

Proceedings of the
34th Annual Conference on

ENGINEERING IN MEDICINE AND BIOLOGY

1981

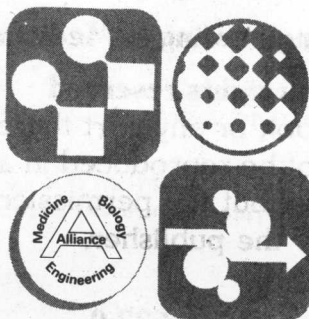
Volume 23

61.267083
C748
:23

Proceedings of the
34th Annual Conference on
Engineering in Medicine and Biology

1981

Houston, Texas
Volume 23



The Alliance for Engineering in Medicine and Biology, Publishers
4405 East-West Highway, Bethesda, MD 20814 301/657-4142

RWT / 2009/03

9749

Proceedings of the
34th Annual Conference on
Engineering in Medicine and Biology

1981

Volume 23
ISSN 0589-1019
LC 61-24788
© Copyright 1981

by

The Alliance for Engineering in Medicine and Biology

All rights reserved

This book or any part thereof
may not be reproduced in any
form without the permission of
the publisher.

81CH1622-0

Extra copies may be purchased from:

The Alliance for Engineering in Medicine and Biology

4405 East-West Highway
Bethesda, MD 20814
301/657-4142

Manufactured in the
United States of America by:
Dependable Printing Co., Inc.

34th Annual Conference on Engineering in Medicine and Biology

Sponsored by

The Alliance for Engineering in Medicine and Biology

Officers

Paul W Mayer, MD, *President*
Francis M Long, PhD, *Vice President*
William R Hendee, PhD, *Secretary*
Arthur T Johnson, PhD, *Treasurer*
Edward J Hinman, MD MPH, *Past President*
Patricia I Horner, *Executive Director*

Past Presidents

Edward J Hinman, MD MPH, 1978-79
Charles Weller, MD, 1976-77
Anthony Sances Jr, PhD, 1975
Harry S Lipscomb, MD, 1974
Alan R Kahn, MD, 1973
Arthur C Beall Jr, MD, 1972
Lester Goodman, PhD, *Founder President, 1970-71*

Council

Donald A Nagel, MD, AAOS
Perry Sprawls Jr, PhD, AAPM
Richard J Johns, MD, ACP
Leslie L Alexander, PhD, ACR
Gerald M Sidel, PhD, AICHE
Alexander F Metherell, PhD MD, AIUM, *Nom Com Chmn*
J Lawrence Katz, PhD, ASEE
David A Simmons, ASHE
Eugene F Murphy, PhD, ASTM, *Const & Bylaws Com Chmn*
Jerry L Baker, PhD, ASAE
Tin-Kan Hung, ASCE
Ralph F Goldman, PhD, ASHRAE
Robert M Nerem, PhD, ASME, *34th ACEMB Chmn*
Michael J Miller, JD, AAMI
Al Potvin, PhD, BMES
Morton D Schwartz, PhD, IEEE
Bernard A Cohen, PhD, ISA
Anthony Sances Jr, PhD, NES
Harry E Emler Jr, SAMS
Robert E Herron, PhD, SPIE
John A Hopps, DSc, IFMBE
Lester Goodman, PhD, *Founder President*
John W Steadman, PhD, *Education Com Chmn*
Herbert Mennen, *Finance Com Chmn*
George N Webb, *Membership Com Chmn*
Alan R Kahn, MD, *Meetings Com Chmn*
Robert E Mates, PhD, *Proj Advisory Com Chmn*
Edward J Hinman, MD MPH, *33rd ACEMB Chmn*
Lawrence E Thibault, PhD, *35th ACEMB Chmn*

ACEMB Conference Committee

General Chairman
Robert M Nerem, PhD, *U of Houston*

Program Chairman
John W Clark Jr, PhD, *Rice U*

Local Arrangements Chairman
Hardy M Bourland, PhD, *Rice U*

Exhibits Chairman
Forrest Fox, *Methodist Hosp-Houston*

Student Program Chairmen
Periklis Ktonas, PhD, *U of Houston*
John W Steadman, PhD, *U of Wyoming*

Conference Director
Patricia I Horner, *AEMB*

Conference Coordinator
Susann P Fletcher, *AEMB*

Program Committee
J Bourne, *Vanderbilt U*
RV Calfee, *Intermedics Inc*
WJ Dorson Jr, *Ariz St U*
RC Eberhart, *Southwestern Med Sch*
KL Gould, *U Texas Med Sch-Houston*
JD Hellums, *Rice U*
JL Katz, *Rensselaer Polytech Inst*
PY Ktonas, *U Houston*
RO Martin, *Intermedics Inc*
LV McIntire, *Rice U*
P Murphy, *Baylor Coll Med*
J Ophir, *U Texas Med Sch-Houston*
DJ Patel, *Howard U*
E Philippe, *Rice U*
A Popel, *U Houston*
FP Primiano, *Case W Res U*
K Richards, *U Texas Med Sch-San Antonio*
GM Sidel, *Case W Res U*
RW Schubert, *La Tech U*
R Srinivasan, *Mgmt & Tech Svcs Co*
PD Stein, *Henry Ford Hosp*
RN Vaishnav, *Catholic U of Amer*
JP Wikswo, *Vanderbilt U*
ME Womble, *Sci Sys Inc of Mass*
A Zermeno, *Mb Anderson Hosp & Tumor Inst*

Local Arrangements Committee
Joe Canzoneri, *The Inst for Rehab & Res*
Joy Pursch, *Rice U*
Carolyn Sterling, *U Colo Hlth Sci Ctr (AV Chmn)*

Student Program Committee
John R Bourne, *Vanderbilt U*
Larry V McIntire, *Rice U*
Robert E Mates, *SUNY-Buffalo*

Registration
Susann P Fletcher, *Chair*
Marguerite R Jerd
Maxine P Smith

The Alliance gratefully

**...Acknowledges financial
contributions from the
following PATRONS**

*Cordis Corporation
Electro-Biology, Inc.
Mr. & Mrs. Stanley E. Hubbard
Medtronic, Inc.
Merck Sharp & Dohme Research Laboratories
Millar Instruments Inc.*

...Thanks

Johnson and Johnson
**for their continuing
support of the
Student Paper Program**

**...Recognizes the assistance
of the following
organizations**

*Baylor College of Medicine
Dependable Printing Company
Houston Convention Bureau
Methodist Hospital-Houston
Rice University
University of Houston*

**35th Annual Conference on
Engineering in Medicine and Biology
September 21-23, 1982
Philadelphia Marriott Hotel
Philadelphia, Pennsylvania**



Paul W. Mayer, M.D.
President
Alliance for Engineering
in Medicine and Biology



Robert M. Nerem, Ph.D.
General Chairman
34th ACEMB

Soon after World War II, engineers, physicians, and other scientists recognized the need to establish communication across the boundary that then separated medicine and the life sciences from engineering and the physical sciences. Although meetings were held, committees became active, and bookshelves overflowed, lack of a central dedicated body with committed leadership led to the realization that interdisciplinary purposes are not served well by individual groups working independently.

At a conference on engineering in medicine and biology in 1969, the Alliance for Engineering in Medicine and Biology was born. It now incorporates 20 constituent societies governed by a Council composed of a representative from each affiliate. The accomplishments of the Alliance since that time have far outstripped the expectations of its founders.

This 34th Annual Conference on Engineering in Medicine and Biology attests to the sense of excitement and commitment with which engineers, physicians, and other scientists look to the future as they report on the state-of-the-art of biomedical engineering. We all can take pride in the accomplishments of the past decade. Now we turn to the challenge of the eighties, and dedicate ourselves to identifying the trends for tomorrow and recommending priorities that will best serve the national interest. Which experimental approaches are most likely to realize their potential? Which are ready for application now? Which are likely to diminish in importance? Which are economically sound? Which will not be cost-effective?

In addition to conducting the ACEMB, the Alliance has made important contributions through a variety of studies and publications ranging from a 5-year ultrasound research and development agenda to guidelines for technology procurement in health care institutions. But much remains to be done and the Council and Executive Committee are pursuing vigorously avenues through which the Alliance and its constituents and their members can contribute further to the profession and to the community.

The Alliance for Engineering in Medicine and Biology

Constituent Associations

American Academy of
Orthopaedic Surgeons

American Association of
Physicists in Medicine

American College of
Physicians

American College of
Radiology

American Institute of
Chemical Engineers

American Institute of
Ultrasound in Medicine

American Society for
Engineering Education

American Society for
Hospital Engineering of the
American Hospital
Association

American Society for
Testing & Materials

American Society of
Agricultural Engineers

American Society of Civil
Engineers

American Society of
Heating, Refrigerating &
Air-Conditioning Engineers

American Society of
Mechanical Engineers

Association for the
Advancement of Medical
Instrumentation

Biomedical Engineering
Society

Institute of Electrical &
Electronics Engineers

Instrument Society of
America

Neuroelectric Society

Society for Advanced
Medical Systems

Society of Photo-Optical
Instrumentation
Engineers

U.S. Representative
International Federation for
Medical and Biological Engineering

American Academy of Orthopaedic Surgeons
444 North Michigan Avenue, Suite 1500
Chicago, Illinois 60611

The American Academy of Orthopaedic Surgeons, established in 1933, is that medical specialty which embraces the investigation, preservation, development and restoration of the form and function of the extremities, the spine and associated structures of the skeleton by medical, surgical and physical methods.

From the very beginning, the purpose of the Academy has been to foster, support, augment, develop, and encourage investigative knowledge of orthopaedic surgery and to prevent disorders of the musculoskeletal system.

The continuing education of its 9,800 members is the Academy's major function. Among the Academy's many educational tools are its instructional courses, averaging between 115-120, and presented yearly since 1942 at the Annual Meetings. In addition, the courses are published to augment the libraries of orthopaedic surgery and selected abstracts of scientific papers were produced in audio cassette form for the first time after the 1976 Annual Meeting.

Other endeavors include the Summer Institute program, patterned after the Annual Meeting instructional course format, and videotapes on selected subjects.

Another important educational service is the Academy's sound-slide and film program. Started in the late 1950's, it now provides more than 600 titles for use in all phases of orthopaedic education.

In recent years, the Academy introduced the self-assessment examination, a voluntary procedure enabling an orthopaedist to identify areas of deficiency and to follow through with appropriate remedial continuing education experiences to bridge the gap between what he wants to know and what he needs to know.

The Academy is active in many areas that in some way relate to patient care including liaison with standards developing organizations, particularly as they pertain to implants and other details of orthopaedic surgery. The Academy does not produce standards on its own.

THE AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE

The American Association of Physicists in Medicine, established in 1958, has a current membership of approximately 1,700. The Association's purposes are to promote the application of physics to medicine and biology, to encourage interest and training in medical physics and to prepare and disseminate technical information in this and related fields. The Association's scientific activities lean heavily towards radiological physics (dosimetry, physics of x-ray diagnosis and therapy, radiation safety, etc.) but there is an increasing emphasis on the physics of other, non-radiological techniques for the diagnosis and treatment of disease.

The primary professional activity of Full Members must be in medical physics but certain other membership categories are open to those who do not meet this requirement. Corporate membership is available to industrial organizations.

The principal scientific meeting is held in the Summer, usually in conjunction with an AAPM organized Summer School. A Winter meeting is mounted jointly with the Radiological Society of North America, and the Association through its membership in the International Organization of Medical Physics (IOMP) has sponsored several international conferences. The Association's Regional Chapters, now numbering 18, also hold frequent meetings and symposia.

The Association publishes a bimonthly journal Medical Physics, which, in addition to scientific contributions, contains a Bulletin section covering Association affairs. Jointly with the Canadian and British medical physics organizations and with IOMP, AAPM sponsors a second bimonthly journal Physics in Medicine and Biology. Several other scientific, technical and educational publications have also been issued.

An important activity is the management of Regional Calibration Laboratories and of the NIH-supported Radiological Physics Center (Houston, Texas). With National Bureau of Standards cooperation, these laboratories act as additional dosimetry intercalibration resources.

The Association is a Member Society of the American Institute of Physics.

335 E 45th Street
New York, NY 10017
212/661-9404

AMERICAN COLLEGE OF PHYSICIANS
4200 Pine Street
Philadelphia, PA 19104

THE AMERICAN COLLEGE OF RADIOLOGY
20 N. Wacker Drive
Chicago, Illinois 60606

The American College of Physicians is a national medical organization consisting of over 51,000 specialists in internal medicine and related subspecialties. The College is dedicated to maintaining and advancing the quality of patient care in internal medicine and allied specialties. The College accomplishes this through graduate and continuing education and by concerning itself with matters of public policy as related to internal medicine.

The College annually sponsors an Annual Session, 25 Postgraduate Courses and 50 Regional Meetings. The College was the major innovator of the concept of self-assessment of medical knowledge combined with continuing medical education and has published 5 Medical Knowledge Self-Assessment Programs. Its fifth program was distributed in October 1979 to 42,000 subscribers. MKSAP VI will be published in 1982. In conjunction with the MKSAP V Program, the College sponsored 85 MKSAP V Postgraduate Courses in various cities throughout the country beginning November 1979. In addition, the College presents 8 awards annually and sponsors 15 teaching and research scholarships.

The American College of Physicians publishes the ANNALS OF INTERNAL MEDICINE and the ACP OBSERVER monthly.

The ACR was founded in 1923 with the objective of creating "a fellowship among medical men who have distinguished themselves in the science of radiology."

Member and Fellow are the two principal categories of membership in the ACR. Members are those physicians practicing radiology who have been certified by the American Board of Radiology or in radiology by the Royal College of Physicians and Surgeons of Canada. The also are required to be members of their College chapter.

Members and Fellows in Physics are those physicists certified by the American Board of Radiology. The Board of Chancellors elects Gold Medalists and Honorary Fellows.

College Fellows are elected from the membership on the basis of contributions and service to radiology. A minimum of 5 years of membership is required. Fellowship nominations are approved by the Board of Chancellors and elections is by the College fellows.

Residents in radiology in approved programs are eligible to become Junior members of the ACR upon nomination of their preceptors. Such membership extends for the training period and entitles the resident to receive publications and attend meetings of the College.

Since its reorganization in 1939, the College has functioned as the spokesman for radiology. It has developed programs in radiation protection, professional and public education, technologist training, practice standards, public relations, legislation, and health care insurance.

The College opened a Washington office in 1969 for government liaison and for contact with other organizations of interest in radiologists.

The officers of the College are the president, vice president and secretary-treasurer. They serve 1-year terms. The president, vice president and nine Chancellors are elected by the membership. The administrative head of the College is its executive director. Working with the executive director are an assistant executive director; directors of public relations, the Washington office, education, and administration; a comptroller, and other assistants. Legal counsel and legislative consultant also are available.

The American College of Radiology Foundation was created in 1958 to carry out educational and other beneficial activities for radiology. The Foundation has begun to accumulate an endowment and has undertaken several projects.

The Professional Bureau is a placement service designed to aid radiologists, radiology residents, medical clinics and hospital medical staffs.

American Institute of Chemical Engineers
345 East 47 Street
New York, NY 10017

The American Institute of Chemical Engineers, a professional society of over 52,000 chemical engineers, is dedicated to advancing chemical engineering in theory and practice, to maintaining a high professional standards among its members, and to serving society, particularly where chemical engineering can contribute to the public interest. It is directed by a Council consisting of the officers--President, Vice President, Secretary, Treasurer, Past President--elected annually and 12 directors elected for three-year terms.

Much of the accomplishment of the AIChE originates in its nearly 30 committees, devoted to such interests as energy, standards, professional development, meeting programs, ethics, education. In addition, the AIChE has 11 divisions covering the environment; nuclear energy; food, pharmaceutical and bioengineering; forest products; fuels and petrochemicals; heat transfer and energy conversion; computer systems and technology; materials engineering and sciences; safety and health; marketing; and management. Over 102 local sections offer the members in their areas monthly meetings, one-day technical sessions, continuing education programs, plant trips, etc., and there are 135 student chapters.

The American Institute of Chemical Engineers--which will celebrate its Diamond Jubilee in 1983--was the first society to accredit engineering curricula, a function it has performed since 1925. Today the AIChE works with the Accreditation Board for Engineering and Technology in the accreditation process.

During the year AIChE holds three meetings and sponsors the Petrochemical and Refining Exposition and the Chemical Plant Equipment Exposition, one each year. Special meetings are also held in cooperation with other societies and with agencies such as the National Science Foundation.

Among its publications are the monthly Chemical Engineering Progress, the bimonthly AIChE Journal, the quarterlies International Chemical Engineering, Environment Progress, Energy Progress, and Plant/Operations Progress, the AIChE Monograph and Symposium Series, equipment testing procedures, and the Student Members Bulletin.

The AIChE is a member of the Accreditation Board for Engineering and Technology, American Association of Engineering Societies, the InterAmerican Confederation of Chemical Engineering, the World Federation of Engineering Organizations, among other groups, and is represented on numerous councils and national committees.

Membership grades are Fellow, Member, Associate member, Affiliate member, and Student member. The AIChE has its headquarters in the United Engineering Center in New York.

AMERICAN INSTITUTE OF ULTRASOUND IN MEDICINE
4405 East-West Highway, Suite 504
Washington, D.C. 20014

The American Institute of Ultrasound in Medicine was founded in 1955 to advance the art and science of ultrasonics in medicine and research. Its activities are educational, literary and scientific. To further the growth of interest and education in ultrasound, the AIUM has established committees in the following areas: Administrative, Archives, Biological Effects, Central Program, Education, Ethics, Public Relations, Publications, Standards, Regional Groups, Constitution, Finance, Project Development, and Manufacturers. AIUM invites participation by its members in committee activities.

Ultrasonics is entering an era of rapid expansion in medical diagnosis, therapy and biological research. Strides made in the past decade by individual investigators and various ultrasonic centers have been highly significant. However, the full potential of this biomedical tool can be achieved only by coordinating the efforts of researchers, clinicians and engineers. The AIUM is designed to create a common forum for these workers and to guide a multi-disciplinary, scientific approach to the diagnostic and therapeutic uses of sonic energy.

Annual national conventions include educational and scientific sessions, and commercial and scientific exhibits. Meetings open with an educational session covering current diagnostic techniques, held in conjunction with the Society of Diagnostic Medical Sonographers. Scientific sessions consist of papers concerned with the medical applications of ultrasound and the interaction of ultrasound with tissue. Workshops are available following the presentation of scientific papers. AMA Continuing Medical Education Category I credits are on an hour for hour basis.

AIUM's membership consists of nearly 5000 physicians and technical specialists, as well as engineers and physicists. Manufacturers and their representatives and medical students are eligible for Affiliate, Associate or Sustaining membership depending upon their qualifications. The classes of membership are as follow: Full, Associate, Affiliate and Sustaining.

Convention scientific session Proceedings are published annually by AIUM. There is a quarterly newsletter, REFLECTIONS, and an annual buyer's guide, SONIC EXCHANGE, as well as special topic publications. The JOURNAL OF CLINICAL ULTRASOUND, published nine times a year, is the official journal of the AIUM. Members receive the JCU as a benefit of membership.

The American Institute of Ultrasound in Medicine is affiliated with the World Federation for Ultrasound in Medicine and Biology, and with the Society of Diagnostic Medical Sonographers.

AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE)
Suite 400, One Dupont Circle (202) 293-7080
Washington, DC 20036
Dr. W. Edward Lear, Executive Director

American Society for Hospital Engineering
V. James McLarney, Society Director
840 North Lake Shore Drive
Chicago, IL 60611

The American Society for Engineering Education, founded in 1893, is dedicated to the advancement and improvement of all aspects of higher and continuing education concerned with the teaching and training of professional engineers and technologists. With 10,000 individual and 600 institutional members, it serves these aims by giving direct aid to the development of more effective teaching faculty and engineering college administrators, producing advanced instructional materials to stimulate new curricula and programs, improving the content and support of engineering research, and by enhancing ethics and standards in the profession. The Society coordinates the interests and activities of its members through a set of institutional councils, professional interest councils, on-campus activity coordinators or committees at member schools, and geographic zones. Members affiliate themselves with a wide variety of divisions and committees devoted to particular areas of interest, including educational research and methods, liberal studies, continuing and cooperative education, biomedical engineering, environmental engineering, governmental relations, engineering economy, engineering design, energy conservation, nuclear engineering, and engineering design graphics. ASEE confers 13 national awards annually upon engineering educators for distinguished teaching, for outstanding research contributions and for other significant service to engineering education. Under the direction of the executive director, the Society maintains headquarters in the National Center for Higher Education in Washington, D.C. This enables the Society to keep in direct contact with federal agencies and other national organizations concerned with engineering manpower and with the role of engineering in developing societies abroad. ASEE has sponsored a congress of engineering educators from throughout the world. As a measure of its recent leadership, the Society has administered or cosponsored over thirty research and study projects, including a study to improve the retention rate of undergraduate engineering students, and activities for the development of predominantly black engineering colleges. ASEE is vigorously pursuing the goal of encouraging more women, as well as members of minority groups, to undertake the scholastic preparation for successful careers in engineering and engineering technology, and encouraging greater awareness among children of junior high school age of opportunities in these fields. During the academic year, ASEE publishes a journal devoted to innovative teaching ideas, Engineering Education, one issue of which is a directory of engineering college research and graduate study. It also publishes a monthly newspaper, Engineering Education News, devoted to current developments in the Society's main areas of interest. Eight Society divisions also produce periodicals.

The American Society for Hospital Engineering (ASHE), the largest of the 15 health manpower societies, affiliated with the American Hospital Association, embraces multiple engineering disciplines utilized in the delivery of health care services in an institutional setting. Plant engineering, clinical engineering technology, and telecommunications are the major disciplines. Special sections for clinical engineering technology and telecommunications have recently been formed.

ASHE publications include a monthly newsletter, monthly technical reports, the Hospital Engineering Handbook, a hospital recall and reporting system for medical devices, a report on automated infusion devices, a policies and procedures guide, a preventive maintenance manual for small hospitals, video tapes of a symposium on environmental safety issues, special alert bulletins, and more.

Topical areas addressed by committee work include: Codes and Safety, Energy, Technology Radiological Engineers, Equipment Purchasing, Environment, Professional Development and Shared Services.

The ASHE sponsors 15-20 programs a year, the major program being the annual Hospital Engineering Conference.

The 1981 Conference will be held in Chicago, June 22-26. In 1982 the annual conference will be held in New York City, July 12-16.

American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
2950 Niles Road, Box 410
St. Joseph, Michigan 49085

The American Society for Testing and Materials is the country's leading management system for the development of voluntary consensus standards. Thirty thousand experts participate on 140 technical committees to develop standards on a wide range of materials, products, systems and services. Over six thousand ASTM standards are published each year in the forty eight volume ASTM Book of Standards.

Standards for medical devices and diagnostic products are a significant part of ASTM's overall program. Committee F-4 on Medical and Surgical Materials and Devices (formerly Surgical Implants) was organized in 1962. Committee F-4's scope is the development of standard definitions of terms, methods of test, specifications and performance requirements for medical and surgical materials and devices. Over four hundred bioengineers, biomaterial scientist physicians, industrial engineers, quality control specialist, government scientist and association representatives are working on F-4 subcommittees on Resources, Orthopaedics, Cardiovascular, Neurosurgery, Plastic and Reconstructive Surgery, Otolaryngology, Ophthalmology, Medical/Surgical Instruments and Urology. There are one hundred draft technical standards being reviewed on polymers, metals, ceramics, composites, test methods, biocompatibility, device retrieval, packaging, osteosynthesis joint replacement, cardiovascular, neurosurgical, urological, surgical instruments.

Committee F-19 on Orthotics and External Prosthetics was organized in 1974 to develop standard definitions, classifications, recommended practices, specifications, test methods and performances requirements for Orthoses, Prostheses and Mobility Aids. The ASTM Committees also provide the expertise for U.S. Technical Advisory Groups (TAGS) for the International Standards Organization Technical Committees 150 on Surgical Implants, 168 on Prosthetics and Orthotics and 170 on Surgical Instruments.

Medical-Related standards are also being developed in ASTM Committees D-11 on Rubber and Rubber-Like Materials, D-20 on Plastics, E-20 on Temperature Measurement, E-25 on Microscopy, E-31 on Computerized Laboratory Systems and E-41 on Laboratory Apparatus.

For Further information contact
Peter G. Brown (215-299-5489).

ASAE is a technical society serving engineering in agriculture. Its objectives are to promote the science and art of engineering in agriculture; to encourage original research; to foster agricultural engineering education; to advance the standards of agricultural engineering; to increase and extend the association of agricultural engineers among themselves and with allied scientists and technologists. Founded in 1907, the Society serves 9,000 members in North America and over 90 other countries.

It is organized into 5 major technical interest areas. The Power and Machinery Division is concerned with agricultural tractors and implements for planting, harvesting, transporting and processing food, feed and agricultural fiber. The Soil and Water Division is concerned with irrigation, drainage, hydrology, erosion control and land use planning. The Electric Power and Processing Division is concerned with efficient handling and processing of agricultural products on the farmstead which frequently requires the use of electric power. The Structures and Environment Division is concerned with structures for livestock and plant production as well as storage of agricultural products and waste management. The Food Engineering Division is concerned with production processing, packaging, storage and distribution of food from the farm to the consumer.

In addition there are numerous Society-wide committees that coordinate special interests of concern to all technical interest areas; such as safety, standards, instrumentation, energy, environmental quality, countryside development, and bioengineering. One of these, the ASAE Bioengineering Committee, is responsible for coordinating bioengineering interests for the Society. This committee is concerned with the role of agricultural engineering in bioengineering and encourages interest in bioengineering among ASAE members. Recent activities include technical programs on agribioengineering in plant and animal systems; bioengineering for maximum crop production through photosynthesis research, genetic manipulation and mathematical modeling; and bioengineering instruction in agricultural engineering.

AMERICAN SOCIETY OF CIVIL ENGINEERS
United Engineering Center
345 East 47th Street
New York, New York 10017

The American Society of Civil Engineers, founded in 1852, has as its objective the "advancement of the science and profession of engineering to enhance the welfare of mankind."

The Society presently has over 78,000 members.

Continuing education and professional growth are primary concerns, as are protection and promotion of professional consciousness within the profession and civil engineering students, stimulation of technical research and publication of new technical information.

More than 3,300 members voluntarily serve on nearly 450 different technical committees, in administrative and coordinating committees and about 150 members conduct 24 professional committees. With the activities of Sections, Student Chapters, Joint Councils, and the many working committees, an average of approximately 100 meetings or other functions are held every weekday by ASCE groups.

The following twenty-three Technical Divisions and four Technical Councils of the Society work to develop and disseminate new technical information:

Air Transport	Structural Engineering
Cold Regions	Surveying and Mapping
Construction	Urban Planning and Development
Engineering Mechanics	Urban Transportation
Engineering Management	Water Resources
Environmental Engineering	Planning & Management
Geotechnical Engineering	Waterway, Port, Coastal, & Ocean Aerospace
Highway	Computer Practices
Hydraulics	Lifeline Earthquake Engineering
Irrigation & Drainage	Codes and Standards
Pipeline	
Energy	
Research	

Through the Technical Divisions and Councils the members are stimulated and aided in producing significant contributions to the knowledge of civil engineering techniques.

Publications of the Society include the monthly magazine, CIVIL ENGINEERING, and the monthly newspaper, ASCE NEWS. Technical Division Journals include papers, and a number of Manuals and Reports provide authoritative information on a variety of subjects. ASCE Transactions is published annually providing guide to all published materials.

ASCE participates in AEMB activities through its Engineering Mechanics Division's Committee on Bioengineering and the Task Committee on Civil Engineering in Biomedicine and Health Care Systems.

AMERICAN SOCIETY OF HEATING, REFRIGERATING
AND AIR-CONDITIONING ENGINEERS, INC.
345 East 47th Street
New York, NY 10017

The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., known popularly as ASHRAE, is the only technical society devoted exclusively to promoting the arts and sciences of heating, refrigerating, air conditioning, ventilation and their allied technologies. Established in 1894, it has grown to more than 40,000 members, and its membership spreads throughout the United States, Canada and 111 overseas countries.

All members belong to the international organization, which is headquartered in New York City, and most members belong to one of the Society's 133 North American chapters.

ASHRAE is a medium for the accumulation and dissemination of technical information in the heating, ventilating, air-conditioning and refrigerating fields, accomplishing this through local and national meetings and an extensive publications program:

ASHRAE JOURNAL is the Society's official monthly publication and the most authoritative periodical on research, design, development, engineering and news in the field.

ASHRAE HANDBOOK & Product Directory is a four-volume series with one updated volume published annually: Applications, Equipment, Fundamentals and Systems.

ASHRAE TRANSACTIONS, published since 1895, contains an unabridged compilation of all technical papers and symposium papers and their discussions presented at Annual and Semiannual meetings of the Society, plus necrology, and chronological listing of ASHRAE past presidents, Society meetings and honors and awards.

THE AMERICAN SOCIETY OF MECHANICAL
ENGINEERS

345 East 47th Street
New York, New York 10017

The American Society of Mechanical Engineers was founded in 1880 as an educational and technical society of individual members, which currently total some 100,000 men and women here and abroad. While its principal aims and objectives are: providing continuing education to mechanical engineers, industry, and society as a whole through the development and dissemination of technical information; developing mechanical standards, codes, safety procedures and operating principles; and encouraging the personal and professional development of practicing and student engineers, the Society also conducts programs which will bring a better understanding of technology to legislators, other professionals and the public at large.

To carry out these objectives the Society receives policy direction from a volunteer body of members and officers, and general administration from a Headquarters staff of some 250 in New York, and four Field Service offices in Washington, D.C., Dallas, Chicago, and San Francisco. The Society also maintains an additional office in Washington, D.C. to monitor legislative activities and to provide technical expertise to Congress and the Executive Branch of the Government.

Members can participate in one or several of the 31 Technical Divisions which sponsor or participate in national and international meetings and symposia (approximately 30 per year), and which contribute to the technical literature. In fact ASME conducts one of the largest technical publications operations in the world, committing a broad spectrum of engineering experience and research to the printed word. Spokesman for ASME is the monthly magazine MECHANICAL ENGINEERING.

The Society also plays a coordinating role in engineering research by sponsoring projects which are conducted by research organizations.

Association for the Advancement of
Medical Instrumentation

Patient care may be significantly improved by technology. Health care professionals must respond to the challenge of technology's dramatic potential.

The cost-effective use of technology in patient care is furthered by good communications between all groups involved with devices, instruments and systems.

AAMI is the only organization that views communications and education as a systems concept. This systems concept recognizes that all segments of the health care field must participate in the continuing process of integrating technology into an effective program of patient care.

AAMI, as an international, professional association, invites involvement and participation in this process through membership—a membership of users, manufacturers and government representatives.

AAMI's objectives are dynamic and change to accommodate the needs of its members and the field.

AAMI objectively integrates user and manufacturer viewpoints in order to meet new challenges and promote progress in the field. Because it serves all viewpoints in its multidisciplinary membership, AAMI provides an impartial forum through which consensus may be achieved on major issues.

AAMI fosters communication, education and understanding among technical, engineering, medical, industrial and governmental groups while advancing innovation and the use of medical instrumentation, devices and systems. Programs continually redefine the responsibilities of, and interface between, users and manufacturers of medical technology.

AAMI's major objectives are to:

- Promote the effective management of diagnostic, therapeutic and administrative technology.
- Continually inform its members about major trends and developments in the field.
- Establish reasonable safety and performance standards for medical instrumentation and systems.
- Provide appropriate recognition and certification of professionals working in the field.
- Reduce the costs of health care through effective application of technology.

AAMI's members are professionals who must manage the dramatic potential of current and new technologies which are revolutionizing patient care.

Current members include, physicians, hospital personnel, clinical and biomedical engineers, technicians, nurses, manufacturers, government officials, purchasers, researchers and distributors.

1901 North Fort Myer Drive
Arlington, Virginia 22209
(703) 525-4890

BIOMEDICAL ENGINEERING SOCIETY

IEEE ENGINEERING IN MEDICINE AND BIOLOGY SOCIETY

The purpose of the Biomedical Engineering Society is to promote the increase of biomedical engineering knowledge and its utilization. The Society was incorporated as a non-profit organization on February 1, 1968 in response to a need to give equal status representation to both biomedical and engineering interests.

MEMBERSHIP

At present, there are approximately 700 members of the Society. There are four types of membership:

Senior Membership for those who have exhibited substantial achievement in, as well as sustained devotion to the goals of the Society. These qualities may be demonstrated in research, education, or administration and management in fields relevant to the activities of the Society.

Membership for those who have significant interest in, or have made significant contributions to the goals of the Society. Members have all the rights of Senior Members.

Student Membership for students pursuing a course of study in biomedical engineering or related sciences (may be held for a period of not more than 5 years).

Sustaining Membership for persons, firms or corporations that share the stated purposes of the Society and wish to sustain those purposes through substantive financial support.

For applications, contact:

Secretary
Biomedical Engineering Society
P. O. Box 2399
Culver City, California 90230

The Biomedical Engineering Society publishes a quarterly Bulletin and an annual Directory for its members.

ANNALS OF BIOMEDICAL ENGINEERING

the Journal of the Biomedical Engineering Society publishes original research in such fields as physiological, behavioral, biological or biochemical systems; biomaterials; bioinstrumentation; design of prosthetic or orthotic devices and artificial organs. It also accepts papers pertinent to health care delivery, predictive medicine, modeling of biological systems, legal, ethical and social factors in biomedical engineering and related subjects. For information for authors, contact:

Peter H. Abbrecht, M.D., Ph.D.
Editor
Annals of Biomedical Engineering
Medical Science Building II
University of Michigan
Ann Arbor, Michigan 48109

The Engineering in Medicine and Biology Society of the Institute of Electrical and Electronics Engineers (EMBS/IEEE) is an association of 7000 members concerned with the application of engineering science and methodology to biology, medicine and health care delivery systems. Participation in a Society of IEEE offers the advantages of membership in a specialized field as well as identification with the world's largest professional engineering organization of 214,000 members. The purposes of IEEE are directed towards advancement of the theory and practice of electrical engineering and allied disciplines and to advancement of members of the profession. IEEE programs include: Technical activities furthering the state of the art; Publications (SPECTRUM, PROCEEDINGS, TRANSACTIONS, Journals, IEEE Press Books); Local, Regional, National, and International conferences and meetings; Standards development; and Recognition through an Awards Program. An IEEE office in Washington, D.C. facilitates exchange of information between IEEE members and U.S. governmental agencies.

Biomedical professionals who do not wish to join the IEEE parent organization may join EMBS as affiliate members and participate fully in all EMBS programs and activities which are planned and administered by an elected governing body of EMBS. EMBS activities include: Publications-THE IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING is a monthly publication of reviewed articles reporting original research and development, short communications, tutorials and reviews. The EMBS MAGAZINE contains news and events of current interest to biomedical engineering professionals. Conferences-In addition to its National Technical Conference the Society also co-sponsors and cooperates in other national and regional biomedical conferences. Conference Proceedings may be purchased at member prices from IEEE. Technical & Professional Committees-EMBS Committees organize conference sessions, workshops, publications and special activities on behalf of the Society. Technical Committees: Bioelec Phenomena; Clin. Eng.; Med. Instr.; Prosth. & Sensory Aids; Signal Processing & Info. Handling; Transducers, Devices; Materials; and Standards. Professional Activities; Publications; Industrial Relations; and Government Affairs. Regional Councils and Chapters-Society members have the opportunity to associate with other members residing in the same geographic area to exchange technical and professional information through the 7 EMBS Regional Councils and more than 35 Chapters. Students participate in these as well as the many Student IEEE and Student EMBS/IEEE Chapters.

Membership in EMBS/IEEE is open to all qualified persons in grades designated student, associate, member, senior member, fellow, and affiliate.

Further information may be obtained from Dr. Morton D. Schwartz, President, IEEE/EMBS, Elec Eng Dept, California State U, Long Beach, CA 90840 or EMBS/IEEE, TAB, 345 E 47th St, New York, NY 10017.

INSTRUMENT SOCIETY OF AMERICA
67 Alexander Drive, P.O. Box 12277
Research Triangle Park, NC 27709

The Instrument Society of America is a technical, scientific and educational organization dedicated to advancing and reinforcing the arts and sciences related to the theory, design, manufacture and use of instruments and controls in the various sciences and technologies for the benefit of mankind. With over 28,000 members, ISA identifies, defines and reflects the needs and objectives of engineers, scientists, managers, technicians, and students involved with instrumentation, systems and automation -- worldwide.

ISA was established in 1945 and maintains its International Headquarters at Research Triangle Park, NC. Its membership is distributed throughout 170 Sections in 13 geographical districts in the United States, Canada, Mexico and other countries.

ISA publishes a monthly journal, InTech, a quarterly journal, ISA Transactions, meeting proceedings, monographs, handbooks, films, video tapes and other educational aids. ISA is an ANSI-accredited standards writing body. Members are given the opportunity to prepare publications; organize conferences and symposia and participate in the activities of twenty-four Special Interest Divisions in the technology and industries and sciences departments.

Neuroelectric Society

The Neuroelectric Society was formed in 1967 for the purpose of studying the effects of electrical currents on biological systems. The Society is dedicated to the furtherance of investigation in the following areas related to the application of electrical currents and their effects on physiological systems:

- Effects of focal and diffuse electrical currents on the central and peripheral nervous systems
- Neurophysiological effects
- Ultrastructure
- Drug interaction
- Neuroanatomical investigations
- Behavioral effects of electrical currents
- Instrumentation and neurophysiological monitoring systems
- Safety standards
- Neurological monitoring
- Current density and impedance measurement
- Mathematical and physical models of brain characteristics
- Effects of currents on cardiovascular, respiratory and endocrine systems
- Electroprosthetic devices
- Electroneuronal implant systems
- Biomechanical analysis of head and spine injuries

The Society encourages scientific research in these fields, disseminates results to the members and assists individual research groups in communicating with each other and with appropriate national and international societies.

After several meetings of various interested groups, the 1st Annual Meeting of the Neuroelectric Society was held in Milwaukee, WI, Oct. 1967; the 2nd in San Francisco, CA, Feb. 1969; the 3rd in Las Vegas, NV, Mar. 1970; the 4th in San Antonio, TX, Mar. 1971; the 5th in Varna, Bulgaria, Sep. 1972; the 6th in Snowmass, CO, Feb. 1973; the 7th in New Orleans, LA, Nov. 1974. The 8th Meeting was held in conjunction with the 4th International Symposium on Electrosleep and Electroanesthesia in Paris, France, Mar. 1974. The 9th Meeting was held in Marco Beach, FL, Nov. 30-Dec 4, 1977. The 10th Meeting was held in conjunction with the 5th International Symposium on Electrosleep and Electroanesthesia in Graz, Austria, Sep. 11-16, 1978. The 11th Meeting was held in Key Biscayne, FL, Dec 14-18, 1980; and the 12th Meeting will be held in conjunction with the 6th International Symposium on Electrostimulation in Albena, Bulgaria, Sep. 24-28, 1981.

Three times a year members receive the Neuroelectric News which reviews foreign and national publications. Membership information and meeting registration forms can be obtained from:

The Neuroelectric Society c/o Dr. A. Sances
Dept. of Neurosurgery 8700 W. Wisconsin Ave.
Milwaukee, WI 53226

SOCIETY FOR ADVANCED MEDICAL SYSTEMS
4405 East-West Highway, Suite 210
Bethesda, Maryland 20814

SPIE--The International Society for
Optical Engineering

The Society for Advanced Medical Systems provides a common communications medium and meeting ground for professionals dedicated to more effective methods of delivering health services.

SAMS coordinates the interests of a number of disciplines in the search for improved methods of health care. Its aims are to . . .

Bring together medical personnel, physical scientists, engineers, and other to foster cooperation in advancing technology for medical care;

Develop standards, terminology, and guidelines for the evolution and employment of technological systems which best serve health measurement functions and therapy;

Stimulate, sponsor, or conduct research in the application and evaluation of technological systems for detection and treatment of disease states;

Promote training and development of professional and allied health manpower needed for advanced medical systems; and

Assist in integration of advanced technological health care systems into the practice of medicine while maintaining high standards of professional ethics.

The Society is composed of Members and Fellows. Any person with interest in advanced medical systems is eligible as a Member; the Society recognizes individual capabilities by election to Fellowship status. All members vote, but only Fellows may hold office in the Society.

Registered full-time students, interns, and residents are eligible for Student Membership at reduced rates. Organizations interested in SAMS activities and objectives may apply for Affiliate Membership.

Membership includes a subscription to the Society's quarterly Newsletter--*Algorhythm* and reduced subscription rates to the *Journal of Medical Systems* which is designed to provide a forum for presentation and discussion of the increasingly extensive application of new systems, techniques, and methods as they apply to clinical and administrative areas of health care systems. The Proceedings of SAMS annual conferences are available at special rates to members and fellows.

Administrative Committees are Bylaws, Executive, History, Meetings, Membership, Nominating, Project Advisory, and Publications.

Operational Committees are Apprenticeship & Training and Quality Assurance.

Through its program, SAMS will take the lead in fostering liaison between professionals of many disciplines. As a result, new and better medical systems may emerge. SAMS is a much needed response to the challenge facing the health care service. Persons with an interest in systems applications in health care delivery are invited to become members of SAMS.

For further information contact Mrs. Patricia I. Horner, Executive Director.

The International Society for Optical Engineering is a non-profit, technical society dedicated to advancing engineering and scientific applications of optical, electro-optical, fiberoptic, laser, and photographic instrumentation, systems, and technology.

Its members are scientists, engineers, and users interested in the reduction-to-practice of these technologies. The Society provides the means for communicating and disseminating new developments and applications to the scientific, engineering, and user communities through its publications and symposia.

Exclusive privileges and benefits are:

1. Subscription to *Optical Engineering* (SPIE bimonthly publication).
2. Reduced tuition rates for seminars and symposium.
3. Membership in national working groups.
4. Special tutorial workshops.
5. Use of *Optical Engineering* placement exchange.
6. Standards information.
7. Awards program.
8. Educational referral service.
9. Contacts with optics industry regarding innovations and services.
10. Member rates at cooperating-society functions.
11. Annual membership directory.

P.O. Box 10
Bellingham, WA 98225
206/676-3290