BSIR 79-1792

INTERNATIONAL ACTIVITIES

The Fiscal Year 1978 Survey of International Programs at NEL

August 1979

National Engineering Laboratory
National Bureau of Standards

U.S. Department of Commerce
Washington, D.C. 20234

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Cover photo: The Font Romeu solar reflector experiment station high in the French Pyrenees (see page 25). Photo by Joseph C. Richmond, CMEPT.

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Abbreviations Used in the Text

AFNOR	Association Francaise de Normalization
AID	Agency for International Development
ANSI	American National Standards Institute
API	American Petroleum Institute
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASTM	American Society for Testing and Materials
BDOE	British Department of Energy
BRE	British Research Establishment
BSI	British Standards Institute
CAM	Center for Applied Mathematics
CBC	Canadian Broadcasting Corporation
CBT	Center for Building Technology
CEBTP	Center for the Study of Buildings and Public Works (France)
CEEE	Center for Electronics and Electrical Engineering
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
CIB	Conseil International du Batiment pour la Recherche, l'Etude, et la Documentation
CISNPC	Comissao Instaladora do Servico Nacional de Proteccao Civil (Portugal)
CIT	Cranfield Institute of Technology (England)
CMEPT	Center for Mechanical Engineering and Process Technology
CNET	National Center for Telecommunications (France)
CNRS	Centre Nationale du Recherche Scientifique (France)
CRIF	Research Center of the Belgian Metalworking Industry
CRIP	International Institution for Production Engineering Research
CSA	Canadian Standards Association
CSTB	Centre Scientifique et Technique du Batiment (France)
CUPE	Cranfield Unit for Precision Engineering (England)
DIN FNM	Deutsches Institut fur Normen, Fachnormenausschuss Materialprufung
DOE	Department of Energy (USA)

EC	Danish Research Center for Applied Electronics
EEG	Electroencephalogram
EER	Energy Efficiency Ratio
EKG	Electrocardiogram
EM	Electromagnetic
EOS	Egyptian Organization for Standardization
EPA	Environmental Protection Agency (USA)
ETSU	Energy Technology Support Unit (England)
FAA	Federal Aviation Administration
FLOMEKO	International Flow Measurements Confederation
GSA	General Services Administration
HUD	Department of Housing and Urban Development
HVAC	Heating, Ventilating, and Air Conditioning
IAEA	International Atomic Energy Conference
IEA	International Energy Agency
IEEE	Institute of Electronics and Electrical Engineering
IFRF	International Flame Research Foundation
IMEKO	International Measurements Confederation
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
KSRI	Korean Standards Research Institute
LNEC	National Laboratory of Civil Engineering (Portugal)
LNG	Liquified Natural Gas
LRMH	Historical Monument Research Laboratory (France)
MAA	Mean Apparent Altitude
MELCO	Mitsubishi Electric Corporation (Japan)
MG	Messer Greishem (Netherlands)
NATO	North Atlantic Treaty Organization
NBRI	National Building Research Institute (South Africa)
NBS	National Bureau of Standards
NBSLD	NBS Load Determination (a computer program)
NDE	Non-Destructive Evaluation
NEL	National Engineering Laboratory
NML	National Measurement Laboratories (Australia)
NRC	National Research Council of Canada
NRDC	National Research and Development Corporation (England)
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

RRL	Radio Research Laboratories (Japan)
RSRE	Royal Signals Radar Establishment (England)
RTH	Rank Taylor Hobson (England)
SEM	Scanning Electron Microscope
SIH	Schweizerisches Institut fur Hauswirtschaft
SPTL	Superconducting Power Transmission Lines
TUD	Technical University of Denmark
UBC	University of British Columbia
UJNR	U.S./Japan Cooperative Program on Natural Resources
UK	United Kingdom
UL	Underwriters Laboratories (USA)
UNESCO	United Nations Educational, Scientific, and Cultural Organization
URSI	International Scientific Radio Union
VLSI	Very Large Scale Integration (of semiconductors)
WZL	Laboratorium fur Werkzeugmaschinen und Betriebslehre (West Germany)

PREFACE

The National Engineering Laboratory (NEL), as part of the National Bureau of Standards (NBS), is committed to participation in international activities that support is overall program. The NEL activities reported in this volume reflect that commitment. The activities you will read about here 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. The report is limited to reporting only NEL activities and participation and as such does not reflect the extensive international activites of the other parts of NBS.

There are a number of means 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 covers visits by foreign government scientists and representatives of research institutions to the NBS facilities. Other means include exchange visits and the hosting of overseas guest workers at NBS. Although this report covers only the first category, and is therefore limited in scope, some significant and gratifying contributions to international technical progress are detailed here. Also, 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 character of this work. This report is not intended to present an evaluation of 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 directly the NEL staff member identified with the activity. Comments on the usefulness of this report will be considered in preparing future editions.

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; 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 1978 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, areas 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, measurements 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 mechanics, 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, economy, 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.

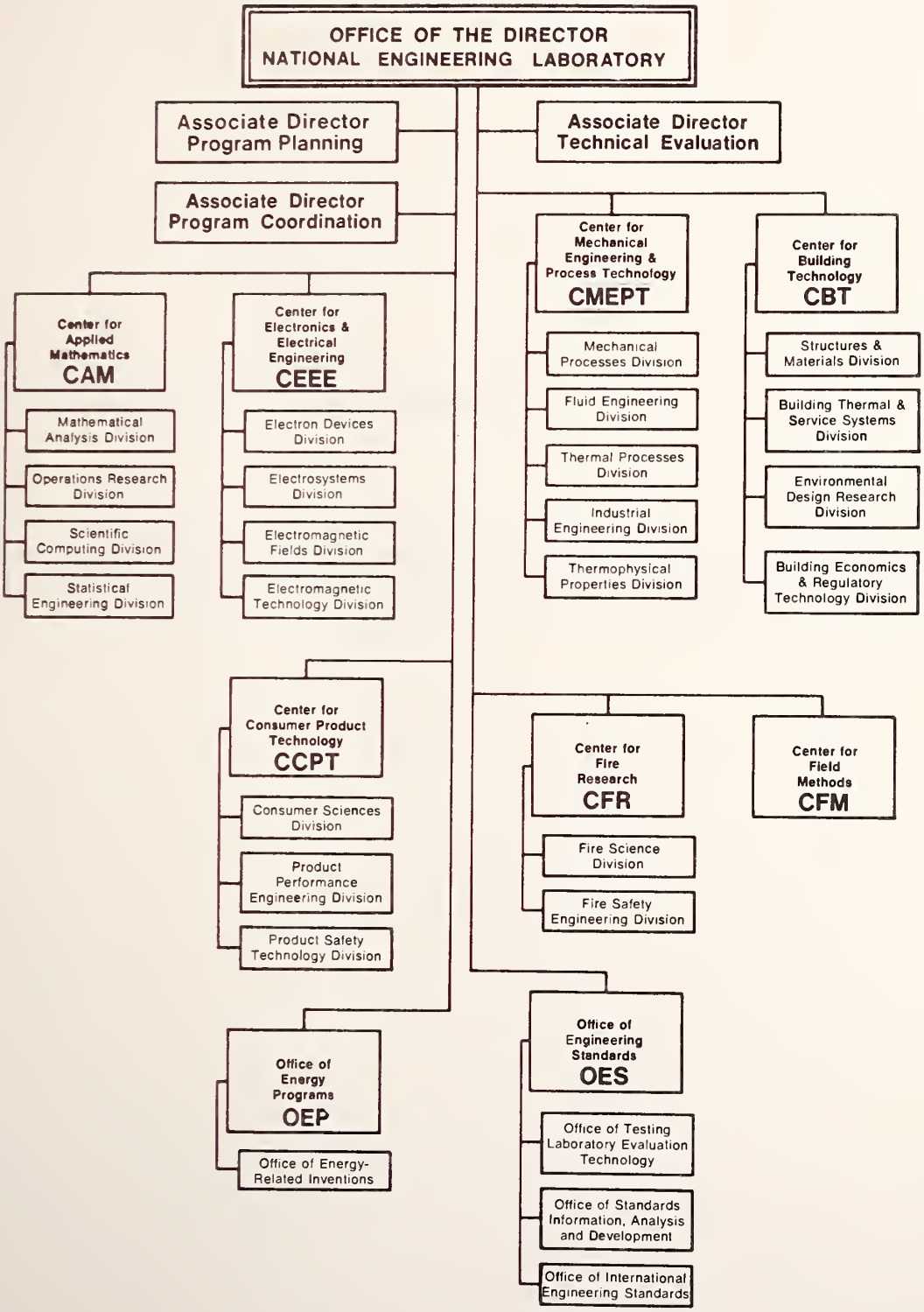
- The Center for Consumer Product Technology performs research and develops the technology needed to measure and evaluate the safety, energy efficiency, and other performance characteristics of consumer products and law enforcement equipment.

- 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 NEL energy-related programs with a focus on conservation and new applications in buildings, communities, consumer products, industry and energy-related inventions.

The Office of the Associate Director for Program Coordination is, among other things, responsible for coordinating NEL international activities and serving as a focal point for interacting with the NBS Office of International Affairs, other agencies, and the international community.


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 Organizational Chart (page 3). Our activities with international organizations and conferences are presented separately in the next section of the report.

Algeria

NEL is participating in the development of data and standards for contractual agreements between several U.S. energy companies and the Algerian National Energy Company (Sonatrach). Sonatrach is also participating in the NBS LNG density project as a co-sponsor.

As a part of this work, **Dwain E. Diller** of CMEPT's Thermophysical Properties Division was asked in April 1978 to give two talks on the NBS LNG Program to the Symposium on LNG Storage and Transfer at the Institute Algerien du Petrole, Boumerdes. He was also asked to visit the new natural gas liquefaction plant at Bethioua.

The Bethioua LNG plant is the world's largest facility for liquefying natural gas for export. The CAMEL LNG plant has been operating there since 1964. The LNG-1 plant, containing six independent "trains" is nearly complete, although only one train is now in operation. Construction of the LNG-2 plant, also containing six trains, has been started by the Pullman-Kellogg Company. Foster-Wheeler Company has been selected to construct the LNG-3 plant, which will contain nine trains.

The LNG-1 plant precools the natural gas with sea water and propane and liquefies it using the Air Products and Chemicals Company multicomponent refrigerant process. The higher hydrocarbons (ethane, propane, etc.) are separated from the feed gas by distillation. The nitrogen content is reduced from about 5% to about 1% by "flashing." The ethane and propane are used for refrigerant makeup. Butanes are used to increase the heating value of the methane to contract specifications. The gasoline fraction is burned to provide electrical power for the plant. The most spectacular features were the Air Products vertical heat exchangers and the two towers, about 500-feet high, used to flare sour natural gas.

The symposium was held at the Institute Algerien du Petrole, at Boumerdes, about 30 miles east of Algiers. The Institute was started about five years ago and now has about 12,000 students. About 100 Algerian students, along with several American and Russian faculty members attended the symposium. There are about 45 Americans on the faculty. A massive building program is underway at the campus.

Australia

In March 1978, **James E. Zimmerman**, a CEEE physicist, conferred with Ian Harvey, who is in charge of the Josephson voltage standard at the National Measurement Laboratory in Sydney. He also spoke with John MacFarlane about experimental methods, with Ron Kemp (in charge of helium liquefiers and other cryogenic facilities), and with Guy White, the author of the well-known book on low-temperature experimental techniques. The Laboratory is now located in a new facility in the northwestern part of the city, and the staff was in the process of moving equipment from the old building on the university grounds near the center of the city.

At the Metric Conversion Board, also in Sydney, Mr. Zimmerman talked to Alan Harper, Chairman of the Science and Technical Advisory Committee, about methods and progress in metric conversion, and collected a package of bulletins on conversion for a large number of special interests: farming, mining, real estate, and building trades. Australia has nearly completed their conversion to the metric system.

At the University of Sydney Energy Research Centre, they are working on a type of flat-plate collector using selective-absorption metal films in glass vacuum bottles with diffuse backup reflectors. They reach no-load temperatures greater than 300°C. At present, Australia manufactures about the same total area of solar energy collectors (about 40,000 m^2) per year that the U.S. does.

Belgium

Russell D. Young, Chief of CMEPT's Mechanical Processes Division, toured the Research Center of the Belgian Metalworking Industry (CRIF) in September 1978. The group is composed of about 25 University of Leuven staffers and 25 industry-sponsored employees. In general, their interests are in developing technology to improve productivity. They are active in computer-aided design and manufacturing, and have built an assembly robot that uses strain sensors to "feel its way." They are involved in adaptive control techniques with a component (air bearings, spindles, etc.) to improve machine-tool accuracy and efficiency. **Robert J. Hocken** of CMEPT also visited the Research Center.

In April 1978, **Irwin A. Benjamin,** Chief of CFR's Fire Safety Engineering Division, visited the State School Construction Fund in Brussels. He interviewed them about their work in developing fire safety requirements for the schools and homes that house the mentally retarded, especially the mentally retarded who also have physical handicaps.

Bolivia

In June 1978, **David Hogben** of CAM's Statistical Engineering Division gave a seminar to about 25 people in La Paz on the use of the OMNITAB program. The seminar was arranged and sponsored by the Bolivian Ministry of Labor, Ministry of Planning, Centro Nacional de Computacion (CENACO), OAS, AID and NBS.

The lectures were held at the Instituto de Superior de Administracion Publica. Special attention was given to the features of OMNITAB. CENACO, the Ministry of Labor, and the Ministry of Planning were most interested in how to use tapes or discs, how to obtain output on a remote high-speed printer, and how to use the editing and table making (cross-tabulation) instructions.

Other subjects covered were basic arithmetic operations, including array and matrix operations; data manipulation, including data manipulation with matrix operation instructions; statistical analyses and regression; and plotting. Some time was spent discussing the advantages of OMNITAB, which is a programming language with "statistical package" features, over the common control language statistical packages. The advantages of writing OMNITAB instructions in Spanish rather than English were also discussed.

Time was taken on one afternoon to discuss the use of OMNITAB CALCOMP instructions. CENACO is acquiring a CALCOMP plotter and Basilio Plaza was anxious to install the program units used by OMNITAB.

As a practical exercise, some statistical work was done on a household survey of persons working in small establishments in the Informal Sector of La Paz, where many poor people live. A comprehensive questionnaire had been prepared to obtain their responses to 47 questions. The questions were related to current occupational status. Variables to be included in the analyses were sex, marital status, skills, current occupation, effort made to obtain employment if unemployed, etc. Hogben and his associates looked at one of four files. Approximately 120 tables had been requested. Much more time was needed to understand the data and analyze the results, but some progress was made. Eventually, the file was reduced by about 150 records.

Brazil

In September 1978, **John W. Lyons**, Director of NEL, visited the superintendent and technical director of the Institute for Technological Research (IPT). The four-year cooperative program with NBS has now come to a close. This meeting was the fourth and final program review.

The program is judged to have been a success. Visible evidence of this includes a new Standard Reference Materials Program in operation, a Collaborative Reference Program in operation, and expanded efforts in areas such as building research, fire safety testing and certification, insulation, solar heating and cooling, and measurement assurance programs.

It was agreed not to recommend a continuation of formal agreements between NBS and IPT but to encourage continued informal working relations. Occasional senior staff visits, possibly a succession of senior scientist guest workers at NEL (with a part-time liaison role), and ad hoc arrangements whenever necessary for training, joint work, and the like -- all these are examples of close informal relations and are typical of NEL technical assistance and information exchange with major laboratories around the world. Three possible areas of collaboration are in metallurgy, automated machine tools, and geotechnical engineering.

Canada

Jeffrey T. Fong, of CAM's Mathematical Analysis Division, co-chaired a technical session entitled "New Frontiers in Computer-Aided Design and Manufacturing," during a joint U.S.-Canada conference on pressure vessels and piping. The meeting was held in Montreal in June 1978. Fong also visited Dr. D. H. Page, Director of the Materials Science Division of the Pulp and Paper Research Institute of Canada at Pointe Claire, about 50 miles away from Montreal. As the mathematical modeling consultant to Dr. E. Graminski, Project Leader on Paper Physics in the Center for Materials Science, Fong has been concerned with the paucity of single-fiber strength data and statistical information. Dr. Page, the world's foremost authority on single-fiber research, provided much useful information to advance this modeling work.

Richard J. Van Brunt of CEEE's Electrosystems Division visited the Institude de Recherche de l'Hydro-Quebec (IREQ), in Varennes, Canada, during August 1978. He went at the request of the DoE to study gaseous dielectrics proposed for use in future high-voltage electric power transmission systems.

IREQ has a large research effort directed toward understanding chemical activity in electrical insulation and its effect on aging or long-term reliability. Advanced chemical analysis techniques are being used such as gas chromatography, mass spectrometry (GC/MS), and infrared absorption spectroscopy. All of the gaseous dielectric work there has until now been on SF_6 or SF_6 solid-insulator combinations, although they have plans to look at other gas combinations.

The researchers at IREQ believe that, of the analytical techniques available, GC/MS is the only technique that can access all degradation products simultaneously. But even this technique has its limitations when applied to breakdown products of SF_6. It is often difficult, if not impossible, to obtain meaningful quantitative information on certain contaminant concentrations. For example, HF, one of the more troublesome products of electrical breakdown, is too reactive to be transmitted through most chromatographic columns. Also SF_4, another toxic primary product of electrical breakdown in SF_6, reacts readily with trace amounts of H_2O and is thus difficult to observe with a chromatograph without special conditioning. To observe many corrosive fluorine compounds with GC/MS, it is necessary to use cells and transfer tubing made out of teflon or a combination of teflon and aluminum. It was pointed out that it may be desirable to develop in situ spectroscopic techniques to

monitor some of the reactive degradation products. One difficulty likely to be encountered with in situ optical methods is the attack of windows by degradation products.

As in the work planned at NBS, there is a great deal of interest at IREQ in the effects of trace amounts of H_2O on gas degradation in corona or arc-over. There is evidence that trace amounts of H_2O can have significant effects on corona inception and discharge-induced chemicl activity in SF_6 or other electronegative gases. The effects of low-level H_2O concentrations have been difficult to substantiate. Water concentration in the gas is not easily controlled and quite difficult to determine, particularly at the 1 to 10 ppm level. The group at IREQ is planning to look more carefully at this problem, and hope to develop more reliable methods to determine H_2O concentration.

John A. Molino of CMEPT's Acoustical Engineering Division travelled to Montreal and Varennes in March 1978 to discuss a standard magnetic tape format for recording the noise from high-voltage transmission lines. Meetings were held with engineers from the Canadian Electrical Association and the Institute de Recherche de l'Hydro-Quebec. Discussions centered around the three North Americn psychoacoustics research projects on corona noise either planned or underway: AC/DC comparisons at IREQ; response to AC operating lines at the University of Western Ontario; and the measurement scale research at NBS.

The meetings were set to agree upon a format for magnetic tape recordings so that these groups could exchange tapes. Several manufacturers had demonstration models available for testing at IREQ. During the meetings, recording techniques at the Canadian Broadcasting Corporation (CBC) and the U.S. Library of Congress were discussed. NEL already has developed an automatic tape recording system that operates on 8-track 1-inch tape on 14-inch reels at 15 ips. Since the Canadian-American cooperative effort would require about seven tape recorders, price was an important factor. The NEL proposal would require the purchase of studio-quality tape recorders.

A compromise was agreed upon that would permit the use of either studio-quality recorders or intermediate-quality recorders, which are considerably cheaper. At the same time this format would exclude home-quality tape recorders, which would not be able to reproduce the corona noise spectrum. The compromise tape format was 4-track 1/2-inch tape on 10-1/2 inch reels at 15 ips.

In September 1978, **James C. Rainwater** of CMEPT's Thermophysical Properties Division travelled to the University of British Columbia, Vancouver, to consult with a number of specialists on the transport properties of moderately dense gasses. Mr. Rainwater's present work on transport properties is based on the theory of Snider (University of British Columbia), Curtiss, and others. The project has three parts: analytic solution of the equations for some simple model potentials, efficient numerical solution of the equations for realistic potentials, and a self-contained review of the theory. The latter is necessary because the theory has been fragmented into many papers and never has been written up as a coherent whole. As a result, it has not received its proper appreciation to date among the theoretical physics community.

The theory is most easily developed by means of a mathematical technique known as irreducible Cartesian tensors, which is Professor Snider's specialty. After Mr. Rainwater conferred with him, he was able to write a much shorter development of the theory than that which originally appeared.

Professor Snider also suggested some future collaboration in extending the theory to effects not now covered, such as the contributions of bound states, quantum corrections, non-spherical potentials, and gas mixtures. Such a collaboration would combine his theoretical

experience with NEL skills in numerical computation and access to the best experimental data. This Division has proposed a rigorous theory of moderately dense gases and gas mixtures as one of its milestones for FY 83.

In March 1978, **H. I. McHenry** of CMEPT took part in a seminar on fracture control in pipelines, sponsored by the Canadian Welding Development Institute. He presented a paper entitled, "Fitness-for-Purpose Evaluation of Defects in Pipeline Girth Welds," which was treated as one of the highlights of the meeting. Among other papers, J. M. E. Wallbridge, of Foothills Pipelines (Yukon), Ltd., described the methodology for control of fracture propagation in pipelines. Again empirical correlations based on full-scale test results were used. For propagation, the toughness required for crack arrest was defined as a function of stress level. A higher level of toughness is required for control of crack propagation than for control of crack initiation. This does not present a problem in material specifications because average toughness that exceeds the minimum required for arrest is regarded as satisfactory for propagation control. Use of mechanical arrestors was shown to be of secondary importance for pipelines with satisfactory toughness. Foothills has plans to build a burst test facility for gas line pipe.

Dr. R. J. Cooke, of Alberta Gas Truck Line Co., discussed code philosphy -- i.e, should pipeline weld quality requirements be based on workmanship or on fitness-for-purpose criteria? He tended to favor workmanship criteria with some changes based on fitness-for-purpose. In particular, he recommends changes in requirements that are so difficult to consistently meet that there is a tendency to ignore them.

Geoffrey Frohnsdorff of CBT's Structures and Materials Division toured the materials research labs of the Canadian National Research Council, in Ottawa, late in August 1978. He visited laboratories carrying out work on paints and surface coatings, building joint sealants, degradation of plastics (including those in solar collectors), performance of super-plasticizers for concrete, evaluation of fly ashes for use in concrete, uptake of moisture by thermal insulation exposed to humidity gradients, and sulphur-impregnated mortars. In individual conversations, he discussed methods for determining stresses in paint films with Dr. S. Crowl, and new devices for use in determining time-of-wetness of building materials with Peter Sereda, Chief of NRC's Building Materials Section. Prototype models of the time-of-wetness sensors have already been provided to CBT as part of a collaboration with NRC, and additional sensors will be made available to us in the near future. The quality of work carried out in the building materials area at NRC is of a high caliber and much of the work is complementary to NEL's. There could be significiant benefits through further increasing the links between the two groups.

In a separate visit to NRC, also in August 1978, **Larry Masters** of CBT explored areas of mutual interest with solar program staff members of NRC, which is undertaking solar heating and cooling studies similar to those at NEL.

The Canadian Standards Association, under contract with NRC, is charged with the development of standards, performance criteria, and testing and accreditation of solar hardware. They are basing their program to a great extent on the work done by NEL in these areas. To encourage a greater interaction and consistency between the two programs, a meeting will be held at NEL between representatives of NEL and NRC to discuss performance criteria, testing procedures, laboratory accreditation and certification. NRC also agreed to make optical measurements of the materials being studied in the CBT collector reliability/durability program. Since their instrumentation is somewhat different from the equipment with which CBT will be performing measurements, this will make it possible to determine instrumental variations.

In November 1977, **Walter J. Rossiter** of CBT's Structures and Materials Division traveled to Ottawa to visit the Canadian Department of Public Works and the National Research Council. The Department of Public Works has conducted testing on urea-formaldehyde based foams for the Canadian Government Specifications Board, which prepared the Canadian standard. To date, only their test results for corrosion have been published. Mr. Ted Shimizu discussed the reasons for choosing the test parameters and the significance of the test. He mentioned that he never tested urea-formaldehyde based foams for corrosiveness toward aluminum wiring.

With regard to shrinkage, Mr. Shimizu is attempting to develop an accelerated test method to predict its magnitude. In brief, the test involves temperature cycling of a foam specimen, while maintaining a vapor pressure differential across the specimen. Temperature cycling conditions are still being studied.

At NRC, Mr. Rossiter visited the laboratory containing urea-formaldehyde foam specimens. The discussion centered on heat transmittance testing of full-scale walls insulated with foams and the effect of shrinkage on the thermal resistance. The results of these tests are not yet published.

In February 1978, Mr. Rossiter returned to Ottawa to attend and participate in meetings scheduled by the Canadian Committee on Urea-Formaldehyde Thermal Insulation. This committee had developed the Canadian Standard for urea-formaldehyde foam insulations and was meeting to consider possible revisions. The Canadian Government Specification Board had requested his attendance at the meetings because of the past cooperation between the NRC and NEL.

In a review of NRC's large-scale test apparatuses for measuring the thermal performance of buildings, **Paul R. Achenbach** of CBT and **Frank J. Powell** of OEP visited Ottawa in July 1978. The NRC has two large hot-boxes that can accommodate full wall sections. One is an ASTM 236 guarded-hot-box (non-rotatable) for heat transmission measurements. The second is a box to measure heat transmission through windows and doors. Detailed discussion on these devices was very useful since CBT is in the process of designing a large wall tester that will be capable of measuring heat transmission, air transmission, and moisture performance of wall sections that contain windows and/or doors (specimen size approximately 10 feet high by 14 to 15 feet wide) and a floor/ceiling tester including attic spaces. Discussions centered around design concepts, measurement procedures, operational experience, and problems.

Richard W. Bukowski, of CFR's Fire Safety Engineering Division, was asked to address the Canadian Association of Fire Chiefs at their annual convention in August 1978. His topic, residential fire detectors, attracted so much attention that he was later interviewed on both local radio (in Saskatchewan) and the Canadian Broadcasting network. It was remarked that Mr. Bukowski's information would be of great value to the chiefs as they begin to prepare local legislation to require residential smoke detectors in newly constructed and, in some cases, existing residential structures.

Another CFR staff member, **David E. Swason,** went to Toronto in March 1978 to help the Ontario Research Laboratory set-up and calibrate a new flooring radiant panel. Ontario Research operates a Flooring Radiant Panel Tester and will be participating in a round robin test series on cellulosic insulation material. Their total heat-flow meter was calibrated against the NEL standard flux meter.

Melvin R. Meyerson, Chief of CCPT's Product Systems Analysis Division, was an associate member of the Canadian Standards Association (CSA) for a technical committee meeting held in November 1977. The activity of this committee is closely associated and interrelated with two NBS programs: Appliance Energy Labeling and Consumer Product Information Labeling.

At the meeting, considerable discussion resolved around sampling plans. Although CSA is opposed to placing a sampling plan in its standards, the Government member of the Committee needed one to obtain funding. The location of the plan, whether in the Standard or elsewhere, was left to further consideration by CSA.

Industry had submitted a sampling plan which was accepted by the Committee. For refrigerator-freezers there are 164 basic models made in Canada. The statistical minumum number of tests required to attain a 95% confidence level of not more than + 10% of the true mean was given as 5 units of each basic model. To cut down on the amount of testing, the 164 models were regrouped into 36 basic models. Although there are differences in efficiency of those products in the new arrangement, the differences are small. Only one basic model from each group of 36 will be tested, that with the lowest efficiency. All other units in each group will bear the label generated by testing the least efficient in the group. At some later date, in Phase II, all 164 basic models will be tested.

The label itself is very simple. It merely states that the unit uses x kWh of electricity per month. The message is written twice, once in English and once in French. No consideration was given to placing dollar usage figures on the label, a tactic that permits considerable simplification of the label. Mr. Meyerson pointed out the advantages of using an annual rather than a monthly value on labels, particularly for other products, and the Committee will consider that approach.

CSA plans to use test procedures developed at NEL to the extent that they agree with them. They particularly are interested in the usage patterns developed here, since they have no surveys or data of their own. In the case of refrigerator-freezers they are proposing a change in the test procedures with regard to frozen food and defrosting loads.

In the category of cooking ranges, only electric-powered units are considered. Microwave ovens have been deleted for now. The reason given was that microwave units used too little energy and their inclusion would delay the range test procedure.

For electric clothes dryers (gas dryers are not in their program), the prime concern is the method of accounting for overdrying possible with mechanical timers. The Committee was of the opinion that aside from the timer there was very little difference in efficiency between dryers.

Denmark

In August 1979, **Ramon C. Baird** of CEEE's Electromagnetic Fields Division visited the Technical University of Denmark (TUD), in Copenhagen. The purpose of this visit was to discuss arrangements for a joint course on near-field antenna measurements to be held in Europe in 1979. A secondary reason was to ascertain the status of the spherical near-field work being conducted in Denmark. TUD has an anechoic chamber that can be used as low as 50 MHz. The reflectivity of this chamber is approximately -60 dB at 10 GHz and gradually degrades to approximately -20 dB at 50 MHz. It provides a nice environment for near-field measurements and will be used in evaluating the spherical technique, although its size limits the antennas that can be measured to those with apertures less than about 1 meter. For these measurements they are developing special probes using ortho-mode conical horns attached to a circular waveguide. These probes will measure both polarizations at once by switching the probe polarization at a 5 kHz rate while the probe is scanning. This will reduce the measurement time by a factor of two.

Professor J. Apple-Hansen inquired about the possibility of TUD measuring the gain of some S and X band standard gain horns which had been previously calibrated by NEL.

At the invitation of Professor Olesen, **Daniel Gross,** of CFR's Fire Safety Engineering Division, visited the fire research laboratory of Aalborg University in June 1978. They recently assembled 3 fire resistance furnaces for testing columns, beams, and joists, at a cost of $70K ($35K for furnaces, $35K for load equipment and instrumentation). The unique features of these furnaces are: the modular construction, which permitted rapid assembly (4 days) and allows for simple changes in the size of the test specimen; and the use of lightweight ceramic fiber insulation in place of firebrick, which reduces the heating and cooling cycles and saves fuel. Short visits were also arranged to see the fire research activities carried out in the Heating and Air Conditioning Laboratory at the Technical University (Lyngby) and to the Danish Center for Applied Electronics, where automatic fire-detection systems are tested.

In October 1978, **Richard G. Bright** of CFR went to Horsholm to visit the Danish Research Center for Applied Electronics (EC). This laboratory is the pre-eminent laboratory in Scandinavia for the environmental testing of electronic components. In addition, EC is preparing a draft on environmental tests for automatic fire detectors for ISO/TC21/SC3, to which Mr. Bright is a delegate. While most of EC's work is in electronics, the NEL interest

in the laboratory relates to their vast experience and facilities for environmental tests of electronic components and devices as well as to their work with automatic fire detection devices. In addition, EC was given the task of validating the performance of the recently developed measuring ionization chamber. This instrument was developed by Cerberus as a standard laboratory reference instrument to be used to monitor the smoke aerosol in fire experiments.

Egypt

James R. Wright, Deputy Director of NEL, and **Samuel Kramer**, Associate Director for Program Coordination, attended the Sixth Meeting of the U.S.-Egypt Joint Working Group on Technology, Research and Development, held in Cairo, February 11-12, 1978. The meeting was jointly chaired by Deputy Assistant Secretary of State Oswald H. Ganely (U.S.A.) and Dr. Ibrahim Badran, Minister of Health (Egypt), assisted by Dr. Hassan Ismail, President Emeritus, Cairo University.

Dr. Wright served as Co-chairman of the Panel for Building Materials, Building Research and Transportation. Mr. Kramer served as rapporteur. Mr. Aly F. ElDaghestany, Vice Chairman, Transport Planning Authorities, Cairo, was the other Co-chairman.

In the building areas, seven projects were proposed and endorsed. One project in particular, "Identification and Evaluation of Materials for the Building Industry," has a fully developed technical proposal and is ready for implementation by the General Organization for Housing, Building, and Planning Research (Egypt) and NEL. The Panel stressed the need for prompt funding of this proposal. The Panel also endorsed an investigation of a survey project on Egyptian metrology by NEL.

In a vist to Ismalia, plans for redevelopment were reviewed as well as drawings for various housing types under construction. On-site visits were made to a new town being developed. This town was in varied stages of completion, with many low-income, single-story houses being occupied and others under construction. These single units were constructed of 400-mm thick load-bearing stone walls. The mass of the load-bearing walls contributed significantly to the comfort of the dwellings as evidenced by the temperature differentials between the interiors and exteriors. On-site inspections were also made of high-rise stone load-bearing buildings under construction. These structures were being built almost entirely by hand with no mechanization on the job except for a stationary concrete mixer. The mix for the concrete seemed to be based upon intuition rather than the use of any measurement system. Quality control measures and testing were absent from the project. This type of project was labor intensive and was dependent upon skilled stone cutters. The load bearing walls of the buildings were made of stones set in mortar 600-mm thick in the first floor and 400-mm thick on the second through sixth floor.

Later, a visit to a brick factory in Helwan permitted the team to see the existing mode of production, discuss the potentials for improvement, and review changes that would be required due to use of a substitute raw material. The visit to another new city under construction showed high-rise buildings being fabricated from pre-cast concrete components.

The research laboratories of the General Organization for Housing, Building, and Planning Research provided the team an opportunity to relate research efforts with the needs of the building community. The material research laboratories, structures laboratory, and general test area were among the facilities visited. During these visits the team was able to identify areas of mutual interest and potential areas for cooperative efforts. In particular, the material research area and need for Standard Reference Materials were identified for follow-up actions by both Egypt and the U.S.

In December 1977, **Lawrence D. Eicher and Cheryl P. Wise** of the Office of Engineering Standards traveled to Egypt to review progress of, and plan future activities for, the Pilot Project for the Development of the Standards Information Services of the Egyptian Organization for Standardization (EOS). In these meetings a number of decisions concerning the project were made and deadlines agreed upon. Among the important results was the Advisory Committee's concurrence with the recommendation that EOS should coordinate its building standards acquisitions with those of the Building Information Program, under the leadership of Dr. Ahmed El-Erian in cooperation with **James L. Haecker** of CBT.

Federal Republic of Germany

In August 1978, **C. M. Allred** of CEEE's Electromagnetic Technology Division visited the Forschungsinstitut des Fernmeldetechniches, Zentralamt, in Darmstadt. He was interested in their fiber-optics work. Among other pieces of equipment, Mr. Allred was shown a mechanism for producing a graded-index fiber by heating the fiber in the presence of various gases. The glass material at this stage is about a meter long and 1 cm in diameter. They then put it in a special furnace and draw it into a single fiber. The losses were in the order of 4 or 5 dB per kilometer. They measure their losses by the common method of a photocell looking at the light coming out of the fiber and then cutting a piece off and measuring the change in power. The mode distribution was reasonably constant after the first ten meters.

Russell D. Young, Chief of CMEPT's Mechanical Processes Division, toured WZL, the Laboratorium fur Werkzeugmaschinen und Betriebslehre der Rheinische-Westfabschen Technischen Hockschule, Aachen, West Germany, during September 1978. **Robert J. Hocken,** also of CMEPT, toured the laboratory. This group, composed of 400 employees, half of them students, is engaged in production engineering. At present, they have several large machine tools equipped with adaptive control devices including microprocessor hardware. Their computer-aided planning activities are now in use in many industrial plants.

WZL has an operating data bank on machine-tool wear and life derived from data supplied by 54 companies; it provides cutting information to all German manufacturers. In 1979 these data will be available to all, after approval by the industrial participants. WZL is also developing time-sharing systems using microcomputers so that remote computers can more economically serve a number of machine tool facilities.

They have also created a work-station, involving chucking and materials handling, with two robots and three machine tools. WZL foresees an unmanned factory in the near future.

Harold P. Van Cott, Chief of CCPT's Consumer Sciences Division, visited West Germany in August of 1978 to confer with leaders in ergonomics and to tour laboratories engaged in product design, testing, and standards. He also chaired a symposium at the Tenth Intenational Congress of Applied Psychology.

Today, a number of developments in the European community suggest that the application of ergonomics is much more widespread here than in the United States. Whereas U.S. industry

is production-oriented and tends to introduce those technological and environmental changes that increase worker productivity and safety, in Europe there is more emphasis on changes that enhance the quality of worker and consumer life. This trend, largely supported by strong labor unions, has resulted in standards for environmental control (e.g., noise levels) and technology design that have not yet been developed or adopted in the U.S.

Germany has completed an anthropometric survey of the key static and dynamic characteristics of a sample of persons above 18 years of age representative of the total German population. The approach employed classical anthropometric measurement devices, with some semi-automatic safeguards against human error in measurement readings (i.e., use of two observers, etc.). The University of Kiel team that collected the measurements rejected the use of stereo-photogrammatic methods because the reading of reference and measurement points from stereo-photographs was excessively time-consuming, expensive, and subject to error.

The Germans have recently completed the first of a multi-volume manual of ergonomics reference data that is currently in use as a design and standards development handbook. Intended mainly for use in the design of military equipment and systems, the handbook also has application to the development of commercial products for consumers and industry. The notable characteristic of the handbook is not the technology used to produce it, which is conventional, but the thoroughness and completeness of its coverage: ranging from physiological and sensory to bio-mechanics data.

A visit with Professor Carl Graff Hoyos, Director of the Institute of Psychology, Munich Technische Hochschule, covered the work that he and his colleagues are doing on driver behavior. Of particular interest is a recently developed driving simulator. The simulator consists of a driver compartment and a wide-angle screen onto which is projected a simulated view of the road ahead. Variables being studied at the moment are the coding (spacing and length) of the center and edge lane lines to determine their influence on driving errors (e.g., deviations from an optimum vehicle trajectory) and to measure the extent to which changes in the lane stripes (e.g., decreasing the length of stripes and the distance between them) provides information that allows a driver to accurately negotiate curves. The simulator is also being used to study such other variables as the influence of obstacles on road shoulders and the effects of sleep deprivation.

A visit to Dr. Schmidtke's Ergonomics Laboratory, at the Technische Hochschule, uncovered a number of devices being used to study human control behavior in tracking tasks and to develop mathematical models of human control dynamics. Another part of the laboratory included facilities for measuring the noise characteristics of consumer products (these are used in compliance testing) and a two-axis-of-motion simulator. The simulator was being used to study the effects of vehicle movement on visual acuity.

In July 1978, **Stanley I. Warshaw** of CCPT went to Berlin to meet with Hans-Walter Bosserhoff and Annelore Lange-Stumpfig of DIN. These two head a group of seven that is responsible for putting together a product information labeling program for DIN. DIN will be responsible for all product information labeling in Germany. The labeling function reports separately to the head of DIN and is not a part of the normal administration. In addition, as in England, this group will be responsible for overseeing consumer advice centers that operate out of various towns. DIN is an association that has been operating in standards for approximately sixty years. Like ANSI and AFNOR, DIN reports to ISO. Like AFNOR, it puts out a quality mark "GS". For covering the safety aspects of consumer products, DIN uses various testing laboratories for conducting tests to qualify for the "GS" label.

Warshaw also met with the Director of DIN, Mr. Reihlen. There are approximately 130 steering committees in DIN with some 2,500 specific committees. The consumers participating in DIN come from the ten Central Advice Centers and 130 other local centers that contain sounding boards of from two to seven people. Most advice centers are run by the Consumers Union of Germany. Some advice centers are run by manufacturers, such as those sponsored by the electrical-appliance makers; and in some of the centers the government provides additional financial support.

France

In August 1978, **Steven B. Kaplan** of CEEE's Electromagnetic Technology Division, travelled to France to discuss mutual interests in propagation of electrons and phonons in superconductors with J. P. Maneval at Ecole Normal Superieure in Paris, and to discuss controllable weak links with Dan Ostrowsky and Alain Gilabert of the Universite de Nice.

By using superconducting detectors, Maneval and his collaborators have been able to determine dispersion curves for phonons in Ge, p-type InSb, and superconducting tin. Similar experimental methods have been used to measure 2 k_F in metals. Although these measurements are much simpler than many conventional technqiues, the question of their accuracy has not yet been settled. However, NEL should be aware of these clever uses of phonon detection. By applying a magnetic field to superconducting samples, an energy-threshold for the detection of phonons propagating through the samples was observed. Thus, Maneval and his coworkers have demonstrated that a real energy gap exists in superconductors under the influence of magnetic fields large enough to tune the gap (a result which has helped to resolve an on-going controversy).

Further discussions centered on Maneval's efforts to understand his detection of a signal with a phase velocity of approximately 5×10^6 cm/s arising from the nonequilibruim excitation of a single crystal of tin. Explanations of this new propagating mode are speculative at this point, but the most likely ones involve a diffuse propagation of quasiparticles or phonons.

Finally, and of more direct importance to NEL work, was a dicussion of heat flow from thin films. Maneval's three different types of measurements of thermal relaxation in Al-Sn alloy films indicate that calculations of the acoustic mismatch to various substrates underestimate the measured thermal relaxation times of approximately 1 to 30 ns by an order of magnitude.

Discussions with Dan Ostrowky and Alain Gilabert were concerned with controllable superconducting weak links. Not much work has been done in Nice during the past year on optically-induced Josephson effects. The reason for this was an effort to rebuild the experimental apparatus for greater mechanical stability, indicating that this is indeed a problem in such experiments. Gilabert was interested in learning how NEL developed the

photoresist-defined Pb-alloy quasiparticle-injected weak links. He is about to start making some Pb links for study.

In July 1978, **William L. Gans** of CEEE's Electromagnetic Technology Division was a guest professor at the Lannion, France, summer school. Each summer for the past eight years the French National Center for Telecommunications Studies (CNET) has conducted a three-to-five week summer school in Lannion with the assistance of the Institut Universitaire de Technology (University of Renes). Each summer school has addressed a different area of interest to telecommunications engineers and scientists and has been taught as a graduate-level course.

This year, **N. S. Nahman**, also of CEEE, delivered a series of lectures on the fundamental properties and methods of Time Domain Measurements and W. L. Gans presented lectures on Automated Time Domain Measurement Systems and related signal processing techniques. In addition, eighteen additional lectures were presented by specialists working with time domain techniques.

As part of this trip, Nahman and Gans also visited the Thompson CSF plant in Paris. There they reviewed the manufacture and testing of a number of traveling-wave-tube oscilloscopes (4-5 GHz bandwidth, 0.15-0.2 V/cm sensitivity) and optical streak cameras (25mm/ns to 50mm/ms scan speed, 2-10 ps time reso ution). At present the oscilloscopes are regarded as the fastest real-time oscilloscopes in the world, but they are quite expensive (approximately $75,000).

The Centre Nationale de Reserche Scientifique (CNRS), Font Romeu, is located in French Pyrenees, near the Spanish border, at an elevation of about 1600m. In July 1978, **Joseph C. Richmond** of CMEPT's Thermal Processes Division went there. CNRS has the largest solar reflector in the world. The parabolic reflector is roughly rectangular, 40m high and 54m wide. The bottom is truncated, so that the focus is 17m above the bottom. The focal length is 18m. It is made up of over 9000 square mirrors, each 45cm on a side.

The heliostat field consists of 63 heliostats, each consisting of 180 mirrors, each 50cm square. These mirrors are mounted on the steel framework of the heliostat, and have been adjusted to be coplanar to about 1' of arc. The heliostats are located on a series of terraces on a hill facing the parabolic mirror. They are so spaced that, when in operation, their individual beams form a single parallel beam, without holes or penumbra, incident on the parabolic mirror.

Each heliostat is individually controlled to keep the reflected beam horizontal and pointing south, to within one minute of arc. The mirrors are rotated about vertical and horizontal axes by means of hydraulic pumps controlled by an individual sensor for each mirror.

J. D. Siegwarth of CMEPT went to Paris in February 1978 to discuss the handling and transport of LNG, to compare densimeter studies with F. Dewerdt at Gaz de France, and to discuss LNG work with Elf Acquataine and SIM France.

J. W. Ekin and A. F. Clark of CMEPT's Thermophysical Properties Division visited the Centre des Etudes Nucleaire (CEN) research center at Saclay. There, Henri Desportes is heading the magnet development group. In just two years, this group has become the leading magnet development group in Europe. Currently they are building a low-radiation-length magnet (Cello) for the high-energy experiment, Petra. This is a collaborative project between Karlsruhe, Hamburg, Munich, Orsay, University of Paris, and CEN/Saclay. Cello is one of the few large-scale magnets being stabilized by aluminum.

They are also constructing superconducting magnets for the bubble chamber at CERN, a quadropole magnet for a high energy physics experiment, the plasma confinement magnets for the Euratom fusion program, and dipole magnets for the Russion 3000-GeV accelerator. They expressed a genuine concern about transverse compressive fatigue in superconducting composites, particularly in these dipole magnets -- perhaps this is a property NEL should be measuring.

A formal program to exchange building research results and to coordinate research objectives has existed between France and the U.S. since 1969. Since then, the Centre Scientifique et Technique du Batiment (CSTB) has been CBT's primary point of contact. CSTB's main facility is near Paris, with other laboratories in Nantes, Grenoble, and Champs-sur-Marne.

In April 1978, **James R. Wright,** Deputy of Director of NEL, and **William C. Cullen,** Deputy Director of the Office of Engineering Standards, visited the Paris headquarters of CSTB to meet with its director Dr. R. Rossi. Considerable time was devoted to reviewing the progress of the NBS/CSTB agreement items. The highlights of the discussion are noted below:

o Building Economics

CSTB is very interested in the area of building economics and have an economic unit under the direction of R. Urien. Some areas of specific interest include the economic consequences of standards and the economics of industrialization of buildings. It was felt that more exchange of information between CBT (Dr. Marshall) and CSTB (Mr. Urien) would be useful.

o Acoustics

CBT will begin a new program in building acoustics. As soon as CBT has an acoustician on its staff, arrangements should be made for him to visit CSTB's regional establishment at Grenoble to observe their facilities and discuss programs.

o Rehabilitation and Renovation Program

Greater emphasis should be placed on the renovation and modification of the existing building stock rather than on demolition and rebuilding. CBT is interested in evaluating buildings by NDE techniques. Other areas of concern include criteria, codes and standards, and the economics of rehabilitation.

o Modeling Room Fires

The NBS/CSTB agreement addresses the problem of modeling room fires. Further, the cooperative program also includes other areas as simulation modeling and toxicology associated with building fires. It was noted that CSTB staff is not doing work in toxicology. However, research toxicologists from university medical schools are exposing animals to toxic conditions at CSTB facilities. The arrangements is much the same as the Center for Fire Research has with the Johns Hopkins School of Medicine. CFR has recently added a microbiologist to its staff to provide a capability in toxicology. Dr. Rillings of CSTB visited CFR in June 1978 to study the physical-mathematical modeling of fires.

o Consumer Product Technology

CSTB is currently engaged in a study to develop novel ways of setting consumer product standards. CSTB is concerned about the performance of non-ferrous metals such as copper, zinc, and titanium. Work is being carried out under the direction of Mr. Anrijo. A state-of-the-art report on corrosion developed by the National Measurement Laboratory's Metallurgy Division was sent to CSTB.

In September 1978, **Samuel Kramer,** Associate Director of NEL for Program Coordination, travelled to Paris to visit the director of CSTB. This meeting was to set the final arrangements for the forthcoming CSTB visit to NEL. As part of this trip, Kramer also visited the Laboratoire National D'Essais, at which time he met personally with M. Clavier, director, Mlle. Nonn-Desalle, in charge of international affairs, and other directors of technical activities. In addition, Dr. Alan John Bryden joined Kramer to review potential areas of cooperative activities. Dr. Bryden is at the sub-cabinet level within the Department of Industry in France, the organization to which all French national laboratories report. Dr. Bryden discussed his forthcoming visit to the U.S.

During October 12-24, 1978, a French team representing CSTB visited CBT. The visit was coordinated by **Samuel Kramer,** Associate Director for Program Coordination NEL, and **Richard Wright,** Director, CBT. Jacques Bietry, Chief of the Nantes laboratories represented R. Rossi, Director of CSTB.

The meetings held during the two-week visit provided opportunities for NEL and CSTB technical investigators and managers to conduct indepth discussions that resulted in identifying nine technical areas for potential cooperative and complementary efforts. The areas are: 1) wind effects; 2) acoustics; 3) materials for use in solar heating and cooling systems; 4) performance of building materials; 5) rehabilitation and renovation; 6) solar heating and cooling energy conservation; 7) fire research; 8) building economics; and 9) consumer product technology. As part of the nine future research activities, the US/French cooperative program provides for continuing exchange of Guest Workers between CSTB and NEL; continuing exchange of technical reports on research programs and descriptions of program activities; and exchange of information.

In connection with the UNESCO/RILEM symposium on stone preservation (June 1978), **Gerald Sleater** of CBT's Structures and Materials Division visted two laboratories near Paris engaged in preservation work and materials testing -- the French Historical Monument Research Laboratory (LRMH) at Champs-sur-Marne and the Laboratories of the Center for the Study of Buildings and Public Works (CEBTP) at St. Remy-les-Chevreuse.

At LRMH, the work is mainly directed to repair of or preservation of artistic works; stained glass, painting, as well as stone sculpture. Diagnosis of problems as well as repair of the damaged or decayed objects is part of their work program. Materials are tested in an accelerated weathering machine (heat, cold, and light in one chamber).

At CEBTP, large-scale testing is done both in the laboratory and in the field. To test the effectiveness of controls for rising damp, an outdoor exposure site of over 100 meters of masonry walls, the bases of which are in water, has been built. At another outdoor location a series of stone walls have been built to test the long-term effectiveness of waterproofing materials; yearly measurements are made of selected test areas of walls, to determine the absorption of water by the treated stone; spalling or similar decay of the walls from the waterproofing is also studied. Laboratory studies have used sound transmission, modulus of

elasticity, and freeze-thaw measurements to develop a scheme for the French Building Industry as to what types of stone may be used in a building depending upon their expected exposure to water.

Mr. Sleater also presented a paper on the CBT test program for stone preservatives. The purpose of the symposium was to inform architects, curators, restorers, and others involved with historical monuments on how to assess the state of deterioration and the effectiveness of treatments. The paper sparked a great deal of interest in the U.S. research. Professor Zador of the Technical University, Budapest, asked for the complete set of slides used in the presentation. Following the meeting, several participants discussed the special test machine (Chamber for Accelerated Decay) used at CBT. Dr. Sramek of the State Institute for the Care of Monuments (Prague) has sent CBT stone specimens for testing.

James Clifton of CBT's Structures and Materials Division also attended the symposium and presented a paper on solvents for adobe and stone preservatives. Since then, there have been many requests for publications based on CBT's adobe research. Surprisingly, participants from Hungary and Poland were interested in adobe, not for preservation reasons, but because some farmhouses are still being built in their countries of grass, sod and earth.

As for the other topics discussed at the symposium, RILEM is developing recommendations for standardizing the sodium sulfate crystallization method for predicting the resistance of stone to damage by soluble salts. Dr. Clifford Price (Building Research Establishment, England) described the progress of work. Much attention is being given to this test because salt damage is one of the leading causes of stone deterioration in Europe. CBT will be using this method to evaluate the effectiveness of stone consolidating materials.

Dr. M. Torraca (Assistant Director of the International Center for the Conservation and Restoration of Cultural Objects, Rome) reported that his organization has found little evidence to suggest that biological attack is a major cause of stone deterioration. This appears to be in accord with earlier CBT work that showed that while biological growth was found in some cracks in the stone of the Lincoln Memorial, it was not responsible for the crackling.

The prevailing opinion expressed at the symposium was against the use of stone preservatives. However, stone consolidants are being extensively studied and used in Europe. The most promising consolidating materials appear to be silanes, epoxies, and acrylates. Of these materials, silanes are claimed to have the greatest depth of penetration, the least effect on the appearance of stone, and the most durability. Mr. Hempel (Victoria and Albert Museum, London), referred to a silane (T-04149) being produced by Dow-Corning that he has found to be effective in consolidating limestone statutes. Although this particular silane is not available in the U.S., silanes are being used by many conservators in England and Germany for the consolidation of both deteriorated sandstone and limestone. Mr. Feilder (Director of the International Center for the Conservation and Restoration of Cultural Objects, Rome) said he was opposed to the indiscriminate use of consolidants. There is a need for a performance criteria for the selection of consolidants; such a project is now underway at CBT under the sponsorship of the National Park Service.

The application of nondestructive testing methods to determine the condition of stone in historic structures was discussed in several papers. Mr. Bouineau (CEBTP, France) has been using ultrasonic pulse velocity techniques. He has been using transmitting and receiving transducers that have pointed heads and comparatively small contact areas. Such a system could find many applications in the U.S.

Charles M. Hunt, a chemical engineer in CBT's Building Thermal and Service Systems Division, visited CSTB and several other laboratories in the spring of 1978 with an eye to their research in ventilation. In general, he found that the French make much greater use of natural ventilation and less use of air conditioning than is common in the U.S. Also, while we, at the moment, are thinking of ways to reduce ventilation to a minimum, they are concerned with the best ways to provide ventilation. In France it is common practice to introduce a series of small holes over windows in new construction to provide ventilation. CSTB has a patented flap that allows these holes to "breathe", but closes like a valve when wind blows against the face of the building. Also, kitchen and bathroom exhausts use natural drafts in place of small fans.

Windows are tested by a pressurization technique somewhat reminiscent of the ASTM test for curtain walls, doors, and windows. This consists of applying pressure to a mounted specimen and measuring air leakage as a function of Δp. Another part of the CSTB test consists of measuring water leakage under pressure.

Windows are placed in three categories, A_1, A_2, and A_3, on the basis of their tightness. They must be selected according to their position in the building, and also according to the geographical region. Regions above 1,000 meters are more severe than regions below 1,000 meters.

In the United States we are discovering that the moving parts of windows and doors do not account for most of the leakage in buildings. There appears to be no comparable data on French buildings. It should be noted, however, that they use more concrete and masonry construction and less wood frame, so the leakage patterns may be different.

The Centre pour Techniques du Bois tests wooden components used in construction. One of the current interests is uses and limitations of pressboard. They also have a test device for measuring air and water permeability of windows.

The Electricite de France Renardieres Laboratories, at Moret sur Loing, have undertaken studies of air movements in rooms as well as the testing of diffusers, grilles, and other terminal devices. They recently completed a study of heat pump efficiency in a complex of small apartment buildings.

The Centre d'Etude Technique des Industries Aeraliques et Thermiques, at Orsay, is an industry-supported laboratory where research and testing related to a number of industry needs are carried out. There, in a test duct for air filters, they are using sodium chloride aerosol, similar to the British, instead of the atmospheric dust or DOP for determination filter efficiency. The sodium can be measured with a high degree of sensitivity with a flame photometer. They also had large test ducts that could be used to calibrate flow equipment. In addition, they calibrate sampling probes for stack sampling and emission monitoring.

Porter Driscoll, Manager of CBT's Design and Construction Technology Application Program, took part in a November 1977 study tour of French schools in a joint project with CSTB. In general, reinforced concrete -- cast-in-situ and several varieties of precast -- dominated the construction scene. All twelve schools visited made extensive use of concrete and only two of the twelve used any significant quantity of other materials. The Educational and Cultural Center at Istres used a steel rationalized, traditional form of construction, i.e., rolled steel shapes and steel deck, stabilized with exposed diagonal bracing both vertically and horizontally; and the nursery school at Rumilly used laminated wood beams and conventional wood roof framing to achieve a domestic scale and character. Pre-cast concrete was of excellent quality and in many cases was given no "cosmetic" finish. The heat loss

through concrete floor systems over unheated or exterior spaces appeared to be a problem and was diminished somewhat through the insertion of rigid wood fiber panels similar to "Tectum" into the coffers or channels of the floor system.

Exterior walls are most often of concrete and are produced in a wide variety of forms, textures, and colors. Large concrete exterior wall panels and deep concrete beltcourses between the window heads and roof line are often heavily textured to add interest and to visually unify disparate elements. In some cases the large panels contain windows formed into the panel themselves, whereas in other cases the window is joined in a conventional manner to vertical wall panels and roof or floor panels. The windows are mostly horizontal sliding or of the "Italian" pattern, which allows the head of the window to tip in toward the room about six-inches to provide ventilation and also to swing into the room for cleaning. This latter style window is extensively used and is available both in aluminum and wood. Almost universally windows are shielded from vandalism, excessive heat exchange, and glare by means of wood, metal, or plastic slats that roll up into a box placed above the window head. In many cases this exterior device can provide a solar shade for the window while still providing natural ventilation.

The majority of the school roofs are generally flat (having a slope less than 1/2" in a foot), but there are two examples of sloped roofs, one in concrete (Pontcharra) and one in wood (Rumilly) to give regional character. Extensive use is made of sky lights in circulation areas, places of assembly, and workshops, and "Pyrodomes" are used for venting in case of fire. The combination of extensive fenestration and sky lights allows great quantities of natural light into the building. In most cases the head of the window comes very close to, if not flush with, the ceiling and provides natural light deep into the room. This coupled with reflections from relatively light interior finishes often provides all the illumination necessary.

Heating systems in the schools consist of electric resistance heating, fossil-fueled hot water and steam systems, or forced hot-air systems. During the heating season artificial ventilation is provided at the rate of three to four air changes per hour, or not less than 15 cubic meters per pupil per hour. There was no evidence of air conditioning in any of the schools, but this lack is causing a certain amount of discomfort particularly in the southern regions. CSTB research is being conducted on alternative methods of providing thermal comfort during hot weather; in lieu of mechanical refrigeration they use intense mechanical ventilation providing 20 volumes of air per hour taking advantage of the thermal inertia of the building with supplemental air cooling by means of water evaporation. Both summer and winter the air velocity varies from 2 to 5 meters per second with the range of 3 to 4 meters per second being most usual. This translates into approximately 600 to 750 feet per minute, a velocity which does not seem to trouble the room occupants. The tempered air is pumped into each classroom high on the wall opposite the window wall and is drawn out through acoustically trapped openings in bottom panels of the doors. There is a perceptible breeze at the seats adjacent to the window wall, but it is not uncomfortable or annoying.

Lighting and electrical distribution is most often handled quite simply and directly in school building construction. Artificial lighting appears to be designed to supplement natural illumination. Fluorescent fixtures are used in classrooms and incandescent elsewhere. Incandescent fixtures are modest and unobtrusive except where they are used to accent design elements; then the fixture and the light it produces is playing a major role. In the case of ceilings of precast concrete, the electrical conductor, resembling Romex, is often run unprotected in the joint between two adjacent slabs and emerges only to enter a surfacemounted junction box to which the light fixture is secured. Overhead electrical disribution for typewriters, sewing machines, and other appliances is common, with the final connection by means of drop cords into which the appliances are plugged. The overhead

electrical distribution system consists of Romex supported on a pendant-mounted perforated metal channel similar to unistrut.

In July 1978, **Stanley I. Warshaw**, Director of CCPT, visited the laboratories of CSTB and AFNOR, the Association Francaise de Normalisation, the French equivalent of ANSI. Over the years, AFNOR has issued about 8,000 standards, of which 100 are mandatory. It also is involved in product labeling. The National Laboratory of Test, called the Laboratoire National D'Essais, serves as an arbitrator in any issues that may arise among AFNOR, its committees, and manufacturers. This is binding arbitration.

L. G. Porter, of CCPT's Consumer Sciences Division travelled to the University of Paris and Rene Descartes University in July 1978 to attend a NATO Symposium on Applications of Human Biostereometrics and to discuss the development of the Human Biometry Data Bank at the University of Paris with Professor A. M. Coblentz.

Biostereometrics uses optical, laser, holographic, scanning electron microscope, and X-ray photogrammetry techniques to investigate body surfaces, volumes, contours, growth, and even some types of motion. Data retrieval, however, can be time consuming and costly depending on the amount, type, and accuracy of the data requirements.

At the University of Paris, the data bank is from the USAF and RAF, along with some French anthropometric information. Although the data base is on discs at the university's Univac 1108, their data retrieval and analysis software packages are very limited, being restricted to the simplest of available statistical analyses. At present they cannot do complex multivariate analyses such as eigenvector analyses, response surface methodologies, or trivariate analyses.

Professor Coblentz is strongly interested in working with the U.S, the NATO countries, and ISO to develop an international ergonomics data base. The establishment of an international data bank and international sizings standards might have a significant impact on imports/exports between European countries and the Western hemisphere. For example, F-15 cockpits, designed for American pilots, have had to be redesigned for Korean, Japanese or Iranian flyers. An international data bank would help exporters design for sales to particular countries.

Charles P. Howard of CCPT's Product Performance Engineering Division travelled to the University of Campiegne during April 1978. There, at the Engineering Mathematics Center, two days were spent with Prof. Gilles Cantin and his group discussing the finite element methods of modeling heat transfer systems that might be used in heat recovery. Prof. Cantin is one of the world's recognized authorities in finite element analysis. Of particular interest were the techniques for obtaining convergence for transient operation in heat exchangers. The information from these discussions was important to the programs currently to be carried out for DOE.

Greece

In a joint project of the DOE and the National Energy Council of Greece, an international conference on energy and community development was held in Athens in July 1978. More than 300 representatives of 27 countries attended, including **C. W. Phillips** of CMEPT's Thermal Processes Division. Overall, the conference was structured to address the following subjects:

- The community as an energy consuming system. Ways of achieving energy-conserving and environmentally sound communities.
- Rational use of energy in communities, with emphasis on non-depletable and recycled resources.
- The application of energy-related decisions for community development.
- Environmental and policy impacts of innovative, decentralized community energy systems; policy and decision-making at the national and community levels for community energy systems.
- Institutional impediments to the rational use of energy in the planning, development, and operation of human communities; international cooperation, exchange of information, and technology transfer.

A major focus of the work was an in-depth description and critique of a joint Greek-American project to design and establish an energy-effective community at Frangocastello, Crete.

In addition to the goal of establishing a viable community in an area where none now exists, the community is intended to provide relief for the slum crowding that now is a serious problem in the larger mainland cities of Greece. The community is planned to eventually accommodate a population of 250,000. Immediately following the conference, approximately 60 representatives from the 27 countries participating in the conference visited proposed site on a coastal plain in the south of Crete.

Israel

In March 1978, **Philip S. Klebanoff** of CMEPT's Fluid Engineering Division attended the Second Bat-Sheva Seminar on MHD-Flows and Turbulence held at the Ben-Gurion University of the Negev, Beer-Sheva, and to visit the School of Engineering at Tel-Aviv to discuss their work in fluid mechanics.

At the conference, 42 papers were presented, covering MHD-duct flows, turbulence interaction, turbulence structure, and power generation. The bulk of the papers, including those on MHD power generation, were concerned with a liquid metal as the working fluid. Surprisingly, no papers on diagnostic methods in liquid metals were presented. However, the need for adequate diagnostic methods, particularly in the area of two-phase liquid metal flows was stressed in panel discussion. The formal contribution of NBS consisted of a talk on recent measurements of turbulence structure. Mr. Klebanoff was also chairman of a session on MHD turbulence.

Major emphasis was given to the complex problem of MHD-duct flows interacting with nonuniform magnetic fields. The motivation for such interest apparently stems from the possible use of Lithium cooling blankets, particularly in fusion reactors. This interest was gratifying inasmuch as an NBS contribution at the first Bat-Sheva Seminar on MHD-Flows and Turbulence in 1975, was based on results obtained in the NBS MHD Flow Facility, which pointed out the importance of this problem.

The School of Engineering at Tel Aviv University, now has a newly constructed building known as the Wolfson Building, and a prominent Department of Fluid Mechanics and Heat Transfer. Of particular interest is the research of Professor Wygnanski, whose major area of interest is experimental turbulent fluid mechanics with emphasis on measurement and analysis of basic phenomena of turbulent flows. Currently, he is doing research on the behavior of turbulence spots, and at the present time this subject is receiving a great deal of attention in connection with attempts to understand the long-scale coherent structures of turbulent boundry layers.

In June 1978, **Joseph C. Richmond** of CMEPT's Thermal Processes Division travelled to Jerusalem to confer with Dr. Harry Tabor, Scientific Director, The Scientific Research Foundation, at Hebrew University. Dr. Tabor is one of the early pioneers in the utilization of solar energy. His work in this field dates back to the early 1950's.

Richmond also met with Dr. Alvin Milgrim of the Weissmann Institute in Rehovot, on the subject of solar energy measurements. Among other developments, Richmond also observed a quick method of measuring normal emittance, in which a sample is placed on a heater block in a fixed position, and the emitted radiant power is measured with a total radiation detector. The device is calibrated by use of samples that have been measured calorimetrically.

Japan

Paul F. Wacker, a physicist in CEEE's Electromagnetic Fields Division, reviewed the activities of a number of Japanese electronics establishments during August and September of 1978. His first stop, the Radio Research Laboratories (RRL) of the Ministry of Posts and Telecommunications, has long been involved in radio propagation. RRL has also been involved in space communications since 1960, maintains its own ground-station complex at Kashima, and has been actively concerned with the design and use of four experimental satellites, forerunners of a national communication and broadcast system. Their antenna coverage patterns are contoured to the shape of Japan for maximum use of power and minimum interference in other areas. In addition to system evaluation, their investigations include dual polarization, millimeter waves, their attenuation by rain. Color TV is transmitted from the satellite at 12 GHz; with an ordinary TV set, a 1-meter antenna, and electronics including a frequency converter, little if any snow is observed; with mass production, the front-end electronics are expected to sell for about $300.

To determine the patterns of their satellite antennas, they plan a near-field scanning facility with planar, cylindrical, and spherical scanning; they previously sent Dr. Tasuku Teshirogi as a guest worker to NEL to learn the techniques; he submitted a proposal for the facility to the Minister of Finance during Wacker's visit. The absorber in their anechoic chamber is a carbon-loaded polymer similar to that used in the U.S., but is backed by ferrite. Since this combination gives good results down to 136 MHz, it deserves further investigation for use here.

Dr. Fukushima has developed a technique of determining air-temperature profiles along a 2-km line to about 0.6°C by monitoring the propagation of a sound pulse by means of radar backscatter. This might possibly provide the basis for an on-board device to warn aircraft of clear air turbulence. Using a propagation window in the visible with range-gated sharp pulses to reject backscatter, they are developing a laser undersea communication system for TV and high-speed data transmission and undersea observation TV.

Wacker also visited Nippon Electric Company ($3 billion of annual sales in satellites, ground stations, microwave systems, optical fiber research, VLSI, and charge coupled devices) and Mitsubishi Electric Corporation ($4 billion annually in space electronics, communication equipment, fiber optics, numerical control equipment, and electronic measuring equipment).

Mitsubishi (MELCO) also mass-produces panels for segments of reflector antennas, the molds being designed to allow for elastic recovery after release from the mold. Their recent papers discuss bidirectional laser transmission using a single optical fiber, beam-shaping in aperture antennas, elimination of cross-polarization in offset dual-reflector (e.g., Cassegrain) antennas, design of dual-polarization and millimeter-wave antennas, and broad-banding of corrugated waveguide and conical horns by ring loading. Due to the large number of geostationary satellites, new generations of satellites and ground stations are required worldwide, with beam shaping (contoured patterns), dual polarization, low sidelobes and cross-polarization, and high frequencies. MELCO is in the forefront of this effort.

The conventional techniques of measuring antenna gains and patterns are becoming inadequate for the new generation of space antennas. To determine the patterns of their antennas, MELCO is actively considering near-field scanning and may well have the first such facility in Japan.

At Tokyo Shibaura Electric Company, Wacker reviewed the development of ultrasonic imaging systems for medical observation of soft tissues, linear-scanning for the abdomen, and sector-scanning for the heart. The linear scanning is similar to the side-looking radar used for military reconnaissance in that a transmitter-receiver of low directivity is moved along a line and the received signals processed together, with attention to their phases, yielding resolutions comparable to those obtained with an aperture equal to the transit length. Here, however, to avoid mechanical motion, an array of ultrasonic transducers is used with the elements activated electronically in sequence; moreover, electronic focusing on both transmitting and receiving is used for a sharper image, and small-angle steering of the array is used to obtain almost twice as many scan lines as array elements. For viewing objects behind bone or air (e.g., for viewing the heart), the array is steered as a unit. Both systems give real-time moving pictures and resolutions of 2 or 3 mm and use time delays. These techniques, together with range gating to avoid reflections from objects outside the range of interest, should be useful for various remote sensing problems, both electromagnetic and ultrasonic, such as those encountered in prospecting.

The Yokosuka Electrical Communication Laboratory carries out research and development related to data communication systems, data processing techniques, transmission systems, and input/output devices. Their present research is devoted to digital communication networks, optical fiber systems, high-speed coaxial Pulse Code Modulation (PCM) systems, and both Frequency and Time Division Multiplex. In January 1977, they placed in commercial service a PCM digital system with 5,760 telephone channels, the highest bit rate digital carrier over a coaxial cable in the world; they are working on still higher capacity systems. They have also developed and placed into service 20-GHz radio relay systems with the same number of telephone channels; they have developed and carried out long-run tests on a circular millimeter wave-guide system with 26 channels, each with a capacity of 11,520 telephone channels or 800 megabits/second, using Phase Shift Keying and a bandwidth from 43 to 87 GHz. Further, they have developed a Time Division Multiple Access system for flexible channel assignment between earth stations. For one satellite, they developed a shaped-beam horn reflector antenna for simultaneous operation with contoured patterns at four frequencies between 4 and 30 GHz; they are now studying the characteristics of the reflector, made of Carbon Fiber Reinforced Plastic with an aluminum honeycomb core. Their earth station in Sendai makes use of the first offset Cassegrain antenna put into practical use. It has low sidelobes due to the absence of aperture blockage and low wind loading because the main reflector is nearly horizontal. For simplicity in fabricating the panels forming the main reflector, it represents part of an axisymmetrical paraboloid, with shaping applied to both the sub- and beam-waveguide-reflectors.

At Kokusai Denshin Denwa Company, a joint stock company that handles Japan's international telephone services, researchers are looking forward to digital speech transmission systems. They are investigating high-efficiency encoding of speech signals; for reducing bandwidths in TV transmissions, they have developed a video simulator that makes it possible to treat 30 seconds of commercial color TV pictures for digital encoding. For optical-fiber communication systems, they have developed a 1.27 μm indium phosphide (InP) light emitting diode, whose relatively low frequency provides low loss in the fiber. They have developed a low-cost Gregorian ground-station antenna capable of tracking a geostationary satellite; the small longitudinal drift is compensated by controlling the main reflector about a quasipolar axis and the perpendicular motion is compensated automatically by controlling small beamguide reflectors. They have reduced the wide-angle side- and backlobe levels of parabolic reflector antennas by 10 dB using hoods covered with 6 or 7 mm of rubber ferrite; almost all their antennas use this system. With a tapered dielectric sleeve inside a conical horn antenna, they obtain a circular beam and the cross polarization characteristics of a corrugated horn without the weight of the latter; their horn was selected for INTELSAT IV-A. They have developed an offset Gregorian antenna with an elliptical subreflector and a parabolic reflector; the sidelobes are low due to the absence of aperture blockage and the cross-polarization characteristics good due to mutual compensation by the two reflectors. They claim that the sidelobes are conspicuously suppressed as compared with both conventional parabolic and Cassegrain antennas and that the cross-polarization characteristics are incomparably superior to those of horn reflectors or any other antenna.

Richard Y. Koyama of CEEE's Electron Devices Division toured Japan's semiconductor industry in October of 1977 to review their efforts in deep-level defect measurements, use of test patterns for process control, and production of high-power devices, among other topics.

In general, his survey found that measurement practices for process control and materials characterization vary. Dummy wafers are often used for process control measurements. The use of test patterns, although not universal, is evident, and is particularly true for product wafers in early stages of design and process development. Deep-level measurements were made only occasionally and then only in laboratory environments. Minority carrier lifetime measurements were made using a variety of methods and with only one exception, all were standard techniques. Spreading-resistance and four-probe measurements were routinely available.

Although some new techniques for measuring semiconductor device and material characteristics were mentioned, new developments in measurement methods were not generally depended on. As is true in the U.S., manufacturers are motivated more to produce devices rather than develop new measurement methods. Although there are standards organizations that seek to promote measurement methods, there appeared to be no single organization where such new techniques are investigated and developed.

Production of high-power devices in Japan is quite comparable to that in the U.S. However, they have a strong commitment to the use of thyristors for power generation/transmission systems. They already have a number of DC links in operation and at least two manufacturers were providing large devices for the Honshu-Hokkaido undersea DC link. In addition, during this trip, one Japanese manufacturer announced a prototype thyristor that is the largest in the world.

Similarly, **Robert I. Scace** of the CEEE Electron Devices Division reviewed Japanese semiconductor manufacturing practices during November 1977. He found that the industry has established a network of satellite plants all over Japan, rather then being concentrated in the Tokyo-Osaka region as it had been a decade ago. Operations in the extreme northern

and southern parts of the country can tap new sources of labor at somewhat lower costs. Nevertheless, labor costs in Japan are as high as in this country when all fringe benefits are included. This factor has led to the use of sophisticated automation in device assembly operations, to a degree matched only by two or three of the largest U.S. companies. For some Japanese companies, highly automated facilities have improved yields by 30 percent.

Careful attention is paid to quality control. While considerable variation from place to place was noted in the kinds of in-process measurement in use, final electrical testing was universally carried out with extreme thoroughness. Quality control organizations are strong, with technically excellent staffs, and generally report independently to upper management. Their influence is evident everywhere, and one has the strong impression that the reputation of Japanese semiconductor products is earned by meticulous quality control and assurance methods well-known in this country but not always well-practiced.

The highly publicized VLSI (Very Large Scale Integration) program was explored in two government laboratories and five companies. This four-year effort, funded jointly by the government and the participating firms at a total of $280 million, is part of a concerted effort to make Japan the world leader in the manufacture of large main-frame computers. Significant effects will also be felt in making large-scale integrated circuits for telephone equipment, smaller computers, industrial controls, and consumer products.

The program is about one-third of the way to its conclusion. It is still gathering momentum and very little effect is visible at this time. Because of the way the people working on the VLSI effort are distributed geographically (due in part to Japanese employment traditions) there are at least a dozen physically separate locations whose work must be coordinated. This represents a serious management problem. On the other hand, the technical competence and the sophisticated equipment being applied to the work are such that significant technical advances will be made.

Bruce Ellingwood of CBT's Structures and Materials Division spent 12 days in Japan in the summer of 1978 as part of a disaster investigation team acting under the auspices of the U.S./Japan Cooperative Program on Natural Resources (UJNR). The team was sent to survey damage caused by the Miyagi-Ken-Oki earthquake of June 12, 1978.

Team members spent five days in the Fukushima-Sendai-Ishinomaki area, 320 km NE of Tokyo, meeting with local building authorities and photographing damage to buildings, commercial and industrial facilities, bridges, and earth structures. Professional staff from the Ministry of Construction accompanied the team members, easing access to damaged areas, arranging meetings with local engineers and building owners, and providing seismic data.

Team members then spent three days in Tokyo, meeting with officials from the Public Works Research Institute and the Building Research Institute on matters related to seimsic engineering. One day was spent visiting Tsukuba, the new science complex north of Tokyo, where most of the research functions of the government of Japan are being consolidated.

The final day was spent inspecting damage to roads, tunnels, and earth slopes on the Izu Peninsula south of Tokyo caused by an earthquake in January 1978.

A seminar was held on August 29, 1978, at NBS at which preliminary results of the earthquake investigation were presented by all team members. This seminar was attended by over 100 people. A definitive report on the earthquake will be issued by the team in 1979 under the auspices of UJNR.

In October 1977, **Tamami Kusuda**, of CBT's Building Thermal and Service Systems Division, made several stops in a three-week survey of Japan's most advanced heating and cooling programs. His first visit was to the Oita University solar energy project, part of the Japanese Sunshine Project, a national program for energy independence. There, a large-scale solar collector (500 m^2) is being installed atop the three-story building to heat as well as cool the entire structure. A special feature of the system is a double-effect absorption chiller of 63,800 kal/hr capacity, for which supplementary heat is provided at the higher stage, while the solar energy is used in the lower stage.

Kusuda's next stop was at the Kuju plant, one of the world's most modern geothermal electricity-generators. Daily, the plant produces 23 mw of electricity, and is one of the pilot plants that could potentially supply 20 percent of Japanese electric power. Its greatest problem today, however, is the cleaning of the water return-to-the-ground system because of its extremely high concentration of scaling material.

Kusuda also met with Professor Urano of Kyushu University to discuss the building heat transfer programs that are his responsibility. Professor Yamasaki and Mr. Watanabe joined the discussion on energy transfer functions, convection simulation, aerial thermographic surveys of buildings, and energy conservation standards. Also discussed during this meeting was a potential NBS guest worker program with the Kyushu University in the coming year. Incidentally, Professor Urano was an NBS guest worker during 1976-1977.

At the Research Laboratory of the Matsushita Household Appliance Company, Kusuda observed several advanced research activities in the area of environmental measurements on heat pumps and unit heater systems. Also shown during the visit was their newly developed solar hot-water heating system that employs a double wall heat exchanger, 2 m^2 single-glaze reinforced fiberglass plastic sheet covered solar collectors, and a 70-gallon hot water storage tank.

Approximately 20 to 30% of Japanese homes have at least one room cooler, a split-unit air conditioner of less than 1-ton capacity. The Matsushita Electric Company is one of the largest producers of this, the most popular appliance in Japan. A visit to the Kusatsu plant uncovered a very modern facility producing 2,000 such coolers per day. The machining, assembly, soldering, charging of the refrigerant, and inspection were all performed in a completely automated fashion and in clean rooms. The EER (energy efficiency ratio) of the Matsushita unit is 10, which is very high by U.S. standards. In addition, the units are extremely quiet and compact.

Kusuda gave a seminar on "Solar Heating and Cooling in the United States" to a group of approximately 150 HVAC engineers in the Nagoya area. After the meeting, a discussion was held with Dr. T. Noguchi of the Nagoya Industrial Research Laboratory, who has been validating the ASHRAE standards for testing and rating solar collectors and storage devices. These standards were developed from NBS standards prepared by Hill, Kusuda, and Kelly. Dr. Noguchi, a famous solar scientist in Japan, was impressed with the CBT solar collector test methdos.

Mr. Ishihashi of Yazaki Industries of Shizuoka, gave an extensive guided tour of his well-organized and efficient plant, where approximately 1,000 units of high-efficiency solar collectors are being produced monthly. Yazaki also mass produces high performance absorption-type water chillers.

The present Yazaki Industries solar systems cost approximately $20 per square foot of collector area, for which the collector cost is $8. The Ashitaka Home total construction cost was $1.16 million, for which the solar system cost was $120,000 and the total HVAC

system cost was $280,000. As mentioned earlier, the Japanese solar cooling is well on its way to practical application, and it is expected that many more solar cooled buildings will be built in the near future.

At Waseda University energy conservation and solar heating/cooling research were discussed with Dr. K. Kumura and Professor Inoue. Professor Kumura was experimenting with a silica-gel adsorption air-dryer saturator system. A similar system is also being developed at IGT in Chicago. In the afternoon of the same day, Tokyo University was visited to see Professor Mastuos' experiments on solar collector testing, thermal responses of buildings, and weather data analysis for annual energy calculations.

Kusuda was the guest of Dr. T. Tsuchiya at the Japanese Building Research Institute. Dr. Tsuchiya is responsible for experiments on solar heat storage in the ground, airflow in buildings, humidity response functions, and energy conservation standards. He also talked with an internationally known fire-smoke specialist, Dr. Wakamatsu. Dr. Wakamatsu was successful in simulating the recent fire-caused smoke migration in the Osaka Sennichi Building that caused the death of 114 people.

At Ohbayashi-gumi, one of the largest Japanese construction companies, Kusuda met with Mr. Nakuhara, chief of environmental design. Mr. Nakuhara's group is responsible for many imaginative applications of computerized HVAC controls to minimize building energy consumption. At a group discussion on the latest HVAC related research, Mr. Kusuda presented a slide show of the NBS heat pump and Stirling cycle heat pump research; and the Japanese engineers talked about the latest centrifugal refrigeration, ventilation control, and computer controls.

On October 27, Kusuda presented a seminar to a group of 300 Japanese refrigeration engineers on the subject of "Solar Heating and Cooling Activities in the United States." Later, at the sixteenth anniversary conference of the Society of Heating, Air Conditioning, and Sanitary Engineers of Japan, he gave the memorial lecture on the subject of "U.S. Energy Conservation Research and the GSA/Manchester Energy Conservation Demonstration Project." The seminar was attended by approximately 400 HVAC engineers throughout Japan.

Korea

Under a Memorandum of Understanding between NBS, AID, and the Government of the Republic of Korea, **Tamami Kusuda**, of CBT's Building Thermal and Service Systems Division, presented two seminars to the Korean Standards Research Institute (KSRI). Nearly 150 specialists attended these two lectures, one on the solar heating and cooling programs in the United States, and another on the NBS energy conservation demonstration building. Kusuda also visited the construction site of the new KSRI laboratories in Tae Jung, approximately 100 miles south of Seoul, and made several suggestions on HVAC systems, environmental studies, and energy conservation criteria for their facilities.

Netherlands

In August 1978, **C. M. Allred** of CEEE's Electromagnetic Technology Division visited the Phillips Research Laboratory in Eindhoven. There, he reviewed their work on interference and compatibility. Among other matters, they are quite concerned about the Canadian interference regulations. They said some of the common market countries are issuing regulations that favored their own industries. Very few homes in Europe have microwave ovens, but microprocessors are being increasingly used in consumer items. They predict severe problems. Already they have received complaints of a malfunctioning washing machine due to interference.

In connection with the 1978 FLOMEKO-IMEKO conference on Flow Measurement of Fluids, held in Groningen last September, **G. E. Mattingly** (chief of CMEPT's Fluid Engineering Division) attended the official opening of the new Dutch Flow Calibration Facility. He also visited the Laboratory of the Service of Weights and Measures at Dordrecht in the south of the Netherlands. Here, the Dutch are making the shift from static mass standards and timing standards to "flow standards." This laboratory was very well-organized and equipped. The process is to calibrate small positive displacement meters for gas against a volume of displaced hydraulic oil, which is weighed to determine the volumetric flow rate of air. Meters so calibrated are then piped in parallel (ten or so such meters) and then used to prove large turbine meters flowing at high pressure. These turbines are then piped in parallel to prove the largest meters used in The Netherlands. This hierarchy of meter proving is very well quantified and backed up with replacement meters.

Today, there is little round-robin testing and cross-checking of meters across national boundaries. But there was considerable interest in such activities on the part of the Dutch and myself. A future agreement on round-robin meter testing would do much to establish mutual confidence in the metering of essential and costly fluid resources and fuels.

At the FLOWMEKO Conference, Mr. Mattingly gave a talk on NBS computational efforts to optimize flow conditioning in meters and to minimize the pressure drops across such devices.

James A. Brennan of CMEPT's Thermophysical Properties Division also attended the Groningen FLOMEKO sessions. He presented a paper and took the first steps toward a unique interlaboratory testing program on some newly modified turbine flowmeters from the Dutch firm, Messer Griesheim (MG). The flowmeters would be tested at MG and possibly Air Liquide in France and then sent to us by the end of the year.

Mr. Brennan also distributed copies of an NEL paper on LNG sampling procedures. At present, N. V. Nederlandse Gasunie is constructing a new LNG import terminal near Groningen; they were here to see the results of the NEL work.

The Technical Center for Fire Protection, Delft, was toured by **Daniel Gross** of CFR's Fire Safety Engineering Division in September 1978. There, the following projects are underway:

(1) Measurement of the effect of possible heat conduction along exposed corrugated sheet steel decking (supporting normal weight concrete) to the upper flange of a 1-hr protected I-beam.

(2) Examination of hangars for unrated suspended ceilings that have ventilation openings, to ensure that premature collapse (during 30-minute evacuation) does not occur.

(3) Protection of ship bulkheads with sprayed intumescent fireproofing to protect off-shore housing platform against oil fire.

(4) Protection of plastic pipe using glass-reinforced Palusol sleeve -- intumescent action causes complete closure of opening as PVC softens and collapses.

(5) Fire tests of protected timber joist floor for remodeling of existing buildings.

(6) Smoke-tightness of a wooden door exposed to a high-temperature fire.

Norway

A. F. Robertson of CFR visited the Fire Research Laboratory in Trondheim during May 1978. This extensively equipped laboratory is the only one of its type in Norway. It currently has two large fire endurance furnaces and is planning a new one that will be capable of testing wall-floor systems and the associated joint. At the time of the visit they were measuring the fire safety of wood-burning stoves in connection with their export to the U.S. Their test methods are the same as UL tests.

Portugal

In December 1977, **James Robert Harris** went to Lisbon to provide technical advice to the Government of Portugal regarding disaster relief and preparedness plans, specifically with respect to earthquakes. Mr. Harris is a staff member of CBT's Building Economics and Regulatory Technology Division.

The trip was requested by the Comissao Instaladora do Servico Nacional de Proteccao Civil (CISNPC, the Civil Protection Committee) of the Ministry of National Defense. The first portion of the week included meetings with CISNPC, the National Laboratory of Civil Engineering (LNEC), the National Institute for Meteorology and Geophysics, and the Lisbon Fire Department. CISNPC also arranged a symposium at LNEC that was attended by about 125 scientists, engineers, industrialists, insurers, and government officials. The symposium was to sensitize the attendees towards seismic hazards in Portugal and to encourage them to work together in developing a plan for disaster preparedness and a program for disaster mitigation.

Some findings from the trip follow:

- The typical engineer in Portugal has received little training in the design of earthquake resistant structures. Although LNEC has an active program in earthquake engineering that is staffed by excellent people, the practicing engineers may not be receiving the fullest benefit of it.

- The building regulatory system does not appear to be effective in assuring an acceptable level of risk in new buildings. The national building code does contain provisions for seismic resistant design, and significantly revised provisions are currently being circulated for discussion.

- LNEC appears to be particularly advanced at using scale models of buildings, dams, and other structures to predict structural behavior and at correlating the physical models with analytical models. Cooperative work could be valuable to both the U.S. and Portugal. It is possible to foresee joint ventures with CISNPC and LNEC on several topics (e.g., seismic resistance of reinforced and unreinforced clay tile walls and techniques for assessment of old structures).

Spain

In September 1978, **James R. Wright,** Deputy Director of NEL, and **Samuel Kramer,** Associate Director for Program Coordination, traveled to Madrid to meet with representatives of a select group of Spanish laboratories to review on-going cooperative research between the two nations and to explore future extentions of these programs. The first meeting was with the Subdirector General de Tecnologia y Productividad Industrial Ministerio de Industria y Energia. The purpose of the meeting was to explain the organization, expertise, and programs of the National Engineering Laboratory (NEL), NBS, and likewise for the NEL representatives to gain an understanding of the programmatic interests of the Ministry. It should be noted that their director, Sr. Gil Pelaez, also serves on the Joint Committee for Science and Technical Cooperation, 1976 Treaty of Friendship and Cooperation Between United States of America and Spain. Sr. Pelaez expressed interest in the activities of the Center for Applied Mathematics with respect to sampling methods for quality control; the labeling program of the Center for Consumer Product Technology; and the National Voluntary Laoboratory Accreditation Program (NVLAP). The major interests and discussions focused on NVLAP.

Wright also met with the director of the Centro de Esudios de la Energia, whose interests are focused upon energy conservation (primarily in industry), transportation, and new sources of energy, excluding nuclear. It was noted that of the energy consumed in Spain, over 55% is by industry. Energy consumption for residential heating and cooling and for home use in Spain is not substantial (less than 7%) and in view of the climate and personal attitudes towards acceptable thermal environment is not considered to be a primary target for energy conservation activities. With respect to new sources of energy, this laboratory is looking into wind and solar power and bio-mass.

The director of the Laboratorio Central de Ensayo de Materiales de Construccion was also visited. A facilities tour provided an opportunity to see the new equipment that has been acquired during the past 18 months. Included were new universal material testing machines equipped with environmental conditioning chambers, accelerated weathering machines with dispersant injectors and monitors, and a scanning electron microscope. Special purpose equipment for the cooperative research project has been constructed and was in use. The Laboratorio has also expanded their data acquisition system and computer facilities.

Sweden

In May 1978, **Robert F. Jones** of CBT's Building Thermal and Service Systems Division traveled to Stockholm, Gothenburg, and Lund. He took part in a series of meetings designed to bring together U.S. and Swedish researchers. The meetings focused on energy conservation in buildings and solar energy for building heating. The most important interactions were in areas where Sweden and the U.S. have not had much contact, such as in the field of plastic piping where excellent test facilities and procedures were observed. Likewise, the dependency of Sweden on solar energy has caused them to launch experiments in areas not yet touched nor likely to be investigated by the United States very soon.

Switzerland

Richard G. Bright of CFR went to Mannedorf in October 1977 to visit the Cerberus firm to discuss developments in the technology of automatic fire detection along with the latest developments in the testing and approval of such devices.

Cerberus is the oldest and largest manufacturer of automatic fire detection devices and systems in the world. As a consequence, their knowledge and information as to the state of fire detection devices and technology is of much importance to those of us working in the field. In addition, Cerberus maintains the most up-to-date and complete fire detector test facilities anywhere.

In July 1978, **M. B. Kasen** of CMEPT's Thermophysical Properties Division visited the offices of Ciba-Geigy, S.A., in Basel. His hosts were Dr. Ursula T. Kreibich and Dr. Rolf Schmid, both of whom collaborate with Dr. Hartwig of Karlsruhe (Institute for Technical Physics, Germany) on epoxy matrix development for cryogenic composites. They believe that the thermal contraction of the resin strongly influcences the cryogenic composite behavior.

R. D. Reed, M. B. Kasen, and A. F. Clark (all from CMEPT) together met with the cryogenics group at the Center for Nuclear Research (CERN), Geneva, under the direction of F. Schmeissner. Included was a visit with Mr. Knud Dahlemo-Petersen, who is building facilities for mechanical testing of composite materials manufactured by European firms. Glass-reinforced epoxies, phenolformaldehydes, polyimides, polyesters, and teflons will be tested along with graphite, boron, and Kevlar-fiber materials. The test program appeared to be mostly a screening effort in tensile and compression.

In July 1978, **Stanley L. Warshaw** went to Zurich to meet with Dr. H. Stoffel, Director of Schweizerisches Institute fur Hauswirtschaft (SIH), and Institut Suisse de Recherches Menageres (IRM). This facility contains a product-testing laboratory and is principally devoted to approving products submitted by manufacturers to allow them to use the quality markings, SIH and IRM. The Institute publishes a complete listing of all the products it tests and in some cases even the results of some comparative tests. SIH also maintains a "hot line" for consumers two days a week where consumers can call and ask for any product information that they would like, including comparison of performance between various brands. Their clients are required to resubmit products for tests at a minimum of every two years, o earlier, if any significant design changes have been made.

United Kingdom

During an August 1978 meeting with Professor C. W. Clenshaw, Lancaster, England, **Daniel W. Lozier** of CAM's Mathematical Analysis Division reviewed the evaluation and computer testing of a new algorithm developed by Clenshaw and F. W. J. Oliver of NBS. The algorithm is capable of producing values of the exponential function for completely unrestricted values of the argument and to completely arbitrary precision. It will be useful in future standards work. Later, Mr. Lozier and Professor Schonfelder of Birmingham discussed various aspects of quality and portability of mathematical software, particularly with regard to the above-mentioned program and another recent program for computing certain special functions (normalized Legendre polynomials).

In July 1978, **C. M. Allred** of CEEE's Electromagnetic Technology Division visited the National Physical Laboratory, Teddington. Their new primary standard of attenuation--a waveguide-below-cutoff attenuator--was impressive. It uses an interferometer for displacement measurements, air bearings for piston support, and a unique magnetic coupling between the push rod and floating piston prevents misalignment forces from being transmitted to the piston. A special step-motor driving a lead screw with controllable step size was used for producing displacement. The barrel was electroformed copper and an effective control of diameter and other effects due to ambient conditions was "calculated" electronically. The attenuator can cover a frequency range from 10 MHz to 200 MHz, has a 120 dB dynamic range, and an accuracy of 0.0002 dB/10 dB.

It is interesting that their power measurements, which extend up to 65 GHz, are made by static calorimeters (working standards) that use temperature-sensitive resistance wire wound around the waveguide or coaxial load. They are distributed in such a way as to sense the temperature rise due to dissipation of microwave energy. They preferred this technique over the use of thermistors or thermocouples. The accuracy was stated to be between 0.1-0.2%.

Mr. Allred's next stop was to Royal Signals Radar Establishment (RSRE) at Great Malvern, where he was shown an attenuation system with a resolution of better than 0.0001 dB. In fact, the stability at high signal level was 0.0001 dB. They have also done quite a bit of work trying to improve the stability, sensitivity, and accuracy of their thermistor power meters.

Norris S. Nahman of CEEE's Electromagnetic Technology Division visited the National Physical Laboratory, Teddington, in July 1978, a few weeks after Mr. Allred's visit. Regarding laser pulse sources in the visible-spectrum, they have a flash-pumped, mode-locked dye laser--although its stability as to pulse shape and repeatability leaves something to be desired. They have ordered a synchronously pumped mode-locked dye laser and are awaiting delivery. Other work was concerned with streak camera performance.

Mr. Nahman also made visits to the Imperial College, London (to review work on the generation and measurement of short pulses), and to Southampton University. The present worldwide interest in the 1.3-1.4 μm wavelength range for optical transmission is primarily due to the work of the Southampton University group. They have demonstrated by experiment and careful analysis the optimization method for wavelength selection; their work showed that 1.3-1.4 m was the desirable range considering cladding, index-grading, and glass properties.

Mr. Nahman's last stop in England was to the Post Office Research Center, Ipswich. Among other matters, they are specializing in high bit-rate digital transmission and have developed 565-MB/s signaling methods for digital transmission over in-place coaxial lines. Such lines were never intended for digital transmission, let alone, for frequencies above 1 MHz. This work is impressive and is currently using in-place cables in London and elsewhere. They are also working on the development of an optical submarine cable.

Russell D. Young, Chief of CMEPT's Mechanical Processes Division, visited the National Engineering Laboratory, Glasgow, during September 1978. Their researchers had just completed a 500-page report on a study of "Automated Small Batch Production." A goal of the study, among others, was "to draw up a skeleton plan for the evaluation, on a step-by-step basis, of a completely automated system for small batch manufacture, and to specify in more detail what should be the R/D aims in the next five years in the UK."

The major new thrust in robotics is partly based on the success of Japanese robots. The laboratory staff estimate 20,000 robots in use today, 60,000 by 1981 in Japan alone. The choice of arc-welding, as a promising application of robots, is based on the fact that they are using robots for experimental arc-welding and that they are working with the Welding Institute in Cambridge.

The group is also actively engaged in studies of machine-tool performance, adaptive control, vibration analysis, and tool wear detection. They are in the final stage of introducing a fiberglass-based ball plate for transferring measuring machine calibrations. These instruments are used to verify the quality of components by industry.

The Mechanical Processes Division of CMEPT recently bought a new Scanning Electron Microscope from V.G. Microscopes, Ltd., of East Grinstead, England. In connection with that purchase, **Stephen Jensen** of CMEPT's Mechanical Processes Division undertook a two-month work-study program at the V. G. Microscopes plant.

The V. G. Microscopes HB-50A Scanning Electron Microscope (SEM) represents the state-of-the-art in scanning electron microscopy and in surface analysis by means of Auger electron spectroscopy. There are only three such systems in commercial use at present. Two are in England; one is at CERL while the other is at the University of Sussex. The third is at N. V. Phillips' Gloeilampenfabrieken in Eindhoven, Netherlands.

While at V.G. Microscopes Ltd., Mr. Jensen had the opportunity to interact with all of the personnel in the company either in the form of training or in open discussion about some aspect of the SEM. Most of Jensen's training was provided by Dr. Stephen Ormrod and Mr. John Colling. Dr. Ormrod's specialty was the ultra-high vacuum system, its operation, and maintenance, while Mr. Colling taught in the operation of the SEM and maintenance and repair of items within the electronics console.

In addition to the formal training, there were a number of other discussions. The more significant of these were the following:

- Discussions regarding the interfacing and necessary electronics to provide digital output from both the secondary electron detector and the Auger electron detector. This would then be input to the Division's Interdata 732 based image processing unit, which will be near the SEM. Line scan data and 512 x 512 raster scanning were both discussed.

- Discussions were also held on the subject of automating the SEM both in terms of focusing and specimen position control. An Interdata 716 would be used for this purpose and also to buffer the digital data output from the SEM.

- Extended discussions were made on the theory of operation of the Auger electron spectrometer. Possible modifications of the unit both to enhance the signal-to-noise ratio and also to allow the unit to be used for energy loss spectroscopy of backscattered electrons were explored.

- Discussions were held on the incorporation of an electron beam blanking capability in the electron optics column so as to avoid specimen damage due to the probe electron beam.

- The possible addition of a thermiomic electron source to supplement the field emission source for probe sizes greater than 0.5 microns was discussed.

- Extensive discussions were held regarding the V.G. Microscopes specimen stage and the piezoelectric stage mechanisms being built at NBS. Interfacing these two is an essential step in the development of a precise micrometrology calibration stage.

Mr. Jensen also traveled to the University of Sussex to consult with Dr. John Venables and Dr. Adrian Jannson. Dr. Venables, who is one of the pioneers of scanning Auger microscopy, explained the Auger work that he had done and also showed the Auger electron detector he used. His group is now using their HB-50A SEM to perform dynamic deposition studies whereby a cesium atomic beam is observed as it strikes a tungsten (or other metal) surface. They are also performing deposition studies at oblique angles onto a surface containing nickel spheres and are then observing the line edge in the penumbra of the sphere.

Mr. Jensen also toured the HB-50A SEM facility and discussed the modifications that had been made. Their group is in the process of digitizing the raster-scan onput of the SEM for computer storage and image processing. They have also added a second titanium sublimation pump and a liquid-nitrogen-cooled collector to their specimen chamber to achieve an ultimate vacuum of 5×10^{-11} torr. Both of these modifications are of interest in the usage of the HB-50A at NBS.

F. E. Scire and T. V. Vorburger of CMEPT's Mechanical Processes Division toured a number of English laboratories during September 1978 to learn about the most advanced techniques and

important applications of surface metrology, to see the latest developments in 3-D surface topography and noncontacting techniques, and to discuss the proposed international roughness comparisons.

The meetings at Teeside Polytechnic Institute, Middlesbrough, were devoted to surface topography, its measurement and application. This meeting was a rare opportunity to learn from those people who are the leaders in this field. The lecture series was organized by Dr. T. R. Thomas, who has written a review and bibliography of "Surface Topography in Engineering" and is currently doing work on surface topography measurements and their relationship to the viscous drag of ships.

During the meeting, they visited Dr. Thomas' laboratory and talked to Mr. King, who is doing the surface finish/drag measurements. We were also able to see their 3-D equipment. The system uses a standard Talysurf 4, where the stylus is traversed along one axis and the other axis is an air-bearing slide. Data acquisition was on-line to an IBM 1800 digital computer. Because of the restrictions of the Talysurf 4, trace length is limited to 8 mm. The importance of Dr. Thomas' work is not necessarily related to the ability of his equipment to take pertinent data, but rather his application of that data to "real-world" problems. Two of these applications were: topographic mapping of cartilage, and skewness of the slope measurements of disc brake rotors (an apparent skew of the profile slopes provides better braking when rotated in one direction as opposed to the other).

At the Department of Naval Architecture, University of Newcastle-upon-Tyne, and the British Ship Research Association, Seire and Vorburger spoke with Dr. R. L. Townsin and Dr. David Byrne about the surface roughness problem of ships. According to Dr. Townsin, ships have notoriously rough surfaces mainly because of quality control of the paint-spraying process in drydock. It is difficult to apply an even coating from a cherry-picker in the outdoor environment of a drydock. In addition, the process is rushed because of the economic pressure to get the ship through with drydock and back into service quickly. The best surface roughness that was ever achieved was 150 μm mean apparent amplitude (MAA) and some ships go to sea with as much as 800 μm MAA. Dr. Townsin said that the drydock painting process might be improved if ship owners were made more aware of the large economic gains possible with smooth hull surfaces.

Likewise, the measurement of hull roughness in drydock is a tedious one because of inhomogenieties on the surface. The measurement requires 650 mm traces in approximately 100 different places on the ship. Dr. Byrne is doing computer analysis of ship surfaces and studying the amplitude density functions and power spectral densities in the wavelength regime between 2 and 50 mm. Some of his theoretical results indicate the potential energy savings for very smooth hulls could be enormous.

Their visit to the National Engineering Laboratory, East Kilbride, Scotland, uncovered a good deal of surface work being done by Mr. Harvie and Mr. Beattie on a standard Rank Taylor Hobson Talysurf 4. The instrument is connected to a Rank minicomputer and thus can provide some of the more common parameters. They do have the facility for data transfer (by paper tape) to a large computer facility for further analysis. As near as we could determine, all their hardware and software facilities have been purchased from Rank Taylor Hobson (RTH).

If they were to do any 3-D work, it would be carried out on the Talysurf 4 using a standard RTH stage for one axis, and the normal traversing mechanism for the other axis.

In addition to his other duties, Mr. Harvie has been designing a ball plate consisting of carbon fiber rods in a triangular 3-D array with the location balls at the intersection of

the rods. Their intention is to calibrate this ball plate and use it in the calibration of 3-D measuring machines as a service to British industries.

In the Product Engineering Division, Robert Pettigrew is developing an optical stylus instrument for measuring surface roughness. The instrument uses double wavelength interferometry to measure very rough surfaces. At present, the correlation between traces made with the optical stylus and those made with a conventional stylus seem quite good. However, Pettigrew himself has reservations about whether a coherent optical technique like this can be successfully used as a general purpose surface instrument. The major problem is the sensitivity of the phase of the scattered light to variations in the surface composition.

At the labs of Rank Taylor Hobson, Scire and Vorburger were given a tour of the quality control area and the calibration lab by Jeff Sharp, who is in charge of both operations, and by Dr. Robert Spragg, the Director of Research and Development. The calibration lab is part of the British Calibration Service. They have a Talystep, an automated two-axis Talysurf 4, and the computerized Tayrond 73, which did the original measurements on the roundness of the quartz balls for the Stanford gyro experiment. The lab is staffed by 2 to 3 people and draws in about $60K per year in calibrations. During the tour, Spragg mentioned that RTH was developing a precision machine with machining accuracies in the microinch range. The spindle and bed was entirely their own design, but the details were secret.

Dr. Derek Chetwynd discussed their pioneering work with computer techniques and mathematical analysis. Their new computerized Talysurf 5 is so successful that the company has approximately a 1-1/2 year backlog of orders.

A visit to the Cranfield Unit for Precision Engineering (CUPE) was hosted by P. A. McKeown, who is the Director of this organization and is also the head of the new Department for the Design of Machine Systems at Cranfield Insitute of Technology (CIT). CUPE is an industrial unit that has ties to, but is separated from CIT.

While at CUPE, Fred Scire was invited by Dr. McKeown to discuss the design and operation of the "piezo-flex stage" at a meeting of the CUPE engineering staff. Among other things, they saw the assembly of an 84-inch diameter precision positioning system for testing randomes, the precision grinding machine, and the camshaft grinding machine. The diagram of a working optical device for inspecting the bores of bearing races for surface damage and roughness was also examined. These machines were described by Mr. Warren Bailey, project leader for the design of the precision grinder, which uses hydrostatic spindles and ways. The machine itself uses oil shower cooling.

Mr. Bailey strongly recommends slow speed ways and spindles for surface topography measurements. In general, he preferred the hydrostatic bearing, but had a number of other suggestions, such as using a spindle supported at three points by a product called Delrin AP. His preference for a hydrostatic bearing was supported by P. A. McKeown, who suggested that this externally pressurized bearing use a low viscosity oil, or kerosene, to reduce torque and thus any heat.

In talking about 3-D surface measurements, Mr. Bailey knew of work being done by the School of Mechanical Engineering at CIT on bolted joints where surface topography was being measured. The system used was a Talysurf 4 and a RTH cross-slide with another stacked slide driven by a stepping motor. The stylus was stationary during measurements. The specimens under observation are relatively rough (R_a = 2.5 μm), but the processing of the data is excellent. Data are stored on cassette tape and handled by a central computer facility that will calculate all the surface parameters and print out the topographic map as well.

The software handles the data in such a way as to print out a true isometric map that eliminates shadowed contour lines to avoid confusing the reader.

In August 1978, **Hratch G. Semerjian** of CMEPT's Thermal Processes Division interviewed the Heat Transfer group at the Imperial College, London, headed by Professor Jim Whitelaw. Their main area of interest is combustion (diagnostics as well as modelling.) They have developed a 3-dimensional combustion model, using a finite-difference technique and a 2-equation turbulence model. The model has been successfully applied to practical systems such as industrial furnaces and boilers. Cooperative efforts with NEL to further develop such models are now being considered.

Mr. Semerjian also visited the University of Sheffield, Department of Chemical Engineering and Fuel Technology. Particular areas of research being pursued are structure of liquid spray flames, structure of eddies in turbulent flames, temperature measurements in turbulent flames, temperature measurements in turbulent combustion, structure of swirl stabilized flames, and particle-size measurements by laser anemometry. They also have a small project on combustion kinetics of pulverized coal. The principal diagnostic tools being used are laser anenometry, fine-wire thermocouples, and double-spark photography.

David Daney of CMEPT's Thermal Processes Division traveled to Harwell and Oxford in September 1978 to visit two British laboratories. The Heat Transfer and Fluid Flow Services group at Harwell has an experimental program to study two-component, two-phase flow and heat transfer in plate-fin heat exchangers. This work is sponsored by industry, including several U.S. manufacturers of plate fin heat exchangers. At the Oxford University Cryogenic Laboratory, activities include boiling heat transfer to cryogenic liquids including two-component mixtures. In some composition ranges, serious degradation of heat transfer can result. In another program, the stability of open thermosyphons is being studied experimentally and analytically.

The Police Scientific Development Branch, at St. Albans, was visited by **Joseph C. Richmond** of CMEPT's Thermal Processes Division in July 1978. Among other projects, they have developed a video system that can scan a lane of traffic for car license plates, detect wanted cars with the help of a computer, and alert a waiting squad car. They have also developed a 1st generation night vision device that has only aobut 4% distortion, compared to the 18 to 20% distortion in the normal devices manufactured in the U.S. This device is now manufactured commercially in England.

A. F. Clark of CMEPT's Thermophysical Properties Division went to the Derby plant of Rolls-Royce in June 1978. He was interested in their experiences with the combustion of titanium in aircraft engines. Because of the many fires in an early all-titanium engine, they began some research on causes and effects (about 15-20 years age). Their basic results they feel are still valid. These are that primary causes are ingestion, failure, and tip rub. Eventually, they stopped using Titanium in the stators and casings and increased clearances so that debris would be less likely to lodge and start fires.

In their research they concluded that alloying makes little difference. Further, you cannot blow out a Ti fire, although the heat-sink effect can quench it. Their current concerns appear to be more with rub materials and the formation of Ti-Ni eutectic, which has a melting point of only 1000°C, and the need to extend the design limits of titanium alloys irrespective their fire potential. They generally don't feel coatings are an answer nor do they believe compressor stall could be a cause. These discussions will be detailed in a report to the FAA.

In September 1978, a special meeting on Structure and Motion in Molecular Liquids was held in Canterbury. **Howard J. M. Hanley** attended for CMEPT's Thermophysical Properties Division. The objective was to learn about the recent advances in calculating the structure and properties of molecular, that is, polyatomic fluids.

Overall, it was found that theoretical studies of polyatomic fluids (mainly via computer simulation) can be very complex, time consuming, and, unless special provisions are made, extremely expensive. They are not yet to a point where they can reliably predict the properties of fluids. It was argued this may never be possible.

Nevertheless, the theoretical studies are necessary: They give results on the structure of liquids, and indicate the behavior, as opposed to the properties, of fluids under various conditions. Further, and perhaps most significally, mathematical procedures are refined or introduced and computing techniques are advanced by such research.

Topics of special interest were: the effect of a electrostatic moment on vapor-liquid equilibria, the critical point of a ternary mixture, and the calculation of the viscosity coefficient by molecular dynamics.

In July 1978, **Michael J. Hiza, Jr.** of CMEPT's Thermophysical Properties Division visited the London Research Station of British Gas, at the invitation of Dr. Richard M. Gibbons, to confer on experimental measurements and the prediction of phase equilibria properties of mixtures of LNG components. Rich Gibbons is the head of their thermodynamic properties research. He showed a new model of a natural gas combustion calorimeter British Gas has developed and is now proof testing, the flow metrology facility that is the basis of their meter evaluations (based on time of flight), their rich gas catalysts research program, and some of their more fundamental research experiments. He also showed the results of their comparisons of phase equilibria calculations using the corresponding states method (CSM) and several simpler models, such as the Redlich-Kwong, Carnahan-Starling, and Peng-Robinson. Their conclusion is that the CSM cannot be trusted in such calculations - for whatever reasons - because it takes an unnecessary effort to be sure that it is not giving erroneous results.

Mr. Hiza also visited the Department of Chemical Engineering and Chemical Technology, Imperial College, at the invitation of Dr. Selby Angus, Thermodynamic Properties of Fluids Program Coordinator, to confer on the evaluation and correlation of fluid properties. Their methane correlation is now published. In the final version, they left out saturation densities since all of the NBS data were not yet available, and they could not obtain liquid densities consistent with the Oxford data. Selby wrote to Lionel Staveley and informed him that as a result of their correlation of PVT properties, they concluded that the Oxford data must be in error by 0.3% or so. Selby said later that they were relieved to see that our methane results from the LNG density project confirmed their conclusions. Barrie Armstrong showed me some of their new graphic results for ethylene and propylene. The ethylene report is already in draft form and is being circulated for comments. For propylene, they are missing reliable experimental results, for example, saturated liquid densities. Selby showed a new monograph (1977) on the compilation of nitrogen and ammonia by Sytchev, et al. (in Russian). There is also a nine-volume compilation of binary mixture and pure fluid properties from the Institute of Physical Chemistry in Warsaw.

Mr. Hiza also visited L. A. K. Staveley at Oxford University's Inorganic Chemistry Laboratory. There he investigated the experimental equipment being used for measurements of heat of mixing and excess Gibbs energies for simple liquid mixtures. Their heat of mixing apparatus is probably the only one in use today, although one or two others were built in Europe earlier. The excess Gibbs energy (total vapor pressure) experiment is in the same

laboratory and quite simple by comparison. In two other laboratories Staveley has experiments in progress on PVTx properties of liquid mixtures to high pressure and calorimetric properties of solids and solid mixtures. The temperature range of the latter experiment is from below the boiling point of helium to 100K and higher.

Another of Hiza's stops was the Rutherford Laboratories, Chilton, Didcot, at the invitation of Dr. Ronald W. Newport, Head of the High Energy Physics Group, to confer on new directions in their high energy physics program. As many people are aware, Nimrod, the Rutherford 7 GeV Proton Sychrotron is being shut down. In the space being vacated by Nimrod, an experiment called Spallation Neutron Source will be installed. Much of the existing equipment will be reused in the new experiment, but there are also many items such as helium refrigerators, specially designed superconducting magnets, and special helium cryostats for polarized targets that are surplus. The main features of the Spallation Neutron Soruce will be a high repetition rate high-intensity 800-MeV proton synchrotron that will deliver high energy protons onto heavy metal targets, i.e., tungsten or uranium.

In May 1978, **Lawrence S. Galowin** of CBT's Building Thermal and Service Systems Division visited the Building Research Station (BRS) in Watford. There, he reviewed the testing of water closets with less than a six-liter flush and the modifications to provide an air-break siphon valve. There is a requirement for a lift siphon in the U.K. to prevent leakage from a water closet valve. The low flow European/Swedish models under test with low water usage cannot be used without redesign of that lift. Test results from removal of light and heavy solids showed no serious difficulties for removal.

The testing procedures evaluating water conserving devices as they are completed and reported will be applied in the CBT laboratory. Recent experiences at BRS have shown that test methodologies of individual units are suitable for rating performance but primarily useful as a comparative measure. To develop useful design information will require tests not only of component performance but also systems performance (to account for the effects of piping, branches, and connections).

Later, Galowin presented a seminar to the faculty and students of Brunel University, Uxbridge. His topic was the plumbing research underway at NEL.

In October 1978, **Brian C. Pierman** of CBT's Environmental Design Research Division visited with a number of British authorities working in the general area of building occupant safety. His first stop in London was to the Department of Prices and Consumer Protection. Data from their hospital surveys reinforce those collected in the U.S. Stairs are the leading cause of accidents related to architectural features, as well as the number one producer of death related to consumer products. Floors are second and doors are third. This is a convincing verification that these elements of buildings need serious consideration in design for safety.

He next visited the Watford Junction Installation of the BRE Research Establishment. There, Dr. G. M. B. Webber supervises an activity very similar to NEL's Occupant Safety Program. They emphasize stairs as we have, but with the following methodological exception: They are building a facility to conduct stair-use studies in which stair parameters such as handrail height, riser-tread relationship, lighting, and other variables can be changed and observed in use.

Pierman next visited the BRE Fire Research Station at Elstree. There, he talked with Dr. Ian Appleton and Mr. Cooke. The meeting with Dr. Appleton was particularly productive since he has been using questionnaires to determine public perception of risk. His respondees rank paraplegia, burns over 90% of the body, and brain damage as greater

displeasures than death. Does this suggest we should regulate disability more than death? How? Dr. Appleton also suggests that the populace is fairly well in touch with the probabilities of occurence. They give a reasonable ranking according to total numbers.

Mr. Cooke is a specialist in smoke detectors. He showed a film on how people use extinguishers in an experimental setting. The actions are amazing. One person got so frustrated she threw the extinguisher into the fire. Another person was still reading the instructions well after the experimental gasoline fire went out by itself. Mr. Cooke suggested that pictographs rather than words could be used as instructions on extinguishers.

Irwin A. Benjamin, Chief of CFR's Fire Safety Engineering Division, visited the University of Edinburgh in January 1978. There, he spoke to a class about the NEL program and had an opportunity to learn more about the current programs at the University. He also visited with Alan Roach of the Department of Environment, where U.S. and British regulations on nursing homes and hospitals were compared.

Benjamin also visited the Fire Research Station at Borehamwood and attended a staff review session on smoke control. He gave a brief review of U.S. practice. Other aspects of current work at the Fire Research Station, particularly in regard to venting of shopping malls, were also reviewed.

In April 1978, **Sanford Davis,** Chief of CFR's Fire Safety Engineering Division, toured the British Fire Research Station in Borehamwood. They have recently begun work on a flammability test for upholstered furniture as a British standard. It involves a mock-up (similar to our fabric classification apparatus) exposed to a cigarette in the crevice and to seven levels of flaming ignition. Acceptability would be based on a given ignition size for a particular occupancy. At this time, the standard is not expected to be mandatory for general use. They are also very much involved with analytical work on the products of combustion. They feel that it is important to identify the products of combustion obtained under various conditions before efforts are made to determine the effects on animals.

As for insulation problems, their main concern is the increasing use of ground polyurethane foam as loose-fill attic floor insulation. They are now just beginning to see imports of cellulosic loose-fill insulation from Canada. Mr. Davis reviewed the work CFR has been doing and the use of the critical radiant flux method.

In connection with this visit, Davis also presented a paper at the International Fire, Security, and Safety Exhibition and Conference in London. His talk was based on the CFR mattress study.

In February 1978, CFR's **Merritt M. Birky** visited the Fire Research Station at Borehamwood. He met with Dr. Dave Woolley and Mr. Roger Kennedy. The majority of the time was spent discussing combustion product toxicity and the chemical analysis of specific toxic products. At present, they are making measurements that will further our understanding of the sublethal effects of HCN in fires. They are recording EEG, EKG, nerve conduction velocity, and respiratory rate. The effects of HCN on these physiological parameters are fairly well known. Sublethal behavioral or performance deficiencies would be more appropriate since this may prevent a person from escaping a fire. Since the primate studies now underway are sublethal and apparently below any significant stress levels, performance changes would be more informative.

As for fire detectors, they have run some large-scale smoldering tests with various materials and found serious deficiencies in the ionization detectors. When the smoke from a smoldering piece of polyurethane foam diffuses through the bulk material or a cover fabric,

the smoke builds up to an optical density of 6 before the detector is activated. In fact, the concentration was so high that the smoke mixture was flammable, and all indications are that fatal concentrations of gases may have been reached or exceeded. This lack of response of the ionization detector apparently occurs for other materials as well, to varying degrees.

Richard L. P. Custer of CFR made a January 1978 visit to the manufacturing plant of Mather and Platt, Ltd. in Manchester. This company is probably the largest sprinkler manufacturer in the world. In addition to a full range of fire protection equipment, including CO_2 Halon dry chemical equipment and alarm panels, they also produce electric motors and industrial pumps. They also make a variety of sprinkler deflectors that produce unusual spray patterns not seen in the U. S. Of particular interest was their "marine" sprinkler that throws most of the water in a narrow-angle horizontal sheet. This concept would be of major value in the U.S. for protection of combustible concealed spaces.

Daniel Gross of CFR's Fire Safety Engineering Division visited the Borehamwood Fire Research Station in September 1978. There, a project of particular interest involves the full-scale validation of smoke penetration through doors. Tests have started in which a wood crib (50 kg) fire in a 3 by 3 by 2.5 m room with an adjustable window generates a "repeatable" smoke load and the quantity of smoke passing into an adjoining vestibule through the test door is measured. Calibration tests have been conducted using noncombustible board doors and stops with a range of preselected sizes of gaps and rebate widths. These doors were fixed so they would not move or deform.

The Director of CCPT, **Stanley Warshaw,** visited two British laboratories in July 1978: the Consumers Association Testing Laboratories in Harpenden, Hertfordshire, and the British Standards Institute Test House at Hemel Hempstead.

The Harpenden Testing Laboratory is the lab facility of the Consumers Association. It is primarily engaged in comparative test and research on goods and services for the magazine publication Which (similar to Consumer Reports). They are similar to the testing laboratories of Consumers Union. During the visit Mr. Warshaw saw electric drills being tested on a multi-station dynamometer.

The British Standards Institute Test House can be likened to that of Underwriters Lab., both in the nature of the activity and in its support. In fact, BSI is an agent for Underwriter Laboratories in the electrical and electrical products area in the United Kingdom. The following tests were observed during this visit: performance testing of domestic bedding and furniture; portable electrical tools; timers; thermal controls; switches; televisions; radios; hi-fi equipment; lawn mowers; irons; protective headgear; safety belts; windows; doors; architectural safety glass; vehicle lighting; lighting; and a variety of cookware.

G. P. Lewett, Chief of the Office of Energy-Related Inventions, visited the National Research and Development Corporation (NRDC) and the British Department of Energy (BDOE) during the Spring to compare notes on past experience and operating problems.

NRDC has been operating as a nationally owned corporation since 1949, primarily to encourage more effective exploitation of inventive ideas arising in the United Kingdom and, through the licensing of patents and know-how, to maximize the national benefits resulting from the country's investment in research and development. The corporation is designed to be self-supporting on the basis of financial interests in the inventions it supports. Moreover, their statistics on yield are in agreement with ours; by concentrating on the more credible sources (minimizing solicitation of inventions from private individuals) they have increased their overall yield. It was also of interest to note that they find about 20% of those

supported are in the end successful (profitable ventures), and that the Corporation is now self-supporting.

BDOE is characterized by heavy involvement of industry and other governmental agencies in energy R & D. Further discussions addressed the nature of R & D programs being directly sponsored by the BDOE. It seems this activity is principally directed through the Energy Technology Support Unit (ETSU) at Harwell.

In August 1978, **T. A. Coultas,** of the Office of Energy-Related Inventions, visited ETSU to discuss a number of their promising projects. One of these was wave energy, which the British calculate at 50 gigawatts. Limited experiments indicate that a large (> 10%) amount of that energy can be extracted.

Studies in the United States, however, estimated capital costs may be 3 to 10 times that of nuclear plants. These cost estimates have very recently been confirmed The effect of these high costs on the future of wave energy R & D in England has not been assessed.

The objective of the visit to NRDC was not technical in nature, but to discuss criteria for identification of promising inventions. NRDC is charged with not only evaluation of inventions (and not limited to energy-related ideas) but with following these inventions to commercial deployment. Their best example is the ground-effect ferry that now regularly operates between Dover and Calais on the English Channel. This invention is returning some of the NRDC investment, but break-even is not expected for several years. We discussed the "failures" they had funded. They noted that these failures were usually because of poor management or technical judgment by the inventor or entrepreneur. The other major cause, as might have been anticipated, was failure to make the device economically attractive. The technical failures were usually caused by the inability to solve problems foreseen upon beginning the development. Unforeseen technical problems did not seem to be a major cause of failure.

Union of South Africa

At the request of Dr. T. L. Webb of the National Building Research Institute (NBRI), **Tamami Kusuda** of CBT's Building Thermal and Service Systems Division traveled to Pretoria in August 1978 to help them with their use of the NBSLD computer program. The program will be used in a project to rationalize a number of such computer programs to be used to simulate energy demand.

Among other studies, Kusuda visited Mr. W. Cawood, who has been conducting an experimental project that measured the thermal performance of several solar collectors using the ASHRAE 93-77 procedure. Mr. Cawood expressed his concern over the sky heat loss, which is not included in the ASHRAE 93-77 procedure. At NBRI's Energy Conservation Demonstration Dwelling, a solaron air collector and rock-bed heat storage are used to heat a slab-on-grade, single-family dwelling. Hot water was also generated from the solaron hot air through a heat exchange.

Dr. Kusuda also discussed the status of U.S. Standard Weather Data for Energy Analysis with Dr. J. Wentzel, who has been active in generating test reference year data tapes for South African cities. Most of the cities in South Africa are located in climatic regions that require very small amounts of heating and cooling as compared to the United States. The standard energy consumption of a typical South African home is around 1,000 KW hours per month and is used only for lighting and domestic hot water.

Overall, the visit provided a wealth of information related to CBT thermal research. NBRI's computer analysis validation effort parallels CBT's efforts and should provide mutually beneficial information. Daylight data being collected will be important to the CBT daylighting research. The unique instrumentation technique for detecting the surface absorption and release of moisture through building walls could be adapted for CBT air moisture transfer research. And indoor habitability data obtained from low-cost housing test cells will be useful in the development of our passive solar house design.

Union of Soviet Socialist Republics

David Daney of CMEPT's Thermal Processes Division travelled to Moscow and Minsk in September 1978 to participate in joint US-USSR studies of heat transfer and hydrodynamics related to problems of cooling superconducting power transmission lines.

In addition to the joint experiments and general discussions on helium heat transfer and hydrodynamics, Mr. Daney made three formal presentations at seminars (Moscow, Minsk, and Novosibirsk) describing the NEL research in support of superconducting power transmission (SPTL) with special emphasis and detail on his recently completed experimental study on thermally induced flow oscillations in supercritical helium. Both this work and current NEL work on transient helium heat transfer seemed to be of considerable interest to Soviet scientists.

At the Kurchatov Atomic Energy Institute, Moscow, there is a group of about 100 people engaged in applied superconductivity and cryogenics. They seem to have solved the problem of cracking of perforated-plate cryogenic heat exchangers by using spacers of the same material as the plate in combination with silica filled epoxy. They pointed out an interesting example regarding the myth of the relative unreliability of cryogenic equipment. When constructing a large high-field magnet (superconducting outer solenoid, and water-cooled inner solenoid), they made the superconducting magnet easily removable -- expecting it to be the source of trouble. In practice, the superconducting solenoid has never given any trouble, whereas the life expectancy of the water-cooled solenoid is about 100 hours.

As a part of a HUD-sponsored program to stimulate exchange of technical information on building construction, **John A. Rockett,** Chief of CFR's Program for Physics and Dynamics, travelled to Russia in January 1978 for an exchange program on building fire technology.

In general, it was found that in Russia the major emphasis of fire protection was on containment. A simple statement of their goals would seem to be: a factory fire must not cause a major disruption of production; an apartment fire must not force relocation of building residents except those from the apartment of origin. These goals are being pursued in a building environment where there are great pressures to reduce construction costs and times. They have the same building trends we do, with the most noticeable difference being a much larger amount of offsite fabrication; about 40 percent of their concrete is poured offsite. The lighter weight systems they are considering, like ours, generally have reduced passive fire resistance and less redundant endurance.

It is easy to imagine that, with their centeralized governmental system, Gosstroy, the setter of all standards, has great arbitrary power. This is quite incorrect. Their codes and standards are apparently arrived at by a consensus procedure not very different from ours. We did not learn anything of the committee structure by which a consensus is developed, but did encounter frequent evidence of its action. The outcome of this visit was a protocol that calls upon each side to prepare a number of review papers on a broad range of fire topics. If the corresponding Russian reviews are as wide-ranging as their presentations to us suggest they will be, they should be of considerable value.

Robert S. Levine, Chief of CFR's Fire Science Division, took part in the same trip. Among other things, he noted that firefighting personnel in the Soviet Union are professionally trained. Generally the entrance level is that of the rookie fireman, and like ourselves, the Russians want the sons of firemen and other dedicated persons to volunteer for this activity. However, when there are not enough volunteers they accept draftees and convert them to specialized firefighting personnel. (The Fire Defense people are really part of the Army.) These people are trained in firefighting techniques and the operation of equipment. After 2 years of practical experience in fighting fires, the personnel may apply for attendance at various fire protection schools in the Soviet Union. One is in Leningrad; there are perhaps 20 or so others scattered around the Soviet Union. The course is 4 years, during which the student learns a great deal of physics, chemistry, and electrical engineering along with the tactics of fighting fires. Graduates of this school become fire chiefs or the equivalent. After 2 more years of experience in command status, the very best of these personnel are eligible to attend the Higher Fire Engineering School in Moscow. This is a 3-year course. The Higher Fire Engineering School accepts only 200 people per year, so their total student body is 600 people. Essentially a graduate school, it has faculty in a number of scientific fields as well as a political faculty, and carries out graduate-level research in fire protection. The graduates are eligible for the senior-level fire protection jobs in the Soviet Union.

In September 1978, **Lawrence S. Galowin** of CBT's Building Thermal and Service Systems Division went to Russia as part of a delegation of Working Group 10.02, "Industrialized Building Systems and Utilities" of the US/USSR Joint Committee on Cooperation in the Field of Housing and Other Construction.

The trip was to afford the team a chance to exchange technical information during a series of inspection tours to Soviet building sites. Among them were trips to the Design and Research Institutes, a building complex that will eventually house 20,000 people on 180 acres, a district heating plant, and the design labs where the Moscow Olympics' arenas are being mocked up and tested. They also reviewed the seismic provisions incorporated into the rebuilding of Tashkent after their 1966 earthquake.

Yugoslavia

R. P. Reed of CMEPT's Thermophysical Properties Division is a principal cooperative scientist for one of the NBS grants in Yugoslavia that are part of the U.S./Yugoslavia Science & Technology Agreement. This project concerns rapid metal-alloy cooling and is conducted at the Institute of Physics, Zagreb. They are studying the production of amorphous metals during rapid cooling, using the Fe-Ni-B system. With high cooling rates, very thin sections of specimens are formed by dropping from the melt between two rotating drums which have been cooled to 77 K. Since the rate of cooling depends on the heat capacity and temperature of the substrate drums, Leontic and Bonefacic of the University of Zagreb will use sapphire wheels, cooled to about 20 K, to achieve higher cooling rates.

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 interchangeability 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 June 1978, **Daniel Gross,** Deputy Chief of CFR's Fire Safety Engineering Division, took part in the thirteenth biannual meeting of CIB Commission W14 (working group on fire). **A. F. Robertson** of CFR also participated in the sessions. The meetings were held at the Technical University in Lyngby, Denmark. The meetings were divided into two group sessions sandwiched between the general technical session. Group I dealt with Codes, Structural Fire Protection, and Full-Scale Fire tests. Group II dealt with Smoke Movement, Fire Loss Statistics, and Fire Growth and Behavior.

The CIB W67, Energy Conservation in the Built Environment, meeting was held in Dublin in February 1978. **Preston E. McNall,** Chief of CBT's Building Thermal and Service Systems Division, attended and gave a presentation on the energy-efficient home recently completed at Mr. Airy, Maryland by the National Association of Home Builders with HUD support. He also reported current information on the Norris Cotton Building in Manchester, New Hampshire.

Since economics is an important part of energy conservation in all countries, the goal was to agree on the method of handling economic information within W67. It was proposed to use "long-run marginal costs" of generating additional energy in making economic comparisons. It was recognized that long-run marginal costs are difficult to obtain and that they may vary from country to country, but their use seemed to be realistic. This point was generally agreed upon by W67. Another proposal was the use "internal rate of return" in reporting economic benefit, which could be used for ranking the benefits of various alternative projects. Internal rate of return or return on investment was defined as "that discount rate which forces the net present value to be zero." This concept avoids arguments of differences in present and projected discount rate among various countries. With these methods, investment decisions could be compared subject to the true economic value of added

energy. It was recognized that for a nation as a whole this concept could be meaningful, but an individual faced with a decision on an individual building would have difficulty since the current rates of his available fuel would not necessarily reflect long-run marginal costs.

In September 1978, **Charles T. Mahaffey** of CBT's Building Economics and Regulatory Technology Division went to Dublin to participate in the meeting of the International Council for Building Research Studies and Documentation, CIB W24, Dimensional and Modular Coordination.

CIB W24 is the research arm of TC 59, Subcommittee 1, the ISO standards committee that is developing worldwide standards for applying dimensional coordination in construction. W24 has long held a close working relationship with SC 1 and is often used as an example of the kind of prestandardization research cooperation now being established between the CIB and ISO. This new relationship stems from, and is directly related to, the building regulatory harmonization program of the UN Working Party on the Building Industry.

This meeting stressed the significance of international agreements on dimensional coordination for Third World countries. This aspect of strengthening dimensional coordination standards among the developing countries, as a way of providing fruitful avenues for promoting economic growth and stability leading to an increase in trading possibilities, is also of interest to the U. S.

DIN Semiconductor Materials Standards Meeting

The DIN FNM 221 technical committee on semiconductor materials standards was held in Stuttgart, West Germany, in September 1978. **Robert I. Scace** of CEEE's Electron Devices Division participated. Deliberations included work on silicon reference materials, single crystals, impurity distribution, defects observed by X-ray topography, and measurement of edge contours.

IEEE Industrial Application Society Annual Meeting

This meeting--held in Toronto, Canada, in October 1978--was attended by **Frank F. Oettinger** of CEEE's Electron Devices Division. Five sessions pertaining to power semiconductor devices and applications were attended. An example of the state-of-the-art in the production of high power thyristors was given by a Japanese paper on the development of a 4000 V, 2500 A, high voltage-high power thyristor. Other discussions generally centered on the NEL power semiconductor materials and devices measurements and how they relate to foreign research needs.

International Atomic Energy Agency

Richard A. Mitchell of CMEPT's Fluid Engineering Division traveled to Europe in September 1978 to discuss our Nuclear Safeguards ISPO Task A.40 (UF_6 Mass Determination) with the project sponsor, the International Atomic Energy Agency (IAEA), which is headquartered in Vienna.

At present, NEL has the task of developing a load-cell based portable system for directly weighing UF_6 cylinders weighing up to 50,000 pounds. The system must be portable to the extent that an IAEA inspector can carry the more sensitive and critical components in commercial air travel.

We have developed a list of 10 specific questions regarding procedures, requirements, and practical aspects of the inspection process that need to be answered before we can select a design approach for the system. These questions were the basis for one-on-one and small group discussions with the contract monitors, section heads, and inspectors.

International Bureau of Weights and Measures

In July 1978, **C. M. Allred** of CEEE's Electromagnetic Technology Division went to Sevres, France, to represent NBS on the High Frequency Working Group of the consultative committee on electricity of the International Bureau of Weights and Measures. This group is concerned with international intercomparisons of radio and microwave quantities.

International Combustion Symposium

The seventheenth annual International Combustion Symposium was held at the University of Leeds, England, in August 1978. A total of 1045 delegates from 27 countries were present. Attending from NBS were **Andrej Macek** of CMEPT, who presented a paper on coal combustion in boilers; **James G. Quintiere** of CFR, who spoke on experimental and theoretical analysis of quasi-steady small-scale enclosure fires; and **Gerald D. Mitchell** of CFR, who attended sessions on fire and explosions, flame structure and chemistry, and soot. **Hratch G. Semerjian** of CMEPT's Thermal Processes Division also presented a paper to the assembly.

International Conference on Communications

The International Conference on Communications is a large annual meeting sponsored by the IEEE Communications Society. It primarily serves system design engineers. Last June, Toronto, Canada, was the site of its 1978 conference. There **Gordon W. Day** of CEEE's Electromagnetic Technology Division presented a paper on optical fiber measurements. Mr. Day also took part in meetings of the IEEE Fiber Optics Subcommittee. Altogther, interaction with the international community of communications systems designers was useful in refining the NEL efforts to serve the optical communications industry, particularly as our work relates to standards and methodology.

International Conference on Durability of Building Materials and Components

The first such conference was held in Ottawa in August 1978. Representing CBT was **Goeffrey Frohnsdorff** of the Structures and Materials Division.

The conference, which NEL co-sponsored with the National Research Council of Canada, ASTM, and RILEM, extended over three days. A total of 103 papers were presented covering many aspects of the durability of non-metallic building materials and components. The conference was attended by 313 persons from about 20 countries. The first session consisted of opening remarks by representatives of the four sponsoring organizations followed by four invited papers. **Richard N. Wright,** Director of CBT, made the opening remarks on behalf of NEL.

Dr. Frohnsdorff then presented the paper, "The Meaning of Durability and Durability Prediction," which was co-authored by Larry Masters. The paper drew attention to the new ASTM Standard Recommended Practice for the Development of Short-term Tests for the Prediction of Service Life of Building Materials and Components, ASTM E632, and was well received. It aroused a great deal of interest in the standard, developed under NEL leadership.

Larry Masters of CBT also attended this conference and presented a paper describing a testing program being undertaken at NEL to determine the reliability and durability of solar collectors and their materials. The results will be used to develop meaningful aging tests at both the solar collector and materials levels. Another CBT staff member, **David Waksman,** also spoke at the conference. His topic dealt with the NEL program to develop aging tests for solar collectors and the materials they are made of.

International Conference on Low-Temperature Physics

The fifteenth annual meeting in this series was held in Grenoble, France, August 22-29, 1979. **Steven B. Kaplan** of CEEE's Electromagnetic Technology Division attended and presented a paper.

Although no major breakthroughs in understanding Josephson effects and nonequilibrium effects in superconductors were presented, there were several excellent papers on the subject. What is clear is that the superconducting state is sensitive to ambient conditions, especially the longevity of the excitation and the heat transfer from the junction. The concepts of branch and charge imbalances were central to many papers. The papers on microwave and phonon-enhancement of superconductivity suggest that more work is needed to validate the Eliashberg-Scalapino and Chang theories. Experimental work on collective modes in superconductors and nonequilibrium effects in microbridges were also of interest.

In the realm of superconductive tunneling, the nature of the subharmonic gap structures seen on the "single-particle" tunneling I-V curve was shown to be the result of "double-particle" tunneling. These structures may be identical to those seen in junctions at the NBS Boulder Laboratories. In addition, several new types of tunneling barriers that had variable tunneling characteristics or low dielectric constants were discussed.

International Conference on Recognition of National Programs for Testing Laboratories

The purpose of this conference was to bring together all the countries of the world, to exchange information and determine the individual and international direction of the testing laboratory accreditation.

This, the first such conference, was hosted by the Danish National Testing Board in October 1977. **Gene A. Rowland,** Chief of the Standards Application and Analysis Division, attended for NBS. The outcome of the conference was the establishment of three working groups:

- First, a task force to study the impact of international laboratory accreditation on ISO-guided certification programs and to develop areas of future cooperation towards common goals, and to report back to this conference at its next international meeting.

- Second, a task force to identify, study, and report on the legal problems that may affect participation by nations in any international arrangement for reciprocal recognition.

- Third, a study group to consider the preparation of an international register of accrediting organizations, and in this connection to identify those items in laboratory accreditation documents that are predominant in all countries.

International Congress on Noise as a Public Health Problem

NEL was represented at this conference, held in Freiburg, Germany, in September 1978, by **Simone L. Yaniv** of CBT's Environmental Design Research Division. She presented a paper synthesizing the state-of-the-art on the effects of time-varying noise on people. Other research presented at the conference is summarized over the next few paragraphs.

Auditory Effects: Heating Loss

Research data reported in Freiburg show that exposure to both intense and moderate noise levels over time produce permanent damage to the auditory system of both animals and men. Moreover, Marrazzo of the US EPA reported that occupational hearing loss is the most prevalent occupational disease in the U.S., while Scholtz indicated that compensation costs alone average 140 DM per person in West Germany annually. Although several researchers concerned themselves with establishing relationship between temporary threshold shift, asymptotic temporary threshold shift, integrated temporary threshold shift, and permanent threshold shift (PTS), these relationships appear not yet clearly defined. Thus, susceptibility to PTS continues to be a major and key issue. A general finding of the congress was that a shift in auditory research is required towards large-scale longitudinal studies for the purposes of defining dose-reponse relationships -- in particular, the contribution of non-occupational noise exposure presbycusis, sociocusis, and their correlation with PTS.

Auditory Effects: Speech Communication

Studies on speech levels during conversations in homes, department stores, hospitals, and transportation vehicles indicate that normal conversational levels may be lower than previously though. If these results are confirmed, there might be implications regarding design criteria for schools, conference rooms, etc.

Speech recognition in the presence of noise continues to be of major concern. Although a great deal of this type of research continues to address steady-state noise, recent findings indicated that the aged and the hard of hearing who suffer from poor hearing at high frequencies (above 2 kHz) suffer poorer speech intelligibility than predicted when noise is present. This implies that the present predictor of speech discrimination is a poor one; a formula based upon hearing levels at 1 kHz, 2 kHz, and 4 kHz would be much better for the aged and the hard of hearing.

Two researchers have looked specifically at speech intelligibility indoors. Their findings indicate that reverberation time may be an important factor that has been previously neglected. For normally hearing subjects, a degradation in speech intelligibility is found to occur in the quiet when the reverberation time in the room increases above 0.8s, while for hearing impaired this degradation occurs at a shorter reverberation time. When noise is present, degradation of speech perception occurs faster for normal hearing subjects but remains unchanged for the hard of hearing. This finding could indicate that the effects of reverberation time on speech perception of hearing impaired subjects outweigh the effects of increased background noise.

Non-Auditory Physiological Effects

Laboratory studies involving animals have continued in France and in Germany and epidemiological studies of human populations have been carried out in the USA, Netherlands, Germany, and Japan. Results indicate that in the rat the reproductive cycle is modified by intense noise exposure and that these modifications worsen when noise is combined with other stressors (vibration, heat, over-crowding). Specifically, the number of pups per litter is decreased when the mother is exposed to noise during pregnancy, the pups are smaller, and the interval between litters is increased.

Although great caution must be exercised in extrapolating animal data to men, preliminary epidemiological studies performed in the USA and Japan suggest that exposure to intense aircraft noise early in pregnancy may somehow increase fetal distress in susceptible human populations. Similarly, animal studies reveal that noise exposure seems to produce premature aging of the heart. This aging is reflected by increased collagen in the interstitial spaces of the myocardium, followed by increased noradrenalim secretion in the urine. Epidemiological studies suggest that people exposed to high noise levels around airports, in factories, and around highways tend to have increased systolic and distolic blood pressure than matched people from quiet areas. These effects have been found to occur even among children.

Community Response: Sleep

Most congress participants expressed the opinion that sleep researchers must move on to longitudinal field studies involving disturbances due to road and highway traffic noise because social surveys data reveal that traffic is the most predominant source of community annoyance and sleep disturbance. Moreover, preliminary data indicate that road traffic noise may evoke stronger sleep reactions than aircraft noise.

Community Response: Annoyance

Although most researchers agree that the average response of groups of individuals can be reasonably predicted, most felt that individual response remains elusive. Indices for environmental noise were found to correlate well among themselves but some doubted that various noise indices such as the day average sound level and the equivalent sound level accurately predict community annoyance. The overall consensus of the congress participants was that research should focus on time-varying noise; longitudinal studies of annoyance, individual susceptibility versus individual dose, day/night weightings, and contours for activity interference. Moreover, it was felt that there was a need to bridge the gap between laboratory and field studies and that research should move away from aircraft noise, which has dominated activities until now.

International Cryogenic Engineering Conference

The seventh in this series of conferences was held in London in July 1978. Of particular interest were papers on European efforts in superconducting motors and generators and a cryogenic wind tunnel. The U.S. wind tunnel, National Transonics Facility at Langely Research Center, has encountered problems with thermally insulating the tunnel so that it meets fire safety regulations. The European facility will circumvent this problem by using external insulation. The session discussing materials for use at cryogenic temperatures included a paper by Dr. Rosenberg on the thermal conductivity and thermal expansion of carbon-glass composites.

Larry L. Sparks of CMEPT's Thermophysical Properties Division presented a summary of his work on magnetothermal conductivity of alloys. There appeared to be an extreme amount of interest in these data. The European efforts in superconducting machinery led to much of the discussion.

M. D. Kasen of CMEPT also attended and presented a paper on the mechanical properties of several graphite-epoxy composites at cryogenic temperatures; this paper elicited numerous requests for further data. It was complemented by a paper on the thermal and electrical properties of graphite-epoxy materials given by Prof. H. M. Rosenberg of Oxford University. Dr. Rosenberg concludes that graphite-epoxies are good thermal insulators at low temperatures, their conductivity being very small. Parallel to the fibers, conductivity at low temperatures is controlled by a Kapitza-type phonon scattering at the fiber boundary, while in the fiber direction, conductivity is controlled by phonon scattering from crystallities in the graphite.

R. P. Reed, also of CMEPT, was chairman of the materials properties session and presented an invited paper on the USSR/USA joint program on LNG materials research.

International Cryogenic Materials Conference

This conference was held in Munich in July 1978. **Larry L. Sparks** of CMEPT's Thermophysical Properties Division attended and presented a paper dealing with expanded plastics for use as thermal insulators. A reasonable amount of discussion resulted during the remainder of the conference, even though expanded plastics were on the fringe of interest for most attendees. Two other papers dealt with thermal insulations. Mr. Sharpe of NASA Langley Research Center presented the results of thermal cycling tests on foams. The tendency to crack had been stressed by Mr. Sparks and this work verified the problem. A paper by Mr. Padawer of Cabot Corp. noted that very little low-temperature thermal and mechanical property data are available for balsa wood. An effort by NBS to determine these properties would provide worthwhile design data for LNG-oriented facilities.

J. W. Elkin of CMEPT also delivered an address, correlating epoxy properties with preliminary training data. Although NEL was just beginning to fabricate and test a more complete series of epoxy impregnated rings, after the talk a number of people had suggestions for materials to consider for these new tests. One, in particular, is the MY740, D230 Ciba-epoxy system. This is well characterized mechanically and is the principal epoxy used for impregnation of superconducting windings at several laboratories in Europe.

M. D. Kasen of CMEPT presented a review paper on the applications of composites in cryogenic structures in the United States. He also presented a paper on dynamic elastic modulus and damping of several composites for H. M. Ledbetter.

R. P. Reed of CMEPT is chairman of the conference board. As such, he helped organize and run the entire conference. **A. F. Clark** of CMEPT pre-edited the papers for the proceedings.

International Electron Devices Meeting

Martin G. Buehler of CEEE's Electron Devices Division attended the International Electron Devices' Device Technology Subcommittee Meeting at Carleton University, Ottawa, Canada, in August 1978. Mr. Buehler serves on the subcommittee. This meeting was held to select papers to be given at the general meeting to be held in December 1978.

International Energy Agency Seminar on Air Infiltration

The International Energy Agency (IEA) is an organization of petroleum-user countries formed at the time of the Oil Embargo. It operates within the framework of the Organization for Economic Cooperation and Development (OECD). Among its objectives is a resolution to reduce dependence on imported oil.

To that end, **Charles M. Hunt** of CBT's Building Thermal and Service Systems Division was invited to be a panelist in an April 1978 seminar on air infiltration in buildings. Infiltration research represents an active facet of IEA research on conservation. The purpose of the seminar was to draw up a list of research projects in infiltration and recommend which ones should be supported and by whom.

Two days of the seminar were devoted to informal papers on infiltration. They dealt with measurement techniques, retrofit to reduce infiltration, and infiltration modeling. Two days were devoted to the effects of open windows on infiltration and energy consumption. Studies of when people open windows and why were also presented.

One of the tasks assigned to attendees of the seminar was to review current activity, define problems and needs, and recommend R & D. A list of twelve recommended projects was also drawn up.

International Ergonomics Association

Harold P. Van Cott of CCPT was invited to present a paper to the joint conference on "Product Design and Product Liability," sponsored by the Western N.Y. Chapter of the Human Factors Society, the Southern Ontario Chapter of the Human Factors Association of Canada, and the International Ergonomics Association. The conference was held in November 1977.

One of the most interesting themes to emerge from the conference was that of reducing the variability of consumer behavior in using a product by careful attention to the mechanical design of the man-machine manipulation interface. This can be done in the design of a variety of hand-held tools. Examples of this practice were given by several Canadian and U.S. speakers. Another topic of interest was a presentation by a representative of Design Canada, a department of the Canadian Department of Industry, Trade, and Commerce. The representative, Mr. Anthony Parsons, described the work of Design Canada in stimulating good product design by means of design advisory services, awards, citations, and grants.

International Fire Safety in Hospitals Symposium

The purpose of this Paris symposium was to review problems of fire safety in hopsitals and nursing homes. The aim was to provide a forum for exchange of ideas, to stimulate new thinking, to help identify topics that need further study, and to point the way for further conferences or workshops on specific aspects of fire safety.

The program, which covered a wide range of topics, was designed not only for health specialists and researchers, but also for policy makers, legislators, insurers, managers, architects, engineers, and fire officers.

Irwin A. Benjamin of CFR was invited to present a paper, "An Evaluation System for Life Safety," to the assembly.

International Flame Research Foundation

In August 1978, **Hratch G. Semerjian** of CMEPT's Thermal Processes Division visited the International Flame Research Foundation (IFRF), Ijmuiden Station, Netherlands. The IFRF is an international research organization that attempts to provide a focal point for combustion researchers from different countries.

The facilities of major interest are several large furnaces. The first one has a 2m x 2m cross section and is 6m long. Burner opening is 1m in diameter. Furnace walls are refractory brick, the front wall is adaptable to different burner designs. A slot along one side wall allows for visual observation and for insertion of probes. When not in use, the slot is covered with small water-cooled doors. The probes being used are quite sizable, ranging upwards of 3m in length, and special cranes are used to move them around in the furnace. Temperature, pressure, velocity (with pilot tubes) and radiation measurements are the principal measurements made in the furnace. Most of the diagnostic instrumentation has been developed at IFRF. They also have sizable coal-handling equipment, for crushing and pulverizing.

Current programs include blast-furnace gas combustion, oil-shale and high-ash-content coal combustion, pollution abatement from liquid- and solid-fuel combustion, and combustion of coal-oil mixtures. In the past, they have done quite a bit of work on modelling, but their forte has been instrumentation development, including several types of pyrometer probes.

International Heat Transfer Conference

The sixth annual conference was held in Toronto, Canada, in August 1978. Representing CBT was **George E. Kelly**, who presented a paper on an NBS computer program that can evaluate the effectiveness of different combinations of selected energy-saving features for gas-fired residential heating furnaces. Kelly also exchanged ideas with a number of European researchers who are performing research on furnaces and heat pumps similar to the work CBT is doing.

International Indoor Climate Symposium

This conference was held at the Copenhagen headquarters of the World Health Organization in August 1978. **Preston E. McNall, Jr.,** Chief of CBT's Building Thermal and Service Systems Division, presented a paper and chaired one session of the meeting. Briefly, the conference amounted to a world-wide review of developments on thermal comfort, including basic physiology, psychologic responses to the thermal factors, and the effects of transients. The air quality section included a similar update on odors, bacteria, tobacco smoke, other contaminants, and the effect of air ionization and electric fields. All information will be important in CBT's work on development criteria for standards consistent with energy conservation.

Other significant developments included electric fields as an indoor environmental variable, an update on Radon (222) in homes, and an update on thermal transients and head-to-foot gradients in spaces that are critical to comfort.

International Institute for Production Engineering Research

Russell D. Young and Robert J. Hocken of CMEPT's Mechanical Processes Division took part in the 28th Meeting and General Assembly of the International Institution for Production Engineering Research (CIRP) in Eindhoven, Netherlands from August 27 to September 2, 1978.

CIRP is the world leader in reporting and coordinating international research in the fields of automation, metrology and surface characterization. CIRP members, in concert, conduct cooperative international studies through voluntary participation. American industry benefits from improved national and international standards resulting from these studies. Highlights of the meeting include:

- West Germany has created considerable interest with the modular control system now under development (Stute and Worm). When completed, standard interfacings and modules will permit a machine tool manufacturer to assemble a suitable control system from modular building blocks.

- Diamond turning precision lathes are being introduced throughout the world for a wide variety of manufacturing applications.

- On-line speckle holography is under intensive study as a means for determining the shape of a high-quality manufactured part in England.

International Microwave Symposium and Conference on Precision Microwave Measurements

Four staff members of CEEE's Electromagnetic Technology Division participated in this year's conference, held in Ottawa, Canada, in June. **Ernest L. Komarek** took part in the technical sessions of the symposium as the organizer of the Automated Network Analyzer Techniques Session and as chairman and organizer of the Microwave Measurements Session.

Paul Hudson exchanged information with primary contacts from Japan, Sweden, Canada, and England. **Cletus A. Hoer** presented two papers: "Calibrating Two Six-Port Reflectometers with a Precision Length of Transmission Line" and "The Application of 'TSD' to the Calibration of the Dual Six-Port." **Glenn F. Engen** also presented two papers: "An Overview of Six-Port Development" and "An Improved Method for Calibrating the Six-Port Reflectometer." In addition, these four staffers learned of standards that NBS is not now supplying, e.g., noise standards in communications satellite bands. Steps toward filling this gap are now being taken.

Raymond S. Turgel of CEEE's Electrosystems Division presented a paper on "High Precision Audio Frequency Phase Calibration Standard."

International Organization of Consumers Unions

The Ninth World Congress of the IOCU was held in London in July 1978. The Director of CCPT, **Stanley I. Warshaw**, attended. The Congress opened with a message from the Duke of Edinburgh, the Patron of the IOCU. His Grace cited the U.S. as being the originator of the whole idea of consumerism. He stated that, "There is little that we say or fight for on behalf of our members that was not being said and fought for in the U.S. in the late 20's and 30's." From what information was presented in the various papers at the meeting, the U.S. has made more progress than most every nation represented with perhaps the exception of the Australians, Germans, and English, where Consumer Advice Centers are operated in major shopping areas of cities. These centers provide consumers walking in from the street information on any consumer product of interest, including the various characteristics and features offered in the marketplace as well as the range of prices by brand name. Technical knowledge is made available to these centers through individual companies, trade associations, government labs, and consumer union organizations.

International Organization of Legal Metrology

Roscoe L. Bloss of CCPT's Consumer Sciences Division and **Charles B. Phucas** of the Office of Engineering Standards attended the OIML meeting on strain gages in Paris during September 1978. The meeting had been called to discuss the First Pre-Draft International Recommendation on Performance Characteristics of Metallic Resistance Strain Gages, developed by the U.S. National Working Group for Strain Gages. As the reporting secretariat nation, the U.S. was responsible for chairing and recording the meeting as well as presenting and defending the document being discussed.

The meeting made excellent progress towards producing an international document that would standardize terminology; require that values of specific characteristics be listed on packages of strain gages, with uncertainty (tolerance) levels, in a standardized format; and establish procedures for determining whether the gages are of the quality stated. Specific actions towards this goal included accepting that strain gages are properly covered by OIML, adopting a terminology section for the document, and agreeing on the contents and format of the document. A strict timetable for completing a second predraft was accepted and specific tasks assigned. Mr. Phucas chaired the conference.

In October 1977, **Carroll S. Brickenkamp,** of the NBS Office of Weights and Measures, headed the U.S. delegation at the first meeting of OIML Pilot Secretariat 18, Reporting Secretariat 1, on "Humidimeters for Cereal Grains and Oleaginous Seeds." The meeting was held at the Paris headquarters of OIML. The agenda was to discuss and modify a draft of an international recommendation on a standard working method for checking instruments for measuring the moisture content of grain.

International Scientific Radio Union

The 19th General Assembly of URSI was held at the Technical University of Finland in Otaniemi (near Helsinki) from July 29 to August 8, 1978. **Ramon C. Baird** of CEEE's Electromagnetic Fields Division attended as an official U.S. delegate and representative of Commission A, Electromagnetic Metrology. He was the organizer and chairman of a technical session on Electromagnetic Fields and Antenna Measurements, at which he presented papers on International Intercomparison of Electric Field Strength at 100 MHz and on Recent Time-Domain Antenna Measurements at The National Bureau of Standards. In a session on Signal and Noise Measurements, he presented a paper on An Improved Solid-State Noise Source and a Statistical Measure of Stability.

Norris S. Naham of CEEE also attended the URSI meeting and chaired the session on Measurements in Optical Communications. Among other findings presented to the assembly, Mr. Naham noted that optical electronics work is moving strongly into optical integrated circuits. Electromagnetic theory of optical waveguiding systems continues to be developed with the single-mode concepts emphasized in the integrated circuits; fiber guides may remain multimode as equalization (index grading) is very adequate and the resultant guides are rugged. Single-mode fibers are very sensitive to bending. Many of the optical integrated circuits have their counterparts in the submillimeter integrated circuit.

International Symposium on Antennas and Propagation

Paul F. Wacker of CEEE's Electromagnetic Fields Division attended this symposium, held in August 1978 in Sendai, Japan. Among the many papers presented, was one on microstrip antennas by M. Haneshi of Saitama University. It described a small, simple, light-weight Dielectric Plate Antenna with 17 dB gain and -20 dB sidelobes. Although many microstrip antennas are designed by cut-and-try procedures or proprietary recipes, this antenna is quite simple to design, much simpler than a microstrip Yagi. In the field of small antennas, V. A. Pavlyuk of the Physico-Technical Institute of Low Temperatures at Kharhov, U.S.S.R., described a superconducting loop antenna making use of Superconducting Quantum Interferometer (SQUID) sensitivities of 10^{-30} Joules/second or field sensitivities of 10^{-12} erg/Hz $^{1/2}$ over a wide frequency band.

In the first successful experiment with a superconducting dipole, S. Adachi of Tohoku University found that superconduction increased the transmitted field intensity by 17.6 dB over a normal copper dipole and increased the Q from 100 to 3,700. With a two-element endfire superconducting dipole array, they found the working gain to increase by 21 dB over the corresponding normal array. At ordinary temperatures, Y. Hiroi and K. Fujimoto of Matsushita Communication Ind. Co. found that use of a parasitic electric dipole close to a small ferrite loop increased the voltage output of the loop by as much as 10 dB by improving the energy transfer. By using curved rather than straight wires, F. M. Landstorfer of the Technical University of Munich was able to increase the gain of a dipole from 2 to 4 dB (for a straight dipole, depending upon the length) to 7.8 dB and to 10.5 dB for a dual wire dipole; for a 3-element Yagi array he obtained 11.5 dB gain with a 20 dB sidelobe attenuation and a 26 dB front-to-back ratio. With a 6-element dualwire log-periodic antenna, he obtained an average gain of 16 dB from 470 to 610 MHz.

Dr. Frank Jensen described the design of a spherical near-field scanning facility being built at the Technical University of Denmark. Mr. Wacker himself described his general theory of near-field scanning (and highly efficient data processing), which includes planar, circular cylindrical, and spherical scanning as mere special cases. By moving the subreflector, Dr. Tasuku Teshirogi of RRL extended to Cassegrain antennas the technique of determining the gain of a large reflector antenna in its near field, an approximate technique based upon geometrical optics. Prof. D. C. Chang of the University of Colorado described the use of an annular, coaxially-driven slot antenna for probing the roof thickness in a coal mine. W. -M. Boerner and Y. Das of the University of Manitoba gave expressions for the shape of a

body in terms of its cross-sectional area as a function of direction, based upon the Radon transform. J. A. Kong of MIT and the NASA Goddard Space Flight Center reported on measurements of brightness temperature of snow above an aluminum ground plane. H. Hirosawa of the University of Tokyo reported on cross-polarized radar returns from rough soil surfaces.

International Symposium on Locational Decisions

The first such symposium on this topic was held in Banff, Canada, jointly sponsored by the University of Calgary and the University of Western Ontario, during April 1978. **Douglas R. Sheir** of CAM's Operations Research Division served as program chairman for session on "Network Location Problems."

The conference brought together participants from quite distant locations (including Israel, West Germany, Brazil, Denmark, as well as North America) to discuss and disseminate the latest research advances on location/allocation decision models. In addition to the scheduled formal sessions, there were several valuable informal exchanges of technical information with N. Christofides (U.K.) and G. Handler (Israel). Mr. Shier discussed a current project relating to dimensional coordination/catalog optimization with several of the participants. Also, certain of the solution tactics presented in talks at the conference will be relevant to enhancements of the current catalog optimization model. Moreover, up-to-date information on techniques for solving location problems was available at the conference and these are expected to be pertinent to a number of NBS projects: weather station siting, location of environmental sensors, and strategies for building evacuation.

International Symposium on Remote Sensing of the Environment

The twelfth symposium in this series was held in Manila in April 1978. **Doyle A. Ellerbruch**, of CMEPT's Electromagnetic Fields Division, presented two papers on his work in this area. Currently, NBS is actively engaged in relating electromagnetic metrology by providing data on the fundamental relationship between electromagnetic scattering and the physical properties and natural structures of soils and snow. This fundamental information, called "ground truth" by many in the realm of remote sensing, is often neglected by researchers.

International Symposium on the Use of Computers for Environmental Engineering

Tamami Kusuda of CBT was Chairman of the General Committee for the Third International Symposium on the Use of Computers for Environmental Engineering Related to Buildings, held in Banff, Canada, in May 1978. He spoke on the energy budget concept and the NBS thermal load determination program.

The symposium was attended by 175 architects, engineers, and energy analysts from 17 countries. A total of 60 technical papers were presented on such topics as heating/cooling load calculations, building heat transfer, HVAC systems simulation, daylight utilization, and computerized controls.

IMEKO Conference on Measurement of Force and Mass

This International Measurement Confederation (IMEKO) conference was held in Braunschweig, Germany, in September 1978. **Richard A. Mitchell** of CMEPT's Fluid Engineering Division presented the paper "Characterizing the Creep Response of Load Cells" (co-authored by Saul M. Baker). There was further detailed discussion with Bergquist (Sweden) and Gizmajer (Poland) who have research experience in this area. Gizmajer had studied our 1971 paper on load cell analysis and boundary load distribution effects. This was the seventh conference of a series that began in 1969. It was attended by 130 people from about 15 different countries.

ISO

The International Organization for Standardization (ISO) is comprised 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 the expansion of trade, the improvement of quality, the increase of productivity, and the lowering of 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 acceptable to as many countries as possible.

In March 1978, **Daniel Gross**, of CFR's Fire Safety Engineering Division, took part in meetings of ISO Technical Committee TC 92 on Fire Tests. The meetings were held at the laboratory of the Timber Research and Development Association in High Wycombe and at the British Standards Institution in London.

At the meeting of Working Group 3 (Fire Performance of Doors, Shutters and Glazed Elements), revisions were made to three documents dealing with the fire testing of Smoke Control Doors. These documents will form the basis of Draft International Standards to be circulated for ballot within the year. At the meeting of Working Group 11 (Fire Resistance), discussions were held on revisions to the existing standard (ISO 834) and to a document for fire testing of suspended ceilings protecting steel constructions. At the meeting of Working Group 14 (Ventilation Ducts), details were discussed for the fire testing of ventilation ducts that may be exposed to exterior and interior fires. The principal criteria are integrity, heat transmission, stability, tightness, elongation and restraint forces.

The University of Ghent, Belgium, was the site for the September 1978 meetings of ISO TC92, Working Groups 3, 11, and 14. **Daniel Gross** of CFR again attended as a delegate.

Richard A. Bright of CFR went to Hamburg to participate, as a U.S. delegate, in the meeting of ISO TC21 SC3. This subcommittee is responsible for the preparation of international standards for the testing and approval of automatic fire detection devices.

Richard L. P. Custer went to Cologne, Germany, in January 1978 to take part in the deliberations of ISO TC21. He was a delegate to Working Group 1, on automatic sprinklers, watersprays, and foam equipment. Standards are currently under development for automatic sprinkler (nozzles) and wet alarm valves. He also worked on the draft of new standards for Working Group 2, on CO_2 systems.

In February 1978, **Merritt M. Birky** of CFR's Fire Science Division attended the ISO TC92, WG12 meeting on Combustion Toxicology in Ludwigshafen, Germany. At this meeting the German delegation proposed a new test method for screening for "super" toxic combustion products. The rest of the meeting was spent reviewing the test method and finalizing various aspects of this method.

Irwin A. Benjamin, Chief of CFR's Fire Safety Engineering Division, participated in the London meetings of ISO TC92 on Fire Tests on Building Materials and Structures: Working Group 2 - Test Methods, WG4 - Reaction to Fire Tests, and WG7 - Policy Coordination. The sessions were held in January 1978. The meeting on test methods was devoted to discussions on the noncombustibility test. In addition, the rate of heat release test was reviewed and comments were supplied for modification of the work.

ISO TC92 WG7 discussions were held on the reorganization of TC92. A discussion was held on the desirability of a classification and criteria system to be applied to standards. A task group was set up to investigate to pursue this on the existing tests.

ISO TC92 WG4 meetings covered both revising the ignition apparatus and the rate of flame spread apparatus. Further work will be done by th NBS on flame spread.

During the same month, **A. F. Robertson** of CFR participated in several other meetings of the ISO TC92 working groups. Those were WG2, WG6, Terminology; and WG12, Toxic Hazards in Fire.

In October 1977, two members of the Office of Engineering Standards **(Lawrence D. Eicher and Cheryl P. Wise)** travelled to Paris and Geneva to take part in meetings related to the ISO International Standards Information Network (ISONET). The Paris meeting, sponsored by UNESCO and ISO, centered on the development of ISONET insofar as the services it will provide, its users, and technical conditions for establishing the network. Eicher's presentation, "Information Services to be Provided by ISONET," was one of 15 papers delivered at the Symposium.

Also in Paris, a training seminar was held for standards information personnel who would be closely involved with ISONET as it becomes operational. It was attended by 65 people from 30 countries. Eicher participated in a panel on "Functions of National Information Centers," and addressed the organization and duties of standards information centers. Wise presented a review of the U.S. and international standards information services at NBS.

In December, Eicher -- a member of the ISONET Management Board--took part in the second meeting of that group, held in Geneva. Essentially, the board dealt with two key issues: membership rights and obligations, and financial aspects of information exchange between ISONET members.

The board concluded that graded membership for ISONET was desirable under the following conditions:

- Different levels of membership should be called "stages" rather than categories. The term "stage" is meant to imply a degree of development within a member's information center (specifically with respect to services to be provided through ISONET).

- ISO countries seeking ISONET membership will declare their "stage" of development upon entering ISONET.

- The lowest or least developed stage of ISONET membership will only require the member to provide a subject-ordered list of their national (ISO member body) standards in one of the official ISO languages.

- Higher stages of membership will indicate levels of development with respect to indexing and documentation, scope and document coverage, and degree of automation.

It was generally agreed that ISONET members would exchange information on a quid-pro-quo basis, depending on their individual stages of membership. ISONET members in lower stages would limit their requests to higher-stage members to well-specified questions. There will not be any exchange of information that is not specifically requested.

In September 1978, Eicher again returned to Geneva, this time to present a paper, "Making Standards Known and Used," to an ISO seminar meeting. He also was the ANSI delegate to the Plenary Session of the ISO Council Committee on Scientific and Technical Information on Standardization. He also attended the meeting of a committee developing guidelines for the use of microforms in standards information centers.

In September 1978, **Brian C. Pierman** of CBT's Environmental Design Research Division went to Paris to serve as a member of the U.S. delegation attending the ISO TC21 Committee Meeting, Subcommittee One, on Signs, Symbols, and Classifications of Fire.

The major goal of the U.S. delegation was to dissuade the committee from accepting a number of symbols that were found to have the lowest level of recognition in the preliminary test program. Of special concern were a symbol devoted to egress in a fire emergency and a symbol designating a blind alley. Based on the concern of the U.S. and Canada, plus the presentation of test data by the U.S., both of these symbols were abandoned. In place of the rectangle, a Russian symbol of a man passing through a door was proposed and adopted. To designate no exit or blind alley, the international ban symbol of a circle with a diagonal line was placed over the Russian symbol and likewise adopted.

Charles T. Mahaffey of CBT's Building Economics and Regulatory Technology Division travelled to Geneva in October 1977 to participate in meetings of ISO TD3. The meetings were to develop an ISO response to the United Nations, Economic Commission for Europe request for performance-based standards suitable for use in building regulations. While in Geneva, he also attended the plenary session of ISO TC59, on building construction. The activity covered not only the standardization for dimensional coordination and performance-type building standards, but also the application of these priniciples to specific segments of building technology. Later in the same month, the TC59 subcommittee meeting was resumed in Stockholm, with special attention to the application of dimensional coordination to buildings and building components.

In November 1977, **James R. Whetstone** of NEL attended the London meeting of ISO TC28. There, he presented an overview of the Physical Property Project, including a discussion of the preliminary data available at that time. The API's Committee on Petroleum Measurement wanted to use this opportunity to advise Technical Committee 28 that it intended to

revise the volume-reduction tables used to compensate for the thermal expansion of petroleum, and to bring before the committee at its next session in 1979 those tables based on the Project's database. Two weeks later, Mr. Whetstone presented the same paper to the First Andean Petroleum Congress, held in Lima, Peru.

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 an isolated villa near the town of Frascatti in September 1978. Fifteen invited speakers, covering the area of nondestructive evaluation of semiconductors, lectured for about three hours each during the two-week institute.

Representing NBS were **James R. Ehrstein and George G. Harman** of CEEE's Electron Devices Division. After their lectures, they were to be available, on an extended basis, for consultation with students and other lecturers at the Institute. The students were chiefly interested in compound semiconductors, especially Gallium Arsenide.

Redwood International Gas Measurement Seminar

The Redwood Seminar was held at Slough, England, in February 1978, and covered most aspects of LNG and LPG handling, transport, storage and the measurements required in the custody transfer of the fluids. The custody handling considerations dominated the meeting. Gustav Grob, of the Redwood Division of Societe Generale de Surveillance, was in charge of the meeting arrangments.

J. D. Siegwarth of CMEPT was invited to present a paper on densimeters. Other speakers covered the topics of ship container systems, safety, and the problems associated with changing cargos and maintaining the purity of cargos used as chemical feed stocks. If they are out of specification, they may have to be dumped. In one case, a shipload of vinyl chloride had to be taken to sea and dumped because of contamination in the load.

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 beginning his fourth 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. Concurrently, he is beginning his fourth year of a five-year term as the RILEM Delegate for the United States, and in this capacity represents 32 U.S. RILEM members.

In April 1978, Dr. Wright went to Luxembourg for a series of concurrent meetings of the Bureau, the Advisory Group, and the Coordinating Group, and joint meetings of those three. As such, this series of meetings constitutes the major planning activities for the working year. **William C. Cullen,** Deputy Director of the Office of Engineering Standards, attended the meetings in his official capacity as a member of the RILEM Coordinating Group.

Among other matters, the Bureau took action with respect to full membership in RILEM. It dealt with the expansion of qualifications for full members beyond that of a Director of a research laboratory engaged in construction materials research. The Bureau agreed that full membership could be based on outstanding scientific contributions to the construction materials field as manifested by a full professorship in a major university or a senior research fellow in a highly recognized research organization in both public and private sectors of a given country.

As for laboratory accreditation, a number of RILEM delegates expressed great interest in the National Voluntary Laboratory Accreditation Program (NVLAP) as a model for laboratory accreditation in their own countries. They are anxious to see the first laboratories accredited under this program.

Mr. Cullen was active in the Coordinating Group review. The annual report of each Technical Committee was reviewed in respect to progress toward the committee goals and their technical accomplishments. Particular attention was directed toward the recommendations and symposia. The specific accomplishments of the various committees were evaluated in terms of planned milestones and objectives. The final report was prepared for presentation to the RILEM Permanent Committee at the annual meeting in Athens, in October 1978.

Later, Mr. Cullen attended that meeting as a participating member, with special attention to the 6th meeting of the RILEM Commission 24BW and the RILEM/CEB/CIB Symposium on Mechanical and Insulating Properties of Joints of Precast Reinforced Concrete Elements. He also attended the W23A Safety of Load Bearing Walls meeting. Topics covered were the mechanical and insulating properties of joints of precast reinforced concrete elements, mechanical properties of joints under static and dynamic loading, fire resistance of joints, insulating properties of joints of large panels, tolerances, influence of building processes on properties of joints, significance of laboratory tests, and in situ behavior of joints.

Geoffrey Frohnsdorff of CBT attended the meeting of the steering group of RILEM Committee 31-PCM on Performance Criteria for Building Materials, which was held in Ottawa, Canada, in August 1978. The meeting was chaired by Mr. T. Sneck of Finland and was attended by P. Sereda of Canada, A. Traetterberg of Norway, R. Al-Kass of Iraq, M. R. Ammar of Belgium, J. Bresson of France. Reports from task groups within 31-PCM were given by their chairmen: Environmental Characterization (Sereda), Performance Tests for Roofing (Frohnsdorff), Performance of External Vertical Surfaces (Sneck), and Identification of Problems with Aggregates Affecting the Performance of Concrete (Traetterberg). Attention was drawn by Sereda to the large number of committees in international groups, such as ISO, UN, ECE, CIB, etc., which were working on environmental characterization. It was important that the 31-PCM Committee should coordinate its work with these other groups. It was agreed that the work of Committee 31-PCM was proceeding satisfactorily and that the committee should be wound up in 1981 with sponsorship of the Second International Conference on the Durability of Building Materials and Components.

Semicon/Europa

This exposition of the international semiconductor industry took place in Zurich in September 1978. **Robert I. Scace** of CEEE's Electron Devices Division chaired the technical papers session. This year's equipment exhibition was at least a third larger than that of the 1976 SEMICON, filling the hall to capacity. The increase was primarily from European firms. The British were particularly visible, with a booth from the British government as well. Only one silicon supplier had a large exhibit (SMIEL, part of Montedison of Italy). The silicon business is very good at present, with some products on allocation and thus little need to advertise. SMIEL is still in the entering phases of becoming a supplier and therefore has to work harder. For example, they are just getting started in 3-inch Czochralski crystal production, with some prototype samples of 4-inch crystals. TOPSIL (Denmark) had a booth, but was primarily showing their crystal pullers.

Standardization in Support of Development: A Seminar

In October 1977, NEL held a two-day seminar at Gaithersburg. Its aim was to appraise the benefits derived from six years of cooperative programs with developing countries designed to improve their standardization and measurements services. With financial support from the Agency for International Development, participants came from Argentina, Bangladesh, Bolivia, Egypt, Ghana, Indonesia, Iran, Kenya, Korea, the Philippines, and Thailand; from regional and international organizations; from key U.S. standards writing bodies; and from industries, professional societies, and government in the United States. The papers presented and the discussions were organized around the session titles:

- Six Years of National Bureau of Standards and Agency for International Development Programs, and

- Standardization in the U.S.A. --A Resource for Development.

It was concluded that the developing countries concerned with this program had benefited in a variety of ways from the standards surveys and workshops conducted by NEL, and that efforts should be made to continue the program with full support. The proceedings of the conference have been published as NBS Special Publication 507.

Symposium on Electromagnetic Fields in Biological Systems

The Electromagnetic (EM) Fields Division of CEEE develops standards and techniques for producing known EM fields and measuring EM radiation hazards or pollution in the environment. As a result, **Ezra B. Larsen** was invited to present a paper at this conference, given in Ottawa, Canada, in June 1978. His paper was entitled, "Techniques for Producing Standard EM Fields from 10 kHz to 10 GHz for Evaluating Radiation Monitors." Most of the other papers related to measured effects of rf radiation on laboratory animals (including behavioral effects) and phantoms. Although a few dealt with theoretical calculations, only four papers dealt with electronic instrumentation or measurement of EM field strength and dosage.

Symposium on Structural Use of Wood in Adverse Environments

The objective of this international symposium was to bring together as much useful information as is available on the structural use of wood in adverse environments. Information on this topic is generally scattered in the literature and not readily available to the engineer or architect. State of knowledge summaries were presented by 13 invited speakers, while current research and practical engineering experience was derived from contributed papers and discussion from the floor. The conference was held in Vancouver in May 1978.

Larry Masters of CBT presented a paper entitled, "Predictive Service Life Testing of Structural and Building Components."

The Symposium was divided into two sessions. The first, Adverse Environments and Related Design Considerations, consisted of papers on structural environments and temperature, moisture, chemical, weathering and biological effects. The second session, Structural Design and Evaluation, consisted of papers on the effects of loading on design, designing for natural hazards, processing environment effects, limit state design methods, durability testing, and evaluation of the residual strength of timber.

Moreover, the NEL leadership role in durability testing of structural and building components was demonstrated by the discussion of the new ASTM Recommended Practice E632 for the development of durability tests, which is based upon NEL research.

World Hydrogen Energy Conference

The Second World Hydrogen Energy Conference was held on the campus of the Swiss Federal Institute of Technology in Honggerberg, Switzerland during August 1978. Over 500 delegates from 35 countries participated. NEL was represented by **Jesse Hord** of CMEPT's Thermophysical Properties Division, who presented a paper entitled, "Hydrogen Safety: An Annotated Bibliography on Regulations, Standards and Guidelines."

In general, it can be said that production techniques, efficiencies and costs are the major barriers to the large-scale use of hydrogen fuel. Expanded use of hydrogen as a chemical feedstock over the next few decades seems to be universally accepted. Current research is focusing on production and storage problems in hydrogen energy systems.

Although hydrogen is still too expensive to use as a fuel, its potential advantages in future applications are sufficiently attractive to justify sustained research and competitive consideration with other synthetics.

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 activities, interactions with the representatives of international organizations and foreign countries, the subjexts discussed, significant technological items, and the benefits of 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.

Mr. Michael Olmert reviewed the foreign trip reports, extracted data, and prepared this text. We greatfully acknowledge Mr. Olmert's work in preparing this report.
Mr. Steffen H. Peiser's (Chief, Office of International Relations, NBS) contribution in providing an extensive review of this report is greatfully appreciated.

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NBS-114A (REV. 9-78)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBSIR 79-1792	2. Gov't. Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

INTERNATIONAL ACTIVITIES
The Fiscal Year 1978 Survey of International Activities at NEL

5. Publication Date: August 1979

6. Performing Organization Code

7. AUTHOR(S)

Samuel Kramer (Michael Olmert-Editor)

8. Performing Organ. Report No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, DC 20234

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS *(Street, City, State, ZIP)*

National Bureau of Standards
Department of Commerce
Washington, D.C. 20234

13. Type of Report & Period Covered

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

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 1978.

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, 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. 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.

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☒ Order From National Technical Information Service (NTIS), Springfield, VA. 22161

19. SECURITY CLASS (THIS REPORT)	21. NO. OF PRINTED PAGES
UNCLASSIFIED	120
20. SECURITY CLASS (THIS PAGE)	**22. Price**
UNCLASSIFIED	$6.50

USCOMM-DC

*U.S. GOVERNMENT PRINTING OFFICE : 1979 0-281-067/241