



CoHemis... update

Overcoming through cooperation

December 30, 1993
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University of Puerto Rico at Mayagüez -- National Science Foundation

Colorado St. Univ., Sandia and Los Alamos join UPRM

THE CoHEMIS CONSORTIUM BECOMES A WORKING REALITY

The CoHemis Consortium has become reality through agreements signed by UPRM with three renowned American institutions of excellence that are committed to support hemispheric cooperation in science and technology. Colorado State University and the Sandia and Los Alamos National Laboratories have joined the Consortium, while the University of Florida (Gainesville), Georgia Tech, Argonne National Laboratory, and Simon Bolivar University (Venezuela) are expected to become members shortly. Contacts have been also initiated with the National University of Chile (Santiago), National University of Colombia (Bogota), National Universities of Rio Cuarto and Cordoba (Argentina) and the University of the Republic of Uruguay (Montevideo).

The objectives of the CoHemis Consortium are: to improve the global competitiveness of Western Hemisphere industry; to increase the number and quality of Hispanic-American, Latin American and Caribbean Engineering and Applied Science Ph.D.'s; to develop awareness of high priority regional problems among researchers; to enhance the technological capabilities of Latin American and Caribbean countries and hence their social, economic and commercial development; and to foster the protection of the hemisphere's environment and resources. This network of

institutions of excellence can have an enormous impact on the enhancement of science and technology (S&T) in the hemisphere. There are more Ph.D.'s in S&T in a large National Laboratory than in most Latin American and Caribbean countries.

In order to achieve these objectives, the consortium institutions will stimulate and facilitate exchanges of researchers, professors and students, as well as foster joint research and technology assessment projects expected to produce results with potential short term benefits for more than one country in the hemisphere. They will share information, exchange publications, evaluate pre-proposals, identify areas in (Continues on page 3.)

CoHemis Entrusted with REPADI Outreach Program

NEW NETWORK WILL ENHANCE ENGINEERING IN LATIN AMERICA

With the objective of enhancing graduate-level engineering education for Latin America and the Caribbean by means of international cooperation, several institutions attending a meeting sponsored in Venezuela by UNESCO created REPADI (Spanish acronym for "Network of Programs Supporting the Development of Engineering"). CoHemis' director Luis Pumarada-O'Neill belongs to its Executive Committee, and CoHemis has been put in charge of its educational outreach program.

CoHemis' co-directors, Dr. Jorge I. (Continues on page 5.)

"UNITEC" Will Do Technology Assessment

CoHemis Creates a Division for TA Projects

CoHemis' effort to provide Puerto Rico and UPRM with a unit for conducting Technology Assessment, Monitoring and Forecasting (TA) projects have culminated in the creation of UNITEC. It is presently a division of the CoHemis Center.

UNITEC is about to begin TA projects in Puerto Rico with the collaboration of the island's government. Its plans are to eventually serve Latin America and Caribbean. Four multidisciplinary teams of UPRM researchers have been formed. These teams will conduct the first TA projects for Puerto Rican public corporations and possibly a Federal agency.

TA information will allow decision-makers to achieve more effective technology transfers and eliminate the possibility of making blunders. This will benefit both the exporting and the host countries. The technology which is best suited for the context, resources, and objectives of the importing country will most likely be the one selected as a result of a multidisciplinary evaluation process which will include not only a cost/benefit analysis but also environmental and social impacts, technical feasibility, infrastructure needs, etc.

UPRM has the credibility and most of the multidisciplinary expertise needed for TA studies in Puerto Rico and abroad. CoHemis will complement this with Consortium specialists when needed and recruit experts from the host countries to participate in the assessment process. This will enhance the endogenous TA capabilities of Latin American and Caribbean countries by means of experiential learning and at the same (Continues on page 4.)

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Activities Scheduled for 1994

For more information on any of the following please contact CoHemis.

"Workshop on Methodologies and Experiences in Technology Assessment", by Dr. Anthony Dvorak, Argonne National Laboratory. **January 21**, 1:00 - 4:30 PM.

"Panel on Science and Technology Policy for Economic Development". **February 8**, 9:00 AM to 4:00 PM.

"Conference on Technical Assistance for Environmentally Conscious Manufacturing", with speakers from Sandia and Los Alamos NL. **March 7 and 8**. Will demonstrate the benefits of using processes that do not produce waste or contaminants instead of managing the waste or removing pollutants from plant effluents. Will provide information on process alternatives and development opportunities for large and small firms. Expected co-sponsorship by the PR Economic Development Administration (PRIDCO).

Participation in NIST Conference at Tennessee, for enhancing the capabilities of Southeastern states to get NIST funding. **March**.

Case Study Workshop of a Shrimp Industry Crisis as an Indicator of Global Environmental Degradation. **June**. (Pending a grant from NASA, NOAA, or NSF. See page 6.)

Participation in IATAFI Founding General Assembly and First Conference. Bergen, Norway. **May 2-6**. (See page 4.)

"Conference-Workshop on the Repair and Rehabilitation of the Civil Infrastructure of the Americas". **July**. Will invite top experts from industry and academia in the US, Puerto Rico, Latin America, and the Caribbean to discuss problems and alternatives related to deteriorating buildings, highways, water supply, sewer services, etc. Will feature materials, but will not exclude other aspects. (Pending a grant from NSF.)

"Workshop on Geo-environmental Issues Facing the Americas". **September**. Will invite top experts from industry and academia in the US, Puerto Rico, Latin America, and the Caribbean to discuss problems and alternatives related to clean-up and prevention of pollution in soil and subsurface water. A final session will identify Puerto Rico's top research priorities in these fields and foster joint research proposals for solving them. To be funded by: NSF, PRIDCO, Georgia Tech, and UPRM. CSU will co-sponsor.

"Gulf/Caribbean Natural Disaster Assessment and Mitigation Conference and Workshop". **November**. Will invite top researchers and hazard managers from the region to discuss priorities and collaborations. Will lay a basis for developing regional hazard mitigation programs for hurricanes, earthquakes, volcanoes and resulting disasters, such as floods, landslides, and wind damage. (Pending grants from NSF, USGS, FEMA, and other organizations.)

First Success of the CoHemis Pilot Program

Funds Granted to CoHemis Project

One of the five CoHemis Pilot Program Proposals submitted to the Puerto Rico Science & Technology Board has been granted funds. The project will focus on avoiding ground and water pollution produced by waste from the large-scale production of chicken in a tropical environment.

The proposal is called: "Organic Waste Disposal Using Earthworms". This three-year biotechnology project was submitted by Drs. Sonia Borges and José Latorre, from the UPRM Biology and Animal Science Departments respectively. It will also involve a Colombian researcher. CoHemis is searching for additional funds from industry to expand its scope, since a Consortium researcher from the University of Florida may be able to contribute to a downstream phase: converting the worms into ingredients for animal feed. The worms will transform this waste, common in most countries in the hemisphere, into non-polluting, valuable organic fertilizer.

(Continues on page 4.)

CoHemis... update is the newsletter of the **Center for Hemispherical Cooperation in Research and Education in Engineering and Applied Science (CoHemis)**, sponsored by the University of Puerto Rico, Mayagüez Campus and the National Science Foundation of the United States.

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CoHemis-Sandia NL Conference:**“Environmental and Energy Issues Facing the Americas”**

The conference “Environmental and Energy Issues Facing the Americas” was held on September 28-29, 1993, at the Mayaguez Campus. It was organized by CoHemis and Sandia National Laboratories, a member of the CoHemis Consortium. The Renewable Energy National Laboratory and Puerto Rico’s Electric Power Authority (PREPA) collaborated with speakers. As a result of this event, which had some hemispheric participation, several significant action items were identified for eventual implementation.

The activity was an initiative of Dr. Nestor Ortiz, an executive of Sandia NL and a UPRM-alumnus. The visiting speakers included biologist Eugenia Olguin, environmentalist Hugo Sandoval, and geologist Michel Hermelin, from Mexico, Chile and Colombia respectively; Drs. Jim Pacheco, Ken Bergeron, and Chris Cameron, all from Sandia; Dr. Mark Mehos, from Denver’s Renewable Energy National Laboratory; Dr. Mehmet Tumay, Director of the NSF Geotechnical, Geomechanics and Geo-environmental Program; Dr. Emir Macari, from Georgia Tech’s Center for Sustainable Technologies; and Dr. Eileen Chant, from the University of Turabo’s emerging School of Engineering. The UPRM School of Engineering, Georgia Tech, USAID, the Organization of American States, Sandia, and INDUNIV (an industry-university research foundation operated by group of pharmaceutical companies operating in Puerto Rico) contributed with funds and/or travel costs.

The conference began with a welcome message from the Vice-president of the Puerto Rico Planning Board on behalf of the Governor. The first session focused on the EnviroTRADE software project for creating an international network of waste management information. The second session was devoted to solar detoxification technology for waste fluids. The participants discussed the laboratory donated by Sandia to Turabo University and the pilot plant proposal developed at UPRM by Drs. Cardona, Colucci and Reyes from the Chemical Engineer-

ing Department. The third session, which treated renewable energy technologies, featured an interesting presentation on demand trends and renewable energy alternatives for Puerto Rico by Eng. Luis Cruz, Director of the PREPA Planning Office.

Dr. Dallas Alston, from the UPRM Marine Sciences Department, presented an initiative for creating an emergency task force of experts to discuss the shrimp culture crisis at Ecuador’s Guayas Bay. Other participants included Dr. Benjamin Perez de Gracia, Executive Director of INDUNIV, CoHemis’ co-directors Drs. Pumarada and Velez-Arocho, and Dr. David Serrano, Associate Dean of Engineering for Research.

Several possible collaborations were identified as a result of this event and will be followed-up for eventual implementation. Among others: the possible service of CoHemis as a node for EnviroTRADE information exchange with Latin America and the Caribbean; a UPRM-Sandia-PREPA collaboration in an upcoming wind energy demonstration project; a joint PR-Mexico research proposal on integrated hog/algae/fish production;

CoHemis’ participation in the Mexican Institute for Sustainable Energy; UPRM-Turabo-Sandia collaborations in solar detoxification technologies; a possible workshop in solar detoxification technology for Latin American participants; Latin American participation in CoHemis’ 1994 activities; and possible participants in a shrimp crisis task force. The speakers and observers, which included faculty and graduate students, expressed great satisfaction with the conference discussions and results.

The participants were enthused about the potential of the EnviroTRADE concept, which provides, very handily, the most relevant state-of-practice information needed for very specific problems of pollution mitigation and clean-up. The NSF geo-environmental section has also been working in a similar program. An EnviroTRADE network would offer the American environmental technology most suitable for the problem at hand to governments and firms in Latin America and the Caribbean. This information will work to the advantage of all sides in terms of a healthy hemispheric and global environment, efficient match-up of problems and solutions, and advancement of a mutually beneficial economic bloc outlook.

CoHemis Consortium...

which the faculty and facilities of the institutions complement each other, seek financial support for joint projects and exchanges, and collaborate with the CoHemis Center’s projects and activities. The Center does not plan to actively pursue further Consortium growth in the US. Elsewhere it plans to eventually include the best national universities in Latin America and the Caribbean as well as at least one Canadian institution.

In its agreement, Colorado State University intends to grant Ph.D. assistantships to CoHemis MS graduates. CSU also intends to grant doctoral fellowships to qualified UPRM faculty candidates who are American citizens. CoHemis, on the other hand, will facilitate visiting professorships, short courses, and sabbaticals by CSU faculty in Latin America and Caribbean institutions and industry,

and enable its researchers to conduct joint research at UPRM through CoHemis researchers and graduate students by means of short periodic visits. UPRM will continue to provide the facilities, infrastructure and communication support needed by the CoHemis Center.

Consortium Expansion: USA

The CoHemis Center and its Consortium were presented at Georgia Tech and the University of Florida in the second week of November. CoHemis’ co-directors, Luis Pumarada and Jorge I. Velez-Arocho, met enthusiastic responses from administrators at both institutions, while their faculty expressed interest in participating in joint proposals and ongoing CoHemis projects.

In Gainesville they met first with Dr. Paul Yates Thompson, Director of the (Continues on page 5.)

IATAFI CONFERENCE AND FIRST GENERAL ASSEMBLY

The International Association for Technology Assessment and Forecasting Institutions (IATAFI) will hold its first Conference and General Assembly between the 2nd and 6th of May, 1994 in Bergen, Norway. Organizations which conduct or sponsor Technology Assessment are invited to attend this important meeting and join the Association. This conference will focus primarily on technologies developed in the former Soviet Union and Central Europe, whose dissemination and development was hampered by the recent political and economic crises. It will also discuss technology transfer and technology assessment in the context of developing countries. Moreover, it will include workshops on TA methodology.

Technology Assessment information, as a basis for the most effective technology choice, is a critical tool for a country seeking to achieve sustainable development. It allows developing countries to make informed decisions between developing or importing technology, to transfer a technology which will achieve its objectives in the context of the particular country, to enhance impacts on development and mitigate any adverse social and environmental effects.

The goal of IATAFI is to advance international cooperation among institutions evaluating and/or forecasting the impact of technology innovation. This will allow decisions better able to promote continued, sustainable development throughout the world in response to global change. The umbrella association aims: to link the countries which lack TA with countries which have those capabilities; to promote the use and consideration of TA in the decision-making process; to establish communication links and create collaboration opportunities among members, exchange personnel for training to strengthen or build skills and expertise; to coordinate activities, procedures, and methodologies; and to cooperate with international activities being car-

ried out under the global change agenda.

IATAFI's short range plans include a bi-monthly newsletter, the organization of scientific conferences and workshops, the establishment of regional centers in cooperation with member institutions, and the development of its own data base and of communication capabilities to access key databases worldwide.

There is a sliding membership fee. For organizations based in OECD (Organization for Economic Cooperation and Development) countries with fewer than 20 persons working in TA, the fee is US\$1000. For similar organizations in non-OECD countries, it is US\$500.

Its president is Dr. Jan A. Andersen, representing the Bergen High-Technology Centre; its Executive Secretary is Dr. Gary Williams, from Argonne National Laboratory and a CoHemis adviser. For membership or conference information:

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UNITEC...

time produce evaluations which respond well to the host country's particular circumstances. On the other hand, the competitiveness of US technology exports will be enhanced by comprehensive TA studies recommending how to increase the benefits of the technology and how to mitigate or reduce undesirable impacts.

UNITEC has been placed under a board that includes: Dr. Luis Pumarada-O'Neill, its Acting Director, who holds a Ph.D. in the field of Urban Systems and Policy Planning; Dr. Jorge I. Velez-Arocho, a specialist in Statistics, TQM, and Strategic Planning; Dr. Leandro Colon, Chairperson of the UPRM Department of Economics; and Dr. Eduardo Kicinski, Director of its Institute for Regional Studies.

CoHEMIS IN THE IATAFI EXECUTIVE COMMITTEE

CoHemis' director, Dr. Luis Pumarada-O'Neill, has been included in the Executive Committee of IATAFI, the International Association of Technology Assessment and Forecasting Institutions. This association, of which CoHemis is a founding member, is initially being sponsored by the UN, Argonne National Laboratory, and the city of Bergen.

First Success...

The CoHemis Pilot Program began in May, 1992 with a Request for Preproposals sent to UPRM faculty seeking for projects promising short-term economic benefits for more than one country and involving at least one researcher from Latin America or the Caribbean. The twelve acceptable pre-proposals received were sent to voluntary evaluators in collaborating institutions in the US and Latin America. Five were selected, enhanced following the suggestions of the evaluators and sent to compete for funds to the PR Science and Technology Board, an organization which sponsors applied research which may benefit Puerto Rico. Three other pilot program proposals are pending. A fifth one had been withdrawn by its principal investigator when he became Executive Director of the Puerto Rico Highway Authority.

A new Call for Preproposals will be announced in February. Consortium researchers will be invited to produce or suggest joint North-South proposals.

CoHemis Consortium...

Department of Civil Engineering. After a fruitful exchange of ideas, they joined faculty and high-ranking officials from different divisions of the university for a presentation and discussions. Dr. Thompson is presently working on a draft agreement which would be signed by officials from both Universities early in 1994.

In Atlanta, Velez-Arocho and Pumarada participated in several productive meetings. These were set-up by Dr. Emir Macari, Associate Professor of Civil Engineering at Georgia Tech and a CoHemis adviser. Dr. John A. White, Dean of Engineering, showed a strong interest in the possibility of joining the Consortium; he saw CoHemis as a natural partner for Georgia Tech's newly created Center for Sustainable Technologies. Dr. Allan Porter, Director of the Technology Policy and Assessment Center, collaborated with CoHemis' UNITEC division for technology assessment (TA) by explaining how his own TA center works. Dr. David Frost, an expert in geo-environmental problems, accepted to collaborate with Dr. Macari in organizing a CoHemis-NSF geo-environmental workshop set for 1994. Dr. Jean-Lou Chameau, Director of the Department of Civil Engineering and of the Center for Sustainable Technologies, agreed to follow-up on Georgia Tech's joining the Consortium as a milestone in a future official relationship between the Center for Sustainable Technologies and CoHemis.

Faculty and officials in both institutions welcomed the concept, mentioning that it was generally easier to get funding through a consortium than individually. They saw the CoHemis Consortium as a means to participate in exchange, joint research and short course programs with institutions in Latin America and the Caribbean, as well as a way to get more competitive minority doctoral students from UPRM.

The Consortium extends South

On December 15th, CoHemis' co-directors visited the beautiful campus of Venezuela's prestigious Simon Bolivar University, located on the cool, comfortable outskirts of Caracas. Similar in size,

state-support, stability and culture of excellence, SBU is Venezuela's UPRM: the goal of Venezuela's best science and mathematics-oriented high-school graduates. Twenty-one year old SBU, however, has a higher proportion of graduate students and of European-educated faculty than UPRM. Following-up on a previous meeting held in Mayaguez, Drs. Pumarada and Velez-Arocho met with the Vice-chancellor, Dr. Jaime Leon, and the Dean of Graduate Studies, Dr. Carlos Perez. They exchanged drafts of possible bilateral agreements between SBU and UPRM which include the CoHemis Consortium. Possible faculty and student exchanges, short courses, sabbatical leave destinations, and joint research projects are some of the possible outcomes of a promising future relationship between the two institutions.

The Consortium in Action

The "Activities Scheduled for 1994" (page 2) includes brief descriptions of two Consortium collaborations: a workshop on environmentally conscious manufacturing and a geo-environmental hemispheric workshop. In addition:

Dr. Sherry Oaks, from Colorado State University and a CoHemis adviser, will be visiting Mexico with Drs. Pumarada and Velez-Arocho in late January. They will meet with officials from CONACYT, universities, and research institutions. One of the goals of this visit is to invite Mexico's National Autonomous University to join the Consortium.

On January 21st, Dr. Anthony Dvorak, Director of Argonne National Laboratory's Environmental Impact Division, will visit UPRM to conduct a workshop on Technology Assessment, Monitoring and Forecasting. Argonne and CoHemis/UPRM plan to collaborate in a program to enhance student interest and achievement in science and mathematics in a mostly Hispanic Chicago high school: Roberto Clemente Comm. Acad.

REPADI Network...

Velez-Arocho and Dr. Pumarada-O'Neill, accepted invitations to participate in the "Regional Meeting of Research and Development Centers and Graduate Study Institutions in Engineering", held at Caracas on December 13-14, 1993. This meeting was sponsored by the UNESCO Regional Office for Science and Technology (ORCYT), based at Montevideo, Uruguay, and co-sponsored by Venezuela's CONICIT (National Council for Research in Science and Technology) and its COPLAC program for promoting and funding student and faculty exchanges. The meeting featured representatives of institutions from Chile, Cuba, Mexico, Puerto Rico, Uruguay, and Venezuela. The industrial sector was represented by PDVSA, Venezuela's oil and gas conglomerate.

CoHemis was put in charge of the network's educational outreach program, whose objective will be to develop human resources in post-baccalaureate engineering for Latin America and the Caribbean mainly by means of short courses. The other initial network programs will be: Enhancement of Graduate Studies, which will initially focus on exchanges of faculty and graduate students; Inter-University Relations; and University-Industry Relations.

The network coordination was entrusted to Dr. Claudio Bifano, from Venezuela's Engineering Research Foundation and the CONICIT's consultant for the COPLAC program. He will lead the production of funding proposals to industry and international organizations. The COPLAC Program facilitates faculty and graduate student exchanges with travel funds, stipends, and information. Although originally intended to serve Latin America and the Caribbean, COPLAC is presently limited to exchanges which involve Venezuelans because no other country has been providing funds up to this moment.

Counting on the assistance of the CoHemis Consortium institutions, the CoHemis Center will do its best to allow its 1994 activities to serve the purposes of the educational outreach program until REPADI funding materializes. These activities appear in page 2.

CoHemis searches for funding**Proposal to Study Ecuadorian Shrimp Crisis**

“Case Study of a Shrimp Industry Crisis as an Indicator of Global Environmental Degradation” is the title of a CoHemis pre-proposal by Drs. Dallas E. Alston (UPRM-CoHemis) and Philip Buike (Ecuador). The Ecuadorian shrimp culture industry is undergoing a crisis of large proportions. Profitability and investments have waned considerably, and production has declined markedly. Shrimp farming represents the third most important industry in Ecuador, generating over US\$400 million annually. Ecuador, the most important shrimp-producing nation in the Americas, occupied the first place in world shrimp production in 1983 with 35,600 mt. Now it is fourth, following China, Thailand, and India.

Almost twenty percent of the shrimp consumed in the US comes from Ecuador, mainly from the Guayas Bay estuary. A crash of the Ecuadorian industry would certainly affect American commercial and consumer interests. Many US investors are involved in shrimp culture in the region and significant quantities of American materials and equipment are bought by this industry.

Marine shrimp farms are only practical in coastal waters, often threatened by urban, industrial and agricultural pollution. As early as 1986, Guayas' production of wild postlarval shrimp seed for the farm ponds was decreasing. This decline in natural productivity, which has been countered by cultivated larvae, may be due to one or more of the following factors:

- Rapid destruction of mangrove swamps.
- The El Niño phenomenon, with its climatic changes and ocean current reversals.
- Urban pollution of the Guayas estuary resulting from the rapid growth of the city of Guayaquil.

In addition, problems may have become exacerbated due to diseases in hatcheries and ponds and harmful chemicals from industrial wastes and agricultural

applications.

Virtually all Guayas producers have been reporting low shrimp survivals. Survival has recently averaged 15 to 20%, down from 55 to 60%. Some individual producers have reported losses reaching 90% of stocked larvae. Feed conversion ratios have made the industry no longer profitable for many producers. Major mortalities are apparently occurring within the first forty days of stocking.

Preliminary studies have characterized the problem in terms of possible disease pathology, but the etiology remains unknown. It is now conjectured that water and soil quality may be a major factor. Dr. Claude Boyd and Dr. Donald Lightner, water quality and disease specialists, respectively, are currently trying to determine the cause of the problems for the producers.

Given the serious nature of the problem and the fact that environmental factors are suspected, there should be an international collaborative effort to determine the nature and extent of this problem. To this effect, an important meeting is being proposed in Puerto Rico through CoHemis by CENAIME (Ecuador's National Aquaculture and Research Center) and the UPRM Department of Marine Sciences. It would bring together international experts in ecology, water quality, and shrimp pathology and experts from Taiwan and Thailand, who have had similar shrimp industry crises, to discuss this situation in Ecuador. The meeting will also discuss how this situation relates to general global environmental degradation. The industry failures in Thailand and Taiwan were documented largely with anecdotal information and without elucidating key environmental issues from a global perspective.

Arising from the results of the study eventually set up in the meeting, a predictive model will be developed to allow a contingency plan for the management of global aquatic resources relevant to the contemporary world-wide situation together with the application of remote sensing technology for anticipating and/or monitoring such situations.

On 1995: CoHemis will collaborate**World Congress on Intelligent Manufacturing**

Dr. Vladimir R. Milalic, visiting professor at UPRM and a renowned expert on hi-tech manufacturing technology, is organizing the “First World Congress on Intelligent Manufacturing Processes & Systems”. It will be held at Mayaguez, February 13-17, 1995. The potential contributors include NASA and NSF.

The main objective of this congress is to provide a world forum for the exchange of knowledge, experience, and information regarding various aspects of the intelligent factory of the future. Its “first announcement and call for papers, panels and workshops” is just beginning to circulate.

This event will provide the opportunity to put together interdisciplinary and multidisciplinary approaches to create a new generation factory environment. It will pave the way to educate “renaissance scientists and engineers” for the factories of the future. It will feature a two-day Conference on Intelligent Manufacturing in a Space Environment, and eventually may also include Intelligent Manufacturing under the Sea.

The First World Congress on Intelligent Manufacturing Processes & Systems aims: to discuss all aspects of manufacturing intelligence at the decision, control and perception levels for the design, planning, and production tasks in a modern IMP&S environment; to introduce the basic techniques, examine the current state-of-practice, predict future trends, and define a research agenda for the IMP&S environment; and to establish bridges between manufacturing engineering and other related disciplines, such as artificial intelligence, cognition, computer vision, intelligent control, electronics, etc.

For more information, please contact CoHemis or Dr. Vladimir Milalic, Mechanical Engineering Department, University of Puerto Rico, Mayaguez, PR 00681-5000. Tel: (809) 832-4040, ext. 2575 or 2560; Fax: (809) 265-3817.

New UPRM Program**B.S. in Industrial Bio-technology**

The Mayaguez Campus of the University of Puerto Rico will be initiating an undergraduate program in industrial biotechnology in January 1994. It will be the first such program in Puerto Rico and one of the few existing in the United States. It is expected to contribute to the economic development of Puerto Rico by producing capable human resources for this key, expanding field.

This program is focused on satisfying present and future needs of industry in Puerto Rico, particularly the pharmaceuticals. It will provide this sector with the industrial bio-technologists and scientists required for the development of new and better operational processes. In turn, this capability will encourage existing firms to expand their operations and should attract new ones.

The Industrial Bio-technology program will have an interdisciplinary nature, including aspects of industrial microbiology, genetics, biochemistry, chemical engineering processes, environmental sciences and engineering, agriculture, plus food sciences and technology.

UN Expert collaborates with UNITEC and UPRM

Dr. Adolfo Korn, recently retired from the Science and Technology Division of the United Nation's Department of Economic Development, was invited to UPRM by its Global Awareness Program with the collaboration of CoHemis. On December 7, he discussed with UPRM faculty and students the UN's mission, organization and activities, as well as the value of an international perspective related to the education and practice of science, engineering, and business. The next day he met with the directors of CoHemis' UNITEC.

Dr. Korn, a mining engineer with international experience in technology assessment, shared his experiences and valuable advice on TA initiatives with the Unit for Technology Assessment,

UPRM International Shorts

Dr. Eduardo Schroder, a distinguished researcher and professor from the Faculty of Agricultural Sciences, taught the course "Biotechnology of the Biological Fixation of Nitrogen" as a visiting professor in the Faculty of Natural, Physicochemical and Exact Sciences of the National University of Rio Cuarto in Argentina. The course took place between November 22 and December 4, 1993.

Dr. L. Antonio Estevez, Associate Director of the Department of Chemical Engineering, has been named to the Editorial Board of Chile's newly created journal *Investigación Tecnológica*. This journal is expected to have a wide reach within the Latin American scientific community. Dr. Estevez has also been appointed to the Technical Committee of the Second Conference on Computer Applications to Process Engineering, to be held in Santiago, Chile, from November 7 to 10, 1994.

Dr. Vladimir Milacic, visiting professor at the Department of Mechanical Engineering, will be chairing a session on Expert Systems and Manufacturing Applications at the Second World Congress on Expert Systems to be held in Lisbon during January 10-14, 1994. Dr. Milacic will present two papers: "Expert Systems for Tooling Selection in Manufacturing and Process Planning Based on Automation Theory" and "Concepts of FMS Machine Design".

Monitoring and Forecasting. They discussed two proposals currently being developed by UNITEC.

The Global Awareness Program promotes providing UPRM science, engineering, and business students with a broad, international view on cultural diversity, regulations, communications, international organizations, competition, and other aspects. Operating from within the campus' Center for International Perspectives, it is directed by Dr. Ramachandra Asundi and co-directed by CoHemis' Dr. Jorge Velez-Arocho, with the participation of faculty from the three fields involved.

In Washington, DC**CoHEMIS PROJECTS PRESENTED**

CoHemis' co-directors made a short trip to Washington DC on November 9 and 10. Drs. Luis Pumarada and Jorge I. Velez-Arocho presented CoHemis' proposals and preproposals, its new UNITEC division for technology assessment, and the CoHemis Consortium.

In a meeting held at the DOE a new proposal on Solar Detoxification technology produced by UPRM Chemical Engineering and Chemistry professors was discussed, as well as the action items which came up in the September conference "Energy and Environmental Issues Facing the Americas" (described in page 3), which had been co-sponsored by the DOE's Sandia NL, a member of the CoHemis Consortium. In Argonne National Laboratory's Washington Office they met with CoHemis' adviser Gary Williams to arrange a future workshop for UPRM faculty interested in participating in technology assessment projects. In a meeting held at the Congressional Office of Technology Assessment for learning about their methodologies and policies, its Associate Director, Dr. Peter Blair, accepted to become part of an advisory body to help CoHemis' UNITEC. In a meeting at NASA, its University Programs Division offered to seek support of other Administration divisions for a UPRM preproposal for a "Gulf/Caribbean Workshop on Remote Sensing for Land:Sea Interface Studies" and for an emergency task force meeting to consider the Ecuador shrimp crisis, described in page 6.

The trip's highlight was a meeting with the Federal Highway Administration's Associate Administrator for Research and Development, Dr. John A. Clements. This meeting had been suggested by Dr. Carlos Pesquera, Puerto Rico's Secretary of Public Works and a CoHemis adviser. While discussing a possible UNITEC technology assessment project on Intelligent Vehicle and Highway Systems (IVHS) for PR and Latin America, the agency's great interest in Latin America and the great potential which CoHemis holds for contributing to its implementation became very clear to all the participants. A very interesting potential technology assessment project was mentioned: the Darien Crossing of the Pan American Highway.

Collaboration Possibilities for Improving Graduate Engineering Education in Latin America and the Caribbean

by: Luis Pumarada-O'Neill and Luz L. Vega,
CoHemis, University of Puerto Rico at Mayaguez

Summary of CoHemis' paper for the "Regional Meeting of Research and Development Centers and Graduate Engineering Study Institutions in Latin America and the Caribbean", held in Caracas, Venezuela on December 14-16, 1993, sponsored by UNESCO and CONICIT-Venezuela.

In developing countries, the human resources needed for solving a country's most important economic and health problems are scarce in quantity and diversity. As in other fields, it is advantageous to form alliances that combine the resources of the collaborating nations in order to make these resources available to other nations at the most effective moments in ways that benefit all members.

The CoHemis Center and the CoHemis Consortium

CoHemis, the Center for Hemispherical Cooperation in Research and Education in Engineering and Applied Sciences, was founded in Mayagüez in 1991, as a result of a conference sponsored by the National Science Foundation and the University of Puerto Rico's Mayagüez Campus (UPRM). The national science and technology organizations of thirteen countries of the Americas were represented in this conference. The activities of the CoHemis Center focus primarily on serving the needs of the Americas with the participation of engineers, scientists and students from different countries, and emphasizing the projects whose results may bring short-term benefits for more than one country of our Western Hemisphere.

UPRM delegates to CoHemis the initiation and implementation of activities for hemispherical cooperation. CoHemis has been developing a support network, the CoHemis Consortium, based on a series of bilateral agreements between the Campus and other universities and laboratories throughout this hemisphere. At present, the CoHemis Center is the focus of agreements with Colorado State University and the Sandia and Los Alamos National Laboratories.

The purposes of CoHemis' participation in this Regional Meeting are: to expand the CoHemis Consortium to Latin American and Caribbean universities of excellence; and to contribute towards the creation of a Latin American and Caribbean network of research and development centers and institutions for graduate Engineering studies.

Graduate Engineering Study at UPRM

The College of Engineering of the University of Puerto Rico is part of its Mayagüez Campus. It offers the degrees of Master of Science and Master of Engineering in the following branches of engineering: chemical, manufacturing, civil, electrical, and mechanical. There is also a graduate program in Managerial Systems Engineering, offered by the Industrial Engineering Department. A doctoral program in Civil Engineering was started one year ago.

The College of Engineering has approximately 4000 students. 573 were identified as graduate students in the 1992-93 academic year; 36% of these are women, and more than 40% come from Latin America and the Caribbean. About 83% of all UPRM Engineering graduate students receive some type of financial aid.

Graduate students from UPRM who qualify and wish to obtain research and educational experience outside the Campus or to continue doctoral studies in prestigious American universities may use the opportunities provided by the CoHemis Consortium institutions. They can also work in projects with researchers from Consortium institutions either in Puerto Rico or at the institutions themselves.

The cost of graduate study at UPRM for a foreign student is approximately \$1500 per semester.

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Summary of paper...

Normally, it takes a student 2 years to complete a master's degree. Housing and normal, everyday costs for an unmarried student in Mayaguez add up to some \$5000 annually. There are research and teaching assistantships available for full-time graduate students who qualify; priority is given to those pursuing the Masters of Science degrees. Financial aid packages go from a minimum of \$5000 plus tuition for a period of ten months, to a maximum of \$9600 plus tuition for students who are working in projects financed with external funds, including full-time research work between semesters (June and July).

Most courses offered are taught in Spanish, and the rest in English. Textbooks are the same ones used in other universities in the US system. Many Puerto Ricans and Latin Americans interested in pursuing doctorate degrees in famous American universities take advantage of the opportunity offered by the graduate studies at UPRM to improve their English and familiarize themselves with the US educational system. At the same time they can approve graduate courses in Spanish that will be totally accepted in the university where they will pursue their doctorates. All of this with the benefits of a relatively low cost and a Latin American environment. Some students have taken only two years to complete doctorates in prestigious universities such as Purdue and VPI (Virginia Polytechnic) after having completed their MS degrees at UPRM.

Ideas on a Network of R&D Centers and Institutions for Graduate Engineering Studies

A network for supporting graduate education and research must serve and interact with the industries of the different countries and become part of government-academy-industry joint initiatives if it is to have an impact on regional and national economic development.

The network should include, among others, the following mechanisms:

- **Electronic mail** with a "bulletin board" type of service to serve the different fields and sub-fields of Engineering with messages such as:
 - requests for professors for short courses or workshops which complement curriculums, enhance the capability of researchers, or address the immediate needs of industry
 - announcements about professors interested in spending sabbatical leaves abroad
 - announcements about assistantships available for graduate students who are willing to work in specific research projects
 - requests for specialized equipment or personnel for completing teams for joint research
- **Telecommunications network** to transfer knowledge effectively and efficiently through interactive remote courses.
- **Hemispheric or Latin American Conferences on Education, Curriculum, and Other Relevant Topics:**

These conferences allow the education of engineers to respond to today's dynamic technological, environmental, social, and ethical trends. They can help standardize some professional and educational aspects, as well as to encourage multilateral agreements that facilitate exchanges of students and professors.
- **Hemispheric or Latin American Thematic Expert Conferences:**

These conferences promote the formation of multinational research teams and the inter-institutional relations that result in exchanges of students and professors. They facilitate joint research on common or regional problems; direct research towards top priority problems; increase the efficiency of the utilization of scarce resources by preventing duplication of efforts; promote new ideas through the exchange of information, hypotheses and results; and create awareness within investigators from different countries of the problems and needs of other countries, so they may realize the applicability of present and future ideas to these problems.