NBSIR 80-2113

INTERNATIONAL ACTIVITIES

The Fiscal Year 1979 Survey of International Programs at NBS

March 1980

National Engineering Laboratory
National Bureau of Standards

U.S. Department of Commerce
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Abbreviations Used in the Text

AFNOR	Association Francaise de Normalization
AID	Agency for International Development
ANSI	American National Standards Institute
ANU	Australian National University
API	American Petroleum Institute
ASHRAE	American Society for Heating, Refrigerating and Air Conditioning Engineers
ASTM	American Society for Testing and Materials
BDOE	British Department of Energy
BRE	British Research Establishment
BRI	Building Research Institute (Japan)
BSI	British Standards Institute
CAS	Chinese Academy of Sciences
CAM	Center for Applied Mathematics (NEL)
CBC	Canadian Broadcasting Corporation
CBT	Center for Building Technology (NEL)
CCPT	Center for Consumer Product Technology (NEL)
CEBTP	Center for the Study of Buildings and Public Works (France)
CEEE	Center for Electronics and Electrical Engineering (NEL)
CEN	Center for Nuclear Studies (France)
CENACO	Centro Nacional de Computation (Bolivia)
CERL	Central Electricity Research Laboratory (England)
CERN	Center for Nuclear Research (Geneva)
CFR	Center for Fire Research (NEL)
CIB	Conseil International du Batiment pour la Recherche, l'Etude, et la Documentation
CISE	Centro Informazioni Studi Esperienze (Italy)
CISNPC	Comissao Instaladora do Servico Nacional de Proteccao Civil (Portugal)
CIT	Cranfield Institute of Technology (England)
CMEPT	Center for Mechanical Engineering and Process Technology (NEL)
CNET	National Center for Telecommunications (France)
CNRS	Centre Nationale du Recherche Scientifique (France)
COCOM	Coordinating Committee on Export Controls
CRIF	Research Center of the Belgian Metalworking Industry
CRIP	International Institution for Production Engineering Research
CSA	Canadian Standards Association

CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CSTB	Centre Scientifique et Technique du Batiment (France)
CUPE	Cranfield Unit for Precision Engineering (England)
DIN FNM	Deutsches Institut fur Normen, Fachnormenausschuss Materialprufung
DOC	Department of Commerce (USA)
DOE	Department of Energy (USA)
EC	Danish Research Center for Applied Electronics
EEG	Electroencephalogram
EER	Energy Efficiency Ratio
EKG	Electrocardiogram
EM	Electromagnetic
ENEL	Ente Nazional per l'Energia Electtrica (Italy)
EOS	Egyptian Organization for Standardization
EPA	Environmental Protection Agency (USA)
ETSU	Energy Technology Support Unit (England)
FAA	Federal Aviation Administration (USA)
FIRTO	Fire Insurers Research and Testing Organization (England)
FLOMEKO	International Flow Measurements Confederation
FRI	Fire Research Institute (Japan)
FRS	Fire Research Station (England)
GLC	Greater London Council
GSA	General Services Administration (USA)
GSI	Geographical Survey Institute (Japan)
HUD	Department of Housing and Urban Development (USA)
HVAC	Heating, Ventilating, and Air Conditioning
IAEA	International Atomic Energy Conference
IASS	International Association of Shell and Spatial Structures
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IEEE	Institute of Electronics and Electrical Engineering
IFE	Institute of Fundamental Electronics (Poland)
IFRF	International Flame Research Foundation
IIR	International Institute of Refrigeration
IMCO	Intergovernmental Maritime Consultative Organization
IMEKO	International Measurements Confederation
IMP	Instituto Mexicana del Petroleo
INCERC	Romanian Building Research Institute
INPM	National Institute of Weights and Measures (Brazil)
INTI	Instituto Nacional de Technologia Industrial (Argentina)
IOCU	International Organization of Consumers Unions
IPT	Institute for Technological Research (Brazil)
IREQ	Institute of Research, Quebec
IRM	Institute Suisse de Recherches Menageres
ISO	International Organization for Standardization
ISONET	International Standards Information Network
JT	Joule-Thompson
KSRI	Korean Standards Research Institute
LESL	Law Enforcement Standards Laboratory (NEL)
LMA	Laboratorie de Mecanique et d'Acoustique (France)
LNEC	National Laboratory of Civil Engineering (Portugal)
LNG	Liquified Natural Gas
LPG	Liquid Petroleum Gas
LRMH	Historical Monument Research Laboratory (France)

MAA	Mean Apparent Altitude
MELCO	Mitsubishi Electric Corporation (Japan)
MG	Messer Greishem (Netherlands)
MIT	Massachusetts Institute of Technology
MRG	Magnetoretinogram
NATO	North Atlantic Treaty Organization
NBRI	National Building Research Institute (South Africa)
NBRRI	Nigerian Buildings and Roads Research Institute
NBS	National Bureau of Standards
NBSLD	NBS Load Determination (a computer program)
NDE	Non-Destructive Evaluation
NEL	National Engineering Laboratory
NHC	National Housing Corporation (Philippines)
NIM	National Institute of Metrology (China)
NML	National Measurement Laboratories (Australia)
NRC	National Research Council of Canada
NRDC	National Research and Development Corporation (England)
NRLM	National Research Laboratory for Metrology (Japan)
NTF	National Transonic Facility (NASA Langley)
NVLAP	National Voluntary Laboratory Accreditation Program
OAS	Organization of American States
OECD	Organization for Economic Cooperation and Development
OEP	Office of Energy Programs (NEL)
OES	Office of Engineering Standards (NEL)
OIML	International Organization of Legal Metrology
PAN	Polyacrylonitrile
PAGASA	Philippine Atmospheric, Geophysical, and Seismological Administration
PWRI	Public Works Research Institute (Japan)
RF	Radio Frequency
RIBA	Royal Institute of British Architects
RIT	Royal Institute of Technology (Sweden)
RRL	Radio Research Laboratories (Japan)
RSRE	Royal Signals Radar Establishment (England)
RTH	Rank Taylor Hobson (England)
SABS	South African Bureau of Standards
SBM	State Bureau of Metrology (China)
SEM	Scanning Electron Microscope
SFCP	Special Foreign Currency Projects
SIH	Schweizerisches Institut fur Hauswirtschaft
SII	Standards Institute of Israel
SPTL	Superconducting Power Transmission Lines
SQUID	Supterconducting Quantum Interference Device
SRM	Standard Reference Material
THE	Technical Help to Exporters (England)
TUD	Technical University of Denmark
UAM	Universidad Autonoma Metropolitan
UBC	University of British Columbia
UJNR	U.S./Japan Cooperative Program on Natural Resources
UK	United Kingdom
UL	Underwriters Laboratories (USA)
UNAM	Universidad Nacional Autonoma de Mexicano
UNESCO	United Nations Educational, Scientific, and Cultural Organization
URSI	International Scientific Radio Union
VDS	Verband der Sachversicherer
VLSI	Very Large Scale Integration (of semiconductors)

PREFACE

The National Engineering Laboratory (NEL), as part of the National Bureau of Standards (NBS), is committed to international activities that support its overall program. The NEL activities reported in this volume reflect that commitment. These activites have given support to the technical programs of the NEL Centers and Offices, have helped to gather information on technology advances abroad and to further international agreements for cooperation, have contributed to the exchange of technical information among nations, and have fostered a truly international technical community. This report is limited to reporting only NEL's activities, and not those of the other parts of NBS.

There are a number of means through which international activities are conducted: formal visits by one or more NEL staffers to a foreign research organization or conference, visits by foreign government scientists and representatives of research institutions to the NBS facilities, and exchange visits and hosting of overseas guest workers at NBS. A report such as this cannot delve too deeply into the details and specifics of these projects. They can only be surveyed in an attempt to characterize the status and nature of this work. This report is not intended to evaluate the technical programs described or their relative merits.

International activities within NEL are coordinated through the Office of the Associate Director for Program Coordination. This Office serves as the focal point for interacting with the NBS Office of the Associate Director for International Affairs, other agencies, and the international community.

It is hoped that this report will be of assistance to NBS staff members, as well as others, and will serve as a directory and reference document for all those who seek information on our international activities. Readers who would like more information should contact the NEL staff member identified with the activity.

Samuel Kramer
Associate Director for
Program Coordination, NEL

INTRODUCTION

The National Engineering Laboratory of the NBS strives for a rather diverse set of goals. It seeks improvements in the reliability of electronics; measures the performance of consumer products; enhances the technology for the construction of homes and buildings; promotes energy conservation in residences and industry; saves lives and property through studies of fire and natural disasters; supports national programs such as the accreditation of testing laboratories and the labeling of appliances for energy consumption; and contributes to national health and safety by measuring environmental noise or electromagnetic radiation and by developing new technology for such commercial operations as the shipping of liquefied natural gas.

To further these objectives, NEL supplies the nation with engineering measurements and data and proposes the technical basis for new codes, standards, and test methods. In this way, new engineering practices are adopted by industry, government, and academe. In brief, NEL fosters technical innovation.

International research activities are an important part of this work. As they are described in this report, covering the 1979 fiscal year, international programs are of two kinds for the most part: either individual agreements with other nations to jointly pursue common research goals, or institutional memberships and cooperation with foreign and multinational research organizations. In both kinds of arrangements, however, the object is the same: to spread the results of research to the scientific community worldwide. Beyond that, the aim is to bring the best of foreign technology to these shores.

NEL's arrangements to cooperate with research groups in other industrialized nations is a prudent attempt to avoid costly and time-consuming duplication of effort. It is also an admission that no one country has a monopoly over the others in all areas of research. Some nations have active programs and expertise in certain fields, such as: England, for total energy systems; Sweden, for building rehabilitation; Israel, for solar energy; and France, for the fabrication of large-scale magnets. NEL, in turn, has a similar catalog of expertise that is attractive to scientists and engineers in other countries. For these reasons, it is expected that international arrangements like those described in this report will continue to expand over the years. Likewise, tours of foreign laboratories and analysis of international technology will continue to be a source of ideas for domestic technology.

The National Engineering Laboratory's work is carried out in seven centers and two offices, as follows:

- The Center for Applied Mathematics conducts research in many fields of mathematics and computer science. It develops mathematical tools, such as statistical models, computational methods, mathematical tables, handbooks, and manuals.

- The Center for Electronics and Electrical Energy conducts research and development and studies new applications in the field. It also develops practical data, measurement methods, theory, and standards. Its national reference standards and engineering measurements are recognized the world over.

- The Center for Mechanical Engineering and Process Technology provides competence in mechanical engineering, materials engineering, industrial engineering, metrology, and automatic control technology. Its assistance is acknowledged by the manufacturing industries, public utilities, and government.

- The Center for Building Technology seeks to improve the safety, economics, and usefulness of buildings. Its laboratory and field research produces the technical and scientific basis for new test methods, criteria, and standards.

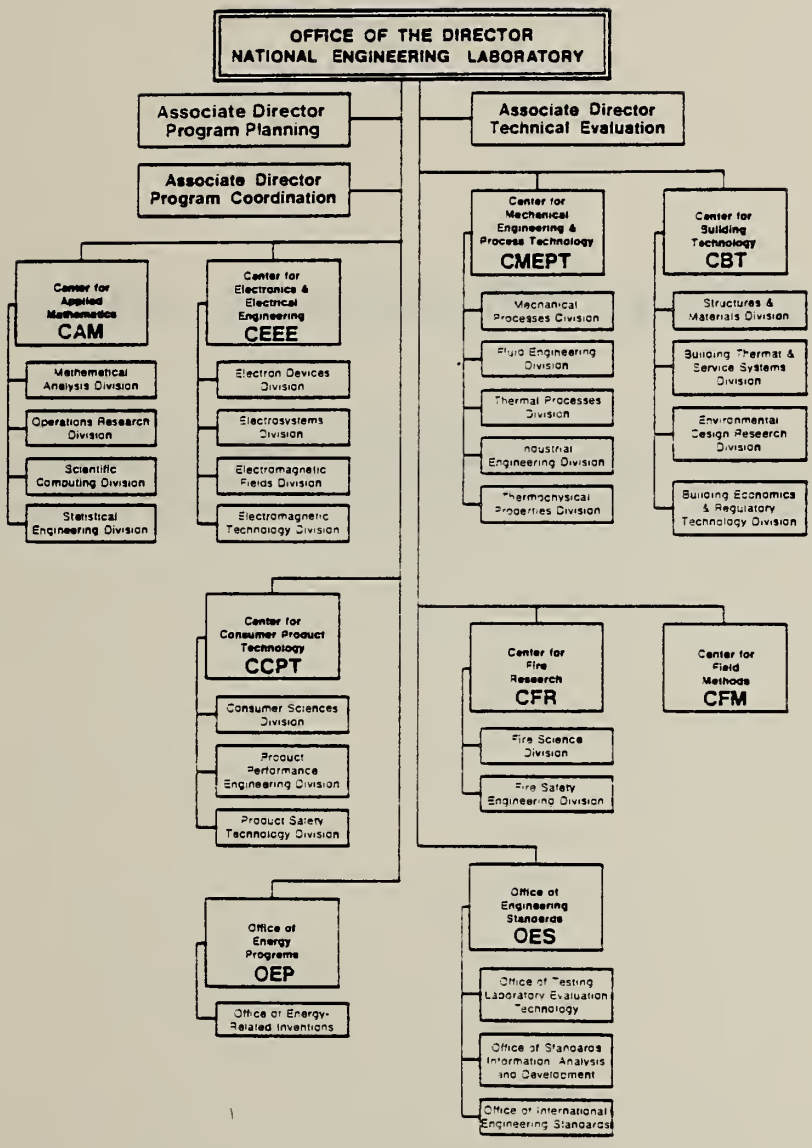
- The Center for Fire Research performs research in all aspects of fire, with an eye to its prevention and control. Biological, physiological, and psychological factors related to fire and its victims are included.

- The Center for Consumer Product Technology performs research and develops the technology needed to measure and evaluate the safety, energy efficiency, and other performance characteristics of consumer products and law enforcement equipment.

- The Center for Field Methods seeks to uncover how the rate and direction of technological change is affected by government and industry.

- The Office of Engineering Standards provides domestic and international engineering standards services, assists in the development of voluntary product standards, assists laboratories in developing procedures for testing materials and products, and is developing a system for accrediting testing laboratories.

- The Office of Energy Programs provides overall management planning and coordination of the NBL energy-related programs with a focus on conservation and new applications in buildings, communities, consumer products, industry, and energy-related inventions.


OFFICE OF THE DIRECTOR
NATIONAL ENGINEERING LABORATORY
Associate Director
Program Planning
Associate Director
Program Coordination
Associate Director
Technical Evaluation
Center for Applied Mathematics
CAM
Mathematical Analysis Division
Operations Research Division
Scientific Computing Division
Statistical Engineering Division
Center for Electronics & Electrical Engineering
CEEE
Electron Devices Division
Electrosystems Division
Electromagnetic Fields Division
Electromagnetic Technology Division
Center for Mechanical Engineering & Process Technology
CMEPT
Mechanical Processes Division
Fluid Engineering Division
Thermal Processes Division
Industrial Engineering Division
Thermophysical Properties Division
Center for Building Technology
CBT
Structures & Materials Division
Building Thermal & Service Systems Division
Environmental Design Research Division
Building Economics & Regulatory Technology Division
Center for Consumer Product Technology
CCPT
Consumer Sciences Division
Product Performance Engineering Division
Product Safety Technology Division
Center for Fire Research
CFR
Fire Science Division
Fire Safety Engineering Division
Center for Field Methods
CFM
Office of Energy Programs
OEP
Office of Energy-Related Inventions
Office of Engineering Standards
OES
Office of Testing Laboratory Evaluation Technology
Office of Standards Information, Analysis and Development
Office of International Engineering Standards

COUNTRY-BY-COUNTRY REPORTS

The sections that follow present the NEL activities on a geographical basis. Within each country, the contributions of each NEL center are discussed in turn -- in the order they appear on the NEL Organization Chart (page 3). Our activities with international organizations and conferences are presented separately in the next section of the report.

Argentina

In September, **Judson C. French**, Director of CEEE, traveled to Buenos Aires. His original purpose was to present an invited lecture at the Conferencia Interamericana de Metrologia. There were also understood to be a few associated formal visits to the Instituto Nacional de Technologia Industrial (INTI) planned for distinguished visitors. In fact, the interest in electronics was sufficently great that numerous special visits to laboratories and with individuals were arranged.

On the day before the Conference, about a dozen guests were taken to the INTI laboratories at Miquelete, outside Buenos Aires. There, the organization, resources, and activities of INTI were described by Capt. Leibovich, National Director of Development of INTI. A tour of the chemistry and food technology laboratories followed. These were new buildings (begun at 1972 and finished in 1977) with a considerable amount of U.S. equipment (as well as equipment from other countries) and a rather small staff.

A matter of some interest was that INTI is setting up an electronics repair facility to care for U.S. equipment since such service is not otherwise available. Much equipment is defective on receipt. This is unfortunately due in part to manfacturer's defects and in some (undetermined) measure to handling in Argentina. Apparently it is often difficult to resolve responsibility for the defects, and the defect problem and lack of local representatives is discouraging to the laboratory.

French also visited INTI headquarters in Buenos Aires to meet the President and Vice President of INTI. After the conference, the delegates and special guests were taken to INTI for a more extensive tour. At that time, he visited the Physics Laboratory (briefly meeting a number of people who had visited and received training at NEL) and a new building where a major effort in automated manufacturing will be undertaken. The building had one very large bay and a number of modern offices. French was told the automated equipment will be supplied by Kearney and Trecker of England. Computer services available now are a DEC PDP11 and a IBM 1130. In the spring of 1980 a DEC VAX 11-780 will be received.

Electronics is a subject of special interest in Argentina. The first of INTI's planned technical and economic studies is a major one devoted to the determination of a proper role for Argentina in this field and Argentina's internal needs for electronics. In Capt. Leibovich's review of INTI, he noted that INTI's work in electronics covers three areas: electronic components, communcations, and the role of Argentina.

Capt. Liebovich was the instigator of the national effort in electronics. As the result of his efforts, and for the first time, three universities and four government agencies are cooperating in a single program. This is now carried on under the National Research Center for Electronic Components (Centro Nacional de Investigaciones en Componentes Electrónicos, CENICE). CENICE was established in July 1977 and is sponsored by the Defense Ministry (represented by the Research Directorate and the Instituto de Investigaciones Cientificas y Técnicas de las Fuerzas Armadas, CITEFA), the Secretary of State for Science and Technology, the Commission Nacional Energia Atomica (CNEA), and INTI. The work of CENICE is on three levels: research, development, and pilot production in preparation for transfer of technology to industry.

Research is primarily done by the universities. For example, at Rosario University a plasma research group is now studying etching; at Santa Fe University, a group is studying purification of gases for electronic applications; and at Buenos Aires University, a solid state physics group is studying diffusion and epitaxy. Work on ion implantation, however, is done by CNEA at the laboratory in Bariloche. Development, from basic to advanced levels, is done at CITEFA, and pilot production will be carried out at INTI in a new building now under construction (current pilot production is at CITEFA).

In a visit to CITEFA, President Barcellandi described his organization's interests in components and microelectronic production technology. CITEFA has a staff of 800, 40 are military and the rest civilian. Its budget is $25M.

The first transfer of technology from CITEFA to industry in electronic components will be in hybrid circuits. CITEFA developed the technology and is training industrial personnel on the CITEFA equipment while awaiting establishment of the industrial facility. The example described was a thick-film attenuator circuit for telephone use which was developed at CITEFA, proof-tested by Seimens in Munich, and, on approval, manufactured at CITEFA for use in local telephone companies. Hybrid work began in 1978. The plan is to develop thin-film technology next, with multi-level metallization and hermetic packages for military use. The hybrid work is carried out by a staff of 11 (five are professionals) under the direction of Sr. Albizu, a physicist.

The semiconductor device fabrication facility and laboratory are headed by Sr. Sagarzazu and operated by a staff of 30, of which 10 are professionals. Some professionals are Ph.D.'s (one did his thesis in epitaxy in France, another in design at M.I.T.) and several have completed some graduate study in France or the United States. The fabrication facility is rather similar to the one at NBS. Equipment is from Europe and the U.S. At present the effort at CITEFA is limited to bipolar processing of two-inch wafers (three-inch is the limit of the facility). A simple transistor is now being made (50V collector breakdown, h_{FE} of 100 to 200, and frequency cutoff in 10 to 20 MHz). Masks have been obtained for a 400 to 500 MHz transistor, and drawings have been completed for a power transistor of several amperes current capacity.

Australia

From October 15 through December 28, 1979, **Howard J.M. Hanley** of CMEPT worked as an Honorary Visiting Fellow at the Research School of Physical Sciences, Australian National University (ANU), Canberra. The bulk of his work was undertaken with Dr. D.J. Evans. Together, they developed a computer procedure to simulate the behavior of a fluid mixture in nonequilibrium and, specifically, to calculate the viscosity coefficient. The behavior of a fluid at equilibrium was also investigated as a byproduct. In so doing, they were able to test current theories of mixtures. One especially -- the conformal solution theory -- is the backbone of all mixture work in the fluid properties section of the Thermophysical Properties Division. It is intended to apply the approach to mixtures of complex molecules. However, it would be unwise to extend the theories without first testing them through computer simulation.

Specific results include: the calculation of the viscosity of a fluid whose molecules interact with an 11-6-8 intermolecular potential (these studies supplement previous work carried out at ANU on the thermodynamic properties of this fluid); calculation of the viscosity of a mixture of soft spheres; calculation of the thermodynamic properties of this mixture; evaluation of the so-called Van der Waals one-fluid theory for mixtures and extension of this theory to viscosity; and extension of the computer program to simulate fluid mixtures whose molecules interact with a realistic potential, such as the 11-6-8, and also to include the interaction of polyatomic fluids.

The power and efficiency of the computer program for the simulation of a liquid should be stressed. It can carry out calculations not previously attempted.

In September, **A.F. Robertson** of CFR visited the CSIRO Textile Research Laboratory at Ryde. It appears that their main concern is woolen products. Significant advances have been made in improving the washability, decreasing the felting behavior, and improving the permanent press of woolen goods. The laboratory for fire tests was very well equipped to work on fabric test methods over the range from small bench tests to full-scale mannequin burns.

The CSIRO Division of Building Research in Melbourne has a small fire research group concerned with reaction to fire test methods primarily as they relate to polymeric materials. Most of their work was prompted by special problems as they were discovered by industry and as evidenced by fire loss experience. The fire group is a small one, only 5 or 6 years old, and is currently headed by Dr. K. Martin.

Robertson and **Daniel Gross** of CFR both visited the fire laboratories of the Experimental Building Station, Chatswood, which are under the direction of the Ministry of State for Housing and Construction. Work underway there has been followed with interest for more than 30 years now. Two large laboratory buildings are available -- one for reaction to fire tests and the other for fire endurance studies. A large part of the work of this group appears to involve relatively routine testing with some test-method development.

During the organized tour, the two observed the Australian Early Fire Hazard Test and Flammability Test, as well as a fire resistance test on a full-size loaded thin brick wall. The demonstration was covered by Australian network TV; the Australian Minister of Housing and Construction, Mr. Ray Broome, also addressed the group.

During the same month, **Irwin Benjamin** of CFR presentd a talk on "A Fire-Safety Evaluation System for Health-Care Facilities" to two groups of Australian planners. He also conferred with five researchers at CSIRO and the division of building research (on the fire exposure of steel sections and columns).

In September, **James H. Winger** of CFR visited Mr. G. Georges of the Department of Mineral Resources and Energy, Chemical Laboratory, Lidcombe, New South Wales. He also met briefly with Mr. R. Burg, the department director. The Chemical Laboratory is responsible for the flammability testing of brattice cloth, hydraulic fluids, paints, greases, and tape, used in underground coal mines. Later, Winger met with Mr. M.R. Lloyd, Director of the Londonderry Centre of the Department of Mineral Resources and Energy, and members of his staff. The Londonberry Centre conducts flammability tests on electrical cable and conveyor belting used in underground coal mines.

Belgium

In May, **E. Clayton Teague** of CMEPT toured the Mechanical Engineering Department of the Catholic University of Leuven. Professor J. Peters hosted his visit and showed him the development and analysis work on adaptive control of a large spark-discharge machine, a high-precision robot assembly, modol analysis of machines and machine tools and air bearings. No work on surface topography measurements was currently in progress, but Prof. Peters showed the equipment and described past projects for light-scattering measurements and for calculating the statistical characterizations used in the study of machined surfaces.

In September, **Clifford H. Spiegelman** of CAM visited the Central Bureau for Nuclear Measurements in Geel, to act as advisory statistician for the working meeting on the preparation and certification of U_3O_8 reference materials.

Brazil

In September, **Judson C. French**, Director of CEEE, visited the headquarters of the INPM (National Institute of Weights and Measures) at Duque de Caxias about 23 km from Rio de Janeiro. INPM employs a total of about 2500 in 22 branches in 22 counties and in headquarters (where about 650 are located). The laboratory work is all done in the headquarters building with typically a single laboratory room devoted to each measurement area such as electricity, length, pressure, etc. Elaborate and extensive facilities are being constructed, with a separate building each for mechanics, acoustics, electricity, optics, and temperature. Other functional but less striking new buildings nearby will be used for future research in instrumentation.

The impact of a law that will add the responsibility for industrial standards to the weights and measures organization was discussed. The law was passed in 1973, but the attitude of voluntary standards organizations was described as causing delays in implementation of the law. The director of INPM, Armenio Lobo da Cunha, was attracted by the idea of exchange workers doing joint work with NEL.

Canada

In September 1978, **William E. Anderson** of CEEE visited the Institude de Recherche de l'Hydro-Quebec (IREQ), in Varennes. He was invited by Richard Malewski, a senior researcher, to participate in the measurement of the power loss in a shunt reactor. Shunt reactors (large inductors) are used in power transmission systems to balance out the capacitive currents to ground. Power losses in these non-ideal inductors can be significant. The shunt reactor to be measured was rated for 110 MVA (424 kV, 260 A). The reactor's loss as guaranteed by the supplier was to be less than 220 kW (dissipation factor < 0.002). For every kilowatt over, the supplier has to pay a $1,000 penalty to IREQ. It should be noted that similar problems are encountered by purchasers and suppliers in the United States. The Bonneville Power Administration, Department of Energy, is also buying shunt reactors and has consulted NBS about the loss measurement problem.

In July, **John A. Molino** of CBT also visited IREQ to consult on planned psychoacoustic studies of the audible noise from their UHV dc test electric transmission line. IREQ has recently completed setting up and testing automated magnetic tape recording facilities to record the audible noise from their test transmission line. The line can examine the various effects of direct current transmission at 1200 kV. He inspected the instrumentation for measuring and recording audible noise and made some suggestions for modifying the equalization used. These suggestions helped to make their system more compatible with the automated tape recording system being developed by NEL. He also auditioned live recordings made under the active line and some recordings made previously. The system appeared to be adequate for making psychoacoustic tapes, except that there was excessive wind noise. He agreed to loan them some of the large urethane windscreens used at NEL.

In October 1978, **John S. Beers** of CMEPT went to Ottawa to attend a seminar on "The Measurement of Length and Associated Quantities," sponsored by NRC, and to give a talk on "New Trends in Gage Block Calibration at NEL." Two other papers presented at the seminar were of particular value to NEL research: "Optical Computers in Metrology" and "A New Photoelectric Microscope," both applicale to dimensional measurement activities in CMEPT.

In December, **Robert J. Hocken** of CMEPT went to McMasters University (Hamilton, Ontario) for technical discussions with Professor Tlusty concerning the role of Working Groups 1 and 2 of the Machine Tool Task Force. Hocken also visited Professor Tlusty's lab, were he saw important work in adaptive control to prevent cutter breakage during die sinking, and experimental measurement of the dynamic cutting-force coefficient.

Gerald L. Howett of CBT traveled to Ottawa in November 1978 to attend a meeting of the Color Committee of the Illuminating Engineering Society (IES). As part of the committee meeting, he visited the new lighting laboratory of the Division of Building Research of the National Research Council (NRC) of Canada. Howett is the recent past chairman of the IES Color Committee. The new chairman of the committee is Dr. Alan R. Robertson of NRC (Division of Physics). The meeting at Ottawa was the first under Dr. Robertson's chairmanship, and it was considered especially important for the outgoing chairman to be present, in order to smooth the transition.

Most of the Color Committee meeting was spent on polishing the draft of the Color chapter to be included in the upcoming sixth edition of the IES Lighting Handbook. Following the break for lunch, the committee went to visit a new lighting laboratory in the Division of Building Research, developed by Dr. Alan Levy. He had had installed in the ceiling of a large (double or triple) laboratory module several types of light sources, which he could control from a master switching panel.

In June, **Jim L. Heldenbrand** of CBT visited laboratories of the Division of Building Research, National Research Council of Canada, in Ottawa. There, he discussed verbal comments and questions on NRC publications on energy conservation in new buildings and obtained information on status of Measures for Energy Conservation. Canada is ahead of the U.S. in promulgation of energy conservation criteria at the federal level, but is behind the U.S. in implementation at the local level. He also discussed the status of the energy-budget approach to building energy conservation criteria. Ken Latta of NRC has a concept in mind for development of numbers, but there is no consensus in Canada for an approach to implementation. The prospect is for publication of energy budgets for information only.

In September, **Andrew J. Fowell** and **Robert A. Wise** of CCPT visited the Canadian Standards Association (in Toronto) to see the energy test facility for refrigerators and freezers, and to witness safety and performance testing of other consumer products. They also attended a meeting of the CSA Committee on the Performance of Major Electrical Appliances to determine the program status and experiences gained from the development of energy and performance standards for major appliances in Canada, and to advise CSA to the status of the U.S. Appliance Energy Labeling and Minimum Standards Program.

On arrival at the CSA Laboratories, they then met with Mr. Allen Sherrard, CSA Project Administrator, and Mr. Robin Haighton, who is in charge of the appliance labeling test program. They briefly discussed the status of appliance energy labeling programs in Canada and the USA. (CSA is under contract to the Canadian Government to establish and run the labeling program, including the development of test methods, product testing, the issuance of labels and associated literature.) They later toured the CSA Laboratory with CSA engineers, James Smith and Ron Pouge. They examined and discussed the instrumentation of the test facility, a temperature (but not humidity) controlled chamber with ten test stations. CSA uses a Hewlett-Packard mini-computer with their own tape-loaded program to initiate a test, record temperature data, perform some data reduction, and print out this information in the form of a report. The energy consumption data must be manually recorded and refrigerators and freezer tests cannot be controlled simultaneously by the program.

In January, **William J. Parker** of CFR attended a Toronto meeting at the Underwriters' Laboratories of Canada (ULC) on flame spread classification methods. The focus of the meeting was on the flammability rating for polystyrene insulation. Although it is required by the building code to be covered by a fire barrier, there is still a flammability requirement for the material. It must have a flame-spread classification (FSC) of no greater than 75. In the standard tunnel test a typical polystyrene foam may have a low FSC (10) due to the melting and falling of the material from the ceiling of the tunnel. ULC has chosen to test thermoplastic materials on the floor of the tunnel. In this location the same material may typically get a 300 rating and thus not be acceptable even though there is no record of a fire problem with protected foam in Canada. What followed at the meeting was a four-way discussion among industry, the testing agency, building officials, and fire reseachers.

The Canadian Centre for Mineral and Energy Technology (CANMET), Ottawa, was visited by **James H. Winger** of CFR in February to observe and discuss flammability tests on conveyor belts for use in underground coal mines. A number of conveyor belts were tested on the drum friction test according to the Canadian standard procedure. Coated belts were tested with both polyester and nylon/cotton carcasses. All the belts met the Canadian requirement that the drum temperature not exceed 300°C.

Denmark

In May, **Preston E. McNall** of CBT visited Dr. Fanger at the Technical University of Denmark. The insulation laboratory, the furnace and heating lab, and their zero-energy house were visited. In addition, he met Niel Jonassen, a radiation physicist, who has done extensive work on radon measurement in buildings, and arranged for him to speak at a later CBT seminar on radon. McNall then presented a seminar for one hour to 20 students and faculty members on CBT work, concentrating on the Building Energy Conservation Criteria Program and heat pump seasonal efficiency program.

Egypt

In November of 1978, **Dennis A. Swyt** of CMEPT visited Cairo in connection with his role as a monitor of several SFCP projects. At Cairo University, he visited research facilities, gave a 90-minute lecture on light and optical physics applied to measurements of microscopic objects, discussed problems and solutions in physics and procedural matters. Although the institution suffers a severe lack of equipment, supplies, and journal literature, dedicated and talented laboratory researchers, particularly Prof. Khashan, the group leader of this project, give evidence for success in project objectives. One major problem is acquisition of fully operating, maintainable equipment with local currency. Another problem is the establishment of steady supply of current scientific and technical literature.

At the National Institute of Standards, Swyt reviewed the contract agreements for three projects -- on ultrasound, volume/flow, and temperature. In discussions with Dr. Mongy, several major obstacles to the ultrasonics project surfaced. For example, researchers have been trying to obtain X and Y cut quartz transducers for two years, but have been deterred by obstacles due to distance, finances, or bureaucracy.

At the Academy of Science and Technology, Swyt met with the president, Dr. Hassan M. Ismail. His main concern is improving the quality of Egyptain building materials and standards. Last, Swyt met with the acting head of the Egyptian National Research Center, Dr. M. Stehata Faraq (an x-ray crystallographer). His interest focuses on spectroscopy and wavelength calibration over the complete range from ultraviolet through infrared.

Federal Republic of Germany

Jeffrey T. Fong of CAM traveled to Stuttgart, Berlin, and Munich in August. Initially, he was invited to be a speaker and panelist on the relationship between engineering data and reliability modeling for nuclear reactor safety at an international conference in Berlin. But he also spoke at a joint seminar of the German Society of Materials Science and the Technical University of Munich (Department of Metallurgy and Metal Science) on a new concept of estimating uncertainties in weld-defect dimensioning. He also accepted an invitation to discuss new mathematical methods and applications for modeling fatigue and crystal growth at the Institute for Theoretical and Applied Physics, University of Stuttgart.

Later, Fong visited several laboratories in Germany to assess the state of research on basic mechanisms of fatigue in his capacity as Chairman of ASTM Subcommittee E9.01 (Fatigue Research). He was likewise able to conduct in-depth discussions with participants in the International Conference on Reactor Technology on the need to standardize in-service and failure data reporting to make the pooling of data for safety analysis more dependable.

At the Technical University of Munich, in May, **Motohisa Kanda** of CEEE visited Prof. F.M. Landstorfer and his colleagues at the Institute for High Frequency Techniques. His work on antenna design using a topological approach was very interesting. Considering the phase reversal within the current distribution of a long-wire antenna, it is well known that radiation normal to the dipole is very poor. For this reason, dipoles considerably longer than one wavelength are scarcely used. He has done considerable work to determine optimum shape so that long dipoles can be made into very efficient radiators. He also applied some ideas to Yagi-Uda arrays and log-periodic antennas for the purpose of increased bandwidth and gain. Prof. H. Groll and his colleagues at the Institute for Microwave Techniques have been engaged in microwave measurements including the conventional automatic network analyzer, 6-port, strip lines, microstrip lines, and active and passive semiconductor device applications.

In April, **Harold E. Taggart** of CEEE visited the laboratories of Schwarzbeck in Alteneudorf, and Rohde and Schwarz in Munich. The purpose of the Schwarzbeck visit was to determine how their precision dipole antennas, designed to operate from 30 to 1000 MHz, are calibrated. He met with Mr. G. Schwarzbeck, owner and manager of the company. He explained the basic design of his antennas and how he calibrated them. He clarified a 10-dB discrepancy that NBL had encountered using his antennas.

Rohde and Schwarz are probably the West German leaders in automated EMI measurements. They have just completed the development of a computer-controlled test system that operates from 25 to 1000 MHz.

In September, **Robert I. Scace** of CEEE toured the Philips Semiconductor Plant (VALVO) in Hamburg. He was visited by Dr. G. Raabe, a member of DIN 221, to discuss their methods for silicon measurement and their process control techniques.

The mercury probe technique for making capacitance-voltage measurements on silicon slices to determine the charge-carrier concentration was devised by Philips, and there is now a fourth-generation probe fixture in use. The repeatability of the technique is now such that they believe they are able to measure to a precision of better than 2 percent such carrier distributions. The test is nondestructive. Depending on the level of interest, Philips may be willing to consider the release of the drawings for the test head to NEL.

Another interesting note: The German government, to support innovation in its semiconductor industry, will grant up to 50 percent of the cost of any development, whether it be a new factory, a new product, or a processing technique, if it meets certain criteria of risk. Two examples were shown. One was a technique for computer-controlled growth of expitaxial layers on silicon, and the other was a new manufacturing facility of about 1000 m^2 area for microprocessors. The cost was several million dollars, judging from the equipment already in place.

In May, **John Arol Simpson** Director of CMEPT, visited Tubingen to renew a long standing scientific relationship between NEL and the Institut fur Angrwandte Physik under Professor G. Mollenstedt. The Institute, in splendid new quarters, continues to work in electron interferometry, characteristic energy loss, and various facets of electron microscopy.

While in Tübingen, he was able to talk with Prof. Mollenstedt's son, Dr. Ulrich Mollenstedt, a partner in Social Data of Munich, a consultant to the Ministry of Industry. He notes that the question of industrial automation is being rethought in view of increasing difficulty in maintaining full employment. However, there is concern that shift work causes social and health problems, so they are proposing a system of one manned shift and one or two unmanned shifts. This concept is being extended even to health service installations. This mixed mode operation should be watched.

In Stuttgart, Simpson was a guest of Dr. E. Schultz and K. Melchior of the Institut fur Produktianstechnik und Automatisierung. This institute is part of the Fraunhofer Gesellschaft, the engineering/industrial counterpart of the Max Plank Institutes in sciences. It is associated with the University of Stuttgart. It provides graduate training in engineering while providing consulting and R&D services to industry. It is unique among such institutes in that it covers not only automation and control technology, but also ergonomics, work organization, material handling, accounting, and scheduling. It is also pursuing the problems of automated metrology although from a limited metrology base.

In April, **E. Clayton Teague** of CMEPT toured the Physikalisch Technische Bundesanstalt, Braunschweig, and conferred with Dr. W. Hillmann, head of the Surface Laboratory. The laboratory has a staff of ten people, four devoted to SEM stereology, two to computer aspects of measurement and characterization, two to calibration services, and one general assistant for graphics preparations, assistance in manuscript preparation, etc. Teague was shown their Cambridge stereoscan electron microscope and viewed a large number of high-resolution stereo images with polarized glasses.

Their main interest in stereology is to compare profiles obtained by manual stereo techniques with those obtained from various radii stylus tips and profiles obtained from projections of SEM contamination lines written on a specimen surface; they expect this work to continue over the next two to three years. They hope that this work will be the first to definitively show limitations of stylus measurements that result from unexpectedly large slopes of surfaces. Their preliminary work shows slopes as large as 60 degrees, whereas it was previously believed that 15° to 20° was the more typical maximum value.

He also discussed with Mr. Kranz his work to measure stylus tip radii with stereology and his work to relate stylus frictional forces to surface-slope.

At the Hannover facilities of Mahr-Perthen, Teague met with Mr. Christoph Fahl, Director of Research and Production. He also visited with Mr. Horst Grove, Mr. Karl-Heinz Sommer, and Mr. Heinz-Jurgen Bohm. Bohm was responsible for all calibration specimen measurements and final checkout of stylus instruments. Messrs. Grove and Sommer were responsible for new instrument development, with emphasis on new micro-processor instrumentation.

During the last several years, they have developed a digital zero-phase-shift filter for incorporation into their instruments. By using two cascaded applications of a rectangular weighting function, they have achieved very fast calculation of the zero-phase-shift filter and plan to offer it as an option within the next year. They feel a major effort will be needed to educate industry, that the new filter is beneficial, and that it conforms to all national standards. Benefits are that the geometry of a filtered signal is maintained relative to the original signal and that a true waviness profile is then produced. Conventional filters greatly distort the roughness and waviness geometries.

In September, **John G. O'Neill** of CFR visited the sprinkler laboratories of Verband der Sachversicherer (VDS) in Cologne and met with Mr. D. Lay, Head of VDS, as well as with Mr. W. Klein, Project Engineer in charge of all sprinkler component tests. The purpose of the visit was to obtain information on their spray measurement methodology as well as to discuss pertinent issues now under discussion within the ISO sprinkler standard development. The VDS serves as a testing and approval laboratory for fire protection and security hardware. The organization is primarily insurance sponsored. However, the VDS tests and criteria for sprinkler system components as well as sprinkler system installations serve as the primary criteria throughout West Germany. In addition, these approvals and equipment lists as well as installation rules are often used in neighboring countries of Scandinavia as well as in Switzerland.

Mr. O'Neill also visited the Walther & Cie Sprinkler Company, Cologne, and met with Mr. E. Landsberg, Head of Engineering, and Dr. R. Manz, Head of Research and Development. Walther and Cie is one of the largest sprinkler system equipment manufacturers and system installers in Western Europe. The company manufactures various fire suppression equipment including sprinklers, alarm valves, CO_2 systems, nozzles and manual extinguishers. A tour of the R&D laboratory included various large and small-scale test facilities for evaluating suppression media for both general fire hazards and specific fire hazards including a device to measure the explosion suppression capabilities of extinguishing agents on coal dust.

While in Aachen in April to attend the meeting of the RILEM Advisory Group, **Geoffrey Frohnsdorff** of CBT visited two internationally known institutes of the Technical University. These were the Institute for Rock Mining Science (Inst. fur Gesteinshuettenkunde) and the Institute for Building Research (Inst. fur Bauforschung).

The Institute for Rock Mining Science has about 30 staff members and 90 students. Its Director is Professor Reynen. Four of the staff members and 15 of the students are in a Cementing Materials (Bindemateriel) Group, and the rest work on other ceramic materials such as clay brick and refractories. The Institute is moderately well-equipped, though very little of the equipment is of recent vintage. The head of the Cementing Materials Group is Dr. Ludwig. The Group's work includes studies of methods for forming tricalcium silicate and alite, alkali-aggregate reactions in concrete, the effects of admixtures, particularly chlorides, on the creep of plaster, swelling pressures in plaster, classification schemes for calcium sulphate and its hydrates as an aid to industry, and hydrothermal reactions in sand-lime bricks. The Group does a fair amount of work for individual industrial companies, as well as doing research funded by the Federal government and trade organizations, such as the German Cement Industry Association.

The Institute for Building Research is best described as a materials and structures laboratory. The Institute, whose Director is Dr. K. Wesche, has 50 permanent members of staff divided into four working groups (divisions). The Institute accepts 500 freshmen each year. Its budget is 1.9 million DM for salaries and about 0.2 million DM for capital investments. Operating supplies are provided free by the university. About 25 percent of the technical work of the Institute is research and the other 75 percent is described as

"scientific test development." The four working groups are cement and masonry, aggregates and concretes, plastics and steel, and metrology and data processing. Examples of research activities are studies of the rheology of fresh mortars and concretes, structural behavior of masonry walls, friction in bearings, creep and mechanical properties of concrete, polymer concrete and polymer-modified concretes, and development of tests and standards for fly ashes for use in concrete. There is considerable interest in the use of image analysis techniques for characterization of concretes and other materials.

Finland

The Low Temperature Laboratory of the Helsinki Technical University (TKK) was visited for two weeks in January by **James E. Zimmerman** of CEEE. The Laboratory was established and operates under the direction of Prof. Olli Lounasmaa. Although the Laboratory was established more than 15 years ago, the present facilities are new. The building itself was occupied during the past two years, and all of the experiments, cryostats and all, were reconstructed or are being built from the ground up.

An attractive feature of the Low-Temperature Laboratory is a continuing stream of short- and long-term foreign guest workers, both old and well-known and young and less-known like Victor Vvidenski and Pradeep Kumar. Kumar is an Indian theorist on a one-year Scandinavian fellowship. Recently they had a young Chinese Peoples Republican. It was said that he was very good at winding miniature 2000-turn coils for the toroidal SQUID (Superconducting Quantum Interference Device). Vvidenski is from Peshkov's Laboratory in Moscow and is working on a biomedical gradiometer with Rantala, Ilmoniemi, and other associates of Ehnholm.

Heikki Collan, who is working on magnetic separation of impurities or minerals from wood pulp and such things using superconducting magnets with large field gradients, has a commercial cryocooler which maintains about 7 K with two stages at no heat load and 10 K and 5 W. A notable operating characteristics is that when heat is added to the second (cold) stage, the first stage reaches lower temperature, and vice versa. In other words, when one stage get warmer, the other stage gets colder, like a Vuilleumier machine. The cryocooler is guaranteed to maintain only 10 K with no heat load. Collan will use it to reduce the helium evaporation rate from the magnetic separation cryostat by a factor of seven or so. He also speaks of adding a small JT (Joule-Thomson) heat exchanger and valve to produce and maintain the helium at a constant level. The JT compressor will be a 4-bar twin-diaphragm unit manufactured commercially. Although 4-bar compression would be too much for helium because of the heat, the compressor can be operated two-stage. It also has double diaphragms for safety. The required cooling power at 4.2 K would be approximately 20 mW.

Gosta Ehnholm is second in command of the Low-Temperature Laboratory. Ehnholm is perhaps best known for his analysis of rf-biased SQUID input impedance and how it may have a negative real component at the signal frequency even when the SQUID is operated in the lossy (hysteretic) regime. However, he is primarily occupied with experimental work. In the past he has developed a thin-film version of the fractional-turn SQUID invented by Zimmerman several years ago. Although thin-film SQUIDS are perfectly suitable for most applications, Ehnholm has recently reverted to development of a Nb SQUID using a point-contact junction,

the latter being also a Zimmerman invention. The purpose here is to make a single-junction SQUID biased at several GHz, using a cooled GaAs FET preamplifier. The essential feature, as perceived by Ehnholm, of the point contact is its low capacitance, and his aim is to make a reliable permanently adjusted contact. The purpose of the rf-biased SQUID is to make a more-sensitive magnetometer for studying magnetic fields of the human brain. For this and similar purposes the laboratory has designed and is building a triply mu-metal shielded enclosure 2 by 2 by 2 meters inside dimensions, which certainly promises to be the best or one of the best in the world when completed. A related development is a second-derivation gradiometer for measuring lung contamination in welders, among other things. A curious statement, by Ehnholm, that certain individuals are unusually prone to contamination leads to the idea that early detection of contamination could prevent later complications by shunting those individuals into other occupations before high levels of contamination build up.

M. Roubeau, of the liquid-helium washbasin ("cryorama") fame, said that he has greatly extended the hold time of a liquid-helium-cryostat, in the case where heat input to the liquid is the primary heat input, by running a JT loop from a compressor at room temperature. The cooling capacity of the vapor is used to cool the compressed gas below the JT inversion temperature. He believes this is a mechanism for putting to good use the cooling capacity of the vapor which might otherwise be wasted, and that the evaporation of the liquid cannot be reduced to zero, or reversed, by this technique. In principle, however, a very large reduction in evaporation rate is possible.

Roubeau made an excellent suggestion for eliminating shuttle heat loss in a twin-piston Stirling refrigeration machine -- a bellows is used in place of the cold (expansion) piston and cylinder. Since gas pressure would tend to expand the bellows, the latter could be actuated from room temperature by members in tension only, the most favorable configuration from the point of view of low heat leak. The most attractive feature of the configuration, however, is that there is no shuttle heat loss, so that with low-conductivity materials, the whole machine can be made relatively short and compact.

Roubeau has a wealth of ideas for refrigeration. He suggests (1) thermal compression by capacitor-discharge in a thin-film resistance inside the compression chamber, (2) multiplying the effect by a succession of successively larger hot heat exchanges in the flow path, (3) a double-diaphragm or bellows compressor liquid-filled between diaphragms, with a strong diaphragm to transmit the compression force, and a weak diaphragm designed for small dead volume, (4) what looks like a magnetic Stirling machine, (5) a method of making helium-gas regenerators which avoids the problem of helium shifting around when heat is transferred, and (6) numerous concepts for efficiently supplying the small amount of work needed to get helium past the JT inversion temperature so as to make a miniature liquefier or cryocooler.

T. Katila with several students is measuring biomagnetic signals such as the magnetoretinogram (MRG). The MRG is a very weak pulse, observed with a magnetometer at the temple near the eye, in response to a light pulse. The associated electrical signal peaks are designated A, B, C, etc., with the A peak having shortest latency. A and B have opposite polarity and different functions of intensity, such that B is seen at low intensity, and A predominates at higher intensity. A gratifying result for us is that they have confirmed our results on magnetic auditory-evoked response in all details, quantitatively. Their results are better than ours. This is partly because their sensitivity is a little better than NEL's, and they also have a cleaver signal averaging system in which individual responses are looked at and are discarded if there are any clearly non-random events, several times the rms value of the rest of the signal.

In discussing biomagnetic measurements on current point sources close to the surface (i.e., the cerebral cortex), Ehnholm suggested that an off-diagonal (figure 8 or double-hole SQUID, for example) gradiometer lying flat on the surface over the source might be the most efficient (i.e., sensitive) measurement device. Cohen (MIT) in fact has used exactly that device configuration to map the α-rhythm or dc currents around the back of the head. However, these are extended sources for which a small figure-8 would not be most sensitive.

France

In March, **Jay W. Bauer** of CBT went to France to help the Centre Scientifique et Technique du Batiment (CSTB) in designing and planning psychoacoustic experiments to test the adequacy of French noise isolation criteria for buildings. This research is part of the joint U.S.-French Cooperative Program in Building Technology, and the reports will be co-authored by CBT and CSTB.

The acoustical research facilities of CSTB are in Grenoble. There, working closely with Monsieur Vian, Bauer designed an experiment on the response of people to music intruding into a room. The basic plan is to have subjects exposed to different samples of music electronically filtered to represent different room partitions, and then have the subjects scale the annoyance or other subjective quality of the music.

Other sound laboratories at Grenoble include a facility to test the transmission loss of partitions, the effects of infrasonic sounds on materials, and facilities to study sound propagation through ducts.

At the Laboratorie de Mecanique et d'Acoustique (LMA) in Marseille, Bauer visited Dr. Mataya from Japan who was working on the technique of anti-noise for reducing noise levels. The concept behind this technique is that identical sound waves completely out of phase with one another can cancel each other out. Work at LMA and at CSTB have obtained from 10 to 40 dB attentuation of sound levels in a room using this technique. The technique is limited primarily to stationary noise sources, and probably would not be acceptable on aesthetic considerations in homes and offices. But it might be usable for quieting ventilating systems in large buildings.

At the Institut de Recherche des Transports, Centre d' Evaluation et de Recherche des Nuisances, Lyon, Bauer's contacts were Monsieur Vallet and Madame Vernet. The work there covers the effects of train and highway noise on sleep behavior. These studies are conducted in situ with people living near railways and highways. They are also conducting research on the effects of noise on the physiological attributes of sleep. This includes both laboratory and field investigations. Although Monsieur Vallet and the staff have been working on these problems for several years, they are just now making headway. This work should provide important input into determining human response criteria for noise isolation provided by building shells and building elements.

In October 1978, **Merritt M. Birky** of CFR visited with Drs. Boudene and Jouany of the University of South Paris. They are working on the toxicological assessment of the large-scale fire tests at CSTB. They demonstrated the exposure of an instrumented rabbit just as it would be for the large scale experiments. The rabbit is instrumented for EKG, EEG, and respiratory rate. The signal is transmitted by telemetry to tape recorders and strip chart recorders.

In the large-scale studies at CSTB they are using a combination of the instrumented rabbits, rats in the rotating wheel, and a variation of the rotor-rod. The latter involves training the rat to jump on an elevated platform when given a signal (light or sound). The rat is given a shock if he fails to respond appropriately within a specified time.

Dr. Jouany stated that the rotating wheel is the most sensitive, i.e., they see the affects of combustion products on the animals in the wheel first. However, they have been unable to see the animals adequately during some of the tests. The results from the instrumented rabbits show that respiratory and cardiac functions are the first to be affected by the combustion products. The affects on cardiac function appear to be the result of respiratory distress. These measurements tend to support the work of Alarie.

To date, approximately 40 large-scale tests have been carried out at CSTB, but little of the toxicity data has been analzyed in any detail. They are also burning an airplane fuselage in the South of France and adding animals to these experiments.

India

In December, **Richard D. Marshall** of CBT went to New Delhi to participate in the Indo-U.S. Workshop on Natural Disaster Mitigation Research. The purpose of the workshop was to explore topics in earthquake and wind engineering that might form the basis for collaborative work of mutual interest and benefit to the United States and India.

The second day of the workshop was spent visiting the School of Earthquake Engineering and the Department of Civil Engineering at the University of Roorkee. Since Roorkee is expected to play a major role in collaborative work that might evolve from the workshop, it was important that the U.S. delegation have an accurate picture of the staff and laboratory capabilities at Roorkee. The school of Earthquake Engineering has a very competent staff and new laboratories with facilities for studying soil and structural dynamics. Shake platforms and a facility for application of shock loadings have recently been commissioned.

The Department of Civil Engineering is also very well staffed with emphasis on structures and hydraulics. Structural research is currently centered around cable-supported structures and masonry construction. The structures laboratory is equipped with a large reaction frame and hydraulic rams, which are suitable only for the application of static loads. The hydraulics laboratory is primarily involved with movable-bed open channels, although considerable work is also done on gates, valves, spillways, etc. Three wind tunnels are available for the study of boundary layers and aerodynamic forces.

Israel

In September, **Paul R. Achenbach** of CBT traveled to Tel Aviv and Haifa to discuss research programs and standards on energy and water conservation in buildings at the Standards Institution of Israel (SII) and at Technion. The Building Division of SII concentrates on cement, aggregate, and concrete research, and they have a soils laboratory. All concrete for buildings in Israel is tested through testing stations and field laboratories. SII is interested in learning who in the U.S. is doing research on reinforced lightweight concrete, durability of lightweight concrete, deterioration (corrosion) of reinforcing bars in lightweight concrete, and fiber reinforcement of concrete.

Solar water heating is mandatory in Israeli public buildings, and is widely used in housing of all types. Electricity is used as supplementary energy source for water heating. Very little work is being done on solar space heating. Portable oil heaters are used for space heating on a "when and where needed" basis. Oil is used for central heating in large buildings from 8 a.m to 4 p.m. and also in some apartment buildings. Energy conservation in housing is a minimal activity. An energy unit was formed last year and a fire research unit is just being formed.

Research at Technion is ancillary to teaching and its directions are largely determined by the interests of the professors. Cement and concrete are favorite research subjects because nearly all buildings in Israel are made of masonry or reinforced concrete. There are very few steel-frame structures and almost no wood is available. The principal wall construction in Israel is comprised of 2 to 3 cm. of polystyrene board attached to the inside of concrete. The lowest temperature is slightly below freezing; snow falls occasionally in the mountains.

The principal problem in Israeli housing is condensation on the interior of the concrete walls during the winter. Condensation is aggravated by the use of unvented oil heaters and indoor drying of laundry. Walls become moldy in the corners. Apparently, they are unwilling to ventilate sufficiently or to provide flues for the oil heaters. They expect that 2 to 3 cm. of interior insulation will alleviate the condensation problem in part.

Italy

In May, **Myron L. Crawford** of CEEE went to Naples to visit the Instituto Universitaria Navale and the University of Naples. The purpose of the visit was to discuss plans for Professor Corona's visit to NEL during the summer of 1979 and to see their reverberation chamber measurement system. Dr. d'Ambrosio, with the assistance of G. Ferrara, demonstrated the reverberation chamber and discussed the technique in some detail. A similar system will be constructed at NEL this summer with the assistance of Dr. Corona. Dr. d'Ambrosio then described some of his work in bioeffects on insects exposed to EM radiation. The University of Napoles is performing experiments funded by the Italian government to evaluate the effects of EM energy on insect embryo.

In September, **Lloyd A. Weber** of CMEPT visited the Turin laboratories of the Instituto Di Metrologia, the Italian equivalent of NBS. His special interest was the Sezione Termometrica, which is primarily concerned with fixed points and temperature scale work. There, Drs. F. Payese and C. Barbero have published papers on the triple points of methane, ethane, oxygen, argon and now neon. In addition they are engaged in research on the temperature scale with emphasis on its practical realization in a general research laboratory. They have developed a sealed calibration cell filled with pure methane, neon, etc., with provision for a platinum thermometer, which can be used in a cryostat to check the calibration of a thermometer. A series of such cells could be used for a complete calibration. They have made an arrangement with Lakeshore Cryogenics for the commercial marketing of these cells. A complete cell, filled and tested, will probably cost around $1500. Current work includes a determination of the triple point of CO_2, and research on the possibility of using nuclear quadrapole resonance as a means of determining temperature and also development of transducers for measuring temperature and pressure on the rotor blades of a helium turbine.

In September, **R. Radebaugh** of CMEPT visited the Milan headquarters of Centro Informazioni Studi Esperienze (CISE). His principal contact there was Dr. A. Ricca who invited him to visit and give a lecture on measurement techniques for AC losses. The AC loss group from the Inst. Fisica in Genova also came to CISE for the talk. CISE is a private company that receives much of its money from the government body ENEL (Ente Nazional per l'Energia Elettrica). CISE works mostly on energy-related problems, especially nuclear reactors and electrical energy. They have about 600 people in several divisions with about 30 in the physics division. Work in the physics division is in such areas as nuclear studies using a tandem Van de Graff accelerator, cryogenic materials, and thermal diffusivity in non-homogeneous solids and anisotropic solids (mostly concrete).

In September, in connection with a visit to Italy to attend technical committee meetings in Venice and Milan, **Frank J. Powell** of OEP talked with Professor Francesco De Ponti in his laboratory at the University of Padua.

The laboratory is used as a teaching facility, for graduate research work, and for testing of materials. Several guarded hot plate and heat flow transducer devices are operated with a capability to accommodate specimens of about 50-cm square and thickness up to about 15 cm. One very large hot plate that covered a temperature range from the boiling point of liquid nitrogen to the melting point of metals used an air cooling system for the side plates. Very precise absolute data on several insulation materials have been gathered. This laboratory will participate in the ISO 163 round robin.

Japan

In October and November 1979, **Russell A. Kirsch** of CAM traveled to Kyoto and Tokyo to visit researchers in industry and government and to attend the US-Japan Seminar on Real-Time Parallel-Image Processing, the IEEE Conference on Cybernetics and Society, and the 4th International Joint Conference on Pattern Recognition. His first stop was with Professor Onoe of the University of Tokyo to discuss the research being done in image processing in Japan. He received an initial impression from this discussion that hardware developments are more extensively emphasized than software developments in this part of the image processing field. Next, he went to the headquarters of Fuji Xerox to meet with William English and Joseph Becker who are developing the ALTO system for word processing to introduce into Japanese offices. He received considerable insight into the nature of the Japanese Computing Industry from them and saw the ALTO system.

With Dr. Masa Kidode, Kirsch reviewed the work being done under the Pattern Information Processing program at Toshiba in Kawasaki City. He saw the parallel picture processing system called Tospics and met with the head of the Information Sciences Division, Dr. Hiroshi Genchi. The parallel image processing work there seems to be competently executed and very definitely emphasizes homogeneous parallel processing and consequent hardware developments rather than software and language developments.

At the Electro Technical laboratory of Toshiba, Kirsch briefed Dr. Nishino and his staff on the work at NEL. Afterward, the questioning showed great interest and understanding of the kinds of work we were doing. In particular, Dr. Shirai challenged some of Kirsch's suggestions about software developments, which led him to the conclusion that these questions have already received some serious consideration. Also, Dr. Nishino noted that Toshiba has announced a commercial word processing system for office automation. Kirsch saw a developmental stage of such a system for handling Japanese katakana characters with 24 characters per line and 16 lines of display on a raster type of cathode ray tube. The individual characters were produced with 24 x 24 pixel matrices. The quality appeared acceptable although the tradition of beautiful writing might lead the Japanese to reject such understandable but inelegant displays.

In October 1978, **Philip S. Klebanoff** of CMEPT went to a number of Japanses cities to exchange information on the latest trends in fluid mechanics, which in Japan is an active research endeavor covering a wide range of problems and staffed by very capable investigators. The Japan Society of Fluid Mechanics, which was established in 1968 and is similar

in character to the Division of Fluid Dynamics of the American Physical Society, has more than 500 members either engaged in active research or interested in applications of fluid mechanics. The Society is interested in the promotion of international cooperation in the field of fluid mechanics, and has established a committee for this purpose with Professor H. Sato of the Institute of Space Aeronautical Science (University of Tokyo) as its chairman.

The laboratories visited, as a whole, have all manner of facilities ranging from small special purpose wind and water facilities to conventional wind tunnels. However, laboratory space, as in U.S. universities, appears to be at a premium. The laboratories are well-equipped and make extensive use of hot-wire anemometry, laser velocimetry, and flow visualization instrumentation. Boundary layer and turbulence research are particulary active in Japan. Considerable attention is being given to the nature of the large-scale coherent structures in turbulent boundary layers, and to problems associated with boundary layer stability and transition.

Comprehensive investigations on the nature of large-scale coherent structures in turbulent boundary types are in progress at the Institute of Space and Aeronautical Science, Gifu University, Nihon University, and Hokkaido University. Although their approaches to the problem are different, they have as their central purpose the identification of the geometric configuration of the large-scale structure. NEL, in a collaborative paper published in 1973, presented a speculative model for the geometric configuration of the large-scale structure in the turbulent boundary layer and had planned to conduct an investigation as part of its program on turbulence control to assess its validity. However, in view of the progress being made in Japan on this subject, it is felt that this research need not be carried out and that a change in direction is warranted.

The visit to the University of Osaka Prefecture was for the sole purpose of discussing the research being conducted by Dr. Nishioka. NEL had earlier demonstrated the importance of the three-dimensional nonlinear nature of boundary layer stability and the presence of a secondary instability in the boundary layer transition process. Dr. Nishioka had adopted the approach used by NEL's investigation of boundary layer stability to the study of the stability of poiseuille channel flow, and in particular was evaluating the validity of the concept of secondary instability. The results he has obtained to date tend to confirm the applicability of the NEL results to this different flow configuration.

Another investigation on that subject is in progress at Hokkaido University under Professor Kobashi. He is studying the transition mechanism of an oscillating boundary layer by using controlled disturbances synchronized to the flow oscillation. The oscillating boundary layer is obtained by oscillating a plate with a crank; the controlled disturbances are generated by a loudspeaker through a row of holes in the plate. It is interesting to note that such an investigation can be readily performed to advantage in the NEL unsteady wind tunnel in which the flow can be oscillated rather than the plate. It will be of interest to see to what extent the NEL results obtained for a steady boundary layer find applicability in the unsteady case.

G.E. Mattingly of CMEPT, whose special interest is water flow measurements, traveled to Japan in October 1978 -- in connection with meetings on the subject sponsored by OIML and ISO -- to conduct a number of technical discussions.

At the invitation of Mr. Toshio Satori, Senior Engineer with the Hokushin Electric Works, in Hisai City, he toured the magnetic flow meter plant and testing facility in Mie Prefecture. This new (1973) plant was designed and built for cost-effective production of magnetic flow meters. Hokushin is one of Japan's leading manufacturers of industrial instruments.

The new plant was arranged for "batch processing" of mag flow meters. Raw materials arrive at one end of the elongated building and finished batches of tested mag meters emerge from the other end. In between, closely coordinated teams of workers perform their operations to move the product through to the finished end of the building. These teams were comprised of young workers (20's to 30's) who were trained to perform multiple tasks such as machining and welding or plastic coating (a critical part of a magnetic flow meter). As such, the workers would accompany the product through more than one operation.

A tour of facilities was arranged by Dr. Michio Kawata of the flow measurement facilities of the National Research Laboratory of Metrology (NRLM) in Tokyo. This laboratory is one of sixteen laboratories that are in the Agency of Industrial Science and Technology, which is part of the Ministry of International Trade and Industry. NRLM, under the direction of Dr. Y. Sakurai, is organized into four technical divisions, having about thirty-five staff members in each. The divisions are divided into 2 or 3 sections each and deal in Engineering Metrology, Thermodynamics, Fluid Metrology, and Type Testing and Legal Inspection Topics. NRLM also has branches in Osaka, Fukuoka, and Nagoya. Mattingly toured a wide range of flow facilities used for flow research and calibration in air, water, and hydrocarbon fluids.

In September, **Gary T. Yonemura** of CBT traveled widely in Japan to discuss the latest developments in lighting research. One stop on his tour was to the large lamp department of the Toshiba Science Institute. Toshiba, like all the large lamp manufacturers in the U.S., is concentrating its research efforts on energy-saving lamps, i.e., lamps using less connected watts, but emitting the same amount of light. An interesting statement was the observation that in Japan high-pressure sodium lamps are seen as "exotic", a positive attitude, as opposed to the U.S. where the attitude is a negative one, involving the poor color rendition of the lamps.

Prof. M. Akita was his host at the Psychological Laboratories, Kyoto Institute of Technology. The chief study being conducted there is the effect of chromatic adaptation on unique hues. They feel they have a tool to investigate chromatic adaptation effects by the use of shifting unique hues, e.g., unique yellow, blue, green and red, as a function of adaptation to monochromatic light.

Prof. S. Nishimura of the Department of Architecture, Kyoto Institute of Technology, had several scale models of residences on display. He is interested in the design of homes for energy conservation, but stated that siting and utilization of daylight for energy conservation was difficult in Japan due to the crowded conditions. His department is also concerned with the functional and esthetic aspects of furniture used in homes, and have full scale mock-ups of furnished residential rooms.

Yonemura's host at Kyoto University was Prof. Y. Ejima, who received his doctorate in electrical engineering, and became interested in psychophysics. He is currently studying the contrast sensitivity of the human eye with grating patterns produced electronically, i.e., displayed on a cathode-ray-tube. He finds the contrast sensitivity, within the experimental limits he investigated, increases with the height of the grating pattern used. He has a prototype of an instrument that can present two colored targets of different chromaticity, size, and location on a background of a third chromaticity, electronically. The saturation of the targets appear to be satisfactorily high enough to duplicate most levels encountered in the real world.

At the Lighting Research Laboratory, Matsushita Electric, Yonemura was shown several special laboratories. Studies currently being conducted in the color-rendering laboratory indicate that the color temperature of sources have little effect on perceived brightness of faces, but color rendition indices appear to be highly correlated positively with brightness perception of faces. In the visual performance laboratory, they were investigating the effects of non-uniform luminous environments relative to a uniform one. They had on display a super high-pressure sodium lamp, which gave a highly flattering color rendition relative to most other sources. This, when compared to the poor color rendition of normal high-pressure sodium lamps, would be highly desirable, but the price paid in lamp efficacy was significant. The efficiency of the super lamp is about 20 lm/W compared to the regular lamp with about 105 lm/W. They had scale models of approaches to tunnel entrances which will be used to investigate adaptation luminance of a driver's eye when approaching tunnel entrances.

In December 1978, **H.S. Lew** of CBT traveled to Tokyo to attend the third planning-group meeting of the U.S.-Japan Cooperative Research Program. The U.S.-Japan Cooperative Research Program in Earthquake Engineering was formed in 1975 to study the three-dimensional behavior of full-size structures under controlled seismic forces utilizing large-scale testing facilities of Japanese government laboratories. During the past decade, U.S. researchers have concentrated primarily on analytical techniques and small-scale tests to predict the anticipated behavior of structures subjected to actual seismic forces. However, the

validity of these techniques have not been fully substantiated by experimental data. Recognizing this weakness, the U.S. researchers have welcomed the opportunity to undertake the joint test program.

In September, **H.S. Lew** and **E.O. Pfrang** of CBT went to Tokyo to lead a U.S. delegation consisting of representatives from eight U.S. agencies to the Eleventh Joint Meeting of the UJNR Panel on Wind and Seismic Effects. In connection with the meetings, the group visited the National Research Center for Disaster Prevention of the Science and Technology Agency. Mr. Naruto Ohira, Director of the Center, received the delegation. The delegation was briefed by the Director and his staff about their major activities. The Center collects earthquake and rain- and snow-fall data and makes them available to other national and international organizations.

The Center monitors seismic events occurring throughout Japan. It also carries out earthquake prediction programs. The Center's research facilities include a large-scale earthquake simulator and rainfall simulator. The earthquake simulator is 15m x 15m. For horizontal motion, it can support 500 tons and can subject the test model to 0.55 g. For vertical motion, it can support 200 tons and can subject the test model to 1.0 g. The rainfall simulator is housed in a structure which measures 50m x 75m in plan and 23m in height. The structure is supported on a track so that it can be moved over four independent outdoor test sites. The rainfall simulator has a feature to vary the diameter of raindrops and the intensity of rainfall, which can be varied from 15 mm/hr to 200 mm/hr. The simulator is used to study slope stability of soil, surface runoff, etc.

In the afternoon, the delegation visited the Building Research Institute (BRI) and was received by Dr. Kiyoshi Nakano, Director General. BRI undertakes research programs on prevention of disaster, improvement of living environment, rationalization of building production and development of new techniques, and effective use of energy and resources. The total floor area of BRI is about 48,500 m^2 used by a staff of 180. The Large Size Structure Laboratory can accommodate a full-scale test structure of eight stories. This facility will be used to carry out a joint U.S.-Japan Cooperative test program on large scale structures. On the U.S. side, the program is supported by the National Science Foundation. The program will be coordinated and implemented by the UJNR Panel on Wind and Seismic Effects.

The group then visited the Geographical Survey Institute (GSI). GSI carries out geodetic, cartographic, and geographical work. This agency produces the fundamental map of Japan on the scales of 1 : 2500 to 1 : 3,000,000. It also publishes these maps and aerial photographs. In addition to the activities of map-making, the GSI develops instruments for cartography, geodesy, geography, photogrammetry, and geophysics. The GSI is primarily responsible for conducting surveys on floods, earthquakes, tsunamis, typhoons, landslides, snow avalanches, ground subsidence, etc., to clarify the relation between the damage and land conditions after disasters.

The delegation also visited the research facilities of the Public Works Research Institute (PWRI), which occupies an area of 134 ha. The delegation was greeted by Mr. Yoshijior Sakagami, Director General, and Dr. Tadayoshi Okubo, Assistant Director-General and other staff of PWRI. The total number of staff at PWRI is about 500. The PWRI has a complex of extensive research facilities of geotechnical and hydraulic engineering. It also maintains a large structures laboratory and boundary layer wind tunnel. Most of the equipment that we saw was new and recently installed.

In February, the fourth session of the UJNR panel on fire research was held in Tokyo. Attending from CFR, were **Frederic B. Clarke, Irwin A. Benjamin, Takashi Kashiwagi.** The meeting was held under the auspicies of the Building Research Institute (BRI) and the Fire Research Institute (FRI). The former is under the Ministry of Construction, with responsibility for regulating materials that are part of the make-up of the building property. The Fire Research Institute, part of the Fire Defense Agency, is responsible for control of furnishings and protection systems especially designed for building fires such as smoke removal and detection.

The proceedings will be published by the Japanese in the near future. U.S. contributions included prepared papers by Professor Quarantelli on Panic Behavior; Professor Bryan on Fire Investigation Techniques; Mr. Benjamin on Stairwell Pressurization

Systems and Fire Safety Evaluation; and Mr. Clarke on Flame and Smoke Retardance. Progress reports were presented by Professor Emmons on Fire Modeling; Dr. Friedman on Smoke Detection and Dr. Berl on Fire Gas Toxicity.

There were several points of particular interest in the Japanese presentation. Experiments on human behavior in smoke-filled environments, conducted by Jin of the FRI, extend earlier work done by this investigator. Stress-testing techniques were used to determine how increasing smoke density inhibits performance of a simple task. The ability of subjects to perform the test falls off as smoke density increases. Jin tried to show that a disproportionate fall-off occurred at the smoke density they have previously identified as incapacitating, but more analyses of these data should be made. In general, the Japanese do a superb job of modeling stress situations related to fire. Papers by Watanabe on evacuation and Murozaki on blood pressure in stress situations are excellent examples of innovative work going on in Japan.

Both the U.S. and Japan have a limited effort in the fundamentals of fire and smoke retardance. Clarke's presentation on fire and smoke retardance dealt primarily with the underlying conceptual problems, while the three Japanese contributions concentrated more on applications. Professor Akita in an overview of the fire retardance area confirmed this view and made a plea for a more closely coordinated effort in Japan. The Japanese problems are similar to our own in that much of the work being done is in industry and is proprietary, so that information exchange is inhibited.

The Japanese presented a progress report on fire modeling as did the U.S. It seems clear that the emphasis of the two countries remains different in this area. The Japanese concentrate more heavily on modeling fire flow through compartments, while the U.S has centered more upon modeling fire growth in individual compartments.

Benjamin's paper on Stairwell Pressurization Systems was an acknowledgment that the use of such systems has grown in the U.S. over the past few years. However, there are no accepted design procedures for the systems. The paper discussed several of the designs now being used in the U.S., with some of the assumptions used for design. Single and multiple injection systems were discussed, as was a report on field tests.

In a series of side trips, Kashiwagi visited Professor K. Akita's laboratory at the Reaction Kinetics Department of Tokyo University. His group is currently working on ignition of polymers, flame spread moving along a polymer rod, effects of flame retardants on polymer pyrolysis and explosion with the species concentration gradient field. He also visited Professor Tsuji's laboratory at the Aerospace Institute Laboratory of Tokyo University. He discussed with Professors Tsuji and Takeno two of their current studies -- the mechanism of flammability limit for counter diffusion flame and turbulent flame.

Kashawagi visited Professor Isshiki's laboratory at the Mechanical Engineering Department of the Tokyo Institute of Technology to view three studies directly related to fire: ignition of a laminated board by a high-intensity lamp, flame spread underneath a paper sheet and along a paper cylinder, and flame spread along two paper sheets separated by various distances. The ignition study is similar to the NEL study but does not account for the interaction of external radiation with decomposition gases. They did modify the NEL theoretical work including reradiation from the surface and the in-depth absorption of the external radiation. They observed a very interesting phenomenon in downward flame spread from the top of a thin paper cylinder that was plugged to prevent any air entrainment from the surroundings. In the middle of flame spread, a loud whoosh sound was heard and a disk shape flame traveled rapidly downward inside the cylinder. However, it appeared that this did not affect flame spread outside the cylinder.

In connection with a CIB Fire Symposium held in Tsukuba in September, **Daniel Gross** of CFR conferred with Dr. T. Wakamatsu, Head of the Smoke Control Division of BRI. They discussed their new facility for measuring and controlling smoke. This consists of a two-story section containing rooms with a conventional interior corridor and a special exterior corridor that can be pressurized to simulate wind-pressure conditions, and a seven-story section containing elevators, stairwells, and vestibules. Although they have only made leakage measurements up to now, they are equipped to make both cold-smoke (using smoke candles and SF_6) and hot-smoke measurements, using any of 11 available fire rooms. The

smoke spread facility is part of a 52.5 by 35.5 meter building also used for a variety of large-scale fire tests: fire resistance of building structures, fire plume studies, fires in compartments, furniture burns, and fire spread on the exterior of wood houses.

At the Fire Research Institute, Gross spoke with the Director, Dr. Y. Kumano, with Mr. A. Watanabe, Head of the Third Research Division, and with Dr. T. Jin, the expert in smoke measurement and its effect on humans. He saw the following examples of work in progress: heat- and fire-resistant apparel for fireman, oil tank corrosion and fatigue testing, dispersion of liquids and gases from tanks, air inflow into liquid-fuel fires, field testing of a "fireball" resulting from liquid-fuel fires, attenuation of fire radiation by smoke, and a rope-throwing gun developed for use by firemen.

He also spent some time obtaining details on the July 1979 fire in the Nihonzaka Tunnel of the Tomei Expressway. This was a very severe fire caused by a multiple vehicle collision which could not be controlled by the installed water sprinkler system since several tank trucks containing up to 10 tons of organic materials were involved.

Korea

Under a Memorandum of Understanding between NBS, AID, and the Government of the Republic of Korea, **Phil Chen** of CBT traveled to the Korean Standards Research Institute in March and April to survey their facility for delivery of a 112,000-lb. Emery dead-weight machine, which was being given to KSRI by NEL. Structural and electrical needs, as well as construction drawings and plans for shipment, were reviewed in detail. Chen remained on-site during the entire installation and debugging phases.

Mexico

G.C. Straty of CMEPT visited the Universidad Nacional Autonoma de Mexicano (UNAM), the Universidad Autonoma Metropolitana (UAM), and the Instituto Mexicano del Petroleo (IMP), all of Mexico City, in connection with properties of fluids and gases, during March of 1979.

At the IMP, Straty conferred with the staff on problems of mutual interest concerning measurement and correlation of fluid properties and gave a talk on fluid properties measurements. Experimental activities at the IMP are also rather extensive, being concerned with petrochemical processes and petroleum recovery. Activities most closely related to NBL interests are experiments on vapor-liquid equilibrium directed by Dr. Monfort and excess volume studies directed by Dr. Leyva. Straty visited both of these laboratories and got the impression that only the simplest and most basic experiments (room temperature, low pressures, etc.) were being carried out.

Straty presented a talk on PVT and dielectric constant measurements on pure fluids to the physics faculty and students at UAM. This group is particularly interested in PVT and dielectric constant measurements on the freons.

Experimental activities at the universities appear to be minimal due to lack of instruments and experimental apparatus. Recently emphasis has only been placed on experimental theoretical work. Attempts to develop experimental capabilities seem to be severely hindered by difficulties in purchasing or importing the necessary instruments.

At UNAM, Straty sat on the examining committee for the thesis presentation of Dr. Richardo Tsumura. Richardo performed his dissertation research for the Ph.D. under Straty's direction at NBS in Boulder.

All professionals that Straty talked with were eager to interact more strongly with U.S. universities and research institutions including NBS. New fluid properties measurement facilities capable of standard quality work are planned for the IMP and UAM. The work that Dr. Tsumura did while at NBS was part of a long-range program to determine reference data and calculation methods for natural gas. These institutions in Mexico will be charged with similar responsibilities for Mexico since U.S. has a large existing and proposed trade with Mexico in petroleum and natural gas; the benefits of close collaboration are extensive.

Netherlands

In September, **Clifford H. Spiegelman** of CAM visited the Netherlands Nuclear facility at Petten, to explore the possibility of a cooperative effort for producing statistical techniques. The European nations have done a lot of work in this area. The NEL effort will have the benefit of basing its investigation on the current developments over there.

Also in September, **Gordon W. Day** of CEEE visited the Philips Research Laboratories, Eindhoven, the largest of several Philips Research Laboratories, employing about 2000 professionals, of whom about 35 work on problems related to optical communications. He spent most of his visit with the fiber development group discussing their work with Dr. P.J. Severin. He also visited the transmitter/conductor development group, which has an elaborate system for characterizing sources, and the source development group, a large group working on several types of semiconductor sources.

In May, **Motohisa Kanda** of CEEE visited the Eindhoven University of Technology, where Prof. M.E.J. Jenken and his colleagues have done extensive work on feed horns for paraboloid reflector antennas. Particularly, their work on a dual-frequency, dual-polarized feed using corrugated coaxial feed systems is very interesting. They also have done extensive work on the compact range, which, they claim, works better than similar ranges elsewhere. Kanda also visited the Philips Laboratories in Eindhoven to speak with Dr. J.J. Goedbloed about the electromagnetic interference and compatibility testing of Philips products. **Myron L. Crawford** of CEEE also attended this meeting.

Nigeria

Following the bilaterial talks between President Carter and the Head of the Nigerian Government, Mr. Obasanjo, a U.S. Government team was sent to Lagos to discuss Nigerian needs for a research program related to building and roads, with the emphasis on the use of native materials. The team also met with the Nigerian Highway Department on their highway maintenance program, and with members of the Nigerian National Capital Planning Board on Planning, Design, and Construction of a new Nigerian national capital.

James G. Gross of CBT was a member of a 3-man team that traveled to Lagos in July. Consultation with the Nigerian Buildings and Roads Research Institute (NBRRI) was the prime reason for the trip. This Institute is one of many under the National Science and Technology Development Agency, headed by Dr. Oragwu. Since the NBRRI now has only a Director (Dr. Madedor) and a Secretary, with a new unfinished building, they stand in need of much organizational and technical support. During meetings with the task force, Dr. Madedor identified six areas of needed expertise that were of immediate concern. It was agreed that it would be best to start with a technology transfer program. It was proposed that two people be sent to Lagos to assist in the work.

People's Republic of China

In April and May, **Edward L. Brady**, Associate Director of NBS for International Affairs, traveled to Beijing, Shanghai, Chengdu, and Nanjing as part of an advance team to negotiate two agreements of cooperation to be signed during a later visit by the Secretary of Commerce. **Harry H. Ku** of CAM accompanied him. The team negotiated agreements for cooperation in the fields of metrology and standards, in the management of industrial science and technology, and in the exchange of technical information.

A second major assignment was to make an assessment of the range and scientific quality of the work done at the metrology laboratories of the Chinese State Bureau of Metrology (SBM) and at the institutes of the Chinese Academy of Sciences (CAS). The State Bureau of Metrology served as host and made all arrangements for visits to the two National Institutes of Metrology (Beijing and Chengdu), to the Shanghai Administration of Metrology, and the Sichuan Provincial Bureau of Metrology. However, only one CAS institute was visited -- the Institute of Physics in Beijing. Thus, while a clear picture was obtained of metrological laboratories and services, only a small beginning was made in gaining familiarity with the research work of the Academy.

By their own admission, the Chinese feel their metrology labs lag far behind such labs in the West. However, their current capabilities seem to be quite well tuned to the needs of industry, and services of the range and sophistication of those of NBS might well be unnecessarily expensive for the immediate future. Services provided are largely manufacture and calibration of equipment used by industry and other institutions. Despite declarations that "research" is an important element of their program, the "research" being done seems to be adoption of techniques already developed in other countries. Scientific and technological research, as carried out by NBS, was not observed at any of the metrology laboratories.

Because the laboratories have not been able to rely upon the Chinese instrumentation industry and have been able to purchase only a few instruments from the more advanced countries, an instrument design and manufacturing shop has been developed at each laboratory. Most of the equipment for classical metrological calibrations has been made in these shops; externally the workmanship seems to be of high quality and the design to be traditional, pre-microprocessor in style.

Computers are not yet being used for laboratory automation but are being used for batch computation of results. Even though the Chinese computer industry is in its infancy at present, the laboratory directors claim confidently that Chinese-built computers will be extensively used in the near future.

The staffs of the laboratories visited appeared to be eager and enthusiastic and entirely competent for the tasks they were assigned. As mentioned, "research" in their understanding seemed to be activities to develop the capability to make measurements as well as anyone else anywhere, rather than the kind of research carried on at NBS. Few of the staff members who explained their work to the NBS team had sufficient English to be able to work at NBS, although a short course of intensive training might well be adequate to bring several of them to the necessary proficiency. Reading ability was much better and many appeared to be quite familiar with the English language scientific literature, especially that written by NBS people.

These conclusions must be modified for the Institute of Physics of the Chinese Academy of Sciences, the only Academy institute visited. This laboratory was clearly working at higher level of sophistication than the metrology laboratories. Good research programs were being carried on; the staff was obviously scientifically competent and spoke good English; and some of them had been educated in the U.S., including the Director, who had received a Ph.D. degree in Physics at Yale around 1934.

At the initial meeting the first order of business was briefing statements by each side to acquaint the other side with the nature of the institutions in each country. Separate Governmental institutions in China have responsibility for metrology and standards: the State Bureau of Metrology and the State Bureau of Standards. Each of these organizations reports directly to the State Council of Ministers and each is headed by a man with ministerial rank. These two state bureaus had been a single organization until last summer, when they were split, and the relationships between the two were said to be still very close. The State Bureau of Metrology has responsibility for ensuring that standards, calibrations, and other services are available to enable scientists and engineers to make needed measurements throughout the entire economy. Three laboratory organizations are under the direct oversight of the State Bureau of Metrology: the National Institute of Metrology (NIM) in Beijing, the National Institute of Metrology in Chengdu, Sichuan, and the Shanghai Administration of Metrology in Shanghai. Each of the 29 provinces of China has its own provincial Bureau of Metrology and receives its basic standards and technical leadership from the two National Institutes of Metrology. The provincial bureaus have responsibility for the administration of all legal metrology in the country; they report technically to the State Bureau of Metrology but their funding apparently is provided from local sources.

The objective of the State Bureau of Standards is to develop and promulgate those standards that will promote efficient production in industry. Industrial production is under the leadership of the State Economic Commission, and therefore the policies of this commission to a large extent shape the activities of the State Bureau of Standards.

Laboratory Visits: NIM Beijing

NIM Beijing is housed in a series of buildings in a residential neighborhood about 20 minutes from downtown Beijing. Several new laboratories (e.g., analytical chemistry) are under construction to house the expanded program planned for the institute.

The staff of NIM numbers approximately 1,600 in total, of whom 830 were said to be experts in metrology. Approximately 15,000 calibrations per year are said to be carried out by this laboratory. The institute is organized into 11 laboratories:

(1) Length. Realization of the meter, calibration of gage blocks, measurement of gears, and related metrology.

(2) Temperature. Realization of the IPTS 1968. Improvement of ability to measure both low and high temperatures.

(3) First Laboratory of Mechanics. Measurements of mass, pressure, vacuum, volume, density, and gas and liquid flow.

(4) Second Laboratory of Mechanics. Force, vibration, hardness, acoustics, and related quantities.

(5) Electrical and Magnetic Laboratory. Primary electric standards, magnetic standards, and methods for the precise measurement of electrical and magnetic quantities.

(6) Optics. Photometry, color, energy and power of lasers, and related measurements and standards.

(7) Quantum Metrology. Development of a laser wavelength as a new primary standard, measurements and standards based on the iodine-stabilized laser and the methane-stabilized laser, and apparently for historical reasons, measurement of the acceleration of gravity.

(8) Radiation. Radioactivity measurements and standards, dosimetry, neutron measurements and standards and related quantities.

(9) Time and Frequency. Basic standards of time and frequency for the country using the cesium clock as a basic for measurements. Experiments are being carried out on the dissemination of time signals by T.V. and satellite.

(10) Microwave Measurements. Measurements and standards in the microwave and radio frequency regions. Quantities measured are attenuation, phase, noise, high-frequency voltage, and related quantities.

(11) Chemistry. Analytical chemistry; development and dissemination of gas standards, particularly for environmental purposes; calibration of pH meters; calibration of viscometers and measurement of viscosity for petroleum laboratories; and related activities.

A major activity in addition to these laboratory functions is a workshop in which most of the equipment used in the laboratories is made. This workshop employs about 400 people and seems to have the expertise to design and make almost any type of instrument used in the laboratory. A workshop of this type is a feature of all the laboratories visited; since the instrumentation industry of China is in its infancy, the laboratories must rely upon their own capabilities to build the equipment they need.

NIM Chengdu

The city of Chengdu is the largest city (population approximately 2 million) in the province of Sichuan, the largest province (population approximately 100 million) in China. It lies approximately 1600 km southwest of the city of Beijing.

The NIM laboratory in Chengdu was established in 1970 with a nucleus of people transferred from Beijing. The reasons for establishing a second NIM in Chengdu were apparently to ensure a metrological capability for defense purposes and also presumably to contribute to the basic plan to disperse technological industry throughout the country. Since its establishment, NIM/Chengdu has grown to its present size of approximately 600 staff members, of whom 240 are regarded as scientific researchers. Senior scientists and engineers, said to be capable of independent research, number more than 100. The institute is divided into 8 laboratories: (1) length and precision measurement, (2) optics and lasers, (3) temperature, (4) electromagnetics, (5) first mechanics, (6) second mechanics, (7) radioactivity, and (8) cryogenics. It also has a workshop with approximately 140 workers. The principal tasks of the laboratory are to maintain primary and reference standards, to do research on standards, and to transfer standards to local authorities, such as provincial bureaus of metrology and industrial ministries. The Director, Mr. Ma Lin, was not at the laboratory during the visit, but later met with the group in Beijing.

Provincial Bureau of Metrology, Sichuan

The Sichuan Bureau of Metrology provides metrological services to the entire province of Sichuan, a vast area which is primarily agricultural in nature and contains little industry. It is probably typical of most of the provincial bureaus of metrology throughout China. According to the laboratory officials, the lab has three major assignments: to transfer standards of measurement to industry and others who need them, to make precise measurements

in its own laboratories, and to do research in metrology. The laboratory was established in 1962, initially focusing on length, temperature, mechanical properties, and electromagnetics. In the years since then, 5 additional laboratory areas have been added: radioactivity, time and frequency, ionizing radiation, optics, and chemistry. A total of 130 people are employed in these laboratories on approximately 80 programs. Much of the activity in this laboratory seems to be carrying out calibrations of instruments used in the industrial plants of the area. A small fee is charged for calibrations, which is retained by the laboratory for its own use. Only 2 to 3 percent of the income of the laboratory was derived from such fees. Examples of activities observed in the laboratory are the following: calibration of viscometers for use by the petroleum industry, calibration of ammeters, calibration of pressure gages, testing of transformers, measuring hardness of steel samples, calibration of standard cells, gage blocks, and potentiometers, and certification of weights for use by weights and measures inspectors.

Shanghai Administration of Metrology

The Shanghai Administration of Metrology is one of the 3 laboratories supervised by the State Bureau of Metrology, the others being the two National Institutes of Metrology in Beijing and Chengdu. However, it was also stated that the Shanghai laboratory was a body of the municipality of Shanghai and was funded largely by the local authorities. Its organizational relationship with the State Bureau of Metrology was not clarified.

This laboratory possessed most of the same capabilities as the two NIM's visited, but there were also some interesting differences. First, the laboratory seemed to have more modern equipment, including U.S. equipment, than the other laboratories visited. Instruments made by Fluke, by Weinschell Engineering, and by other U.S. manufacturers were seen in several laboratories. Second, the time and frequency laboratory used a hydrogen-maser atomic clock, rather than the cesium clock used in the other laboratories. Six separate hydrogen-maser clocks were in operation in this laboratory, four of which have been constructed since 1975. This clock provides the time standards for the Shanghai area. Within the previous several weeks, experiments had begun with dissemination of time signals by both T.V. and satellites. These experiments apparently were going quite well. Third, the chemical laboratory contained in a secondary ion emission mass spectrometer, said to be the only one in China. Parts of this system seem to be of Chinese manufacture, while others were purchased. A similar system in the U.S. would undoubtedly cost $200-300,000. This equipment was being used for studies of the ion-implantation depth in integrated circuits. The system was said to be similar to equipment used by IBM for the same purpose. The spectrometer was also being used for the analysis of metal, particularly for the presence of trace elements. This laboratory itself was not guiding the research being done with semiconductors and metals, but was performing the analysis as a service to industry, to the Institute of Metallurgy in Shanghai, and to the Institute of Semiconductors in Beijing.

Institute of Physics of Chinese Academy of Sciences

Visits had also been requested to either the Institute of Chemistry or the Institute of Computers, but the Chinese officials said that these institutes were fully occupied with the visits of other foreign officials that had already been scheduled. It is easy to understand why the Chinese laboratories can accommodate only one group of "distinguished foreign visitors" at a time; so much personal attention is paid to the visitors by the laboratory director and other top officials for the entire duration of the visit that the visit of a second group simultaneously could not be accommodated at the same level of attention and hospitality.

The Institute of Physics is located along with several other institutes of the Academy of Sciences on a large plot of ground about a half-hour taxi ride from the center of Beijing. As is usual, living quarters for the scientists are located adjacent to the laboratories. About 10 institutes are located in this complex, which was started about 1954. Among the institutes are those for Computer Sciences, about the same size as the Physics Institute, for Chemistry, which is a little smaller, and for Mathematics, Biophysics, and Automation.

The laboratory work in the Institute of Physics seemed to be at a significantly higher level of sophistication than that in the laboratories of the State Bureau of Metrology.

High-level research seemed to be carried on, led by competent, energetic young scientists, most of whom spoke at least some English and many of whom spoke excellent English. Approximately 500 people work in the Institute of Physics, one-fourth of whom are women. Several individuals received education up to the Ph.D. degree in the United States.

This institute was established in 1950 "with support from the party and the Government," and has developed rapidly since that time. Some areas of research begun in that institute have subsequently been transferred to other newly established institutes -- for example, work on semiconductors, solid state luminescence, and infrared phenomena.

The laboratory apparently places strong emphasis on theoretical work. Each scientist is expected, in addition to performing experiments, to do some work on basic theory. In addition, the laboratory has a special group for theoretical research; the only field of activity mentioned was quantum statistical mechanics.

Philippines

In December, **Richard D. Marshall** of CBT went to Manila to hold discussions with members of the staff of the Philippine Atmospheric, Geophysical, and Seismological Administration (PAGASA) concerning progress on the measurement of wind loads on low-rise buildings and the development of revised wind-speed maps for use in the Philippine National Building Code.

With support from the National Science Development Board, PAGASA is conducting a pilot program to determine natural frequencies of certain highrise buildings in the Manila metropolitan area. Utlimately, a strong-motion instrument array is to be installed in the Manila area with UN funding. This effort is in accord with recommendations developed at the 1977 Symposium on Engineering for Natural Hazards Protection. The work is under the direction of Mr. Teodoro Macalincag, Chief, Earthquake Engineering Division.

At the National Housing Corporation (NHC), Marshall met with Col. A. Kabiling and discussed the load criteria developed during the CBT extreme-wind study and its application to NHC projects. These criteria have been used since 1976 without significant increases in cost of construction above and beyond annual inflation. Experience gained during the typhoon of October 1978, indicates that housing constructed using these criteria performed satisfactorily in areas northeast of Manila where peak gusts of 150 km/hr were recorded. In summary, the NHC experience with the new wind load criteria has been entirely satisfactory.

Poland

In June 1979, **Kenneth G. Kreider** of CMEPT visited the Institute of Fundamental Electronics (IFE) of the Warsaw Technical University to discuss cooperative programs in humidity sensors.

Besides presenting an Institute Seminar on research activities in the NEL Thermal Processes Division, Kreider's principal business was to develop specific plans for a project that will develop new solid-state humidity sensors on SiO_2 substrates, which may be useful at high (~ 300C) temperatures or in electronic packages. Dr. Richard Jachowicz is the principal investigator at IFE and Kreider spent most of the visit with him and the Director of the Institute, Dr. Andrej Filipkowski. Kreider also met with the Institute of Heat Engineering's Director, Bogumil Staniszewski.

In September, **Simone Y. Yaniv** of CBT visited the Committee on Acoustics of the Polish Academy of Sciences, Warsaw. The Committee comprises 44 members and provides both control over and leadership to the Polish Acoustical Community. All theoretical and applied research in the areas of acoustics, noise, and vibration control performed in Poland originates with the Committee. The Committee supervises also the training of personnel involved in such research through its inputs in the formulation of curricula for various universities and technical academies. The Committee is also the major force behind the Polish Acoustical Society, which itself comprises roughly 500 acousticians.

At the Building Research Institute, Warsaw, roughly twenty people are engaged in building acoustic research, under the leadership of Dr. Sadowski. Although the group is purported to be a research group, many of its activities are regulatory in nature. The group is involved in the development of regulatory noise standards for buildings and sites, enforcement, assessment of the effectiveness of regulations through "demonstration programs," and routine testing of the acoustical properties of building materials (i.e., sound transmission loss, impact noise transmission, sound absorption). Thus, the group performs many of the services normally provided in the United States by the socalled commercial testing laboratories in addition to its regulatory duties.

The acoustical laboratory facilities of the Institute are good. These include a large reverberation room dedicated to sound-absorption measurements, a small anechoic chamber modeled after the NEL chamber, and two full-scale transmission loss facilities -- one dedicated to testing of floor-ceiling assemblies and the second to testing walls, doors, and windows. A mobile laboratory is also available for field testing. It is used in the Institute enforcement program and in demonstration projects.

In August, **John V. Fechter** of CCPT traveled to Lotz to tour the Institute of Industrial Medicine. There, researchers are studying: the effects of microwave and other electromagnetic radiation on animal and human health and psychological state; how to screen out workers who are more susceptible than others to specific toxins or pollutants or psychological stressors; a radon-gas exposure meter for wearing on the hard hats of underground miners; and psychological indices of brain damage from exposure to industrial chemicals and processes. These psychological indices often suggest physiological damage that will occur if the worker is not removed from the environment in which he/she is suffering ill effects.

Romania

In July, **Randolph Williams** of CBT traveled to Bucharest to confer with representatives of the Government of Romania in developing a list of earthquake engineering equipment to be supplied by the U.S. Government. About $2 million of $20 million in assistance has been provided to purchase strong-motion instruments and earthquake engineering equipment for earthquake monitoring and research. The Rehabilitation Program is being managed by the U.S. Geological Survey under the direction of the Agency for International Development.

The Romanian Building Research Institute (INCERC) is involved in designing a seismic simulation and test station for experimental research on full-scale structures, full-scale structural members, and large-scale structural models (scale 1:2 ... 1:8). The test station is expected to be a national center consisting of a number of data-acquisition systems, two shaking tables, and a system of 50 portable servohydraulic actuators for vibration testing. This station will be among the best, if not the best, in the world. The assistance program also includes the installation of an earthquake-monitoring network throughout Romania and, primarily, around the city of Bucharest. The network will consist of strong-motion instruments that will telemeter ground-motion activity to a central data center within Romania. Data will be shared with U.S. researchers.

Spain

In September, **Edward O. Pfrang** of CBT traveled to Madrid to coordinate ongoing research with the Laboratorio Central de Ensayo de Materiales de Construccion (LCEMC).

The main purpose for the consultations was to keep the NEL commitment to exchange visits at roughly six-month intervals and to discuss progress on a collaborative project. In addition, he discussed the prospects for an expansion of the current project along with the possibilities of beginning new activities in the area of NDE. In meetings with Drs. del Pozo, del Campo, Castro, and Clemente, he discussed the progress of the efforts to date. While the Spanish have been concentrating on the obtaining of field data and laboratory tests on prestressing steel, CBT has been concentrating its efforts on information related to cements and concrete -- particularly, the influence of the introduction of waste materials such as fly ash and metallurgical slags into the concrete mix.

It now appears that the expansion into the area of blended cements incorporating waste materials will be approved by both governments. He also discussed plans for a new cooperative effort in the area of NDE related to concrete. Although both sides have the competence to work in this area and feel that it would be extremely valuable work, some question arises as to whether funds will be available.

Earlier, in March, **Geoffrey Frohnsdorff** of CBT went to LCEMC to review the progress of the collaborative projects and to tour a number of their laboratories. The first of these was the Metallographic and Corrosion Testing Laboratory (Head, Dr. Clemente), where most of the work on the joint project will be carried out. Accelerated tests for stress corrosion cracking are carried out in an NH_4CNS solution in a nitrogen environment, usually at 50°C. A water-jacketed container is used to maintain the temperature.

The Microscope Laboratory (Head, Dr. Barba), has three main instruments -- a Reichart metallograph, a Nikon profileometer, and equipment for macro-photography. An adjacent electron microscopy lab has an old Philips transmission electron microscope and a new ISI Super-III SEM with a microprobe and Kevex analyzer. The SEM has been used extensively for studies of pastes of portland cement and blended cements containing fly ashes and slags. Dr. Barba said that fly ashes there are very uniform and always have less than 5 percent carbon. He also said that his microprobe work suggests that ash does not vary much from particle to particle.

In the Dams and Models Laboratory, Mr. Gelinda mentioned that model studies of several structures, including some large dams, have been carried out. The form for a 1:150 scale model of a dam was on show in the lab. The actual model had been constructed from gypsum plaster but micro-concretes are used for most models. Data had been collected with a very old data collection system using a tape printer. (Equipment funds which are now being requested from the US/Spain Advisory Commission would be used to upgrade their data collection capability.)

The Structures Laboratory is under the direction of Mr. de la Peña. The laboratory has a variety of old test machines and it has just acquired some MTS equipment for dynamic testing. Creep studies on prestressing wires loaded to 80 percent UTS (ultimate tensile strength) are being carried out and the ten-year results will be obtained this year. De la Peña wants to start a new series of creep tests that would be accelerated by increasing the percent UTS to about 90 percent and raising the temperature to about 40°C. The Structures lab is also carrying out a study on curing compounds for concrete.

The Inorganic Materials Laboratory (Head, Dr. Blanco) is mostly concerned with chemical analyses it carries out for government and industry. The equipment includes an atomic absorption spectrophotometer and an induction furnace for hydrogen analysis of steels.

The Head of the Organic Materials Laboratory is Dr. J.J. Ortega. The laboratory deals with the analysis and physical testing of a wide range of organic materials including coatings, elastomeric roofing materials, building joint sealants, rubber and plastics. The laboratory has been outstandingly successful in getting work from industry and, as a result, it has received a large share of new equipment funds. The equipment includes a 1000 kg Instron tester, an extrusion rheometer, an automatic Vicat tester for the setting and hardening of cement paste and rubber, and Shore hardness testers for rubber.

Sweden

In May, **Victor Nedzelnitsky** of CMEPT went to Stockholm, in connection with his duties as a delegate to the International Electrotechnical Commission, and visited the Royal Institute of Technology (specifically, the laboratory of Johansson), which is well-known internationally for its work on characteristics of hearing aids, hearing protectors, and problems related to industrial noise exposure and hearing damage. He also visited the laboratory of E. Borg at the Karolinska Institute in Stockholm. Borg is known for his research on the acoustic reflect and mechanisms by which industrial, military, or other intense sounds induce hearing damage.

RIT has spent considerable time in automating their measurement procedures as much as possible, with particular interest in computer-aided analysis and design of hearing aids. Discussions with Johansson and Frykholm confirmed the belief that measurement of saturation-recovery characteristics of moderate-to-high-gain hearing aids in response to impulsive sounds should be performed in the U.S. to determine the potential significance of these characteristics to the user.

Johansson also described as yet unpublished work in which his audiometric studies over a time period of decades on a stable population of industrial workers indicated that adequacy of the acoustic reflex (middle-ear muscle contraction in respone to intense sounds) is a good correlate of an individual's susceptibility to noise-induced hearing damage. This suggestion that an individual with a weak (inadequate) reflex is very likely to suffer hearing damage has important consequences for industrial hearing-conservation programs, for it suggests a screening procedure to identify high-risk individuals. Such identification is very important because in establishing permissible maximum noise exposures, a continuum of individual sensitivity to damage is involved, and setting permissible noise-exposure levels to be so low that virtually no individuals can suffer damage may well be prohibitively expensive for industry: only a 5-dB difference in permissible continuous noise exposure for American workers (85 dBA vs. 90 dBA) might cost 20 to 30 billion dollars; the figures for 75 dBA could be expected to be much greater.

Johansson's tentative conclusion is supported by the only experimental study in mammals performed by new techniques suitable for high sound pressures (Nedzelnitsky, 1979), which showed that stapedius muscle contraction can reduce transmission of sound to the inner ear by a much as 35 dB. This number is large enough to provide considerable protective effect, particularly for repetitive impulsive sounds (impact tools, paint chipping, forging, etc).

Since middle-ear muscle contraction affects the acoustic impedance of the eardrum, measurements of the acoustic impedance of the ear may offer a convenient, non-invasive procedure for measuring the adequacy of the acoustic reflex.

At the Karolinska Institute, Borg's work has examined acoustic reflex activity using acoustic impedance measurement and loudness balancing techniques and also includes studies of mechanisms of noise-induced hearing damage. The most interesting aspect is that his experimental animal and human data, while not as direct or extensive at high levels and frequencies as the other animal results cited above, are at least consistent with those results, showing that the muscles are capable of producing large attenuations.

Switzerland

In May, **John Arol Simpson.** Director of CMEPT, visited the Center for Nuclear Research (CERN), Geneva, to see the two most highly developed CAM systems now in use and the central computing facility. The CAM facilities, one by Hewlett Packard set up for finite element analysis, the other by Quest (UK) for circuit board design, were not particularly advanced in concept or realization. The central computing facility on the other hand is overwhelming in size and power.

In December 1978, **William C. Haight** of CMEPT traveled to Heerbrugg, Switzerland, to visit the Wild Company, a Swiss instrument manufacturer. The Heerbrugg plant has a staff of 2500 out of Wild's 4000 worldwide employees, and staff members are active in development of high-precision photogrammetric equipment, geodetic measuring instruments, and EDM. Technical discussions were held with U. Frey and A. Rohrbach on photogrammetry and P. Mignaval on laser/theodolite systems.

Of particular interest to NEL is the Wild TC1, a theodolite/laser system with digital readout for horizontal and vertical angles, a cassette tape system for automatic data acquisition, and laser pointing capability for two-station triangulation. Accuracy is ± 3 arc seconds horizontally and ± 6 seconds vertically, making it ideally suited for triangulation of 30-m diameter spheres under construction for LNG transportation in the U.S.

In September, **R. Radebaugh** of CMEPT visited the Eidgenossische Technische Hochschule (ETH) in Zurich and met with K. Kwasnitza. Kwasnitza is studying AC losses in various superconductors, with particular interest in A15 materials such as Nb_3Sn and V_3Ga. He has been looking at the influence of heat treatment conditions on grain size and superconducting layer thickness. The AC losses with these different conditions are then studied. Measurements are done either calorimetrically or with a magnetization technique in an AC field. Both cannot be done simultaneously. They have looked at the variation of AC losses with the angle between the conductor and the AC field direction and get results they cannot explain. The calorimetric and magnetization measurements do not always agree in angular dependence.

Later, Radebaugh went with Dr. Kwasnitza to Brown Boveri (where he also works part time). There he makes AC-loss measurements on large conductors (10,000 amperes size). They have a magnet of approximately 5-inch bore that can be cycled to about 1.5 T. Soon they will get a large dipole magnet for measurements on long straight samples in a perpendicular field.

Union of South Africa

In May, **Jack E. Snell**, Director of the Office of Energy Programs, took part in a Workshop on Building Energy Conservation held in Cape Town. He also presented a keynote paper on energy conservation at the Fourth South African Building Research Congress and held extensive discussions with managers at the National Building Research Institute. NBRI has been directed by Dr. Pluto Webb for 20 years. He has two deputies, Japp Van Straaten and Spencer Richards. In that time they have become a major force in the South African building community. The NBRI is an applied research laboratory which establishes standard test methods for materials and construction practices used in South Africa. It has an annual budget of approximately $4 million and a staff of approximately 250.

The programs of NBRI and CBT reflect parallel emphasis on health and safety, utility and economy in buildings, and energy conservation. NBRI has perhaps gone further than CBT in bringing the behavorial sciences into their programs. For example, the Environmental Engineering Division is carrying out a landmark study of the effects of the thermal environment on the productivity of industrial factory workers. It is their intention to follow this up by analyzing the effects of sound (noise) and other factors on worker productivity. Also, workers in the Architectural Division are working closely with community-level leadership in developing meaningful approaches to providing for the technological needs of low-income communities (an effort somewhat analogous to the CBT work with the Community Services Administration).

In the area of energy, NBRI has been active in solar energy for some 15 years. They have developed a very low-cost (approximately $250 to $300) solar hot water system for low-income families. With a climate much more mild than ours, the South African researchers are intent on making maximum use of "natural" effects for illumination, ventilation, and heating and cooling of buildings.

Snell's tour through the South African Bureau of Standards (SABS) was led by Dr. I.J. Van Zyl, Director of the Civil Engineering Division. Virtually all product testing and certification in South Africa are done by their Bureau of Standards. It is, in essence, a national standard testing laboratory. The Civil Engineering Division tests construction materials of all kinds and also all types of packaging.

Van Zyl was very interested in the National Voluntary Laboratory Accreditation Program. His interest stems from a desire on the part of the SABS central laboratories to assess the proficiency and effectiveness of their district laboratories.

At the Department of Environmental Planning and Energy, Snell spoke with Mr. R.B. Silberberg and Dr. A.J. Neethling. The South African government has established an interagency coordinating group to deal with energy, the staff work for which is carried out in the Department of Environmental Planning and Energy. Studies of energy demand and use in South Africa are being forwarded through NBRI. The principal interests were in macro-modeling of energy demand and use. South Africa is basing its national energy system on coal and coal-based gaseous and liquid products through its multi-billion dollar investment in plants going up at Sasoburg.

Union of Soviet Socialist Republics

In June and July, **Ramon C. Baird** of CEEE traveled to Moscow, Leningrad, Yerevan, and Irkutsk to attend the Fourth Meeting of the US-USSR Joint Working Group for Metrology under the US-USSR Agreement on Cooperation in the Fields of Science and Technology. He also visited a number of laboratories to become familiar with the scope of Russian metrology and areas of interest to NEL researchers.

Vincent D. Arp of CMEPT went to Moscow and Leningrad in September to attend a committee meeting overseeing progress within the US-USSR Energy Agreement on Superconducting Power Transmission Lines (SPTL). The Mosenergo Laboratory, Moscow, is the site of their 100-meter SPTL tests. A rigid SPTL has been installed and tested at pressure, but never cooled down, even though two 150-watt refrigerators are on site. The reseachers there say they need to assemble more instrumentation and a computer facility; they should be ready for tests early next year. Arp also visited the Direct Current Research Institute, Leningrad (Director: Prof. Machenkov), the All-Union Research Institute for Electrical Machine Engineering, (Director: Academician I.A. Glebov), and Electrosilia (Deputy Director: Korovoritz), a large company, with 20,000 employees and its own research institute of 2500 people. They make large turbo generators for hydroelectric plants, plus items as small as vacuum cleaners and electric samovars. Included are some superconducting generators, which they design, build, and test. Arp toured their large production facilities, saw test stands for generators as large as 1000 MW, and watched 2-MW superconducting generators being tested.

United Kingdom

Motohisa Kanda of CEEE visited Professor J. R. James and his colleagues at Queen Mary College (London) in May to discuss their considerable work on microstrip antennas. Particularly impressive are their broadband circularly polarized microstrip antennas. Results indicate that good circular polarization characteristics were achieved with up to 40 percent bandwidth and 50 percent efficiency at X band. (Note that a conventional microstrip antenna has a typical bandwidth of 2-5 percent.)

Arthur D. Yaghjian of CEEE traveled through England in July and August to confer with researchers in near-field antenna measurement. At Queen Mary College, London, A.D. Olver discussed their compact range and probe computation programs. Their use of a serrated absorber to reduce diffraction-produced non-uniformities in the near field is of current interest to the millimeter radar cross-section compact-range program of NEL.

At the Marconi Research Laboratories (Chelmsford), John Brain, Peter J. Wood, and Yaghjian exchanged information on nonplanar scanning. Of special interest was the probe-correction technique used by Wood in his spherical-surface, antenna-measurement scheme. His published papers remain obscure on this important aspect of spherical scanning, but after a lively in-depth discussion his probe correction technique was clarified. They were, in turn, anxious to learn of cylindrical near-field scanning at NEL since they are planning a large, portable tower as a probe transport mechanism to perform cylindrical measurements on large antennas *in situ*.

A.P. Anderson, of the University of Sheffield, and his small but prolific university staff have many years of experience applying "computer holographics", i.e., planewave spectrum techniques, to such inverse scattering problems as detection of buried objects and the determination of near fields of large antennas from very limited far-field data. Their color displays of microwave fields are highly informative and impressive. At the Ferranti Laboratories, Robin W. Forrestor and David Griffiths have many years of expertise in designing and fabricating microwave antennas. They have built a small horizontal, planar near-field scanning system to measure in the very near-field of slotted phased-array antennas. Their unpublished studies and graphs of evanescent-mode phenomena within a wavelength or so of the array elements critically confirms the predominant role of the reactive field in the mutual coupling of the array elements.

In September, **Gordon W. Day** of CEEE visited Southampton University. Southampton is one of the few universities in the world that have strong programs in optical communications.

This program began early (∿ 1968) and has grown continuously to the present fourteen staff members. The work is largely experimental and much of it is on the characterization of fibers. For example, recent efforts include spectral backscatter attenuation measurements with an improved electronics package, spectral group velocity measurements, and index profile measurements on preforms. Having a complete fabrication facility greatly increases the effectiveness of their characterization work because they are able to examine a large number of fibers with carefully chosen variations in important parameters, such as composition and size.

In April, **Nelson H. Hsu** of CMEPT visited researchers at the NDE testing center, Atomic Energy Research Establishment, Harwell. The Center was created in 1965 to expand the nuclear fuel-element inspection activity to nondestructive evaluation quality control in general. The Center now offers NDE services with a team of technicians and backed by more than twenty research scientists. Current research includes infrared radiography, image analysis, laser interferometer, surface activation analysis, concrete analysis by microwave and low frequency ultrasonic testing, positron annihilation, neutron attenuation, magnetography, eddy current, ultrasonics, and acoustic emission.

Hsu's visit started with a general discussion with Drs. Scruby and Widley; both are working on AE signal analysis problems. Later during the day, the discussion was joined by Dr. Sinclair of their applied mathematics group. They were particularly interested in NEL progress on the inversion computation of signals with maximum delay.

One interesting and old technique the Harwell group is very actively pursuing is the acoustic impact analysis of manufactured parts of arbitrary geometric shapes for quality control. The technique consists of waveform and spectral analysis of the sound caused by a hammer hitting the parts and detected by wide-band transducers. With recent advances in digital signal processing techniques, it appears that the old technique may have a new approach that is different from merely empirical correlations. However, success depends on specific applications.

In April, **E. Clayton Teague** of CMEPT visited the Cranfield Unit for Precision Engineering (CUPE) and Cranfield Institute of Technology (CIT), Bedford. Professor Pat McKeown, Director of CUPE and Head of the Department for the Design of Machine Systems, hosted his visits. CIT was created by Royal Charter in 1969 as a post-graduate institution as part of the British government's effort to bridge the gap that existed between traditional university studies and research and that needed by industry and public services. One of the most impressive parts of a student's training in the Department for the Design of Machine Systems was a group project lasting for one year in which the student team assumed overall responsibility for the project, negotiations with a company, design, manufacture, testing, and final presentation for a specified machine. Teague talked with a student group working on a machine to automatically load large rolls of aluminum foil or mylar into machines for packaging cigarettes, candy, etc.

CUPE, while a unit of CIT, operates on a commercial basis obtaining all its income from industrial contracts. With a staff of about 40 engineers and designers, CUPE typically has 30 projects in various stages of completion. The work at CUPE covers all phases of manufacturing specialized machines and prototype equipment. Professor McKeown stressed that a dominant philosophy of CUPE's work was to develop and standardize modular units for building into increasingly larger systems. Examples of this philosophy were a Moire-fringe encoding module which was in turn built into direct-current servo-motor drive modules. Their patented electronic gear-box is then created by properly combining two or more of the encoder-servo-motor modules. Professor McKeown showed a large gear-hobbing machine in which the mechanical gear chain was being replaced with their electronic gear-box to give the machine greater gearing ratio versatility, reduce noise, and, in production, reduce machine cost. Teague also saw precision rotary tables for testing laser gyroscopes which used the encoder-dc motor module and a grinding machine for producing complex contoured cams for diesel engines.

At the laboratories of Rank-Taylor-Hobson (RTH) Teague visited with Mr. Robert C. Spragg, Director of Research and Development at RTH; Mr. Dave Elwood, Leader of Computer Systems Division; Mr. Peter Wright, Marketing Manager for Military Optics in the Optics Group of RTH; and Dr. H.E. Reason.

Mr. Spragg and Mr. Elwood directed his tour through RTH production facilities for all metrology equipment and then through their quality control area for surface metrology instruments and systems. Order intake for all of RTH for the last several years has increased at 30 percent per year. As a result, they are building a new facility on a seven-acre site near their present location. Expected completion of the new facility is early 1980. They design, build, and automatically test all printed circuit boards used in their instruments. They make all their computer interfaces to motors and transducers and have standardized all computerized systems on Data General Computers. In stylus instrument systems, 32 thousand byte memories with 10-bit analog-to-digital conversion is standard. Profiles are acquired as a data set of 1000 to 2000 points.

Mr. Wright directed the tour through their facilities for diamond-turning optical components. Teague was accompained by two representatives from the Agfa Corporation who where prospective customers for a diamond turning machine. RTH has been involved in diamond turning since 1940 when they had to assume responsibility during the early part of World War II for making military optical components. They constructed a second-generation machine in 1956 that was capable of producing aspheric components with a surface finish of 1.5 microinch R_a. Teague saw one of these machines; it was located in a basement shop with no temperature control other than that provided by usual building heating and air conditioning and used conventional slides, ways, and spindle bearings. A third-generation machine will use air bearings for both axes for tool motion and for spindle support; it will also be placed in a room temperature-controlled to $\pm 1°C$. They hope to produce aspheric optical components with a surface finish of 0.5 microinch R_a using this machine design.

With Dr. Reason, Teague discussed the NEL program for making and distributing as SRMs sinusoidal profile precision roughness specimens. Dr. Reason is one of the men most responsible for the development of stylus instruments and surface roughness characterization since 1940. He remains active on the ISO Commitee for surface texture and wanted to make recommendations about the particular wavelengths that would be used and about the future developments of specimens for checking stylus tip radius. His recommendations will be followed if economics of fabrication permit.

At the National Engineering Laboratory, Glasgow, Teague reviewed the development of standard 3-D ball structures made of carbon-fiber rods and steel balls to calibrate 3-D measuring machines and general machine tools, and development of a two-frequency optical profilometer. This optical profilometer looks very promising and work on the instrument was viewed very favorably by other people in the UK. The lab expects to receive in 1980 a large CNC-3D measuring machine from RTH, the Talycheck 3.

At Teeside Polytechnic, Middlesbrough, Teague talked with Professor T. Thomas in the Mechanical Engineering Department. In collaboration with Dr. Williamson, he has performed the most extensive investigations in the world to utilize contour mappings of surface topography. Teague saw their work to determine the relationship between hull surface texture and hull drag.

In April, **Theordore V. Vorburger** of CMEPT traveled to several English laboratories to study developments in optical techniques for surface roughness measurement, surface defect defection, and particle sizing. An early visit was with Dr. David Whitehouse and Derek Chetwynd at the University of Warwick. Whitehouse discussed some work he had done in collaboration with John Webster at the University of Birmingham. They had set up an experiment to test the rotating-sytlus technique for in-process surface roughness measurement. Although the original claims for the technique by Dutschke were overstated, Whitehouse felt that the technique could be used for some in-process measurement of spinning parts.

In the afternoon, Vorburger accompanied Derek Chetwynd to the Mechanical Engineering Department, University of Birmingham to visit Henry Kaliszer's laboratory. He saw a journal-bearing test facility, an optical test facility for examining the waviness of ground surfaces, and parts of the rotating stylus apparatus. With E. Clayton Teague from CMEPT, Vorburger met Bob West and Jeff Dunn at the Sira Institute, a research association that specializes in the development of optical scanning systems for surface inspection of defects in manufactured parts. The group has expertise in optical design, computer interfacing, and data analysis and has developed instruments for a wide range of applications. Among these are an optical-surface gauge for automatic classification of scratches in optical components, a unit for

scanning brake-cylinder bores, an infrared unit to inspect light-sensitive materials, and instruments that use pattern recognition to characterize the dimensions of parts and map their surface defects. They are also doing some research using a software technique known as feature space analysis in an effort to classify automatically defects such as dents, welds, stains, and scratches.

They also showed some results on optical measurements of surface gloss using several approaches. The results, as usual, were less than spectacular. It seems that clear optical testing of surface defects has advanced more than optical testing of surface finish.

Len Tanner, Department of Mechanical Engineering, Brighton Polytechnic, showed his light scattering apparatus. He also showed a clever apparatus for measuring flow in a manner analogous to a wheatstone bridge. He was using it to measure the flow rate over a rough surface in the laminar regime, and his results correlated quite well with surface roughness. There is also ongoing work in the department to study the controlled rake length of tools used in facing and turning processes. Their work showed that proper control of the rake length reduced the instabilities in cutting, reduced tool wear, and cut down on the power requirements of the machine.

Vorburger visited Adrian Janssen in Venables' electron microscope group in the Physics Department of the University of Sussex. He showed their recent work on some striking growth phenomena on high-index planes of tungsten and called attention to Bethge's recent SEM observations of Au-decorated surface steps. Another interesting aspect of the university was a closed circuit cyrogenic facility and capability for conserving helium. Helium is delivered to the labs in the normal way but the exhaust gas flows back to the central facility through flowmeters in each laboratory. The facility monitors the amount of helium delivered and the amount flowing back and charges the researchers only for the helium that is wasted.

Vorburger's visit to the National Physical Laboratory (NPL) included a tour of the optical laboratories in an effort to contact researchers doing work similar to that in NEL. There he saw a high-precision refractometer (M. Debenham), work on diffracting optical components (Richard Stevens), the standards laboratory (K.G. Birch), a profilometer for measuring x-ray components (M. Stedman), and the optical shop (A.B. Penfold).

In September, **Vincent D. Arp** of CMEPT visited the Cryogenic Laboratory, Department of Engineering Science, Oxford University, as a guest of Dr. Brian Hands. Their project for studying bubble growth dynamics in nitrogen (transient heat transfer) has been enlarged to argon-nitrogen mixtures. They have a computerized system for calculating bubble sizes, and following them as a function of time, from a series of photographs. Hands invited NEL to use this system for heat transfer work in the future.

Their rotating heat transfer cryostat has been moved to a new location where it does not shake the building so badly. Similar work is ongoing at Southhampton University, under Scurlock. Results should be valuable for superconducting motors and generators.

Dr. Hands is continuing his measurements on flow system stability. Some of his results may be applicable to C. Sindt's packed bed heat transfer. Mr. Bill Bald, a coworker with Hands, discussed their interest in transient heat transfer in biological tissue, i.e. cryosurgical problems. They are doing no measurements, but are doing careful computer modeling based on available data.

In September, **Lloyd A. Weber** of CMEPT visited the Thermodynamic Tables Project Centre, located in the Chemical Engineering Department of Imperical College. As correlators of thermophysical property data, they have many interests in common with NEL. He met with Barrie Armstrong and Marjorie de Reuck. They are working on properties correlations for chlorine and propylene. In addition, de Reuck has succeeded in programming Wagner's fitting technique. They also showed their first printed copy of the report on nitrogen, which should be available from the printer soon. They also mentioned the existence of a thesis done at the Institute for Marine Engineering in Odessa containing saturated liquid specific heat data for ethylene.

In October 1978, **Belinda L. Collins** of CBT traveled to London to meet with researchers and government officials in England to discuss research on symbols, safety, daylighting, and

energy conservation. Her first stop was with Mark Radcliffe-Genge of the British Standards Institute. He indicated a desire to limit the number of symbols, suggesting that there is only a small number that people can use effectively. He suggested the need to determine first the concepts to be symbolized before developing an array of symbols. He also discussed some of the safety research standards for skateboards and for consumer product labeling.

A further trip was to St. Helen's, near Liverpool, where Pilkington Brothers is located. They are the major manufacturers of glass products in the U.K., and have been active in the fields of daylighting and window performance evaluation. She met with Peter Owen and Keith Jackson. They showed Collins their labs, demonstrated the Pilkington-Pepper Pot technique for predicting amounts of daylight illumination, and showed a task-lighting/daylighting arrangement for a large open-plan office. The energy-balance predictions made by Pilkington indicate that the window has little or no negative influence upon energy consumption in buildings, and can have positive benefits in air-conditioning buildings where daylight is substituted for electric lighting.

In March, **Geoffrey Frohnsdorff** of CBT visited the Building Research Station, Garston, and had a series of meetings with members of the Organic and Inorganic Materials Division.

Among other topics, he noted that glass-fiber reinforcement for concrete is still an important research activity at BRS and that alkali-resistant glass fibers are now being used commercially in concrete panels and filament wound pipes. In other work on fiber-reinforced concrete, BRS has published a paper showing promising results with Kevlar fiber reinforcement. BRS is active in the BSI committee on pulverized fuel ash (fly ash). Attempts are being made to improve the BSI 3892 standard on PFA for use in concrete. The main concern is with durability. The work on preservatives for building stone has shown certain alkoxy siloxanes to be most promising. A patent has been applied for a 3-component mix which maintains a low visocity for 3-5 hours, then gels in a few minutes. The material has been used in the preservation of stone statues at Wells Cathedral.

In a visit to the Princes Risborough Laboratory of BRE, Frohnsdorff learned that a new type of product being evaluated is a cement-bonded particle board developed in Switzerland and now being manufactured in Hungary. The board is attractive from the points of view of durability, fire resistance, and dimensional stability. It could be useful for cladding and interior partitions. Outside exposure tests carried out over nine months have given encouraging results. The material can be nailed, glued, and clipped.

Studies are being made to relate the temperature and humidity in rooms, particularly in schools. The moisture content is measured in the space above the ceiling. Kitchens provide the biggest problem. Most moisture problems in buildings are caused by moisture from within rather than leakage from outside.

In April, **John S. Stroik** of CBT met with BRE researchers concerned with building security. For example, John T. Smith is now working on a project to alleviate vandalism in lifts by preparing a demonstration that will include innovative systems including electronic locks and visitor-screening devices. Derek J. Humphries and Dr. Robyn P. Thorogood, at the Princess Risborough Laboratory at Aylesbury, were also visited. Dr. Thorogood, head of the Wall Component Group, authored an Appraisal of Assessment Procedures for Impact Resistance of Vertical Surfaces in 1978 at the Laboratory and is currently engaged in the development of impact tests. An interesting impact test is that developed by Nilsson for the Swedish Council for Building Research, 1976, which is similar to that developed by NBS in 1976. The BRE relies on using an impactor filled with glass spheres instead of sand for soft-body impacts and the universal method of dropping steel balls for hard-body impacts. It is thought that we will mutually benefit by sharing future test developments.

Mr. Humphries, head of the Non-Structural Components Group, is working on a selection strategy for replacement windows and is particularly concerned with vandalism of windows and doors. Last year in Great Britain $200M was spent on replacement windows while $1-M was spent on new windows. PVC is being used in the majority of installations due to the poor

performance record of wood and aluminum windows. Hardware design has been bearing the blunt of the blame for both door and window performance failures. (It is interesting to note that European hardware is far superior to U.S. hardware, in general.)

In July, CBT's **James G. Gross** presented a paper and took part in a Colloquium on Codes of Practice: Reform or Decline? sponsored by the British Group of the International Association of Bridge and Structural Engineering.

The Colloquium was planned in response to expressed disquiet over codes of practice of engineers. There are many reasons for this concern, including growing complexity of codes themselves, the use of codes in legislation, and inadequate methods of production. In response to these concerns, the British Group decided to devote its annual Colloquium to a discussion of these problems. The Colloquium intent was to develop positive suggestions for the content, production, and use of future codes.

Gross' paper provided background information on the development and use by the United States building community of "Recommended Practice Standards" (U.S. counterpart to the British "Codes of Practice"). The use of such standards for regulatory purposes and building design was discussed. Standard generation methods, with particular emphasis on the "consensus process," were outlined and compared. Potential new Recommended Practice Standards resulting from technical advancements and changing societal needs were identified. Federal Government, building community, legal, and consumer concerns for changing developmental processes were discussed. Five possible major changes in approach were suggested.

In September, CBT's **Porter Driscoll** went to London to confer with managers of technical information programs, with an eye to improving technical communicatons back at CBT. For example, the Building Research Establishment (BRE) spends approximately one quarter of its resources on activities to foster and promote the use of research results. The activities include publications for special audiences, the provision of a comprehensive advisory service to the building community, participation in the programs of building community organizations and participation in the development of British standards.

Research publications include (1) BRE Reports (the traditional research report primarily intended for other researchers), (2) BRE Current Papers (initially reprints from scientific journals, but now reports not requiring the full treatment of the BRE Report), (3) the newly established BRE Information Papers (summaries for the building community of current papers), and (4) the BRE News, which includes summaries of research reports as well as announcements of other BRE publications and films. In addition, state-of-the-art technical information, generated at BRE and elsewhere, is reported in the BRE Digest.

The BRE Digest is regarded as an effective link with the building community -- simultaneously providing useful technical information and the idea that BRE is a valuable resource. The BRE has some problems sustaining a flow of monthly digest publications. The Editor, Dr. Graver, writes the majority of the Digest articles himself deriving his information from the divisions. BRE procedures require the Divisions to provide draft material, but often the material is incomplete and this requires rather extensive interaction with the individual researchers. A partial explanation for this is that Digest articles do not count quite as highly in the scheme of things as do research publications.

Each researcher at BRE is responsible for delivering his research to his peers in the research community and for application in the building community. The communications and services staff supplement the researcher's activities in presenting research findings in the best format and media. Extensive use is made of audio-visual materials, particularly where images are an important part of the information.

It should be noted that the BRE has high standards for the design of all its publications, particularly those for the architectural profession. In addition to the editorial work involved in some 200 publications per year, the publications group prepares audio-visual materials. It is estimated that the BRE audio-visuals are seen by approximately 75,000 people per year.

The Royal Institute of British Architects (RIBA), like its counterpart, the AIA, is an extensive generator and distributor of technical information. Unlike the AIA, the RIBA

produces Product Data Sheets based on technical information supplied by the manufacturers to RIBA. At present there are a total of 1,150 data sheets from some 580 firms. Five additional periodic publications on technical information are prepared by RIBA and include Construction, a series of abstracts on building failures and new techniques: Legislation, a record and review of government policy affecting buildings and their design; Practice, a guide to the dos and don'ts of practice as well as a growing series of case histories on claims against architects; Assessed Product, a series providing a brief detail of products newly approved by the Greater London Council and the Agréement Board; and Bibliographies, a guide to each product identifying official publications and giving the names and address of trade associations and other organizations. In addition, the RIBA prepares National Building Specifications (similar to PSAE for AIA) and offers a discount on indemnity insurance for architects who use the system and the RIBA Building Handbook.

The Department of the Environment is engaged with the Post Office Department in the development of CONTEL, an information system to be available to the construction community by means of telephone links and cathode ray tube displays in each subscribing office. This effort is just starting and is quite expensive now. Bernard Anker of the National Building Agency is under contract to bring the construction industry material into a useful and manageable format.

The Department has just made available to the public the quarterly journal of technical information, Construction, which was hitherto primarily for the professional and technical staff of the Departments of Energy and Transport. This is a good professional journal overall and has an outstanding feature, "Feedback Digest," which identifies building problems, states what was done to correct them (occasionally not successful at the first attempt), and gives the name of the person having additional information.

The Greater London Council (GLC) has the responsibility for developing housing and public buildings and has produced some very good work over the last three decades. It has also made its share of mistakes regarding what is built and how it is built. From these mistakes and from their successes have come a series of very specific design guides, which include Preferred Dwelling Plans, Good Practice Details, Standard Drawings, and the Housing Information File. The majority of these design guides offer a number of options to the designer and often include advice as to why certain things should be provided. These are often good examples of information designed to guide architects and engineers; they are clear, concise, complete, and well illustrated.

The GLC is faced with a dwindling new-construction program, and at present there is great emphasis on rehabilitation of GLC residential properties including a number of high-rise structures. There have been problems with the large concrete panels of some of the Bison high-rise buildings, but the major problem seems to be that high-rise apartments are just not appropriate for families with young children.

The Director of CFR, **Frederic B. Clarke** visited the Fire Research Station, Borehamwood, the Fire Services Technical College, Moreton-In-Marsh, and the University of Edinburgh, in May, as part of a survey and comparison of U.S. with English facilities. Among many interesting discussions, he spent several hours with E. Pigott, Chief of the Operations Research Division, FRS, discussing hardware approaches to remote alarm and sensing procedures. Pigott, an expert in systems work, computerization, and systems analysis, has been with FRS for a relatively short time, and is tremendously enthusiastic about the possibilities of instrumenting multifamily dwellings for remote alarm sensing.

Of particular concern to FRS management is the recent controversy arising out of the tragic fire in a Manchester Furniture Store, which involved polyurethane furniture. This fire trapped and killed nine store customers, and has refocussed interest in the UK on the furnishings fire problem. The dialogue is not too different from that going in this country. There is, however, little apparent interest in an upholstered furniture ingition standard for general use. The Ministry of Interior, the parent agency for FRS, has published a procurement specification for furnishings that contains provisions similar to the California upholstered-furniture standard.

Clarke also visited Cardington, which is the FRS full-scale research facility. Full-scale it is indeed; it is an abandoned air ship hanger. Aside from the fact that individual

test facilities are lost in the huge volume of the Cardington installation, it is the perfect place for explosion research, and FRS undertakes a large amount of work on gas and dust explosions on a reimbursable basis, often in conjunction with industrial organizations. Work has recently been completed on a two-story single family home, wholly contained within the hanger. This home does not contain wiring, nor is it insulated; however, it will be used for residential studies of the movement of smoke and moderately hot fire gases.

Clarke's first impression on visiting the Fire Services Technical College was there is a tremendous amount to be learned about running a fire academy before the United States has a facility comparable to the British. Commandant David Blacktop estimated that constructing the facility on today's market would cost approximately 120 million dollars. This is completely believable, since the complex contains perhaps 200,000 square feet of usable facilities, ranging from classrooms and laboratories to full-scale facilities for shipboard fire fighting. There is a full-time teaching faculty, as well as a practical teaching faculty recruited from the British Fire Services. Clarke spent a good deal of time with the faculty involved in teaching physics and chemistry, including sitting in on lectures in chemistry and hydraulics. The courses are carefully thought out and go quickly from the fundamentals to the quantities and concepts that fire fighters must use.

Clarke spent a full day with Dr. David Rasbash, Chairman of the Fire Protection Program at the University of Edinburgh and his staff of two instructors. David is nearing the end of the five-year probationary period, after which he must demonstrate the academic viability of his program to the University. He seems confident that the program will pass muster, and has a current crop of some one dozen students. Unlike the United States, the curriculum is divided into a series of lectures by experts in various other departments, supplemented by lecturers from Rasbash and his staff. This is in contrast to separate courses in various areas. Clarke gave a talk on the NEL research program, with which the Edinburgh students seemed very familiar. Of particular note is their use of Ben Buchbinder's decision analysis approach to upholstered furniture as a model for decision-making in fire protection.

In June, **Richard G. Bright** of CFR visited the Fire Research Station (FRS) and the Fire Insurers' Research and Testing Organization (FIRTO), Borehamwood. Major projects underway at FRS at the present time are the development of a repeatable smoldering test fire for smoke detectors and the ongoing ambient condition monitoring experiments. Researchers there do not believe the present smoldering test is realistic in that the hot plate used to pyrolyze wood products imparts a much higher velocity to the smoke than would be the case in a true smoldering fire. At present, FRS is experimenting with various configurations of hardwood sawdust in attempts to develop repeatable smoke buildup curves. Bright witnessed one such test which took in excess of three hours to perform. Instrumentation for these tests include photometric smoke density light beams, optical and ionization-type smoke detectors (the latter with analog output), a Taguchi gas sensor (Model 812), a Royco 225 particle counter, and CO using Draeger tubes (grab samples). The hardwood sawdust smoke produces relatively heavy deposits of a brown-colored material, which would indicate a large concentration of condensates in the smoke, probably various types of unburnt hydrocarbons. This opinion was bolstered by the performance the Taguchi gas sensor, which sounded relatively early in the test, just after the optical smoke detectors but before the ionization smoke detectors, even though the Taguchi was located only three feet from the floor.

In September, **John G. O'Neill** of CFR visited FIRTO and met with Mr. Roger Pickard, Head of the Laboratory, and Mr. Roy Young, Head of Fire Protection Systems Testing. The purpose of the visit was to tour the spray measurement test facilities of FIRTO. Discussions included the importance of various facility construction components for the proper measurement of spray distribution, including controls over openings into the area. Also discussed with both Mr. Pickard and Mr. Young was a project involving fire suppression technology for off-shore oil and gas platform blowout fires. FIRTO has not conducted extensive research into these hazards but has conducted tests (under the Fire Research Station) concerning spill fires involving failed gaskets and joints on oil gas platforms to evaluate the performance of foaming and aqueous film-forming solutions for fire suppressions.

While at Borehamwood, Mr. O'Neill met with two members of the Fire Research Station concerning their experimental work in fires involving health care facilities. Mrs. Rogowski discussed the results of a series full-scale fire tests involving patient cubicles. The

purpose of the work was to develop peformance criteria for dividers between individual cubicles.

Mr. O'Neill also went to the Fire Research Station at Borehamwood and conferred with C.R. Theobold, project leader for studies in fire extinguishing agents. Current research is studying how the internal profile of a nozzle affects the characteristics of the emergent jet of water. The resultant jet from conventional nozzles is rough in appearance due to the disruption of the surface by turbulence associated with the design of the nozzles.

This results in the production of spray droplets so that much of the discharge fails to reach the target. Prototype nozzles with differing internal profiles are being studied and models have been developed that improve the performance by placing up to 34 percent more of the total water discharge at the target than with conventional nozzles. Essentially, the jet from the prototype nozzle does not tend to break up as much as conventional nozzles. This enables a higher concentration of large droplets to reach the base of fire plume.

Jets from the various nozzle designs are being studied by a photographic technique in which the film is moved at the same speed as the image. This technique, developed for this project, provided detailed photographs with high resolution using relatively simple equipment. Variations of velocity across each jet are being measured with a clever arrangement using a hypodermic needle as a pilot tube.

A second project concerns the development of small-scale tests of foaming agents. The purpose of this project is to determine if equivalent ranking orders can be achieved in terms of performance between the small-pan fire experiments and the large-scale spill fire tests. So far, fairly good correlation has been achieved in ranking orders. Small-scale tests may be very useful in testing foaming agents that have been in storage.

Mr. Theobold also discussed the results of a recent project that assessed the qualitative behavior of 38 fires in industrial buildings. A quantitative analysis was made of numerical data from 8 of these fires and they were compared with results of experimental fires. Detailed on-site surveys were made and burning rates and fire duration were recorded. Promising results have been achieved in comparing the actual fire cases in terms of rate of burning vs. bulk density of fuel and known fire-test fuels such as wood (cribs) and kerosine pools.

In April, **William C. Cullen,** Deputy Director of the Office of Engineering Standards, visited the Director of Research and Development of Ruberiod Building Products Ltd., London, to discuss the proposed merger of the British Standards Institute with Great Britain's Agreement Board and to review research and testing of moisture isolating materials.

In September, **Charles B. Phucas** of OES visited the Hemel Hempstead offices of Technical Help to Exporters (THE). The purpose of the visit was to learn more about the THE program, with particular emphasis on their information gathering and dissemination practices since our Standards Information Service will be expanded as the result of the Trade Agreements Act of 1979 and will be the focal point for the U.S. in responding to information requests on standards and certification.

THE is one of three Divisions of the British Standards Institute (BSI). BSI is like a holding corporation with divisions for Standards Writing, Certification and Testing, and Technical Help to Exporters, each managed by a Director. Mr. John E. Ware is the Director and Mr. Brian D. Roden is the Group Manager of THE. The staff consists of approximately seventy people: engineers, technical information specialists, and support staff. THE is broken down into eight Sections: Administrative, Library and Information (which includes-Translations, Division Enquiry, and ISONET Liaison), Publications, General Office, Enquiry and Assessment, Engineering and Consulting Park Street Library, and Projects and Development.

There are 1200 United Kingdom members of THE and approximately 70 U.S. members. The initial membership fee is $40 and about $150 annually thereafter. For standards and services there is an additional fee charged. The benefit of membership is that you receive a 20 percent discount in the cost of publications, technical research, specialized services and technical translations. Benefits also include immediate use of the enquiry services (many queries are answered free of charge to members), "Technical Export News" (a quarterly

publication mailed free to members containing topical features and news of developments on the international scene), and a free publications catalogue distributed twice a year.

At the present time THE has no economic data to show a cost-benefit ratio. However, they say that some time in the future they may develop this information. The total budget of THE is two million dollars per year, with twenty-five percent of that from BSI. THE supports itself by selling standards and by selling its consultant services on a contract basis, which includes an engineer going into the exporter's or potential exporter's plant and examining the product to be exported and telling the exporter what he must do to the product to have it accepted into the importing country. This of course is after the engineer has read and analyzed the particular regulations (standard) of the importing country. As a matter of fact THE guarantees to the manufacturers that the product will be accepted into the importing country if the exporter does comply with what the THE engineer specifies.

INTERNATIONAL ORGANIZATIONS AND CONFERENCES

CIB

The Counseil International du Batiment pour la Recherche l'Etude et la Documentation (CIB) was established in 1953 in response to recommendations made by the United Nations Economic Commission for Europe. CIB's major objective is to encourage and stimulate international cooperation in the gathering, refinement, and dissemination of building research information. These mutual exchanges ease the development and adoption of building standards, which in turn provide for the sharing of building research and interchangeabiltity of products on the international level. Fifty countries are currently members of CIB and send delegates from building-oriented organizations to participate in various CIB activities.

In March, CBT's **James G. Gross** met with the Managing Director of CIB, J.R.J. Janssens, to discuss more effective cooperation between CBT and the CIB. In an all-day meeting, the activities of 27 Working Groups and 5 Standing Committees were reviewed. Particular attention was given to W24, Dimensional and Modular Coordination; W55, Building Economics; W60, Performance Concept in Buildings; and W70, Maintenance and Modernization, as the scope of each of these directly relates to the work of the Building Economics and Regulatory Technology Division. The possibility of a new Working Group on Solar Technology was discussed.

In June, **Preston E. McNall** participated in the Copenhagen meetings of CIB W67 (Energy Conservation in the Built Environment) and at the same time attended the Second International CIB Symposium on Energy Conservation in the Building Environment.

In September, **Simone Y. Yaniv** of CBT attended the Athens meetings of Commission W51 (Building Acoustics). There, the majority of attendees felt that present noise isolation criteria for dwellings are inadequate since complaints continue to occur in dwellings that meet present requirements. Social surveys conducted in several countries (France, Belgium, Germany, Denmark, and Poland) indicate that a large segment of the population is dissatisfied with interior acoustical environments.

Daniel Gross of CFR attended the September CIB Symposium on "Systems Approach to Fire Safety in Buildings" and presented an invited paper on Fire Safety in Health Care Facilities. The meetings were held at the Building Research Institute, Tsukuoa, Japan. At the symposium, there were 12 invited talks plus 20 free contributions covering the four session topics (Conception and Objectives; Evaluation and Planning; Active Systems; and Passive Systems). There were 21 attendees from outside Japan plus 100 Japanese attendees. During the introductory and concluding remarks, it was noted that the yearly direct and indirect costs of

fire (approximately 1000 Billion Yen) were estimated to be about equal to the entire cost of Tsukuba Science City.

In October, **Lawrence S. Galowin** of CBT attended the meeting of CIB W62 (Water Supply and Drainage for Buildings). The rehabilitation and modernization of buildings in European countries was discussed as an extension of establishing inter-relationships with CIB W70 on Maintenance and Modernization. In France special systems allowable for renovation are not permitted under new building codes, e.g., the macerator adapter on water closets with pressurized small-pipe waste lines. Sweden has a new rehabilitation code. Denmark is discussing a code with various levels of quality; a primary concern is the economic impact. Germany has no differences between its rehabilitation and new-building codes.

The impact of lowered water flow discharge is evident in research on-going at several facilities. There is now a consensus that the significant problems are those of making the assembled system function and not only the water fixture. Outstanding investigations at Brunel University in the U.K. in long horizontal drains for solids transport show consistency in data correlation with the slope (gradient of horizontal drain) parameter L/g. The interaction effects of branches and stacks are the next-identified research needs. In Denmark new low-water-usage demonstrations, derived from laboratory work, require 5-percent slopes, which is very difficult in building drains and external connecting lines since the vertical depth for accommodating the slope of the piping is very great (2 percent has been an accepted higher value). The U.K. tests have not shown any statistical correlation between slopes and blockage. Inadequacy of conventional instrumentation is often noted for blocking and drainage studies; the BRE station in U.K. has a van with TV probes to insert in piping to evaluate reported blockage.

A multinational research project of several years has shown significant accomplishments in developing hydraulic data. This year the combined tub, basin, branch flow were reported upon. Trap seal failure is always accompained by noise of trap "gurgle." These data are being used to provide common practices in the cooperating five nations: France, Germany, Switzerland, Belgium, and Sweden.

Combustion Institute Meetings

The Spring technical meeting of the Canadian section of the Institute was held at Queen's University, Kingston, Ontario, in May. **Richard G. Gann** of CFR attended and presented a paper, "The Rate of Heat Release Measurements Using Oxygen Consumption." Among the other papers, Ron Braaten of the Canadian Department of Energy, Mines and Resources presented a survey of wood stove design and efficiency. The approach was pragmatic, but served to establish the fact that art, rather than science, still dominates design. This means that we can expect a continuous flow of new stove models, each with its own style of fire hazards. By contrast, Terry Adams of the University of British Columbia presented a model for predicting particulate emissions from a wood waste boiler. He included detailed flow and energy considerations as well as a crude combustion model for wood particles.

Congress of the International Institute of Refrigeration

The fifteenth International Congress on Refrigeration was a joint meeting of all the International Institute of Refrigeration (IIR) Commissions, held in Venice in September. **David E. Daney** of CMEPT presented the paper "Cool Down of Cryogenic Power Transmission Lines," which was co-authored with scientists at the Krzhizhanov Power Engineering Institute and was, in part, the product of a three-week working visit to Moscow in September 1978. That visit was associated with NEL work on cooling superconducting power transmission lines and was sponsored by DoE as part of the 1974 US-USSR Agreement on Cooperation in the Field of Energy.

Frank J. Powell of OEP is an official U.S. member of Commission B-1 (Thermodynamics and Transport Properties) of IIR. Commission B-1 presented its program in 6 sessions with a total of 92 papers. The most popular themes were combined heat and mass transfer, calculation of thermodynamic properties, condensation, energy-saving in refrigerating engineering, heat and vapor transfer in insulation, and insulating systems and measuring techniques. A new president of Commission B-1 was appointed, Professor J.D.F. Bougard, Belgium, replacing Professor Glass of Germany. Powell was nominated to be vice president.

Paul R. Achenbach of CBT took part in the sessions on air conditioning, heat pumps, heat and vapor transfer in insulation, and refrigerated land transport. And Lloyd A. Weber of CMEPT delivered a paper on specific heat measurements in nitrogen.

R. Radebaugh of CMEPT presented two papers: "Analysis of Regenerator Inefficiency for Stirling-Cycle Refrigerators with Plastic Displacers" and "A Standards Program for AC Losses in Superconductors". The second paper included **G. Fujii, D.T. Read,** and **A.F. Clark** as coauthors. In addition, Radebaugh read a paper, "Cold Utilization from Liquefied Natural Gas (LNG)," by **T.M. Flynn** of CMEPT and K.D.Timmerhaus.

Coordinating Committee on Export Controls

As a member of the Semiconductor Advisory Committee to DoC, and also of the Interagency Technical Task Group responsible for establishing the technical content of the U.S. export proposals, **Robert I. Scace** of CEEE was asked by the Departments of State and Commerce to be one of the technical advisors to the negotiating team on COCOM. The meetings were held in Paris in November 1978 and June 1979, and completed work on the following items for a commodity control list:

Semiconductor manufacturing and test equipment
Semiconductor diodes
Transistors
Thyristors
Photosensitive semiconductor devices
Integrated circuits
Surface acoustic wave devices
Certain ferrites and garnets
Semiconductor materials

DIN Semiconductor Materials Standards Meeting

The DIN FNM 221 technical committee on semiconductor materials testing was held in Hamburg, West Germany, in September. **Robert I. Scace** of CEEE's Electron Devices Division participated. Deliberations included work on definitions relating to semiconductor process technology and revisions to standards documents. A new subcommittee was formed to deal with process chemicals for this industry, with the expected chairman to be Dr. N. Harder from E. Merck. One of the main topics of concern will be the determination of particulate contamination in such fluids.

Several NEL staff members are involved in the work of ASTM F-1 on test methods for silicon, and the work of DIN 221 is of value to them in that activity. The close coordination between the DIN and ASTM work has made possible the creation of test methods which, while different in language and format, have the same technical approach and similar precision. Published methods from both bodies explicitly acknowledge this identity of approach. ASTM and DIN standards are applied to silicon regardless of where it is made.

Electrical and Electronic Measurement and Test Instrument Conference

This biennial conference, held last year in Ottawa, was sponsored jointly by the Ottawa Section of the Institute of Electrical and Electronics Engineers, the Instrumentation and Measurement Society of the IEEE, and the Canadian Commission of the International Radio Scientific Union. This conference focused on the use of microprocessors in instrumentation. About 500 people registered, which exceeded the expectations of the sponsors.

Donald R. Flach and **Howard K. Schoenwetter** of CEEE presented the paper "An Automated Test Set for High Resolution A/D and D/A Converters." A copy of the paper was given to Eddy So, a research engineer at NRC; he was also interested in the NEL-constructed 20-bit digital-to-analog converter, and integral part of the automated test set, as was another member of NRC. Mr. So arranged a visit to the Power Engineering Section of NRC. Much of their work, such as an ac impedance bridge, is based on current comparators.

Two of the technical papers presented at the conference were of particular interest. One was titled "Microprocessors in Biomedical Instrumentation," by P. Forgues and M. Goldberg, which described the use of two Motorola 6800 microprocessors in parallel to increase processing speed. On the project under discussion, they needed to take in 256 samples in 5 milliseconds. By using one to take data while the other one was processing data and resetting for the next set of 256 samples, they were able to accomplish this. A scheme of this nature could have an application in NEL, where a large number of data points need to be taken. The second paper described a technique where the IEEE-488 bus lines were interrupted and the attention line set high. This was described as being "easy" to do.

European Conference on Optical Communications

In September, **Gordon W. Day** of CEEE presented a paper to this conference, held in Amsterdam. In combination with the biennial International Conference on Integrated Optics and Optical Communication, this meeting was very large (950 attendees) and drew participants from almost all parts of the world, including one paper from the People's Republic of China. There were no dramatic breakthroughs reported, but several important trends are emerging and gaining strength:

- A sizable fraction of the fiber technology papers concerned single-mode fibers designed to operate in the long wavelength region near 1.3 μm or 1.55 μm.
- Essentially all of the source and detector papers were concerned with 1.3 or 1.55 μm devices.
- There seems to be a consensus that graded-index fiber will not reach the high bandwidths predicted because of severe tolerances on the index profile that must be established and maintained.
- Greater appreciation of the concept of "modal noise" in graded-index fibers leads to the conclusion that lasers with the highest degree of coherence are inferior in this application to multimode lasers. High-coherence lasers will still be important for single-mode fibers, however.

Gastech '78: The International LNG/LPG Conference

Dwain E. Diller of CMEPT presented an invited paper on LNG thermophysical properties data and custody transfer measurement research, to this, the sixth conference in this series. The sessions were held in Monte Carlo in November 1978.

The conference was attended by about 1300 people, mostly top executives, other managers, and project engineers from industry. Over 50 countries were represented. There were over 120 exhibitors, mostly from the cryogenics, shipping, construction, gas processing, and instrumentation industries.

One of the most interesting non-technical talks was the presentation on "The Puzzle of U.S. LNG Import Policy, or the Lack of One" by W.R. Connole, of Connole and O'Connell, Washington, D.C. He said: "There is no official U.S. policy and will likely not be any. However, on the positive side, volumetric limitations on importing LNG have been removed"; he expects that "no unreasonable safety sandards will be imposed; and that there will be no great concern with the possibility of foreign embargo. On the negative side, there is no gas shortage at the moment. US importing projects will continue to be decided on a case-by-case basis. And LNG would be imported only as a last resort and as a result of demonstrated need." The bottom line is cautious optimism. Another speaker, who had spent some years trying to forecast world LNG trade, said that the estimated uncertainty in the US forecast up to 1990 is about 300%.

Interface Symposium on Computer Science and Statistics

The twelfth annual symposium in this series was held in May at the University of Waterloo, Canada. Seven staff members of CAM attended and presented papers to the sessions. **David Hogben** and **Sally T. Peavy** spoke on "OMNITAB 78 Plotting Capability," and aroused a great deal of interest in the system due to the ease of obtaining graphs, both on the on-line printer and CALCOMP plotter. **James J. Filliben** presented "Factors Affecting the Use of Statistical Graphical Software." Others attending were **Ginger A. Caldwell, Janet R. Donaldson. Peter V. Tryon, Dominic F. Vecchia.**

Interflam '79: International Conference on Flammability

In March, **Merritt M. Birky** of CFR attended this conference, held in Guildford, England. He presented a paper on his fire fatality work and conferred with researchers working along similar lines. For example, the British Fire Research Station (Borehamwood) is studying the sublethal exposure of primates to smoke. The animal is strapped into a chair and exposed with a face mask. As a result of this type of exposure, no behavioral effects are obtained. Birky met with Dr. Purser, who is doing the physiological monitoring of the animals, including respiratory rate, EKG, blood chemistry, and EEG measurements. Measurement of cortical evoked response and periphiral nerve conduction velocity have been stopped. They have looked at the effects of polyacrylonitrile (PAN), polyurethane, and wood decomposition products. They are unable to explain the effects of PAN products. The effects appear to be anesthetic in nature, i.e., the animal wants to go to sleep. Of the materials studied so far, this seems to be the only one with surprises. However, another surprise was the finding that exposure to combustion products that include irritants, such as wood, polyurethane, and polyacrylonitrile, result in an increase in respiratory rate rather than a decrease. This runs counter to the results obtained by Alarie and Utah.

Intergovernmental Maritime Consultative Organization

In November 1978 and July 1979, **A.F. Robertson** of CFR traveled to London to participate as a member of the U.S. delegation and as technical advisor on fire test methods to two meetings of the IMCO Subcommittee on Fire Protection. Among other matters, it was noted that the previous draft test procedure for free-hanging slow-burning textiles had been used by, and data reported from, seven countries. The results of this study were analyzed, performance criteria were identified for acceptable fabrics, and some revisions to the test procedure were proposed. Final work in preparing the test method was agreed. Its adoption will be proposed at the next meeting of the Subcommittee.

The recent work done at NBS on the spread of flame test was reported. Norway is in process of constructing equipment of this type and interlaboratory studies are planned when this is completed. Norway reported results on work involving a modification of the NEL smoke-test method for specimens in a horizontal position. Work continues on this modification. Sweden reported a study of differences between ISO and IMCO tests for noncombustible materials. This report proposed certain revisions to the IMCO test procedure. The recommendations were accepted and will be used as the basis of a new interlaboratory study.

International Commission on Illumination

In November 1978, **Joseph C. Richmond** of CMEPT traveled to Paris to attend a meeting of Technical Committee 1.1, called to prepare a fourth edition of the International Lighting Vocabulary. The terms in the third Edition of the Vocabulary (1970) are in twelve sections, which indicate to some extent the scope of the work. They are: Radiation; Photometry, Quantities and Units; Colorimetry, Fundamental Concepts and Quantities; Optical Properties of Matters; Eye and Vision, Color Rendering; Radiometric, Photometric, and Colorimetric Measurements, Physical Receptors; The Production of Light; Lamps; Components of Lamps and Auxiliary Apparatus; Illumination, General; Lighting Fittings and their Components; Lighting for Traffic and Safety.

Since there has been much progress in radiometry and photometry since 1970, it was felt the time was ripe for a revised and enlarged edition. As a rough estimate, the new edition will include some 1500 to 2500 terms, and several new sections will be added, which may include Mine Lighting, Sports Lighting, and Terms Related to Photobiology, Photochemistry, and Phototherapy.

In August 1979, the Nineteenth Quadrennial Session of the Commission was held in Kyoto, Japan. Joseph C. Richmond of CMEPT and **Gary Yonemura** of CBT attended for NBL.

International Conference on Acoustic Emission and Materials Evaluation

Nelson H. Hsu of CMEPT attended and presented a paper to this conference, held in London in April. The conference was organized by the Institute of Acoustics with the support of the British Acoustic Emission Working Group. The Conference organizer was Professor R.B.W. Stephens. Approximately 50 people from Denmark, Canada, Germany, France, Italy, Japan, England, and the United States attended a total of 20 lectures in 5 sessions. Although no significant breakthrough was reported, the general acoustic emission research activity, both in terms of practical application and laboratory materials research, is growing. The following are leading indications. Acoustic emission applied to new materials: ferroelectric and ferroelastic crystals (University of Bath), woven composites (Georgia Tech), and frost-damaged concrete (Technical University of Denmark).

Acoustic emission applied to new structures: offshore oil drilling platforms, and Danish salt domes as gas storage structures (Technical University of Denmark). New commercial equipment manufacturer: B&K, the world-renowned acoustic instrument manufacturer exhibited, for the first time, their AE Pulse Analyzer and sensors at the Conference. The Analyzer, a result of three years' intensive research, has many unique features and is capable of both single-channel pulse energy analysis and four-channel time-difference detection for source location. Their broadband sensor has a patented design of incorporating the preamplifier inside the sensor housing. No price or delivery date has been set yet.

International Conference on the Metrology and Properties of Engineering Surfaces

In April, **Theodore V. Vorburger** of CMEPT attended this conference and presented the paper "Measurements of Stylus Radii," coauthored by E. Clayton Teague, F.E. Scire, and F.E. Rosberry. The most important developments presented at the conference were in the application of stylus techniques to engineering problems rather than in the development of new techniques or methods of analysis. Some of the important applications were in the measurement of highway roughness, in the problem of automobile braking, surface contact, and gas flow through cracks.

International Conference on Noise Control Engineering

In September, **Simone L. Yaniv** of CBT attended this conference, the eighth of a series, held in Warsaw. Among the more than fifty papers presented were the following:

- An Experimental Study on the Relation Between Long-Term Annoyance and Instantaneous Judgment of Level-Fluctuating Sounds, by Namba and Kuwano, Japan.
- Low-Frequency Traffic Noise and Building Vibration, by Martin, England.
- Active Attenuation of Noise: Dipole and Monopole Systems, by Leventhall and Eghtesadi, England.
- Propagation of Vibrations and Noise from New York Subway Tunnels into Nearby Buildings, by Ungar, Wittig, and Paolillo, U.S.A.
- Computer Systems for Noise Control Engineering, by Lang and Maling, U.S.A.
- Measurement of Long-Distance Noise Propagation Over Ground, by Konishi and Aoki, Japan.
- Instrumentation and Procedures in the Measurement and Statistical Analysis of Attitudinal Response of People to Audible Noise from High-Voltage Transmission Lines, by Foreman, Canada.

International Conference on the Physics of Pure Semiconductors

This conference, held in Stockholm in September, dealt with chemical defects and impurities at low concentrations in semiconductor materials, lattice defects induced by both chemical defects and impurities, crystal growing and device preparation processes, and analytical techniques for the study of materials properties.

Santos Mayo of CEEE was invited to represent NEL. Subjects such as hydrogen, carbon, and oxygen impurities in silicon and the formation of complex precipitates were discussed, the goal being impurity identification and control. H.G. Grimmeiss, in an introductory talk, reviewed the field of both shallow- and deep-level impurities, emphasizing the lack of general theory to explain the complex nature of impurity centers in semiconductor materials. Ample reference was made to the so-called x-level in indium-doped silicon.

E. Sirtl reviewed the field of crystal growth and uniform doping in silicon, including economical considerations to limit silicon wafer size to 4- or 5-inch diameters. There is no great advantage in yield and there is a tremendous cost increase when this size limit is pushed up. The origin of hydrogen, carbon, and oxygen in silicon was traced to silicon preparation and purification from raw quartz sand; complete elimination of carbon is therefore very difficult and expensive even in vacuum float-zone refined silicon where the impurity level can be as low as one atom in 10^{10}. The origin of iron impurity was mentioned as an example of unknown ionic contamination in silicon requiring more sensitive analytical techniques. The present iron detection limit is 10^{14} atoms/cm^3, by neutron activation analysis.

J. Schneider reviewed EPR studies of defects and defect-interactions in semiconductors with emphasis on donor-acceptor pairs in silicon, deep-level impurities in general, and the ^{115}In-^{57}Fe interaction in silicon as a possible interpretation of the x-level. Discussions were held on energy changes of deep levels due to environmental changes in the matrix, lattice stress and distortion, and local non-uniform doping leading to an artificial x-level.

The Conference was effective in stimulating informal discussions and contacts, and the reaction of the participants was sufficiently enthusiastic that plans were tentatively developed to hold future meetings at three-year intervals.

International Conference on Special Equipment for the Police

The Chief of the Law Enforcement Standards Laboratory (LESL), **Lawrence K. Eliason**, went to Canberra, Australia, in October to address this, the fourth such conference in this series. He presented an overview of the LESL and discussed the results of the Equipment Testing Program. About half of those in attendence were familiar with LESL. He also chaired the second session of the conference, which was devoted to papers that described advanced equipment development in the United Kingdom, Australia, and West Germany.

International Cryogenic Engineering Conference

In September, **David E. Daney** of CMEPT met in Genoa with members of the International Cryogenic Engineering Committee, the governing organization of the International Cryogenic Engineering Conference (ICEC), which is held biannually. Discussion of preparations for the next meeting, which will be held in Genoa in June 1980, was the major business conducted. A proposal by B.W. Birmingham to hold in the 1982 meeting in Japan in conjunction with the Cryogenic Materials Conference met with general approval.

International Electrotechnical Commission

In May, **Victor Nedzelnitsky** of CMEPT was a delegate to the Stockholm meeting of the International Electrotechnical Commission (IEC), Technical Committee 29 (Electroacoustics)/Subcommittee 29C (Measuring Devices)/WG-2 (Free-field Calibration of One-Inch Standard Microphones) and WG-12 (Half-Inch Standard Microphones). He also took part in the interlaboratory comparison calibrations and technical discussions (especially with the Japanese) necessary to development of new and updated technical standards for microphone calibration. Other topics of interest to his NEL work were electroacoustic testing of hearing aids, acoustic simulators of the ear for calibration and testing of insert and circumaural earphones, and acoustic simulators used in the calibration, evaluation, and testing of hearing aids and industrial noise dosimeters.

The recent work of WG-2 in comparing and evaluating data from various laboratories for the differences between free-field and pressure sensitivity levels for "one-inch" standard condenser microphones has culminated in IEC Publication 655, Correction for Free-Field Response of Microphones (1979). This publication tabulates the values of these differences at normal and grazing free-field incidences for each of several "one-inch" laboratory microphones in widespread use, including some very popular types manufactured in Denmark and used in the U.S. It offers an excellent example of how collaboration among the various national standards laboratories can, at minimal cost to each member nation, provide a relatively large data base from which a reliable document of great practical value results.

The Stockholm session was the first official meeting of WG-12; consequently, it considered the nature of the documents to be prepared. It appears that issuing two supplements to the Publications 327 and 486, dealing with pressure and free-field calibration, respectively, of one-inch microphones, will provide the most rapid and economical means of defining and documentating calibration procedures for the half-inch microphones. Various couplers, including a Japanese standard and a Danish manufacturer's proposal, and adaptors for pressure calibration of half-inch microphones, were presented to the members.

Raymond S. Turgel of CEEE attended the Sofia, Bulgaria, meeting of IEC subcommittee 13B (Electrical Measuring Instruments) in November 1978. The meeting was attended by 28 delegates from 14 countries and two observers from OIML and from IMEKO. Under discussion was the draft document concerned with the revision of IEC Publication 51. While this publication nominally deals with direct-acting indicating meters, its significance goes beyond the immediate subject, because it has traditionally contained the philosophy of accuracy determination used by SC13B for other standards.

In November 1978, **Ramon L. Jesch** of CEEE was a delegate to the IEC meetings held in London, regarding working group 4 of Subcommittee 46D (Connectors for RF Cables). The meeting was called to agree on the general framework of generic, sectional and detail specification documents, document numbering, and quality assurance arrangements for coaxial connectors. Jesch had earlier attended the Subcommittee 46D meetings held in Ottawa.

In September, **Gordon W. Day** of CEEE attended a meeting of Joint Working Group "O" of IEC and the International Telegraph and Telephone Consultative Committee, held in Amsterdam. This group was established to develop a common glossary of terms and definitions related to optical communications for the use in developing standards.

In September, **Robert J. Klein** of CCPT served as the secretary for several IEC meetings held in Ottawa. The sessions covered Technical Committee 46 (Cables, Wires and Waveguides for Telecommunication Equipment), Subcommittee 46B (Waveguides and their Accessories), Subcommittee 46C (L.F. Cables and Wires), and Subcommittee 46E (Fiber Optics).

Such work is necessary, according to Klein, because of the critical role of communications among police departments. Unfortunately, the intelligence carried by radio or wire transmission paths is vulnerable to ingression by unauthorized persons. Coaxial and metal cables present other problems such as weight, bulk, cost, and frequency-carrier limitations. To considerably reduce the problems and yet increase the information-handling capacity of the frequency carrier, fiber optic networks should be considered by police departments when installing new systems.

International Ergonomics Association

The seventh Congress of this association was held in Warsaw in August. **John V. Fechter** of CCPT attended. Generally, much attention at the conference was focused on problems of worker environments (pollution, lighting, noise) and safety. Ironically, some sessions were devoted to papers describing how tasks had been changed to reduce worker exertion and skill/mental requirements yet other sessions were entirely devoted to ergonomics problems arising from jobs that required too little exertion or promoted little worker interest due to very low skill/mental requirements.

More than one session ended on the note that optimization of jobs must consider the short-term problems of errors, lighting, accidents, overexertion -- and also consider long-term issues of boredom, general body health, and longevity associated with the other 16-hours per day workers are not at their primary job.

International Fire, Security, and Safety Conference

In April, **John S. Stroik** of CBT attended three conference sessions, in London, on security and one on special-risk protection. One of the talks, "Crime Prevention in the 80's" by J.C. Alderson, Chief Constable of Devon and Cornwall, reviewed some recent studies in Great Britain and made suggestions for the future. Although crime rates in Great Britain are lower than the U.S.A., they have been increasing similarly with interesting parallels in victimization and criminality. Rates of property crime have increased almost everywhere in the free world with the rise of material affluence and a diminishing cultural authoritarianism (the only exceptions are Switzerland, Israel, and Japan, all of which are thought to have unique authoritarian societies and traditions). Changes in the area of private morality have resulted in a climate of personal amorality for many situations that would be considered immoral or illegal in public. The tremendous increase in the so-called "white collar" crimes was cited as an example.

Other talks described the state of the art for detection equipment selection, design, and installation; and management planning for special-risk protection. The problems of false alarms due to inadequate installation guidelines and standards are similar to those in the U.S. A systematic theory base for security was not evident in the papers presented.

International Institution for Production Engineering Research

Robert J. Hocken of CMEPT's Mechanical Processes Division took part in the 29th General Assembly of the International Institution for Production Engineering Research (CIRP) in Davos, Switzerland in August. At the sessions he was awarded the F.W. Taylor Medal for his research work on 3-D metrology; he also presented a paper on the use of lasers in dimensional metrology. Of the two keynote papers, the most useful was one by H.J. Renker entitled "New Energy Sources and their Influence on Automotive Engine Manufacture". Dr. Renker had developed a scale on which to rate the types of proposed power plants in terms of efficiency, energy storage density, power-to-weight ratio, and other factors. The conclusion, that there is no really acceptable current or promising future substitute for the internal combustion gasoline engine, was almost preordained.

Other papers of interest included: a paper by P.H.J. Schellekins, University of Eindhoven, which reported results very similar to Hocken's on lasers, a paper by A. Ono on an accurate laser positioning system using a laser to position parts for micro-spot laser welding; and a paper by R. Schultschik on the accuracy of machine tools under load.

International Organization of Legal Metrology

The U.S. Senate, on August 11, 1972, approved this country's membership in the International Organization of Legal Metrology (OIML). At the same time, the National Bureau of Standards was assigned responsibility for the development of U.S. positions for technical matters arising in OIML.

Raymond S. Turgel of CEEE was the OIML representative at the November 1978 meeting of IEC Subcommittee 13B held in Sofia, Bulgaria. **G.E. Mattingly** of CMEPT attended the October 1978 meetings held in Kyoto, Japan. The discussions there concentrated on the technical problems of water metering. Mattingly also had the opportunity to present the NEL water measurement activities to an international audience.

International Seminar on Heat and Mass Transfer in Metallurgical Systems

Kenneth G. Kreider of CMEPT presented a paper on the use of infrared thermography in industrial heat-balance calculations (co-authored by Thomas Sheahen) at this conference held in Dubrovnik, Yugoslavia, during September 1979.

The computer modelling of the Blast Furnace is advancing in U.K., U.S., U.S.S.R., Japan, and Italy. Julien Szelely's fundamentals are widely recognized but some of the Japanese work looks more complete. Although there is little data on the core temperatures and many treatments are two-dimensional, the behavior of the core region has been found to contrast sharply with the zone next to the walls. Dynamic response (hours) has been measured by Sumitoho as a function of ore/coke ratio, increased blast volume, oil injection, blast temperature, and blast moisture.

Kazachov gave the background talk on heat and mass solidification. No measurement problems are apparent and it was not clear what advances were made in the last 15-20 years. Measurements of kinetic and constitutional super cooling are probably not critical in ingots. Enthalpy of solidification of iron/steel alloys are known only ± 20 percent until they are measured in precision calorimeters, according to the Russians.

Perhaps the most interesting area relating to Thermal Processes Division work related to the heat treating and quenching of steel. The key papers in this session were given by Beck, Ecole de Mine, Nancy; Michotte, Louvain Catholic University; and Moreauz, also of Ecole de Mine, Nancy. They had experimentally determined optimal heat treating of metallic parts and although their work yielded very substantial benefits it seemed that the IR imaging technique might drastically simplify further work. The benefits are particularly important because of the strong need for minimizing energy and alloying ingredients combined with the recently developed technology of computer-controlled spray cooling. This technique permits one to avoid the "backward" quench you get in inversion caused by the delay from film boiling at high temperatures combined with the stress-induced rapid quench at low temperatures. The computer-controlled spray permits the reproducible production of many more high quality parts than previously possible.

International Solar Energy Society

In January 1978, **John P. Jenkins** of CBT went to New Delhi, India, to present a paper, "Testing of Water-Heating Solar Collectors According to ASHRAE Standard 93-77", and to visit and confer with delegates of the International Solar Energy Society (ISES).

The technical sessions covered solar heating and cooling, latent and sensible heat storage, flat-plate collectors, selective surfaces, and solar radiation measurement. During the course of the conference, a half-day visit was made to inspect the collector test facilities at the Indian National Physical Laboratories and to talk with Dr. V.G. Bhide concerning testing of flat-plate collectors. The opportunity also arose to discuss procedures and problems connected with solar collector performance with Dr. Jeff Symons of CSIRO, Dr. Wolfram Schwaigeren of Stuttgart University, and Dr. Eric Aranovitch of the European Communities Joint Research Center.

International Symposium on Cryogenic Wind Tunnels

In April, **Ben A. Younglove** of CMEPT presented a paper on the thermodynamic properties of nitrogen gas from sound velocity measurements at this meeting, held at Southampton University, England.

The general topics presented at the conference were wind tunnel instrumentation, magnetic levitation for wind tunnels, liquid and gas nitrogen properties, heat transfer, and aeroelasticity. Several wind tunnel projects were discussed. Kilgore of the National Transonics Facility (NTF) at NASA Langley gave a report of their effort on the new large 2.5 meter wind tunnel. The other tunnels, although impressive in their size and projected cost, were somewhat dwarfed by comparison to the NTF. The magnetic suspension work at MIT caused much interest. To date this is a laboratory study but there was talk about perhaps modifying one of the NTF tunnels to use magnetic suspension. The concept of building larger wind tunnels is not entirely an effort to reach larger Mach or Reynolds numbers; to a certain extent it is an effort to achieve data that is more reliable. The effects of viscous drag and vibration are very real and important to the wind tunnel designer. There is more concern about the reliability of test data from these effects than the nonexpert would ordinarily assume. The suspension of the model is a highly discussed subject because of its effects on test data.

Cryogenic tunnels will use cold nitrogen gas vaporized from liquid nitrogen brought to their sites on trucks. Most tunnels of modest size use about two truckloads per day; however, the large, 2.5-meter tunnel at Langley will use 15 truckloads per day. The cold gas nitrogen may be mixed with air before being injected into the tunnels. Considerable interest was shown in the thermodynamic properties of nitrogen. Most refer to Jacobson's report (NBS Technical Note 648) on nitrogen as the standard work on the substance. Albone of RAE reported on a simplified equation of state for nitrogen gas which he developed from TN648. The CMEPT work on nitrogen virials would achieve the same purpose and should be used in conjunction with TN648.

An interesting paper on an area related to wind tunnels was given by Professor Clausing of the University of Illinois on his work at high Reynolds and high Grashoff numbers for gas at low temperatures. Although related to wind tunnel work through high Reynolds numbers, it is directed towards "power-tower" work where very large amounts of solar energy will be extracted by large array reflectors that direct the energy toward a collector mounted on a tower. He intends to model the thermodynamic process occurring there using much lower pressures.

International Symposium on Energy Conservation in the Built Environment

CBT's **Stephen F. Weber** went to Denmark in May to present a paper at this, the second such conference, which was sponsored jointly by CIB, SOFUS-BYG (The Danish cooperative for research, development, and service in building), and the Danish Building Research Institute. Weber's paper, "Cost-effectiveness of Energy Conservation Investments in New U.S. Residences," was well received by the 200 participants from 21 countries. Another presentation involved the use of survey data on individual buildings to assess national energy policy in Sweden. The cost-effectiveness of retrofitting external walls of existing housing was estimated and it was recommended that the order in which buildings are insulated and the amount of added insulation be crucial factors in setting policy. Another paper was presented on the possible conflicts in energy conservation strategy between the macro and micro points of view. A simulation model was used to take into account the balance of payments and labor-market effects of energy conservation.

The second session was devoted to methods to Improve the Building Envelope and included 31 papers. One paper was on infra-red thermography to determine the measured heat loss from specific wall panels. The method involved the imposition of a grid on the wall and the reading of the wall surface temperatures at the interstices of the grid. These temperatures would then be integrated over the entire surface to result in a single-valued weighted index of heat loss. A paper from Norway discussed economic optimization of thermal insulation in buildings. The treatment of windows was analyzed in a number of papers in this session. Venetian blinds and roller blinds were found to be useful in reducing the nighttime U-value of windows; but generally blinds should remain open during the day to permit as much solar heat gain as possible. Eight different types of weatherstrip materials for windows and doors were evaluated in another paper. Tubular strips were found to have the greatest degree of airtightness, while angle strips performed not quite as well. Foam plastics and fiber strips allowed the greatest amount of air infiltration. The influence of window size, properties, and shading on annual heat consumption and indoor temperatures was studied in another paper.

International Symposium on High-Voltage Engineering

This, the third in a series of such symposia, was held in Milan in August. **Robert E. Hebner, Jr.** of CEEE presented a paper at the conference, which also included a panel discussion on the future of high-voltage research and technical sessions on electric-field calculation and measurement, electrical insulation, and instrumentation and measurement.

The common themes that all of the panelists touched upon were three. First, electric energy will be an increasing percentage of our primary energy sources. Second, transmission of electric energy is and will remain vital to link energy resources and load centers. Third, any environmental problems with energy transmission must be identified and solved.

Primarily because of public resistance, most nations are focusing on efficient and compact systems with no increase in transmission voltage level. Both the U.S. and U.S.S.R., however, do anticipate a significant increase in voltage level. J.J. Dougherty explained that higher voltages are necessary to reduce energy losses. The U.S. is reaching, or possibly has reached, the point at which the cost of losses at existing voltage levels exceeds the cost of a new, higher voltage, more efficient system.

The technical sessions on the calculation and measurement of electric fields made up about one-third of the conference. Most of the papers on field calculations were specific examples of calculations using one of the accepted techniques -- the finite element method, the charge simulation method, and the Monte Carlo method. The primary thrust of the discussion, however, was that the real problem is not the refinement of the method of calculation but the development of efficient, user-oriented techniques to assemble the data and to present the results of the calculation. The field measurement papers were interesting on two counts. First, foreign authors were aware of, and referenced, similar research and development at NEL. Second, there is, apparently, world-wide attention on the measurement of the electric field in the vicinity of high-voltage transmission lines.

International Symposium on Mathematical Programming

This, the tenth symposium in this series, was held in Montreal in August. Several staff members of CAM attended and presented papers. **Patsy B. Saunders** presented two papers, "A Methodology for Testing Mathematical Programming Software" and "Performance Indicators for Evaluating Math Programming Software," and was appointed a full member of the Committee on Algorithms (COAL). Several COAL meetings during the course of the symposium provided an opportunity to discuss future directions for research encouraged by COAL and to arrange informal interagency agreements to exchange algorithms and test results useful to future NEL efforts.

Douglas R. Shier presented an invited half-hour paper, "A Computational Study of Floyd's Algorithm," in a session dealing with network algorithms. In addition, he was a co-author of a contributed paper presented by **R.H.F. Jackson** and Patsy B. Saunders.

R.H.F. Jackson presented the paper "A Comparison of Real-World Linear Programs and Their Randomly Generated Analogs" and was appointed chairman of COAL for the next three years. Karla L. Hoffman presented the paper "Processing Time: An Accurate Measure of Code Performance?" and attended the COAL meetings in her role as Newsletter editor for the group. Also attending were **Saul I. Gass** and **Stephen J. Neupauer.**

International Symposium on the Performance Concept

In March, **James G. Gross** of CBT visited Rotterdam to participate in the planning of an international symposium on the performance concept, with particular application to building rehabilitation. This planned Symposium is the third such Symposium. The Symposia are cosponsored by the American Society for Testing and Materials (ASTM), International Council for Building Research Studies and Documentation (CIB), and International Union of Testing and Research Laboratories for Materials and Structures (RILEM).

In a full-day meeting, the planning committee developed the outline of the Third International Symposium on the Performance Concept for Buildings. The Symposium is being planned for the fall of 1981 in Grenoble, France. Three subtitles were agreed upon:

- Methods of Deriving Performance Requirements and Criteria,
- Method of Evaluating Performance Against Criteria, and
- Application of the Performance Concept of Rehabilitation.

ISO

The International Organization for Standardization (ISO) is composed of the national standards bodies of some eighty countries. The work of ISO is aimed at worldwide agreement on international standards for the purpose of expanding trade, improving quality, increasing productivity, and lowering costs.

An international standard is the result of agreement between the member bodies of ISO. A first important step toward the international standard takes the form of a draft proposal -- a document circulated for comment within the technical committee. But the draft must pass through several stages before it can be accepted as an International Standard. This procedure is designed to ensure that the final result is accepted by as many countries as possible.

In December 1978, **William C. Haight** of CMEPT represented the U.S. on behalf of ANSI at the initial working session of ISO TC28/SC3/WG1 (New Tank Calibration Methods for Petroleum Products, Static Measurement). The meetings were held at the Association Suisse de Normalisation headquarters in Zurich.

A total of eight papers was submitted for review. These were in the areas of electro-optical calibration methods using theodolites, lasers and optical plummets, triangulation methods, and photogrammetric methods. The technique developed at NEL by **Hocken** and Haight was submitted in the form of a paper titled "Multiple Redundancy in the Measurement of Large Structures". Three additional techniques submitted are of particular interest to NEL since they are applicable to liquified natural gas supertanker calibrations for international custody transfers. These were:

- "Jaugeage par Théodolite et Laser des Bacs Verticaux de Spherés" (France),
- "The Calibration of Cylindrical Storage Tanks by External Photogrammetry" (Israel), and
- "Tank Calibration by Internal Stereophotogrammetry" (Israel).

In May, **D.R. Flynn** of CMEPT went to Stockholm to attend, as the U.S. member, meetings of Working Group 9 (Noise Emitted by Machinery and Equipment) of Subcommittee 1 (Noise) of ISO Technical Committee 43 (Acoustics) and then to attend, as a member of the U.S. delegation, the plenary sessions on the same topics. At the meetings, considerable discussion arose over

the use of the term "surface sound pressure level" and the appropriate equation to correct for the influence of reflected sound in ISO 3746 and other sound power standards. A compromise wording was achieved; Flynn will undertake also to incorporate this wording in the corresponding American National Standards. It was pointed out that the allowable procedures for obtaining the environmental correction may give very different values for test rooms where the walls are highly sound absorptive.

G.E. Mattingly of CMEPT took part in the October 1978 meetings of Technical Committee 30, Subcommittee 7 discussions on water meters held in Kyoto, Japan.

Belinda L. Collins of CBT was a delegate to the October 1978 meeting of TC 80 held at the Hague. The purpose of the meeting was to make recommended changes and improvements to the draft international standard on Safety Colors and Safety Signs. Because this standard has been under consideration for several years now, it was hoped that agreement could be reached as a result of modification made during the meeting at The Hague. The standard consists of a main body containing the overall signage system, Annex A containing the colorimetric properties of the signs, and Annex B containing the symbols.

Charles T. Mahaffey of CBT participated in the July 1978 Geneva meeting of the divisional consultative council of ISO, the building standards management group. He returned to Geneva in December 1978 to participate in the Seventh Meeting of Technical Division 3 (Building/Construction) as an accredited representative of ANSI, the member body for the United States.

In January 1979, Mahaffey took part in further meetings to develop a program to eliminate building regulations as an obstacle to trade. This scheme is critically dependent on the development of an international program for the acceptance of performance data, developed by nationally accredited evaluation organizations, without requiring retesting in the importing country.

In October 1978, **Merritt M. Birky** and **A.F. Robertson** of CFR attended the Paris meetings of Technical Committee 92, Working Group 12 (Toxic Hazards in Fires).

John G. O'Neill of CFR attended the London meetings of Technical Committee 21, Subcommittee 5, held in November 1978. Working Group 2 is currently working on the development of a draft installation standard for fixed CO_2 systems for both local application and total flooding systems. O'Neill was appointed to the editing committee on behalf of the U.S. delegation. The discussion during this meeting primarily addressed technical details in the design criteria of the standard, including: requirements for CO_2 supply based on room size, the hazard involved, and openings to the outside of the protected area; and size of piping and nozzles for simple designs and calculation methods for individually designed systems.

By contrast, Working Group 1 has taken a different avenue in terms of standards development from that of WG2 and is concentrating on development of product standards for components of automatic sprinklers and other types of water suppression systems. O'Neill also served on the editing committee of WG1 for this meeting. During this meeting the WG1 achieved a significant milestone by completing the draft product standard for automatic sprinklers. Before final resolution was reached there was extensive discussion on two items in particular, the test for stress corrosion cracking and the fire test.

In November 1978, **A.F. Robertson** of CFR participated in the Geneva organizational meeting of the new Coordinating Committee on Fire Tests (within ISO). The fire-test agreements reached at the meeting could have considerable significance for fire research and standards development in U.S.A.

Daniel Gross of CFR traveled to The Hague in February to participate in several working group meetings of TC 92. At the meeting of Working Group 3 (Fire Performance of Doors, Shutters and Glazed Elements), the principal items of discussion were the draft Proposal for Smoke Control Doors (Ambient, Medium and High Temperatures), the preparation of a Technical Report on the use of fire doors, and consideration of the definition of integrity failure. The ambient temperature test has been forwarded to ISO Central Secretariat for ballot as a

Draft International Standard. There are now 5 countries (U.K., Germany, Denmark, Finland, Australia) that have made ambient temperature leakage measurements on fire doors or "smoke control" doors. Several countries (Germany, Netherlands and U.K.) have made or are planning (Belgium, Finland) to make measurements of leakage around doors at medium temperature (up to 300°C), but there are considerable differences in apparatus and means of heating. Under fire conditions, the NBS-sponsored tests at U.L. and TNO tests using half-doors were described. The high-temperature test will be appended to the WG3 Chairman's report together with information on tests carried out (Finland, U.S. and Holland) to invite preliminary comments at or after the Plenary Meeting. The draft Technical Report will be based on a document prepared originally by Malhotra to clarify the different functions of fire doors (compartmentation) and smoke control doors (smoke-free zones), but with modifications based on any comments received.

At the meeting of Working Group 11 (Fire Resistance), the items of discussion were ultimate integrity failure, revision of ISO 834, fire resistance of suspended ceilings, horizontal partitions, fire exposure of exterior columns and facades, and fire penetration through walls, ceilings and joints. It was noted that the definition of ultimate integrity failure for nonloadbearing elements was the most confusing (indefinite) part of ISO 834. Although many countries have adopted ISO 834 (generally only 98 to 99%), there are reported to be appreciable differences in testing conditions and in test results as well as additional requirements in national regulations. Thus, the results are not generally accepted from country to country. An example was given of the variation in test results on identical loadbearing concrete-filled tubular steel columns from 5 laboratories in 3 countries. Most experts felt that the type of boundary conditions (one end intended as a hinged connection) was much more important than the furnace lining, type of fuel, etc. The Draft International Standard on Suspended Ceilings will be circulated for Member Body ballot in approximately one month.

At the meeting of Working Group 14 (Ventilation Ducts), a section-by-section review was made of a draft test method for fire testing ventilation ducts which are not protected by fire dampers. Since the draft requires considerable editing, and the preparation of a Commentary, it will be circulated to Working Group members for additional review prior to the September Plenary meeting.

In March, **A.F. Robertson** of CFR visited the Ministry of Home Construction building, in The Hague, to participate in a meeting of the ISO/TC 92/WG7, which serves as the coordinating committee for TC 92 on Fire Tests. There, plans were being developed for both the plenary meeting of TC 92 that Fall and continued work of the committee. At the meeting, the question of whether a fire test method supported by TC 92 might measure more than one fire property was discussed. This discussion was largely based on the work NEL had done on the spread of flame test method. The group working on the spread of flame test was making use of findings NEL had reported at the Paris meeting last Fall. They have decided to concentrate on the side 45° angle position for the specimen.

Merritt M. Birky of CFR chaired the two-day ISO/TC 92 Working Group 12 meetings held in London in March. The meeting covered the test method for assessing toxicity of combustion products. The German representatives were in favor of the DIN system as a standard test method. The system includes the tube furnace for sample degradation and an attached animal exposure system. This system is being used in Germany, France and Belgium. Its relevance, particularly the method of thermal degradation of materials, has not been established in relationship to large-scale fire experiments or to the toxicity hazards. Analytical measurements done by Dr. Sands show that the CO levels are comparable to CO_2 levels and sometimes exceed CO_2 concentrations.

In April, **Irwin A. Benjamin** of CFR took part in meetings of ISO/TC 92 related to Working Group 2 (Test Methods) and Working Group 4 (Reaction to Fire Tests). In WG2, certain details relating to the drawings for the noncombustibility test (DIS 1182.2) were discussed, and final drawings are expected to be ready soon. The principal discussion item was measurement of rate of heat release. The apparatus designed by the British Timber Research and Development Association is still in the testing and modification stage. Because of the problems with this apparatus, there was serious consideration of the Ohio State/Smith heat release calorimeter as well as the NBS-proposed oxygen combustion techniques.

In WG4, the principal discussion items were proposed tests for smoke measurement, ignitability and flame spread. The Munich smoke box test is still undergoing revisions and refinement, but it was decided to go ahead with a round robin involving 6 laboratories in late 1979. The proposed ignitability round robin is being held up until changes have been made in the pilot flame to resolve existing problems. Decisions were made on the proposed flame spread test which is now being divided into three parts according to the specimen orientation. A round robin will be undertaken involving 12 laboratories and 7 specimens. In the general discussion, concurrence was achieved on the U.S. position of relating test methods to real-life scenarios and validating these methods by full-scale tests.

Richard G. Bright of CFR attended the June meeting of ISO/TC21/SC3 held in Moscow on June 7-8, 1979. TC21 is the technical committee responsible for "Equipment for Fire Protection and Fire Fighting" and SC3 is the subcommittee responsible for "Fire Detection and Alarm Systems". Bright was one of a three-man U.S. delegation to the meeting.

Irwin Benjamin, A.F. Robertson, and **Daniel Gross** attended the September plenary meeting of TC92 held in Sydney, Australia. During the meeting, agreement was reached on reorganization with three subcommittees. One of these on Toxic Hazards in Fire is to be a successor to WG12. The plan is that the U.S. will assume the responsibility for secretariat of this Subcommittee. During meetings of both TC92 and TC38/SC19, Gross reported on the progress of the IMCO ad hoc group on fire test methods. Both committees are concerned with this development but the pressures for development of test methods in ISO and IMCO appear different. As a result of discussion at the meeting and with support from the U.S. delegation, it was decided to relax the TC92 rule of only one property measurement per fire test. TC92 also decided to publish as technical reports three test methods which have as yet not been fully validated.

In September, **James H. Winger** of CFR attended the ISO meetings of Technical Committee 38, Subcommittee 19 (Burning Behavior of Textiles) held in Sydney, Australia.

In September, **John G. O'Neill** of CFR attended the Technical Committee 21, Subcommittee 5, Working Group 2 meeting held in Heidelberg, West Germany. At this meeting a draft installation standard for fixed CO_2 systems was completed. This draft standard includes both local application and total flooding systems. The next week, a Working Group 2 meeting was held in Milan. The meeting centered upon completing a similar draft standard for alarm valves.

In May, **C.W. Devereux** of CCPT went to Pretoria, South Africa, to attend the fifth meeting of ISO Technical Committee 133 (Sizing Systems and Designations for Clothes). The meeting was important to NEL because of its role as secretariat of the ANSI technical advisory group concerned with standards for clothing sizes.

In May, **Eric A. Vadelund** of CCPT went to Geneva to attend the second annual meeting of the ISO Council Committee for Consumer Policy as a member of the ANSI International Consumer Policy Advisory Committee. The meetings showed that efforts in the consumer product safety field at the international level are somewhat behind similar efforts in the United States. Moreover, the question of consumer participation in standardization activities is just now being addressed and has not yet reached the operational level. The institutionalization of such concepts as Consumer Sounding Boards and the public funding of consumer participation in standardization and regulatory activities, is still on the horizon.

John V. Fechter of CCPT attended the August meetings of Technical Committee 159, Subcommittee 3 (Anthropometry and Biomechanics) held in Berlin. There, final draft of the Core List of Anthropometric Measurements was approved. Those core measurements should be included in any future anthropometric studies, and done according to the methods specified in the core list. The draft was submitted to the full ISO/TC159 for approval at the Warsaw meetings held later that month.

Frank J. Powell of OEP went to Milan in September to attend the ISO 163 (Thermal Insulation) meeting as an official U.S. delegate and to participate as a member of two of its subcommittees, two working groups, and the advisory group.

In February, **Lawrence D. Eicher,** Director of the Office of Engineering Standards, traveled to Paris to attend a meeting of the ad hoc drafting committee of the ISONET Management Board. (ISONET signifies the ISO International Standards Information Network.) The meeting was called to redraft the document "Conditions for Participation in ISONET as a National Member."

A later ISONET meeting, in June, confirmed the revisions made at that time. In September, Eicher returned to Geneva, with **Charles B. Phucas** of OES, to attend the annual plenary meeting of ISO Council Committee on Scientific and Technical Information in Standardization, as leader of U.S. delegation, and the annual ISO Council meeting, as a U.S. observer invited by the American National Standards Institute.

Microcircuit Engineering '79: Microstructure Fabrication

This annual conference was held this year in Aachen, West Germany, at the Institute of Semiconductor Electronics of the Technical University of Aachen. The conference covered electron beam lithography, x-ray lithography, resist materials, pattern transfer, metrology, and optical lithography. There were two invited papers, one on "The Physical and Electrical Limitations to Improvement of Silicon Integrated Circuits," by V.L. Rideout and "Metrology for Submicrometer Devices and Structures," by **W. Murray Bullis** of CEEE.

Several aspects of the conference were of particular interest to NEL. First, in his review paper, Rideout predicted that commercial production of 1-micrometer circuits would not occur until 1988. On the other hand, A.C. Tobey projected full production of submicrometer circuits, requiring electron beam writing for some of the circuit levels by 1985. He projects 0.5-micrometer geometries by 1987 or 1988.

Second, researchers from Philips reported work on two electrical test structures, one for making linewidth measurements and the other for making alignment measurements. The linewidth structure is a bar with adjacent current and voltage contacts at either end; the sheet resistance must be determined with an independent measurement. This structure appears to be much less satisfactory than the NEL cross-bridge structure.

It became clear at the conference that NEL is widely recognized for its leadership position in metrology for the semiconductor industry. A representative of Physikalish Technische Bundesanstalt, NEL's counterpart in West Germany, attended the conference to learn more about standards, especially linewidth measurement, at NEL. Representatives of more than half a dozen major European organizations, including the central mask-making facility for the International Telephone and Telegraph Corporation, the new electron beam lithography facility at the Rutherford Laboratory in England, and the British Post Office Research Centre, were anxious to obtain the linewidth measurement artifacts.

NATO Advanced Study Institute

This Advanced Study Institute under NATO auspices is one among about seventy organized each year on a variety of topics. The conference was held in July at the University of East Anglia, Norwich, England. The general topic was "Theoretical Methods for Determining the Interaction of Electromagnetic Waves with Structures."

Arthur D. Yaghjian of CEEE was invited to talk on the singularity of the Green's function in the volume integral equation determining electric fields within biological tissue.

Although most electromagnetic short courses include some representatives from foreign countries, few, if any, have had the varied international cross section of delegates and lecturers displayed by this first NATO Institute on electromagnetics. There were numerous delegates from countries such as Poland, Turkey, and Israel, as well as from the NATO countries.

A pleasant surprise was a general awareness of the electromagnetics work at NEL. Yaghjian was asked continually about near-field measurements, electromagnetic field probes, transverse electromagnetic cells, flat-response antennas, and dyadic Green's functions.

RILEM

The Reunion Internationale des Laboratories de'Essais et de Recherches sur les Materiaux et les Constructions (RILEM) is an international nonprofit association governed by Swiss Law. Its aim is to constitute a medium of exchange and of communication of scientific experience, especially the experience acquired by the study of materials and building elements, by observation, by tests in the laboratory and in-situ, and by research. The RILEM membership list shows representatives from 72 countries. Recently RILEM has become more active in international standards organizations, particularly the International Organization for Standardization (ISO) and has adopted the policy whereby each technical committee must summarize its recommendations as prospective standards and submit them through the Permanent Committee of RILEM to ISO for international standards.

James R. Wright, Deputy Director of NEL, is in his fifth year as a member of the RILEM Bureau. The Bureau of RILEM corresponds to the Board of Directors of an organization such as the ASTM in the United States. He is also the RILEM Delegate for the United States, and in this capacity represents 32 U.S. RILEM members.

In April, **William C. Cullen,** Deputy Director of the Office of Engineering Standards, attended the Aachen, West Germany, meetings of RILEM in his official capacity as a member of the Coordinating Group. The Coordinating Group meets in executive session once each year to review and discuss the activities of each of the RILEM technical committees. An annual report is prepared and submitted to the RILEM Permanent Committee on the progress of respective committees and gives its recommendations to the Adivsory Group for the demise of existing committees and the start of new ones.

Also in Aachen, the Coordinating Group met in joint session with the RILEM Advisory Group, of which **Geoffrey Frohnsdorff** of CBT is a member. This year the group approved proposals for the formation of new committees on resin adhesion to concrete, multi-axial testing of concrete, polymer-impregnated concrete, and the corrosion of galvanized steel pipes. It also recommended that RILEM cosponsor the Second International Conference on the Durability of Building Materials and Components which is to be held at CBT in 1981. The Advisory Group is to develop a 5-year plan as a framework for the setting up of new technical committees. Among subjects for which proposals for new committees will be sought within the next year are corrosion of reinforcing steel in concrete, fly ash for use in concrete, methods for characterization of environments to which building materials are exposed, and materials for solar heating and cooling systems.

Symposium and Technical Exhibition on Electromagnetic Compatibility

This symposium, the third in a series, was held in May in Rotterdam. **Motohisa Kanda**, **Myron L. Crawford**, and **Harold E. Taggart** of CEEE attended and presented papers. The symposium had several sessions dealing with subjects normally outside the conventional EMC discipline: an electromagnetic fields session (where Kanda's paper was presented), a biological effects session, a magnetic fields session, and a nuclear electromagnetic pulse session.

United Nations Economic Commission for Europe

The development of a standardized system for writing building regulations in performance terms and for the development of a widely accepted product evaluation mechanism through the use of standardized test methods are the goals of the UN/ECE. These goals, which include the problems of energy conservation (the UN/ECE region accouts for 80% of the world's consumption of energy), surfacing at the same time as the start of serious U.S. metrication planning, make it reasonable to believe that it would be useful for the U.S. to consider a collaborative role in the UN/ECE-ISO project.

For these reasons, **Charles T. Mahaffey** of CBT took part in the July 1978 Geneva meetings of the Working Party on the Building Industry, in support of both CBT research and the building industry of the United States.

In December 1978, Mahaffey returned to Geneva to participate in an intersecretariat meeting of international organizations supporting the development of the United Nations program on the harmonization of national building regulations. He delivered a report on the Second International Conference on Recognition of National Programs for Accrediting Test Laboratories, held on October 1978 in Washington, D.C. He also took part in a UN/ECE meeting on international standards for low-cost housing.

In January 1979, Mahaffey attended a further series of meetings in Geneva. The meetings produced agreements on 18 points related to the development of an international system for accepting building product evaluations made at the national level. These agreements covered ISO standards processes, the ISO CERTICO program, the referencing of standards by ECE governments, and an appropriate role of testing lab evaluations.

World Congress on Shell and Spatial Structures

In September, **Edward O. Pfrang** of CBT attended this Congress, in Madrid, and presented an invited paper entitled, "Criteria for Assuring Safety During the Erection of Reinforced Concrete Shell Structures."

The International Association of Shell and Spatial Structures (IASS) is the premiere international body dealing with technology related to the design and construction of shell structures. The group, originally formed as the result of initiatives taken in Spain, has a very heavy European flavor to it. Since its inception, IASS had had a reasonable U.S. contribution; however, this has been mainly from academic institutions. Latin Americans and Europeans have carried out some very daring designs using shell structures, and although they have been used to some extent in this country, they have not been as popular here. Since the mathematics related to shell structures is very "elegant" they have received a great deal of academic attention in the United States. On the practical side, they have not received anywhere near as much attention. This being the 20th anniversary of IASS, the Congress was again held in Madrid. Eight themes were considered for discussion: buckling problems; dynamic studies; special problems on cable structures; general analysis using discretizing methods; theoretical and/or experimental investigations on shells and spatial structures; projects and designs carried out during the last ten years; new materials and new shapes in the construction of shells and spatial structures; future development; and repair and reconstruction of ancient monuments.

List of Foreign Guest Workers

Under the guest-worker plan of NEL, faculty and graduate-student scientists or engineers of recognized institutions of learning and certain other mature scientists may be invited to undertake a project of substantial value to the Bureau, using Bureau equipment and facilities. A guest worker is not employed by the Government and accordingly the Bureau pays no compensation or other financial benefits for his service. Guest workers have access to NBS libraries and computer facilities as though they were NBS employees. The duration of the assignment is normally from 6 months to 2 years. NBS, conversely, occasionally posts its own employees to laboratories abroad.

During FY 1979, the following guest workers participated in NEL programs:

D. Bakas
"Building Research," in CFR
Polymer Institute
Slovak Academy of Sciences
Bratislava, Czechoslovakia

P. Barriere
"Building Performance Concept," in CBT
University of Paris
c/o Dr. Jean-Claude Ziv

Olivier Carret
"Heat Release Rates for a Large Variety of Materials," in CFR
Association pour l'Initiation a la Recherche dans la Batiment
29 Avenue d'Lena
75116 Paris

Tridib Chaudhuri
"Thermal Analysis," in CBT
UN Fellow
Civil Engineering Department
National Test House
Alipore, Calcutta

Pierre Conteau
"Application of Solar Technology in Towns and Cities," in CBT
Association pour l'Initiation a la Recherche dans la Batiment
29 Avenue d'Lena
75116 Paris

Martine Gaume
"Building Performance Concept," in CBT
University of Paris
c/o Dr. Jean-Claude Ziv

Kujoshi Ochifuji
"Energy Conservation Projects for Passive Energy Use Programs," in CBT
Faculty of Engineering
Hokkaido University
Sapporo 060

Hakon Olafsson
"Performance of Pozzolans in Concrete," in CBT
Building Research Institute
Reykjavik, Iceland

Dhiraj Kumar Ray
"Metrology Studies," in CMEPT
UN Fellow
India Ministry of Supply and Rehabilitation
National Test House
Alipore, Calcutta

Gilles Renous
"Application of Heat Pumps in Solar-Heated Buildings," in CBT
Association pour l'Initiation a la Recherche dans la Batiment
29 Avenue d'Lena
75116 Paris

Tomonori Saitoh
"Thermal Engineering", in CBT
Ohbayashi-Gumi, Ltd
Tokyo

Ivan Spilda
"Mechanisms of Flame Retardation of Thermoplastics," in CFR
Research Institute of Organic Technology
Bratislava, Czechoslovakia

Thierry J. Tixador
"Building Research"," in CFR
Association pour l'Initiation a la Recherche dans la Batiment
39 Avenue d'Lena
75116 Paris

Jorge R. Tucaraccio
"Air Conditioning Testing," in CBT
Instituto Nacional de Technologic
Libertad 1235
Buenos Aires, Argentina

Acknowledgment

The material presented in this report was derived from the foreign trip reports submitted by the NEL staff upon completion of their travel. These reports summarize the activites, interactions with the representatives of international organizations and foreign countries, the subjects discussed, significant technological items, and the benefits to the National Bureau of Standards. We acknowledge the work of the NEL staff in preparing these Foreign Trip Reports, without which this report could not have been written.

Michael Olmert reviewed the foreign trip reports, extracted data, and prepared this text. We gratefully acknowledge Mr. Olmert's work in preparing this report.

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16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

This report presents a survey of a major phase of the international activities of the National Engineering Laboratory (NEL), NBS, for the Fiscal Year 1979.

There are a number of media through which international activities are conducted. The first of these is the formal visit by one or more NEL staffers to a foreign research organization or conference. The second category covers visits by foreign government scientists and research institutions to the NBS facilities. Other media include exchange visits and the hosting of overseas guest workers at NBS. Although this report covers only the first category and the listing of overseas guest workers at NBS, some significant and gratifying contributions to international technical progress are detailed here.

The report is organized by countries, international organizations and conferences. NEL professional staff involved in these activities are readily identified. Guest workers are listed with their research interests. The report is intended to serve as a directory and reference document for all those who seek information on the international activities of the National Engineering Laboratory, NBS.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Engineering; international cooperation; international research; international standards; National Bureau of Standards (NBS); National Engineering Laboratory (NEL); technology transfer; guest workers.

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