Univ. of Arizona, Dept. of Family and Community Medicine, Tucson
June 16-July 3, 1985	Amin Abdou Professor of Agricultural Economics, NRC	Analysis of nutrition data from demonstration villages	Univ. of Arizona, Dept. of Family and Community Medicine, Tucson
July 6-27, 1985	Osman Galal Head, Nutrition Institute	Review statistical/ analytical procedures for MBF, women in development activities, final report preparation	Univ. of Arizona, Dept. of Family and Community Medicine, Tucson
July 30-Aug 17, 1985	Abdel Rahman El Seidi Professor of Agricultural Economics, Fayoum Univ.	Computer-aided analysis of data on nutrition interventions	Univ. of Arizona, Dept. of Family and Community Medicine, Tucson Tennessee State Univ., International Food & Agricultural Dev., Nashville NAS, Washington, D.C.

DATE	NAME	PURPOSE	PLACE VISITED
August 5-20, 1985	Sylvia K. El Arini* Professor of Biochemistry	In vivo methodologies for quantitative determination of drugs and other trace substances from biological fluids	Food & Drug Administration Biopharmaceutics Lab, Washington
Oct. 18-Nov. 2, 1985	Amin Abdou Professor of Agricultural Economics, NRC	Data reduction/analysis for nutrition and health aspects of MBF for final report	Univ. of Arizona, Dept. of Family and Community Medicine, Tucson Tennessee State Univ., International Food & Agric. Dev., Nashville
	Abdel R. El Seidi Professor of Agricultural Economics, Fayoum Univ.		
March 2-11, 1986	Osman Galal* Head, Nutrition Institute	Analysis of nutrition interventions and completion of report	Univ. of Arizona, Dept. of Family and Community Medicine, Tucson NAS, Washington, D.C.

*International travel paid by another source.

FACT-FINDING AND STUDY VISITS
 January 1, 1978, through June 30, 1986
DEVELOPMENT AND APPLICATION OF BIOGAS TECHNOLOGY
IN RURAL AREAS OF EGYPT

DATE	NAME	PURPOSE	PLACE VISITED
Nov. 2-29, 1979	Fatma El-Gohary Head, Environmental Sciences Division, NRC	State-of-the-art examination of biogas research and applica- tions; economic and social aspects of Asian biogas programs	People's Republic of China (visit coordinated by Chinese Academy of Sciences)
	Adel M. El-Dayem Professor of Chemical Engineering, Pilot Plant Laboratory, NRC		Thailand (visit coordinated by Economic Social Commission for Asia & the Pacific/ESCAP)
	Mohiy E. Abdel-Samie Microbial Chemistry Laboratory, NRC		India (visit coordinated by Dept. of Agriculture and the Water Pollution Control Board, Gujarat State)
	Hoda Mohamed Megahed Head, Rural Research Unit National Center for Social & Criminological Research		
	Said M. Badr El-Din Soil Laboratory, NRC		
April 10-30, 1980	Mohamed M. El-Halwagi Head, Pilot Plant Lab. NRC	4th Internatl. Symposium on Livestock Wastes Bio-Energy '80 World Congress Biogas for community- scale digesters	Amarillo, Texas
			Atlanta, Georgia
			Clean Energy Research Institute, University of Miami, Coral Gables Florida Fiat Co., Total Energy Module System (TOTEM), Rome, Italy

DATE	NAME	PURPOSE	PLACE VISITED
May 10-June 4, 1980	Mohiy Abdel-Samie Microbial Chemistry Laboratory, NRC	American Society of Microbiologists Annual Meeting Anaerobic digestion for methane production	Miami Beach, Florida University of Illinois, Urbana University of Wisconsin, Madison USDA Forest Products Lab, Madison, Wis. Institute of Gas Technology, Chicago, Illinois Dr. T.B.S. Prakasam, Chicago, Illinois (NAS advisory committee member)
Dec. 5-17, 1980	A. M. Abdel-Dayem Professor of Chemical Engineering, NRC	3rd Miami International Conference on Alterna- tive Energy Sources Meet with NAS advisers	Bal Harbour, Florida Dr. T.B.S. Prakasam, Chicago, Ill. Dr. Philip Goodrich, Univ. of Minn.
July 7-31, 1981	M. M. El Halwagi Head, Pilot Plant Laboratory NRC	National Seminar on Biogas Technology Technical visits to biogas pilot plant centers in Asia	Punjab Agricultural University, Ludhiana, India Central Drug Research Institute, Lucknow, India Gujarat Agro-Industries Corp.Ltd. Ahmedabad, India Khadi and Village Industries Commission, Bombay Centre for Non-Conventional Energy Development, Quezon City, Phil- ippines Bureau of Animal Industry, Manila Naval R&D Centre, Cavite City, Philippines Central Luzon State University Philippines Maya Farms, Rizal, Philippines Chinese Academy of Sciences, Peking Chemical Metallurgy Institute, Peking Guangzhou Institute of Energy Conversion, Canton, China

DATE	NAME	PURPOSE	PLACE VISITED
Nov. 29-Dec. 18, 1981	Mohamed A. Hamad Assoc. Professor, Pilot Plant Laboratory, NRC	4th Miami Internatl Conference on Alterna- tive Energy Sources; current biogas R&D activities Meet with NAS adviser	Miami Beach, Florida Clean Energy Research Institute, Univ. of Miami, Coral Gables, Fla. RefCOM, Pompano Beach, Florida Institute of Gas Technology, Chicago Univ. of Illinois, Dept. of Sanitary Engineering, Urbana, Illinois Cornell University, Dept. of Ag. Engineering, Ithaca, N.Y. Dr. T.B.S. Prakasam, Chicago, Ill.
Dec. 13-23, 1981	Fatma El-Gohary Head, Environmental Sciences Division, NRC	4th Miami Internatl Conference on Alterna- tive Energy Sources; current biogas R&D activities Meet with NAS adviser	Miami Beach, Florida Clean Energy Research Inst., Univ. of Miami, Coral Gables, Florida RefCOM, Pompano Beach, Florida Institute of Gas Technology, Chicago Dr. T.B.S. Prakasam, Chicago
Jan. 21-Feb 5, 1982	A. M. Abdel-Dayem Professor of Chemical Engineering, NRC	Symposium: Energy from Biomass and Wastes; biogas project review with U.S. advisors	Lake Buena Vista, Florida Univ. of Minnesota, Dept. of Agricultural Engineering Cornell Univ., Dept. of Rural Sociology
Oct. 21-Nov. 10, 1982	Shawky El-Hawary Water Pollution Control Laboratory, NRC	Detection of pathogenic bacteria and viruses in waste water and sludges	U.S. Environmental Protection Agency, Health Effects Research Lab., Cincinnati, Ohio Baylor University, Dept. of Virology and Epidemiology, Houston, Texas

DATE	NAME	PURPOSE	PLACE VISITED
Oct.29-Nov.19, 1982	S. M. Badr El-Din Soil Microbiology Unit Soil Laboratory, NRC	Soil microbiology, organic manuring, biological nitrogen fixation	USDA Agricultural Research Center, Beltsville, Md. Univ. of Illinois, Dept. of Agronomy, Urbana Univ. of Minnesota, Dept. of Soil Science, St. Paul Univ. of California at Davis, Dept. of Soil Science USDA Soil Conservation Service, Washington, D.C.
Jan.20-Feb.20, 1983	M. M. El Halwagi Head, Pilot Plant Lab., NRC	Symposium: Energy from Biomass & Wastes VII Review various bioenergy research projects	Lake Buena Vista, Florida Univ. of California at Los Angeles Environmental Health Dept. Univ. of California, Berkeley, Dept. of Environmental Health and Sanitary Engineering SRI International, Menlo Park, Calif. New Brunswick Scientific Instruments Co., Edison, New Jersey University College, Microbiology Dept., Cardiff, Wales London Brick Landfill Ltd., Bedford, U.K.
		Meet with U.S. advisors	Dr. Harold Capener, Cornell Univ., Dept. of Rural Sociology (with Drs. Philip Goodrich & T.B.S. Prakasam)

DATE	NAME	PURPOSE	PLACE VISITED
May 1-30, 1983	Mohamed A. Hamad Asst. Professor, Pilot Plant Laboratory, NRC	Conference on Biomethan- ation Systems Fact-finding re biogas experience in rural areas of Asia	Bangkok, Thailand National Institute of Science & Tech- nology, Manila, Philippines Institute of Agricultural Science, Seoul, Korea National University, College of Agriculture, Seoul, Korea Bio-energy Laboratory, Chengdu Institute, Sichuan, China Guangzhou Institute of Energy Sources, Guangzhou, China Indian Institute of Technology, Bombay, India Khadi Village Industries Commission, Gobar Gas R&D Center, Bombay National Institute of Waste Recycling Technology, Bombay Indian Institute of Science, Center for Application of S&T for Rural Areas, Bangalore, India
June 2-30, 1983	Samy El-Afifi Asst. Professor, Pilot Plant Laboratory, NRC	Atomic spectroscopy & gas chromatography courses Analysis of organic pollutants and toxicants in wastewater	Perkin-Elmer Corporation, Norwalk, Conn. Metropolitan Sanitary District of Greater Chicago, Chicago, Ill.
June 5-24, 1983	Mohamed A. Khalafallah Researcher, Soil and Water Use Laboratory, NRC	Nitrogen fixation by microbial populations, fluorescent antibody techniques for soil microbial ecology 9th North American Rhizobium Conference	Univ. of Minnesota, Dept. of Soil Science, St. Paul, Minn. Boyce Thompson Institute, Cornell Univ., Ithaca, N.Y.

DATE	NAME	PURPOSE	PLACE VISITED
Aug.11-Sept.3, 1983	A. M. Abdel-Dayem Professor of Chemical Engineering, NRC	3rd International Symposium on Anaerobic Digestion Observe research programs of Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) in Brazil, including field visits	Boston, Mass. EMBRAPA, Brasilia National Research Center for Dairy Cattle, Juiz de Fora, Minas Gerais National Research Center for Corn and Sorghum, Sete Lagoas, Minas Gerais Institute of Technological Research, (IPT), Sao Paulo Cia. de Tecnologia e Saneamento Basico (CTESB), Sao Paulo Saneamento Basico de Sao Paulo (SABESP) Sao Paulo UEPAE/PELOTAS, Pelotas, Rio Grande do Sul National Research Center for Swine and Poultry, Concordia, Santa Catarina National Research Center for Rice and Beans, Goiania, Goias
Apr.23-May 18, 1984	Shirin I. El Shawarby Assoc. Professor of Chemical Engineering, NRC	Training on Perkin-Elmer instrumentation Fact-finding on bio- chemical engineering instrumentation and scale-up to pilot plant	Perkin-Elmer Corp., Norwalk, Conn. Univ. of Virginia, Dept. of Chemical Engineering, Charlottesville, Va. BioChem Technology Inc., Malvern, Pa. Merck Chemical Mfg. Div., Merck and Co., Elkton, Va.
May 30-June 30, 1984	M. M. El Halwagi Head, Pilot Plant Laboratory, NRC	Planning re November biogas conference 9th International Conf- erence on Energy, Power and Environment BioEnergy '84 World Conference CHEMRAWN III World Conference	NAS, Washington, D.C. AID/BSP, Washington, D.C. Washington Suburban Sanitary Commission Beltsville, Md. Metropolitan Sanitary District of Greater Chicago San Francisco, Calif. Gothenburg, Sweden The Hague, The Netherlands

DATE	NAME	PURPOSE	PLACE VISITED
May 16-June 18, 1985	M. M. El Halwagi Head, Pilot Plant Laboratory, NRC	Editorial and publication arrangements for proceedings of Nov. International Biogas Conference 1984	NAS, Washington, D.C. AID, Washington, D.C. Univ. of California at Los Angeles Dynatech, Boston, Mass. Publishers in London and in Frankfurt, Germany

FACT-FINDING AND STUDY VISITS

January 1, 1978, through June 30, 1986

NEW CROPS FOR ARID AND SEMI ARID ZONES OF EGYPT

<u>DATE</u>	<u>NAME</u>	<u>PURPOSE</u>	<u>PLACE VISITED</u>
July 8-29, 1979	Adel El-Beltagy* Faculty of Agriculture Ain Shams University	Meet with NAS advisors and other U.S. arid land specialists	Utah State University, Logan, Utah Plant Resources Institute, Salt Lake City, Utah University of Arizona, Tucson University of California, Riverside University of California, Davis
Jan.22-Feb.13, 1981	Adel El-Beltagy Faculty of Agriculture Ain Shams University	New techniques for development of salt- and drought-tolerant crops determine suitable sites for Phase II training activities	USDA Agricultural Research Center, Beltsville, Md. University of Wisconsin, Madison University of California, Davis University of California, Riverside University of Arizona, Tucson Texas Tech University, Lubbock, Texas Texas A&M University, College Station
Nov.29-Dec.20, 1981	Abdel R. Sharaf Professor of Horticulture Faculty of Agriculture Ain Shams University	Arid zone salinity problems, plant nutrition, soil fertility	University of California, Davis U.S. Salinity Laboratory, Riverside, Calif. University of California, Riverside University of Arizona, Tucson Texas Tech University, Lubbock, Texas USDA Agricultural Research Center, Beltsville, Maryland

*International airfare provided from non-program funds

NEW CROPS FOR ARID AND SEMI ARID ZONES OF EGYPT

<u>DATE</u>	<u>NAME</u>	<u>PURPOSE</u>	<u>PLACE VISITED</u>
Jan.14-30, 1982	Zein E. Shoeb Chairman, Dept. of Food Science and Nutrition, NRC	Oil crops production and processing	NAS, Washington USDA Agricultural Research Center, Beltsville, Md. Univ. of Arizona, Tucson Univ. of California, Riverside Agra-Energy, Inc., Newport Beach, Calif. Native Plants, Inc., Salt Lake City, Utah Cargill, Inc., Wichita, Kansas
Jan. 14-29, 1982	Sirag Lashin Asst. Professor, Plant Protection Laboratory, NRC Aziza El Sharaby Asst. Professor, Plant Protection Laboratory, NRC	Plant protection	NAS, Washington USDA Agricultural Research Center, Beltsville, Md. Univ. of Arizona, Tucson Univ. of California, Riverside Univ. of California, Davis
June 28-Aug.21,1982	Zaki El Sawi Horticulture Dept., Ain Shams University, Cairo	Plant Propagation through Tissue Culture course Commercialization of tissue culture techniques	Univ. of California, Riverside Native Plants, Inc., Salt Lake City,
July 6-27, 1982	Talaat El-Kobbia Professor of Plant Nutrition, Ain Shams Univ. University	Plant nutrition, soil salinity, drip irrigation hydroponics, fertilizer applications	USDA Agricultural Research Center, Beltsville, Md. Native Plants, Inc., Salt Lake City, Utah Univ. of California, Davis Univ. of California, Riverside U.S. Salinity Laboratory, Riverside California Texas Tech Univ., Lubbock, Texas Univ. of Arizona, Tucson
July 25-Aug.21,1982	Maher Amin Waly* Assoc. Professor of Horticulture, Al Azhar University, Cairo	Commercialization of tissue culture techniques Soil analysis, micro- element deficiency	Native Plants Inc., Salt Lake City, Utah Albion Laboratories, Clearfield, Utah

*Airfare provided by non-program funds

Aug. 12-Sept. 4, 1982	Abd El-Mageid Sleem Horticulture Dept., Al Azhar University	Commercialization of tissue culture techniques 3rd annual meeting, Guayule Rubber Society Field operations, propagation, breeding of guayule	Native Plants, Inc., Salt Lake City, Utah El Paso, Texas Univ. of Arizona, Tucson Univ. of California, Davis
-----------------------	---	---	--

TECHNICAL AND SOCIOECONOMIC EVALUATION OF
IRRIGATION SYSTEMS IN THE NEW LANDS

<u>DATE</u>	<u>NAME</u>	<u>PURPOSE</u>	<u>PLACE VISITED</u>
Feb. 8-27, 1986	Farouk Abdel Al Water Distribution and Irrigation Systems Research Institute (WDISRI)	Current technologies in irrigation and water management, sprinkler and drip irrigation systems, system maintenance and repair, water conservation and water harvesting methods	Univ. of California, Davis USDA Water Management Research Lab., Fresno, Calif. Univ. of Calif. Kearney Agricultural Field Station Farms in Colusa County, Calif. County Farm Advisor, Salinas, Calif. U.S. Salinity Laboratory, Riverside, Calif. Univ. of Arizona, Tucson Colorado State Univ., Fort Collins U.S. Bureau of Reclamation, Denver, Colorado
	A. W. Abdel Wahed Vice Director for Agricultural Projects, Arab Contractors		
	Abdel Hamid Abou Sabe Chairman, Managing Board, International Center for Rural Development		
	Abdel Ati Allam WDSRI		
	Nadia Wahby WDSRI		
	Balaigh Shindi Zikri Director, Soil and Water Research Institute, Ministry of Agriculture		

FACT-FINDING AND STUDY VISITS

January 1, 1978, through June 30, 1986

EVALUATION OF EGYPTIAN PHOSPHATE ORES AND PHOSPHATE FERTILIZER PRODUCTION

<u>DATE</u>	<u>NAME</u>	<u>PURPOSE</u>	<u>PLACE VISITED</u>
Oct.22-Nov.4, 1978	Aziza Yousef Head, Mineral Beneficiation and Extractive Metallurgy Dept., NRC	Orientation with U.S. phosphate fertilizer industry	National Fertilizer Development Center, TVA, Muscle Shoals, Alabama International Fertilizer Development Center (IFDC), Muscle Shoals, Alabama U.S. Bureau of Mines, Tuscaloosa, Ala. Aquafine Corp., Brunswick, Georgia International Minerals & Chemicals Corp., Lakeland, Florida Fertilizer Roundtable, Atlanta, Georgia
Sept.29-Oct.27, 1979	Tawfic Boulos Research Professor Metallurgy Dept. NRC Samir El-Nozahy Researcher Metallurgy Dept.,NRC	Pilot plant scale equipment and commercial beneficiation methods	Denver Equipment Division, Joy Mfg. Co. Colorado Springs, Colorado Hazen Research, Golden, Colorado Colorado School of Mines Research Institute, Golden, Colorado U.S. Bureau of Mines, Salt Lake City Utah International Fertilizer Development Center, Muscle Shoals, Alabama International Minerals & Chemicals Corp Lakeland, Florida U.S.S. Agrichemicals, Bartow, Florida Gardinier Inc., Tampa, Florida Davy McKee Inc., Lakeland, Florida
Oct.5-Dec.15, 1979	Selim I. Moustafa Assoc. Professor Metallurgy Dept.,NRC Adel K. Ismail Researcher Metallurgy Dept. NRC	Pilot plant scale ore beneficiation and wet chemical processing	International Fertilizer Development Center, Muscle Shoals, Alabama

Apr. 19-26, 1980	Aziza Yousef Head, Mineral Beneficiation and Extractive Metallurgy Dept., NRC	2nd International Congress on Phosphorus Compounds	Boston, Massachusetts
	Tawfik Boulos Research Professor Metallurgy Dept., NRC		
Sept. 6-Nov. 8, 1980	Samy El-Afifi Senior Research Officer, Pilot Plant Lab., NRC	Chemical conversion of phosphate ores	International Fertilizer Development Center, Muscle Shoals, Alabama International Minerals & Chemicals Corp., Lakeland, Florida Gardiner, Inc., Tampa, Florida U.S.S. Agrichemicals, Bartow, Florida
	Abdel Gwade Saber Manager, Laboratories & Quality Control, Societe Financiere et Industrielle d'Egypte		
Sept. 7-21, 1980	A. F. Sabry Chairman Societe Financiere et Industrielle d'Egypte	Commercial phosphate processing	World Bank, Industrial Projects Dept., Washington, D.C. Tetra Tech International, Washington Agrico International, Tulsa, Okla, and South Pierce, Florida International Fertilizer Development Center, Muscle Shoals, Alabama National Fertilizer Development Center, TVA, Muscle Shoals, Alabama
Sept. 26-Oct. 10, 1981	Aziza Yousef Head, Mineral Bene- ficiation & Extract- ive Metallurgy Dept. NRC	Technical aspects of fertilizer manufacturing; calcination of phosphate ores	North Carolina State University, Asheville, N.D. Texas Gulf Chemicals Co , Aurora, N.D. J.R. Simplot Co., Pocatello, Idaho Becker Industries, Conda, Idaho U.S. Bureau of Mines, Albany, Oregon
	Tawfik Boulos Research Professor Metallurgy Dept., NRC		

Nov. 28-Dec.19, 1981

Selim F. Estefan
Professor of
Metallurgy, Central
Metallurgical R&D
Institute (CMRDI)

Talaat A.B. Lawendy
Assoc. Professor of
Metallurgy, CMRDI

Fertilizer granulation
technology

International Fertilizer Development
Center, Muscle Shoals, Alabama

FACT-FINDING AND STUDY VISITS
January 1, 1978, through June 30, 1986

CORROSION CAUSES AND CONTROL

<u>DATE</u>	<u>NAME</u>	<u>PURPOSE</u>	<u>PLACE VISITED</u>
March 1-23, 1980	Venice Gouda Chairman, Physical and Inorganic Chemistry Dept. NRC	National Association of Corrosion Engineers (NACE) Corrosion '80 Symposium; monitoring and control of corrosion	Chicago, Illinois Amoco Research Center, Naperville, Ill. Mobil R&D Corp., Paulsboro, New Jersey Mobil Field Research Lab., Dallas, Texas Unichem International, Hobbs, New Mexico
Oct.20-Nov.7, 1980	Sayed M. Sayed Corrosion Laboratory Physical Chemistry Dept., NRC	Corrosion monitoring techniques, refinery failure analysis	Amoco Research Center (Standard Oil Co., Indiana), Naperville, Illinois and Whiting Refinery, Whiting Indiana
Feb.12-Mar.29, 1981	Talaat M.H. Saber Research Professor Corrosion Lab, NRC Abdel G.A. El-Hosary Asst. Research Professor Corrosion Lab., NRC	Training on Electron Spectroscopy for Chemical Analysis (ESCA) equipment	Perkin-Elmer, Physical Electronics Div., Eden Prairie, Minnesota University of Minnesota, Minneapolis Battelle Northwest Laboratories, Richland, Washington
May 9-28, 1983	Abdel Ghany El Hosary Research Professor	Corrosion inhibitors International Conference on Corrosion Inhibition	Lehigh Univ., Center for Surface and Coatings Research, Bethlehem, Pa. Ohio State Univ., Fontana Corrosion Center, Columbus, Ohio Mobil R&D Laboratories, Dallas, Texas Unichem International, Hobbs, N.M. Amoco Research Center, Naperville, Ill. Dallas, Texas

FACT-FINDING AND STUDY VISITS
January 1, 1978, through June 30, 1986

WOOL SCOURING AND WOOL WAX

DATE	NAME	PURPOSE	PLACE VISITED
Jan. 6-26, 1980	<p>Adel A. Kantouch Research Professor of Textile Chemical Technology, Textile Research Division, NRC</p> <p>Ahmed N. El-Bendak Professor, Textile Research Division, NRC</p>	<p>U.K.: study "Lo-Flow" and "WRONZ" wool scouring systems U.S.: marketing & R&D management methods; processing of wool wax into lanolin and other derivatives</p>	<p>International Wool Secretariat, Ilkley, Yorkshire, U.K. Sir James Hill & Son, Ltd., Bradford, Yorkshire, U.K. Croda, Inc., Rawcliff Bridge, Yorkshire Jarmain & Co., Huddersfield, Yorkshire University of Leeds, Textile Dept., Yorkshire, U.K. Burlington Industries, Clarksville, Va. North Carolina State Univ., School of Textiles, Raleigh, N.C. Cotton Incorporated, Raleigh, N.C. The Wool Bureau, Long Island, N.Y. Amerchol, Inc., Edison, New Jersey</p>
Apr. 17-May 9, 1982	<p>Adel A. Kantouch Head, Textile Research Laboratory, NRC</p>	<p>Operational procedures and preventive maintenance for Lo-Flow wool scouring process Orientation on install- ation, operation, and maintenance of centrifuge to be installed at Misr Beida Dyers plant</p>	<p>International Wool Secretariat, London headquarters and pilot plant at Ilkley, Yorkshire</p> <p>Alfa Laval Company, France and Sweden</p>
Apr 27-May 9, 1982	<p>Abou Zeid Production Director, Misr Beida Dyers Company, Alexandria</p> <p>W. Khalil Maintenance Manager, Misr Beida Dyers Company, Alexandria</p>	<p>Orientation as above</p>	<p>Alfa Laval Company, France and Sweden</p>

FACT-FINDING AND STUDY VISITS
January 1, 1978, through June 30, 1986

DEVELOPMENT OF RED SEA FISHERIES

DATE	NAME	PURPOSE	PLACE VISITED
Jan.15-Feb.1, 1981	A. R. Bayoumi Director, Institute of Oceanography & Fisheries ASRT	Meetings with NAS advisory committee	Ben Jones, National Marine Fisheries Service, Seattle, Washington Alonzo Pruter, Seattle, Washington Harvey R. Bullis, Princeton, Florida
Feb.22-Apr.24, 1981	Sherif Ramadan Asst Lecturer Institute of Oceanography & Fisheries, ASRT	Spiny lobster fishery development and research management	National Marine Fisheries Service Miami, Florida; Panama City, Florida; Beaufort, S.C., Highlands, N.J. Florida Dept. of Natural Resources St. Petersburg and Marathon, Florida Virgin Islands Dept. of Conservation & Cultural Affairs, Division of Fish & Wildlife, Charlotte Amalie, V.I. U.S. Environmental Protection Agency, Gulf Breeze, Florida Duke University Marine Laboratory, Beaufort, N.C. Museum of Natural History, Smithsonian Institution, Washington, D.C.

FACT-FINDING AND STUDY VISITS
January 1, 1978, through June 30, 1986

PREPARATION OF SELECTED PHARMACEUTICAL CHEMICALS

<u>DATE</u>	<u>NAME</u>	<u>PURPOSE</u>	<u>PLACE VISITED</u>
April 13-23, 1983	Mohamed B. Fayez Vice President, ASRT	Industrial scale-up factors, opportunities for training in U.S. industries S&T policy discussions	Food & Drug Administration, Washington Ciba-Geigy Co., Cranston, R.I. Creighton Univ., Omaha, Nebraska Merck Sharp & Dohme Research Labs, Rahway, N. J. The Upjohn Company, Kalamazoo, Mich. National Science Foundation, Division of Science Resources Studies, Washington, D.C.
July 21-Aug.20,1983	Ahmed Salem Radwan Research Professor, Natural Products Research Lab., NRC Ahmed F. Aboulezz Professor of Organic Chemistry Natural Products Research Lab., NRC	Manufacture of synthetic pharmaceuticals in U.S. companies	Ciba-Geigy Corporation, Summit, N.J. The Upjohn Company, Kalamazoo, N.J. Sterling Winthrop Research Institute, Renssalaer, N.Y. Smith Kline & French Laboratories, Swedeland, Pa. Hoechst-Roussel Pharmaceuticals, Inc. Somerville, N.J.
Aug.4-Sept.3, 1983	Effat A. Abu-Mustafa Research Professor, Natural Products Research Lab., NRC Mohamed Aboul-Enein Professor of Pharmaceutical Chemistry, NRC	Manufacture of synthetic pharmaceuticals in U.S. companies	Merck Sharp & Dohme Research Labs., Rahway, N.J. The Upjohn Company, Kalamazoo, Mich. Ciba-Geigy Corporation, Summit, N.J. Lederle Laboratories, Pearl River, N.Y.

May 10-June 2, 1984	<p>Zakaria S. Kahfagi Chairman, El Nasr Pharmaceutical Chemicals Co.</p>	<p>Scale-up operations, quality control, safety measures, environmental concerns in U.S. industry</p>	<p>The Upjohn Company, Kalamazoo, Mich. Merck Sharp and Dohme Research Labs., Rahway, N.J. Ciba-Geigy Corporation, Summit, N.J.</p>
	<p>Osama A. W. Kebir Director of Research and Quality Control, El Nasr Pharmaceutical Chemicals Co.</p>		
	<p>Mohamed M. Abo Roumia Head, Development & Project Sector, El Nasr Pharmaceutical Chemicals Co.</p>		
	<p>Faten Ahmed Hamouda Professor of Chemical Engineering, NRC</p>		
	<p>Mohamed Z. Mahmoud Yehya Chief Engineer, Pilot Plant Laboratory, NRC</p>		
Feb. 16-Mar. 6, 1985	<p>Farag Aly F. Hassan El Nasr Pharmaceutical Chemicals Co.</p>	<p>Pilot plant procedures and scale-up in India</p>	<p>Cadila & Cadmich, Ahmedabad Ambalal Sarabhai Enterprises Ltd., Baroda Unichem, CIPLA, Bombay ICPL Ltd. Regional Research Lab., Center for Cellular and Molecular Biology, Hyderabad Ranbaxy Labs Ltd., Delhi</p>

FACT-FINDING AND STUDY VISITS

January 1, 1978, through June 30, 1986

INVESTIGATION AND EVALUATION OF EGYPTIAN BENTONITES

DATE	NAME	PURPOSE	PLACE VISITED
Oct. 1-15, 1983	Adel Abdul-Azim Director, Central Metallurgical Institute (CMRDI)	R&D and marketing of bentonite clays, production scale mining operations, chemical conversion of bentonites	American Colloid Corp., Skokie, Ill., and Belle Fourche, South Dakota International Minerals and Chemicals Corp., Mundelein, Illinois, and Colony, Wyoming.
	Tawfik Refaat Boulos Professor, CMRDI	Discussions re future training opportunities	Haydn Murray, project advisor, Indiana University, Dept. of Geology Colorado School of Mines Research Institute, Golden, Colorado Denver Research Institute, Denver Colorado
	Abdel Kader Atia Staff Scientist CMRDI	Discussions re R&D management workshop to be held in Cairo Training on x-ray diffraction methods for classification of clay minerals (Dr. Atia only)	Indiana University, Dept. of Geology, Bloomington, Indiana
		Mineral beneficiation; additional activities for phosphate project (Drs. Abdul-Azim and Boulos)	International Fertilizer Development Muscle Shoals, Alabama
Apr. 9-22, 1984	M. Fouad Abdel Azim General Manager General Petroleum Co. Nasr City	Applications of bentonites in oil well drilling fluids	Amoco Research Labs, Tulsa, Oklahoma Dowell Division, Dow Chemical Co., Tulsa, Oklahoma Magco Research, Houston, Texas NL Baroid Corp., Houston, Texas Mobil Field Research Lab., Dallas, Texas

Sept.6-Oct.9,1984	Abdel K. Ismail Head, Hydrometallurgy Section, CMRDI	Preparation of bentonites for metals casting and oil well drilling fluids; scale-up of acid/alkali activation processes from pilot plant to production level	Sud-Chemie, Munich, Germany Magcobar Division, Dresser Industries Houston, Texas, and Greybull, Wyoming Weintritt Testing Laboratories, Lafayette, Louisiana Southern Clay Products, Gonzalez,Texas George Fischer Foundry Systems, Inc. Holly, Michigan
	Nabil Sobhy Felix Head, Moulding Material Laboratory, CMRDI	Discuss project progress with advisor Dr. Haydn Murray	Indiana University, Dept. of Geology, Bloomington, Indiana
		Review equipment operation and maintenance proce- dures for chemical conversion of phosphate materials	International Fertilizer Development Center, Muscle Shoals, Alabama (Dr. Ismail only)
Sept. 17-Oct.6,1984	Sabah N. Boulos Professor of Earth Sciences CMRDI	Bentonite mining and production; analysis and testing of Egyptian bentonite samples in Dr. Haydn Murray's lab.	Magcobar Division, Dresser Industries Greybull, Wyoming Indiana University, Department of Geology, Bloomington, Indiana
Feb.20-Mar.6, 1985	Abdel Kader M. Atia Professor of Geology NRC	Annual meeting, American Institute of Mining, Metallurgical & Petroleum Engineers Orientation visits in Washington	New York City U.S. Bureau of Mines, Washington,D.C. U.S. Geological Survey, Washington,D.C.

FACT-FINDING AND STUDY VISITS

January 1, 1978, through June 30, 1986

RESEARCH AND DEVELOPMENT (R&D) MANAGEMENT SYSTEMS

DATE	NAME	PURPOSE	PLACE VISITED
June 18-July 7, 1979	13 participants	Seminar on R&D Management Methods	Denver Research Institute, Denver, Colo.
July 9-27, 1979	10 participants	Seminar on Technical Economics	Denver Research Institute, Denver, Colo.
Aug. 20-Sept. 7, 1979	9 participants	Seminar on R&D Marketing	Denver Research Institute, Denver, Colo.
Sept. 10-28, 1979	11 participants	Seminar on Technology Assessment	Denver Research Institute, Denver, Colo.
	For names of participants in Denver Research Institute (DRI) seminars, see Annex B		
Aug. 8-Sept. 8, 1981	Hatem Ali Head, Animal and Poultry Lab., NRC Sami H. Fayed Assoc. Professor, Water Pollution Control Labs, NRC	U.S. Office of Personnel Management course on "Developing Workstatements for Negotiated Procurements and "Introduction to Program Evaluation" U.S. General Services Adm. course on "R&D Contracting" Other R&D mgt visits	Washington D.C. National Technical Information Service (NTIS), Springfield, Va. Volunteers in Technical Assistance (VITA), Mt. Rainier, Md. USDA Agricultural Research Center Beltsville, Md. General Foods Corp., Tarrytown, N.Y.

DATE	NAME	PURPOSE	PLACE VISITED
July 31-Aug.21,1982	Aboul F. Abdel Latif Vice President ASRT A. S. El Nockrashy Director, Foreign S&T Programs, ASRT Yousef Khalil Mazhar Director, Engineering and Design Development Center, Ministry of Industry	Battelle International Program in Productive R&D Management	Columbus, Ohio
June 11-29, 1983	M. M. El Halwagi Head, Pilot Plant Laboratory	Management of Research, Development, and Technology-based Innovation	MIT, Cambridge, Mass.
July 30-Aug.27,1983	Mahfouz A. M. Kassem Head, Pharmaceutical Sciences Laboratory, NRC Ahmed Ibrahim Naguib Head, Program Implementation Office of the Vice President ASRT Mohamed Hilal Head, Technology Transfer Supervisor, Office of the President, ASRT Ibrahim Fawzi Advisor for University Affairs ASRT	Battelle International Program in Productive R&D Management Visits to relevant U.S. agencies in Washington	Columbus, Ohio U.S. Food & Drug Administration, Biopharmaceutics Laboratory National Science Foundation, Science Resources Studies Division National Science Foundation, Division of International Programs National Science Foundation, Division of Policy Research and Analysis Office of Technology Assessment, U.S. Congress National Technical Information Service, Office of Development Assistance Programs

DATE	NAME	PURPOSE	PLACE VISITED
Oct.20-Nov.13,1983	Farouk M. Taleb Specialized Research Council ASRT Abdel Hamid Agha NRC and ASRT Sinai Project	Workshop on R&D Project Management	Denver Research Institute, Denver, Colorado
Nov. 10-Dec.11,1983	Zein A. Shoeb Chairman, Dept. of Food Science, NRC Mohamed I. Roushdi Secretary General Petroleum Research Institute	Workshop on R&D Institute Management	Denver Research Institute, Denver, Colorado
April 17-May 4,1984	Tawfik Galal Director, Office of Public Relations, ASRT	Seminar on New Communica- tion Methods in S&T	University of Kansas, Lawrence, Kan.
May 26-June 16,1984	Adel Abdul Azim Director, Central Metallurgical R&D Institute (CMRDI)	Models for management information systems, R&D marketing, management decentralization, management evaluation of R&D	Battelle Memorial Institute, Columbus Ohio Arthur D. Little, Inc., Cambridge, Mass. MIT, Cairo University/MIT Program, Cambridge, Mass.
July 23-Aug.1,1985	Nabil Saleh Coordinator, International Programs, NRC	Project planning and review; equipment M&R	Battelle Memorial Institute, Columbus Ohio American Chemical Society, Washington National Institutes of Health, Washington

DATE	NAME	PURPOSE	PLACE VISITED
Feb.14-Mar.13,1986	Mohamed El Hossieny Head, Programming Office NRC	Management control and evaluation systems in U.S. institutions	AID Office of Evaluation, Washington National Science Foundation, Washington USDA Agricultural Research Center, Beltsville, Md. Battelle Memorial Institute, Columbus, Ohio Ohio Agriculture R&D Center, Wooster, Ohio Univ. of Wisconsin, College of Engineering, Madison USDA Northern Regional Research Center, Peoria, Ill. Washington University, Dept. of Tech- nology and Human Affairs, St. Louis, Missouri Midwest Research Institute, Kansas City, Missouri
Feb. 23-Mar.18,1986	M. M. El Halwagi Head, Pilot Plant Lab., NRC	Marketing methods in selected R&D institutes; review waste water treatment for seaport cities	TUBITAK (Scientific and Technical Research Council of Turkey), Ankara and Istanbul City of Los Angeles Bureau of Sanitation, Hyperion Treatment Facility, Palos Verdes, Calif. SRI International, Menlo Park, Calif. Midwest Research Institute, Kansas City, Missouri Metropolitan Sanitary District of Greater Chicago American Clean Water Association Washington, D.C. World Bank, Washington, D.C. U.S. Environmental Protection Agency, Washington, D.C. Tams Pirnie Inc., New York, N. Y.

FACT-FINDING AND STUDY VISITS
January 1, 1978, through June 30, 1986

SCIENCE AND TECHNOLOGY POLICY MEASURES

<u>DATE</u>	<u>NAME</u>	<u>PURPOSE</u>	<u>PLACE VISITED</u>
May 1-12, 1983	<p>Mahmoud Mahfouz Member, ASRT Committee on S&T Policy</p> <p>Essam Galal Member, ASRT Committee on S&T Policy</p>	S&T policy discussions	<p>MIT, Technology Adaptation Program Cambridge, Mass.</p> <p>MIT, Center for Policy Alternatives, Cambridge, Mass.</p> <p>Harvard University, J.F. Kennedy School of Government, Cambridge, Mass.</p> <p>New York University, Center for Science and Technology Policy, New York</p> <p>George Washington University, Program on Policy Studies in S&T, Washington</p> <p>Office of S&T Policy, Executive Office of the President, Washington, D.C.</p> <p>Office of Technology Assessment, U.S. Congress, Washington, D.C.</p> <p>National Science Foundation, Washington</p>

ANNEX B
EGYPTIAN PARTICIPANTS, RESEARCH AND DEVELOPMENT
MANAGEMENT TRAINING PROGRAMS
DENVER RESEARCH INSTITUTE
DENVER, COLORADO
1979

- R&D Management Methods, June 18-July 7, 1979
- Technical Economics, July 9-27, 1979
- R&D Marketing, August 20-September 7, 1979
- Technology Assessment, September 10-28, 1979

PARTICIPANTS IN RESEARCH & DEVELOPMENT MANAGEMENT

TRAINING PROGRAMS

Denver Research Institute
Denver, Colorado

<u>NAME</u>	<u>PRESENT POSITION</u>	<u>PRINCIPAL FIELD</u>
<u>RESEARCH & DEVELOPMENT MANAGEMENT METHODS (June 18-July 7, 1979)</u>		
Adel A. Abdel-Azim	Director, Central Metallurgy Research Institute, NRC	Physical Chemistry
Hatem M. Ali	Head, Department of Animal and Poultry Nutrition, NRC	Biochemistry of Nutrition
Ahmed Bakr	Professor, Faculty of Agriculture, Cairo University	Agriculture and Botany
Fathy Mossad Ebeid	Director, Egyptian Petroleum Research Institute	Chemical Engineering
Mohamed M. El-Halwagy	Head, Chemical Engineering & Pilot Plant Department, NRC	Chemical Engineering
Mohamed El-Husseiny	Professor of Food Technology, NRC	Dairy Science
Anas El-Naggar	Program Manager, Research and Development Department, ASRT	Radiation Biology
Mohamed H. Fadl	Professor of Pulp and Paper, NRC	Applied Chemistry
Sami H. Fayed	Program Manager, Environmental Research, NRC	Water and Wastewater Technology
Fahmy Ramadan	Secretary General, NRC	Biochemistry
Nabil A. Saleh	Professor of Organic Chemistry, NRC	Chemistry
Gamila Wassel	Professor of Pharmacognosy, NRC	Pharmacognosy
Mahmoud I. Younis	Head, Systems and Information Sciences Unit, NRC	Electrical Engineering
<u>TECHNICAL ECONOMICS (July 9-27, 1979)</u>		
Nour El-din Abdel-Aziz	R&D Division, Industry & Technology Transfer Program, National Institute of Standards, ASRT	Physics
Hussein Badawy	Head, Department of Marine Biological Reference Collection, Institute of Oceans & Fisheries, ASRT	Marine Biology

Mohamed Said Mustafa Badawy	Agricultural Economics Research Group, More & Better Food Project NRC	Agricultural Economic
Hanafy Aly Deebes	Technical Office of ASRT and Institute of Geophysics and Astronomy	Geophysics
Attia Abd El-Kader	Assoc. Professor of Mechanical Engineering, NRC	Mechanical Engineering
Mohamed Ali Ghobashi	Head, Optics Division, Scientific Instruments Centre, and Technical Office, ASRT	Technical Optics
Ahmed Labib Hussein	Head, Refractories & Building Materials Laboratory, NRC	Chemistry
Shadia Ragheb Tewfik	Pilot Plant Division, Biogas Project, NRC	Chemical Engineering
Hammam Abdel Rahman El-Abd	Pilot Plant Division, Biogas Project, NRC	Chemical Engineering
Aziza Yousef	Head, Mineral Beneficiation and Extractive Metallurgy Dep., NRC; Principal Investigator, Phosphate Ore Project	Mineral Beneficiation

RESEARCH AND DEVELOPMENT MARKETING (August 20-September 7, 1979)

Mostafa Al-Fouly	Head, Marketing Office, NRC	Agriculture
Ali Hebeish	Marketing Office, NRC; Professor of Textile Chemical Technology, NRC	Textile Chemical Technology
Mamdouh Kamel	Marketing Office, NRC, Head, Biochemistry Laboratory, NRC	Biochemistry
Effat Abu Mustafa	Marketing Office, NRC; Research Professor, Natural Products Laboratory, NRC	Applied Organic Chemistry
Hussein Nasr	Assoc. Professor of Textiles, NRC	Applied Organic Chemistry
Mahmoud Saada	Head, Pilot Plant Laboratory, Professor of Chemical and Biomedical Engineering, NRC	Chemical Engineering

ANNEX C

INSTITUTIONS VISITED BY EGYPTIAN SCIENTISTS AND ENGINEERS

JANUARY 1978-JUNE 1986

APPLIED SCIENCE AND TECHNOLOGY RESEARCH PROGRAM

- I. Universities
- II. Government Agencies and Laboratories
- III. Private Industries and Corporations
- IV. Conferences and Technical Meetings
- V. Other Organizations

Appendix C

Institutions Visited, January 1978-June 1986
Applied Science and Technology Research Program

I. UNIVERSITIES

American University
Center for Technology and Administration
Washington, D.C.

Baylor University
Department of Virology and Epidemiology
Houston, Texas

Colorado School of Mines Research Institute
Golden, Colorado

Colorado State University
Fort Collins, Colorado
Department of Agronomy
Department of Agricultural Economics and Natural Resource Economics

Concordia University
Montreal, Quebec, Canada

Cornell University
Ithaca, New York
Department of Food Science
Department of Animal Science
Vegetable Crops Department
Division of Nutritional Sciences
Department of Agronomy
Department of Rural Sociology
Department of Agricultural Engineering

Creighton University
Omaha, Nebraska

Duke University
Marine Laboratory
Beaufort, North Carolina

George Washington University
Program on Science, Technology, and Public Policy
Washington, D.C.

Georgia Institute of Technology
Atlanta, Georgia
Office of International Programs
Engineering Experiment Station
School of Information and Computer Science

Harvard University
Program for Science and International Affairs
Kennedy School of Government
Cambridge, Massachusetts

Indiana University
Department of Geology
Bloomington, Indiana

Iowa State University
Ames, Iowa
Department of Animal Science
College of Veterinary Medicine

Lehigh University
Center for Surface and Coatings Research
Bethlehem, Pennsylvania

Massachusetts Institute of Technology (MIT)
Cambridge, Massachusetts
Center for the Study of Policy Alternatives
Technology Adaptation Program
Energy Laboratory
Department of Nutrition and Food Science

Michigan State University
East Lansing, Michigan
Department of Food Science and Human Nutrition
Department of Dairy Science

National University
College of Agriculture
Seoul, Korea

New York University
Center for Science and Technology Policy
New York, New York

North Carolina State University
Asheville, North Carolina
Minerals Research Laboratory
Textile Chemistry Department, School of Textiles

North Dakota State University
Department of Agronomy
Fargo, North Dakota

Ohio State University
Fontana Corrosion Center
Columbus, Ohio

Tennessee State University
International Food and Agriculture Development
Nashville, Tennessee

Texas A&M University
College Station, Texas
Food Protein Research and Development Center
Department of Entomology
Plant Science Department

Texas Tech University
Lubbock, Texas
Department of Biology
Department of Chemical Engineering

Tufts University
Nutrition Institute
Medford, Massachusetts

Tulane University
New Orleans, Louisiana
Nutrition Department
Tropical Medicine Department
School of Public Health

University College
Microbiology Department
Cardiff, Wales

University of Arizona
Tucson, Arizona
Office of Arid Land Studies
Department of Plant Science
Environmental Research Laboratory
Department of Soils, Water, and Engineering
Office of International Agriculture Programs
Department of Family and Community Medicine

University of British Columbia
Vancouver, British Columbia, Canada

University of California
Berkeley, California
Department of Chemical Engineering
Department of Nutrition Sciences
Department of Soil and Plant Nutrition
Department of Environmental Health and Sanitary Engineering

University of California
Davis, California
Vegetable Crops Department
Agronomy and Range Science Department
Food Science Department
Soil Science Department
Department of Land, Air, and Water Resources
Department of Agricultural Engineering

University of California at Los Angeles
School of Public Health
West Los Angeles, California

University of California
College of Natural and Agricultural Sciences
Riverside, California

University of Florida
Gainesville, Florida
Department of Entomology
Fruit Crops Department
Vegetable Crops Department

University of Georgia
Athens, Georgia
Coastal Plain Experiment Station, Tifton
Agricultural Experiment Station, Griffin

University of Illinois
Urbana, Illinois
Department of Microbiology
Department of Pharmacognosy and Pharmacology (Chicago)
Office of International Agriculture
Department of Agronomy
Department of Civil Engineering

University of Iowa
Department of Botany
Iowa City, Iowa

University of Miami
Clean Energy Research Institute
Coral Gables, Florida

University of Minnesota
St. Paul, Minnesota
Department of Animal Sciences
Department of Agricultural Engineering
Department of Soil Science
Department of Microbiology
Department of Agronomy

University of Nebraska
Department of Animal Sciences
Lincoln, Nebraska

University of North Carolina
Chapel Hill, North Carolina
School of Public Health
Department of Nutrition

University of Oklahoma
Pediatric Department
Oklahoma City, Oklahoma

University of Southern California
School of Pharmacy
Los Angeles, California

University of Utah
Department of Metallurgy
Salt Lake City, Utah

University of Virginia
Department of Chemical Engineering
Charlottesville, Virginia

University of Wisconsin
Madison, Wisconsin
Department of Food Science
Department of Dairy Science
Department of Bacteriology
Engineering Experiment Station
Department of Meat and Animal Science

Washington University
Department of Technology and Human Affairs
St. Louis, Missouri

II. U.S. GOVERNMENT AGENCIES AND LABORATORIES

City of Los Angeles Bureau of Sanitation
Hyperion Treatment Facility
Palos Verdes, California

Environmental Protection Agency
Washington, D.C.
Denver, Colorado
Gulf Breeze, Florida
Athens, Georgia
Cincinnati, Ohio

Florida Department of Natural Resources
Marine Research Laboratory
St. Petersburg
Marathon

Food and Drug Administration
Washington, D.C.
Division of Nutrition
Division of Chemistry and Physics
Epidemiology Unit
Biopharmaceutics Laboratory

Metropolitan Sanitary District of Greater Chicago
Research and Control Laboratory
Cicero, Illinois

National Fertilizer Development Center
Tennessee Valley Authority
Muscle Shoals, Alabama

National Institutes of Health (NIH)
Bethesda, Maryland
National Institute of Child Health and Human Development
National Institute of Arthritis, Metabolism, and Digestive Diseases
National Institute of Allergy and Infectious Diseases
Division of Research Services, Biomedical Engineering and
Instrumentation Branch

National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Northeast Fisheries Center
Highland, New Jersey
Southeast Fisheries Center
Miami, Florida
Panama City, Florida
Gulf Breeze, Florida
Beaufort, North Carolina

National Science Foundation
Washington, D.C.

Division of Science Resources Studies
Division of International Programs

National Technical Information System (NTIS)
Office of Development Assistance Programs
Springfield, Virginia

Office of Science and Technology Policy (OSTP)
Executive Office of the President
Washington, D.C.

Office of Technology Assessment (OTA)
U.S. Congress
Washington, D.C.

Ohio Agriculture Research and Development Center
Wooster, Ohio

Scientific and Research Council of Turkey (TUBITAK)
Ankara and Istanbul, Turkey

Smithsonian Institution
National Museum of Natural History
Washington, D.C.

Smithsonian Science Information Exchange (SSIE)
Washington, D.C.

U.S. Bureau of Mines
Division of Foreign Data
Washington, D.C.

U.S. Bureau of Mines
Salt Lake City Research Center
Salt Lake City, Utah

U.S. Bureau of Reclamation
Denver, Colorado

U.S. Department of Agriculture (USDA)
Beltsville Agricultural Research Center
Beltsville, Maryland

Cotton Insects Research Laboratory
College Station, Texas

Crops Research Unit
Tifton, Georgia

U.S. Department of Agriculture (cont.)

Eastern Regional Research Center
Philadelphia, Pennsylvania

Forest Products Laboratory
Madison, Wisconsin
Human Nutrition Research Laboratories
Grand Forks, North Dakota

Insects Attractants Laboratory
Gainesville, Florida

Insects Affecting Man and Animals Research Laboratory
Gainesville, Florida

Lake Alfred Agricultural Research and Education Center
Lake Alfred, Florida

National Animal Disease Center (NADC)
Ames, Iowa

National Veterinary Services Laboratory
Ames, Iowa

Northern Regional Research Center
Peoria, Illinois

Quincy Agricultural Research and Education Center
Quincy, Florida

Science and Education Administration (SEA)
Beltsville, Maryland

Soil Conservation Service
Washington, D.C.
Phoenix, Arizona

Southern Regional Research Laboratory
New Orleans, Louisiana

U.S. Salinity Laboratory
Riverside, California

U.S. Water Conservation Laboratory
Phoenix, Arizona

Water Management Research Laboratory
Fresno, California

Western Cotton Research Laboratory
Phoenix, Arizona

U.S. Department of Interior
Bureau of Reclamation
Denver, Colorado

U.S. Department of State
Office of the Coordinator for the U.N. Conference on Science and
Technology for Development
Washington, D.C.

U.S. Geological Survey
Reston, Virginia

Virgin Islands Department of Conservation and Cultural Affairs
Division of Fish and Wildlife
Charlotte Amalie, Virgin Islands

Washington Suburban Sanitary Commission
Beltsville, Maryland

III. PRIVATE INDUSTRIES AND CORPORATIONS

Agra Energy
Newport Beach, California

Agrico International
Tulsa, Oklahoma
Urea ammonium nitrate solutions plant, Verdigris, Oklahoma
Faustina fertilizer production complex, Donaldsonville, Louisiana
Fort Green mine and plant, South Pierce, Florida

Albion Laboratories
Clearfield, Utah

Alfa Laval
Lille, France, and Stockholm, Sweden

Ambalal Sarabhai Enterprises Ltd.
Baroda, India

Amerchol Company
Edison, New Jersey

American Colloid Corporation
Skokie, Illinois, and Belle Fourche, South Dakota

Amoco Production Co.
Tulsa Research Center
Tulsa, Oklahoma

Amoco Research Center
Naperville, Illinois

Aquafine Corporation
Brunswick, Georgia

BioChem Technology Inc.
Malvern, Pennsylvania

Burlington Industries
Clarksville, Virginia

Cadala and Cadmich
Ahmedabad, India

Carnation Research Corporation
Van Nuys, California

Cargill Inc.
Wayzata, Minnesota, and Wichita, Kansas
Flax Sunflower Department
Domestic Soybean Processing Division

Ciby-Geigy Inc.
Summit, New Jersey

Cotton Inc.
Technical Research Services Department
Raleigh, North Carolina

Davy McKee Engineering Design Co.
Lakeland, Florida

Del Monte Research Center
Walnut Creek, California

Denver Equipment Division
Joy Manufacturing Company
Colorado Springs, Colorado

Dowell Division
Dow Chemical Co.
Tulsa, Oklahoma

Dynatech Inc.
Boston, Massachusetts

Eastern Artificial Insemination Cooperative
Ithaca, New York

Faerland Industries Inc.
Bartow, Florida

Foremost-McKesson Company
Gilroy, California

Gardinier Inc.
(formerly U.S. Phosphoric Products)
Tampa, Florida

General Foods Corporation
Tarrytown, New York

George Fischer Foundry Systems Inc.
Holly, Michigan

Gerber Products
Fremont, Michigan

Grande Cheese Co.
Brownsville, Wisconsin

Hazen Research
Golden, Colorado

Hoechst-Roussel Pharmaceuticals Inc.
Somerville, New Jersey

Hunt-Wesson Foods
Research and Development Department
Fullerton, California

ICPL Ltd.
Regional Research Laboratory
Hyderabad, India

International Minerals and Chemicals Corporation
Lakeland, Florida; Mundelein, Illinois; Colony, Wyoming

Lederle Laboratories
Pearl River, New York

Magcobar Division
Dresser Industries
Houston, Texas, and Greybull, Wyoming

Merck and Co., Inc.
Chemical Manufacturing Division
Elkton, Virginia

Merck Sharpe and Dohem Research Laboratories
Rahway, New Jersey

Mobil Research and Development Corporation
Materials Engineering Section, Paulsboro, New Jersey
Mobil Field Research Laboratory, Dallas, Texas

Native Plants, Inc.
Salt Lake City, Utah

New Brunswick Scientific Instruments Inc.
Edison, New Jersey

NL Baroid Corporation
Houston, Texas

Perkin Elmer Corporation
Norwalk, Connecticut

Pfizer Genetics
Doniphan, Nebraska

Plains Cooperative Oil Mill
Lubbock, Texas

Ranbaxy Laboratories Ltd.
New Delhi, India

Ranchers Oil Company
Fresno, California

RefCOM
Pompano Beach, Florida

Smith Kline and French Laboratories
Swedeland, Pennsylvania

Southern Clay Products
Gonzalez, Texas

Stauffer Chemical Company
Vernal, Utah

Sterling Winthrop Laboratories
Rensselaer, Pennsylvania

Sud-Chemie A.G.
Munich, Germany

Tams Pirnie Inc.
New York, New York

Tetra Tech International
Arlington, Virginia

Unichem, CIPLA
Bombay, India

Unichem International
Hobbs, New Mexico

U.S.S. Agrichemicals
Bartow, Florida

U.S. Steel Corporation
Engineers and Consultants, Pittsburgh, Pennsylvania
Research Laboratory, Monroeville, Pennsylvania

The Upjohn Company
Kalamazoo, Michigan

Webster International
Los Angeles, California

Weintritt Testing Laboratories
Lafayette, Louisiana

IV. CONFERENCES AND TECHNICAL MEETINGS

<u>DATE</u>	<u>MEETING</u>
Oct. 31-Nov. 1, 1978	Fertilizer Industry Roundtable Atlanta, Georgia
March 3-7, 1980	National Association of Corrosion Engineers (NACE) Corrosion '80 Symposium Chicago, Illinois
April 14-18, 1980	Fourth International Symposium on Livestock Wastes Amarillo, Texas
April 21-23, 1980	Bio-Energy '80 World Congress Atlanta, Georgia
April 21-15, 1980	Second International Congress on Phosphorus Compounds Boston, Massachusetts
May 11-17, 1980	American Society for Microbiology Annual Meeting Miami Beach, Florida
June 8-11, 1980	Institute of Food Technologists Annual Meeting New Orleans, Louisiana
Dec. 14-17, 1980	Third Miami International Conference on Alternative Energy Sources Bal Harbour, Florida
Aug. 15-23, 1981	XX International Congress of Nutrition San Diego, California
July 7-10, 1981	Institute of Food Technologists Annual Meeting Atlanta, Georgia
Jan. 25-29, 1982	Symposium: Energy from Biomass and Wastes VII Lake Buena Vista, Florida
August 24-26, 1982	3rd Annual Meeting Guayule Rubber Society El Paso, Texas
May 2-6, 1983	Conference on Biomethanation Systems Bangkok, Thailand
May 16-20, 1983	International Conference on Corrosion Inhibition Dallas, Texas

June 20-23, 1983	9th North American Rhizobium Conference Ithaca, New York
August 14-19, 1983	3rd International Symposium on Anaerobic Digestion Boston, Massachusetts
June 4-6, 1984	9th International Conference on Energy, Power, and Environment San Francisco, California
June 18-21, 1984	BioEnergy '84 World Conference Gothenburg, Sweden
June 25-29, 1984	CHEMRAWN III World Conference The Hague, Netherlands
Apri 25-27, 1985	2nd Conference of thr Assoc. for Women in Development Washington, D.C.

V. OTHER ORGANIZATIONS VISITED BY EGYPTIANS

American Chemical Society
Washington, D.C.

American Clean Water Association
Washington, D.C.

Arthur D. Little Inc.
Cambridge, Massachusetts

Battelle Memorial Institute
Columbus, Ohio

Battelle Pacific Northwest Laboratories
Richland, Washington

Burke Rehabilitation Center
Nutrition and Metabolic Research Division
White Plains, New York

Cia. de Tecnologia e Saneamento Basico (CTESB)
Sao Paulo, Brazil

Chengdu Institute
Bio-energy Laboratory
Sichuan, China

Denver Research Institute
Office of International Programs
Denver, Colorado

Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA)
Brasilia, Brazil

Fertilizer Institute
Washington, D.C.

Guangzhou Institute of Energy Sources
Guangzhou, China

Indian Institute of Science
Center for Application of S&T for Rural Areas
Bangalore, India

Indian Institute of Technology
Bombay, India

Institute of Agricultural Science
Seoul, Korea

Institute of Gas Technology
Chicago, Illinois

Institute of Technological Research (IPT)
Sao Paulo, Brazil

International Bank for Reconstruction and Development
Washington, D.C.

International Center for Arid and Semiarid Land Studies
Lubbock, Texas

International Fertilizer Development Center
Muscle Shoals, Alabama

International Wool Secretariat
London (headquarters) and Ilkey, Yorkshire (pilot plant)

Khadi Village Industries Commission
Gobar Gas R&D Center
Bombay, India

Midwest Research Institute
Kansas City, Missouri

National Institute of Science and Technology
Manila, Philippines

National Institute of Waste Recycling Technology
Bombay, India

National Research Center for Corn and Sorghum
Sete Lagoas, Minas Gerais, Brazil

National Research Center for Dairy Cattle
Juiz de Fora, Minas Gerais, Brazil

National Research Center for Rice and Beans
Goiania, Goias, Brazil

National Research Center for Swine and Poultry
Concordia, Santa Catarina, Brazil

Nutrition Foundation
New York, New York

Resources for the Future
Washington, D.C.

Saneamento Basico de Sao Paulo (SABESP)
Sao Paulo, Brazil

SRI International
Menlo Park, California

UEPAE/PELOTAS
Pelotas, Rio Grande do Sul, Brazil

Volunteers in Technical Assistance (VITA)
Mt. Rainier, Maryland

The Wool Bureau
Woodbury, Long Island, New York