COMMITTEE ON PROSTHETICS RESEARCH AND DEVELOPMENT
DIVISION OF ENGINEERING—NATIONAL RESEARCH COUNCIL
NATIONAL ACADEMY OF SCIENCES—NATIONAL ACADEMY OF ENGINEERING

ANNUAL SUMMARY REPORT
ACTIVITIES FOR YEAR ENDED JUNE 30, 1971[a]

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PURPOSE

The Committee on Prosthetics Research and Development engages in activities which serve research and general advancement in the fields of prosthetics, orthotics, and sensory aids.

The Veterans Administration, Department of Defense, and several divisions within the Department of Health, Education, and Welfare, notably the Social and Rehabilitation Service and the Maternal and Child Health Service, have responsibilities in the care of amputees and other individuals with orthopedic and sensory disabilities and deprivations. A number of private foundations also have interests in these fields.

Because the overall volume of business in artificial limbs, orthopedic appliances, and devices to assist the blind and deaf is small, private enterprises have not been stimulated to support extensive research. In order to maintain progress commensurate with other technical, medical,

and paramedical fields, therefore, there has been a continuing need for government agencies and private foundations to support research and development within their organizations or by establishing research contracts with universities and industrial organizations, or by combinations of these two methods.

Operating within this milieu the Committee on Prosthetics Research and Development seeks to:

keep abreast of all new developments in prosthetics, orthotics, and sensory aids;

correlate and coordinate research sponsored by the Veterans Administration, the Social and Rehabilitation Service, the National Institutes of Health, the Army, the Navy, and others;

advise sponsors through National Academy of Sciences—National Research Council channels by means of special and periodic reports and personal liaison of the scope and progress of the program;

recommend areas of need for future research;

ensure that new devices and techniques that contribute to improved treatment are made available promptly to organizations concerned with the education of medical and paramedical personnel in these fields; and

disseminate research results nationally and internationally through publication of the journal *Artificial Limbs* and other technical reports.

ORGANIZATION

The Committee on Prosthetics Research and Development operates within the Division of Engineering of the National Research Council. The committee's membership is comprised of physicians, engineers, and representatives of other disciplines who are actively interested in furthering the development of prosthetic and orthotic devices and sensory aids and in the expeditious utilization of these improvements. Appointments to the committee, normally for a 3-year period, are made by the Chairman of the Division of Engineering with the approval of the President of the National Academy of Sciences.

In seeking to achieve its objectives, the Committee on Prosthetics Research and Development has over the years established five permanent subcommittees (Fig. 1): the Subcommittee on Fundamental Studies, the Subcommittee on Design and Development, the Subcommittee on Evaluation, the Subcommittee on Child Prosthetics Problems, and the Subcommittee on Sensory Aids.

The Subcommittee on Fundamental Studies seeks to stimulate research which will provide basic information prerequisite in the design of im-

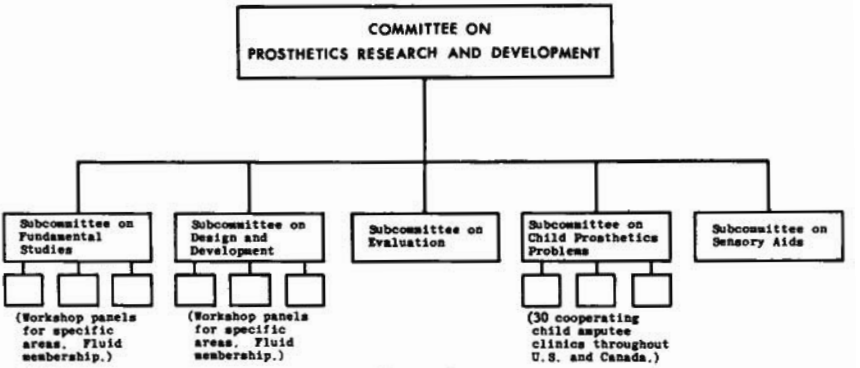

FIGURE 1

proved prosthetic and orthotic devices. Basic research is also directed to obtaining data which will afford a better understanding of treatment processes. The subcommittee operates through small working panels which focus on specific subject areas and involve persons directly interested and/or engaged in research in those areas. Identification and coordination of currently available information is correlative with the stimulation of research in areas where information is needed.

In pursuing its goal of encouraging and coordinating the design and development of improved prosthetic and orthotic devices, the Subcommittee on Design and Development arranges periodic meetings of individuals actively working in specific areas. The subcommittee promotes an active interchange of information between developers, provides leadership in attacking critical problems, provides a forum for the evaluation of new ideas and suggestions, and encourages the endeavors of competent designers. Much of the activity of the Subcommittee on Design and Development is effected through so-called workshop panels. These panels now cover the entire spectrum of prosthetics and orthotics in discrete segments, viz, lower-extremity prosthetics, upper-extremity prosthetics, lower-extremity orthotics, upper-extremity orthotics, and spinal orthotics.

The difficult, but essential, realm of evaluation of new and revised prosthetic and orthotic devices and techniques is a major continuing concern of the Committee on Prosthetics Research and Development. The Subcommittee on Evaluation encourages and coordinates an orderly effort to determine the relative merits of individual items stemming from the research and development program. The findings are made available to the education groups and clinicians.

The Subcommittee on Child Prosthetics Problems provides a strong stimulus for research in prosthetics related to the juvenile amputee

population and disseminates the results of this research to clinicians and others engaged in the treatment of the child amputee. Under the auspices of this subcommittee, the Cooperative Child Amputee Research Program is carried on through 30 participating treatment centers which have met standards of practice established by the subcommittee. An important medium for the exchange of information within the clinic family is the *Inter-Clinic Information Bulletin* which is published monthly through New York University on behalf of the subcommittee. Material for the bulletin is assembled and edited by the Assistant Executive Director of the Committee on Prosthetics Research and Development. In response to a charge from the parent committee, the Subcommittee on Child Prosthetics Problems is now in the process of enlarging its responsibilities to include orthotic needs of the juvenile patient. In this expansion of its activities, the subcommittee is focusing its attention initially on the orthotic requirements of children with cerebral palsy, spina bifida, and Legg-Perthes disease.

In fulfilling its role of providing advisory services to interested agencies, both governmental and private, the Subcommittee on Sensory Aids endeavors to keep fully informed of current activities in the development of sensory aids for the blind and partially sighted, and the deaf and hard of hearing, and to encourage and coordinate meritorious research in these areas.

The Committee on Prosthetics Research and Development is served by a staff of full-time personnel employed by the Academy Research Council. It consists of an executive director, an assistant executive director, a staff engineer, two editorial associates, an administrative assistant, and two secretaries. During the past year, the committee was fortunately able to obtain the services of a staff surgeon for 6 months.

OPERATIONAL CONCEPT

General

The Committee on Prosthetics Research and Development endeavors to achieve its objectives in a variety of ways depending upon the requirements and circumstances of a given project. The committee meets twice a year or as necessary to review the recommendations of its subcommittees and *ad hoc* committees. The subcommittees, whose members, like those of the parent committee, typically are appointed for a period of 3 years, also usually meet two or more times per year. Since the work of certain of the subcommittees is closely related, for example, Design and Development and Evaluation; and Design and Development and Child Prosthetics Problems, members of one subcommittee frequently attend meetings of other subcommittees.

A rewarding modus operandi in dealing with special topics or areas of interest particularly under the Fundamental Studies and Design and Development Subcommittees has been the use of so-called workshop panels. Some degree of continuity is sought in the chairmanships of these panels. However, the participants in the workshops are selected for their special or technical knowledge in the area under review and hence may vary from meeting to meeting. *Ad hoc* committees for study of special problems are also freely used. Appointments to such *ad hoc* committees, as is true also of the workshop panels, are not restricted to the membership of the Committee on Prosthetics Research and Development. Persons with the specialized knowledge to serve on the workshop panels and *ad hoc* committees are selected from a large number of qualified individuals affiliated with the Prosthetics Research Program and willing to serve. Personnel from the Educational Programs are included in order that the Educational Programs can be kept up to date on developments and thus effect a compression of the time required between research and education.

Governmental Relationships

Through the Academy-Research Council, the Committee on Prosthetics Research and Development provides advisory services to the Veterans Administration, the Maternal and Child Health Service, and the Social and Rehabilitation Service, the latter two being agencies of the Department of Health, Education, and Welfare. Liaison representatives designated by these governmental agencies participate without vote in the deliberations of the committee. Laboratories cooperating with the Committee on Prosthetics Research and Development include the Army Medical Biomechanical Research Laboratory, the Navy Prosthetics Research Laboratory, and the Veterans Administration Prosthetics Center. From time to time, individuals from these laboratories participate in the committee's activities.

Interdivisional Relationships

Continuing liaison is maintained with the Committee on Prosthetic-Orthotic Education, Division of Medical Sciences, National Academy of Sciences–National Research Council, the chairman of that committee being a liaison member of the Committee on Prosthetics Research and Development. Moreover, several individuals are members of both committees. Notices of meetings and copies of publications are transmitted to the Committee on Prosthetic-Orthotic Education. The journal *Artificial Limbs* is a joint undertaking of the two committees. Also liaison is maintained with the Committee on the Skeletal System of the Division of Medical Sciences as appropriate.

ACTIVITY REPORTS

General

During the period July 1, 1970, through June 30, 1971, the Committee on Prosthetics Research and Development provided continuing services in the coordination of government and privately sponsored research in the fields of prosthetics, orthotics, and sensory aids. At the request of the sponsoring agencies, the committee reviewed 17 proposals for new research and development projects and 22 proposals for continuance of projects already in progress. *Ad hoc* groups appointed by the committee conducted two site visits to development and treatment centers.

CPRD Meetings

The 22nd meeting of the committee was held in Washington, D.C., on May 17, 1971, immediately preceding the spring meeting of the Committee on Prosthetic-Orthotic Education so that members of each committee would have the opportunity to attend both meetings. The meeting was well attended by members and by representatives from the Social and Rehabilitation Service, the Veterans Administration, the Committee on Prosthetic-Orthotic Education, and the American Orthotic and Prosthetic Association–American Board for Certification. Each of the five subcommittees reported on its recent activities. Recommendations for continuing *and* future work were made with particular focus on a number of special events. A comprehensive report of the meeting has been distributed.

Subcommittee on Fundamental Studies

At a meeting on October 5, 1970, the subcommittee established four panels: Locomotion and Gait Studies, Neuromuscular Control, Biomechanics of the Spine, and Materials.

A special group also met at the United States Public Health Service Hospital, Carville, Louisiana, to plan a series of conferences to be held during the next year or two on the effect of pressure on human tissues.

The Panel on Locomotion and Gait Studies held a series of meetings involving representatives of laboratories engaged in these activities to standardize data-collection procedures so that results would be comparable.

Subcommittee on Sensory Aids

On September 14-15, 1970, the subcommittee held its fourth meeting in Boston, Massachusetts, at which time an opportunity was taken to visit a number of research projects in that city. The fifth meeting was held in Washington, D.C., on December 12, 1970; and the sixth meeting

in Annapolis, Maryland, February 26-27, 1971. A goal of these meetings was the development of specific plans for research in the near future.

The Panel on Mobility Aids met three times during the reporting period to develop a plan for the evaluation of the Bionic Laser Typhlocane.

A number of items, including reading machines and mobility aids, are now emerging from research and development programs and the Subcommittee on Sensory Aids will become increasingly involved in the coordination of evaluation programs.

Subcommittee on Design and Development

The tenth meeting of the Subcommittee on Design and Development was held September 8-11, 1970, in Annapolis, Maryland. At this meeting, working panels of carefully selected individuals were charged with developing plans and priorities for the prosthetic-orthotic design and development effort over the next 5 years. Each panel focused on one of six specific areas of work: lower-extremity orthotics, lower-extremity prosthetics, upper-extremity orthotics, upper-extremity prosthetics, spinal orthotics, and surgery. The productive outcomes of this meeting were incorporated into a design for the future which has been transmitted to the sponsors.

In addition to the major Annapolis meeting the subcommittee continued to sponsor an active program of workshop panels and special events.

Panel on Upper-Extremity Orthotics

This newly constituted workshop panel held its first meeting July 8-10, 1970, in Hillside, Illinois. At this meeting the current status of upper-extremity orthotics pratice in relation to selected disabilities was reviewed with prime focus on the quadriparetic, quadriplegic, and hemiplegic hand and wrist.

A Conference on Fracture Bracing

On January 27-28, 1971, a special conference on the use of orthotic principles in the treatment of tibial and femoral fractures was held at Fitzsimons General Hospital, Denver, Colorado. This meeting, a follow-up to a prior conference held in 1969, reviewed the current status of techniques involving the use of cast-orthoses in the treatment of tibial and femoral fractures. Representatives of a number of hospitals and treatment centers pioneering in these techniques presented papers on their current practice. The outcomes of the meeting were incorporated in a document designed for the guidance of others interested in this treatment area.

A Conference on Wheelchairs

A special conference on the clinical aspects of wheelchairs (and other mobility aids) was convened at Rancho Los Amigos Hospital, Downey, California, on February 2-4, 1971. The purpose of the meeting was to develop a comprehensive, accurate, up-to-date body of information on: 1. types of wheelchairs used by specific kinds of patients; 2. selection of special wheelchair features in relation to specific disabilities.

Much useful information was obtained in this difficult and complex subject. These data will be expanded and reorganized for publication.

A Conference on Cosmesis and Modular Limb Prostheses

This conference, held in San Francisco, California, March 3-8, 1971, and attended by 78 people from 10 different countries, reviewed demonstrations of cosmetic and modular prosthetic components and systems now in research or production, and sought to establish international agreement on concepts and guidelines for future efforts. A strong consensus emerging from the meeting was that modular and/or skeletal systems for upper- and lower-extremity prostheses offered definite advantages in function, cosmesis, and cost over existing conventional systems. Hence, a strong research and clinical practice effort was required to improve existing items.

Subcommittee on Evaluation

The eleventh meeting of the Subcommittee on Evaluation was held on September 11, 1970, in Annapolis, Maryland. Evaluation programs currently in progress were reviewed and possible new items for evaluation were considered.

The twelfth meeting of the subcommittee was held in Durham, North Carolina, on November 9, 1970. At this meeting the results of the evaluation of externaly powered elbows were reviewed. Recommendations based on the results of this study were formulated. The status of evaluation studies on lower-extremity orthoses then in process was also reviewed.

Veterans Administration Prosthetics Center Patellar-Tendon-Bearing Brace

The evaluation of the Veterans Administration Prosthetics Center PTB brace, which had been delayed for various reasons, was reactivated and completed during the year. A final report on this study (E-2) was prepared and distributed early in 1971.

Externally Powered Elbows

By November 1970 the data-collection phase of this study had been essentially completed and, following review of the results with both the

developers and the clinics that had been involved in the evaluation, a final report of the study (E-4) was prepared and distributed in February 1971.

Lower-Extremity Orthotic Devices

A program for the clinical evaluation of four selected lower-extremity orthoses was launched in the late summer and fall of 1970. At the end of the reporting period, fittings of these braces had been essentially completed at the seven clinics participating in the study. A document presenting the results of the study is being prepared for distribution.

Comparative Evaluation of Below-Knee Orthoses

Plans were made to conduct a biomechanical analysis and comparative study of nine below-knee orthoses whose primary function is to correct the drop-foot condition associated with hemiplegia and other diseases causing partial paralysis of the foot. Following preliminary discussions with personnel at Moss Rehabilitation Hospital, Philadelphia, Pennsylvania, where the study was to be conducted, a meeting of participants was held January 25-26, 1971, to complete the plans for the study. At the close of the reporting period the data-collection phase of this evaluation was well advanced.

Ljubljana Functional Electrical Peroneal Brace

This device incorporates the principle of controlled stimulation of muscle rather than exoskeletal support and is the first of its type to be subjected to the evaluation procedure. One hundred units have been fabricated and supplied by the University of Ljubljana (Yugoslavia). Following tests for reliability, the units will be evaluated at four centers: Moss Rehabilitation Hospital, Wadsworth VA Hospital in Los Angeles, Rancho Los Amigos Hospital, and Northwestern University. An orientation seminar on the use and application of the units was held at the Texas Institute for Rehabilitation and Research, Houston, Texas, on April 19-21, 1971. At the close of the fiscal year units that had met mechanical testing standards were being distributed to the participating clinics for fittings.

Subcommittee on Child Prosthetics Problems

Two meetings of the Subcommittee on Child Prosthetics Problems were held during the reporting period, one on October 16, 1970, and the other on March 6, 1971. The first meeting was primarily concerned with the consideration of evaluation projects currently in progress or in the planning stage.

At the March meeting, consideration was given to the initial steps that had been taken to develop a cooperative orthotics research pro-

gram. Three clinics in New York have indicated interest and an attempt will be made to work out a modus operandi with these clinics. Attention was also given to the problems of producing commercially items which had been evaluated with positive results, particularly the electric cart developed at the Child Amputee Prosthetics Project, University of California, Los Angeles.

Cooperative Clinical Research Program in Prosthetics

Thirty clinics specializing in the treatment of the child with limb deficiencies are now participating in the program conducted by the Subcommittee on Child Prosthetics Problems (Fig. 2). Direct contact has been made with 40 additional centers, some of which will join the cooperative program over the next few years. The assistant executive director maintains close contact both with the clinics in the program and with those in the process of development.

CHILD AMPUTEE CLINICS PARTICIPATING IN THE COOPERATIVE RESEARCH PROGRAM

Akron, Ohio
Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Buffalo, N.Y.
Chicago, Ill.
Denver, Colo.
Durham, N.C.
Elizabethtown, Pa.
Grand Rapids, Mich.
Greenville, S.C.
Houston, Texas
Los Angeles, Calif.
Memphis, Tenn.
Milwaukee, Wis.
Montreal, Can.
New Orleans, La.
Newington, Conn.
New York, N.Y.
Oklahoma City, Okla.
Orlando, Fla.
Pittsburgh, Pa.
Portland, Ore.
St. Louis, Mo.
Schenectady, N.Y.
Seattle, Wash.
Springfield, Mass.
Toronto, Can.
Washington, D.C.
West Orange, N.J.

FIGURE 2

Inter-Clinic Information Bulletin

The assistant executive director continued to serve as editor of the monthly publication *Inter-Clinic Information Bulletin* which is published in cooperation with New York University. Approximately 2,800 copies of each issue are distributed to physicians, prosthetists, and others interested in the care of the child amputee.

Monograph on Selected Lower-Limb Anomalies

Four papers on the surgical and prosthetics management of selected lower-limb anomalies--tibial hemimelia, fibular hemimelia, total hemimelia tibia, and absence of the lumbar spine and sacrum—which were presented at the meeting of child amputee clinic chiefs in 1969, were published toward the close of the year. Approximately 400 copies of this publication will be distributed to interested treatment centers and medical and prosthetics schools.

Symposium on the Treatment of the Child with an Acquired Amputation

At the 1970 meeting of child amputee clinic chiefs a series of papers on the treatment of the child who had lost his limbs because of a trauma or disease was presented. These papers are being prepared for publication in a monograph which will also be distributed to clinics and centers treating child amputees.

Special Meetings and Activities

Postgraduate Course in Lower-Extremity Prosthetics and Orthotics

A Postgraduate Seminar on Lower-Extremity Prosthetics and Orthotics–Recent Developments was held on December 4-6, 1970, at the Americana Hotel, Miami Beach, Florida. The University of Miami School of Medicine conducted the seminar with the cooperation of the Committee on Prosthetics Research and Development and the Veterans Administration.

Conference on the Establishment of Bioengineering Centers

Following a preliminary meeting in Washington, D.C., on June 19-20, 1970, an enlarged meeting to discuss the need for bioengineering centers was held September 12-13, 1970, in Annapolis, Maryland. The latter meeting included representatives from institutions with possible interests in planning model centers. As a result of the meetings, recommendations as to criteria to be met in the establishment of Rehabilitation Engineering Centers were formulated.

Artificial Limbs

During the reporting period, two issues of *Artificial Limbs* were published. The Autumn 1970 issue was distributed in December 1970 and the Spring 1971 issue in June.

As "A Review of Current Developments," *Artificial Limbs* continued in high demand with approximately 5,000 copies of each issue distributed to an international mailing list.

Topical articles printed in the Autumn 1970 issues were: "Projects,

Programs, and Perspectives," "The Prosthetics and Orthotics Program," "Amputees and Their Prostheses," "The Use of External Support in the Treatment of Low Back Pain," "Evaluation of Synthetic Balata for Fabricating Sockets for Below-Knee Amputation Stumps," and "A New Approach to Patient Analysis for Orthotic Prescription—Part I: The Lower Extremity."

In the Spring 1971 issue topics presented were: "Evaluation," "Premodified Casting for the Patellar-Tendon-Bearing Prosthesis," "Technique for Forming Sockets Directly on Above-Elbow Stumps," "Elastic-Liner Type of Syme Prosthesis: Basic Procedure and Variations," "A Technique for Fitting Converted Proximal Femoral Focal Deficiencies," "Clinical Applications of the Veterans Administration Prosthetics Center Patellar-Tendon-Bearing Brace," "A Modification of the VAPC PTB Brace," and "Clinical Evaluation of Externally Powered Prosthetic Elbows."

American Academy of Orthopaedic Surgeons

A close liaison was maintained with the American Academy of Orthopaedic Surgeons, particularly in relation to the Academy's Committee on Prosthetics and Orthotics. The Committee on Prosthetics Research and Development is assisting the Academy in the preparation of a new textbook on orthotics and in the development of a system for the graphical analysis of musculoskeletal disabilities.

International Activities

At the invitation of the National Science Foundation the Assistant Executive Director visited Yugoslavia and Poland during April 1971. He assisted in the identification of individuals and institutions interested in submitting proposals to NSF under the Foundation's PL 480 program.

In June 1971, the Executive Director served as consultant to the Division of International Activities of the Social and Rehabilitation Service. He assisted in the review of ongoing projects in Yugoslavia and in the initiation of an international evaluation program on the functional electrical stimulators developed in Ljubljana.

Site Visits

During the fiscal year, the Executive Director and Assistant Executive Director made site visits with small groups of experts to the Stanford Research Institute, Palo Alto, California, and Beekman Hospital, New York City.

The Assistant Executive Director made visits to numerous child amputee centers. Some of the centers are already participants in the cooperative research program, coordinated by the Subcommittee on Child

Prosthetics Problems; others are prospective participants. The centers visited were: Duke Orthopedic Amputee Clinic, Durham, N.C.; Georgia Juvenile Amputee Clinic, Atlanta, Ga.; Crippled Children's Hospital, Memphis, Tenn.; Florida Crippled Children's Commission, Orlando, Fla.; Gillette State Hospital, St. Paul, Minn.; Children's Hospital, Denver, Colo.; Shriners Hospital for Crippled Children and the Juvenile Amputee Clinic at Texas Institute for Rehabilitation and Research, Houston, Texas; Hospital for Special Surgery, New York City; Kosair Crippled Children Hospital, Louisville, Ky.; and Shriners Hospital for Crippled Children, Lexington, Ky. In addition, the Staff Engineer made a visit to the Children's Hospital in San Diego, Calif.

25th Anniversary

A week-long program of events marking the 25th anniversaries of both the Committee on Prosthetics Research and Development and the Prosthetic and Sensory Aids Service of the Veterans Administration was held at the Mayflower Hotel in Washington, D.C., October 12-16, 1970. A feature of the outstanding program was a banquet attended by more than 200 people honoring the five previous chairmen of the Committee on Prosthetics Research and Development.

Proposals Reviewed

The Committee on Prosthetics Research and Development, using specially appointed *ad hoc* groups, reviewed and made recommendations concerning 39 proposals for support of new research or continuation of ongoing studies which have been submitted to various agencies as follows:

VA		
Prosthetics and Orthotics	2 new proposals	15 continuations
Sensory Aids		3 continuations
SRS		
Research and Demonstrations	1 new proposal	
International Division	1 new proposal	
Sensory Study Section	10 new proposals	3 continuations
OTHER		
MCHS		1 continuation
Office of Education	1 new proposal	
NSF	2 new proposals	

Miscellaneous

The staff responded to more than 1,500 requests for publications and technical information.

American Orthotic and Prosthetic Association—American Board for Certification

Close liaison was maintained with the American Orthotic and Prosthetic Association and with the American Board for Certification through personal contact and by staff participation in various activities of these two groups.

UCOPE and COPE

In October 1970 the Assistant Executive Director was appointed secretary *pro tem* of both the University Council on Orthotic-Prosthetic Education (UCOPE) and the Conference on Orthotic-Prosthetic Education (COPE) and acted in this capacity at meetings of the two groups held in Miami, Florida, December 5-6, 1970.

These appointments provide the basis for an intensification of the close liaison already existing between the research and education programs.

FUTURE PLANNING

The Committee on Prosthetics Research and Development proposes to continue its activities in the coordination and correlation of governmentally and privately sponsored research projects in the fields of prosthetics-orthotics, and sensory aids. In general, these activities fall into three broad categories: continuance of ongoing programs and relationships; furtherance of programs initiated or given new emphasis during the current fiscal year; and the initiation of new endeavors.

Continuance of Ongoing Programs

The well-established and highly productive system of workshop panels conducted under the aegis of the Subcommittee on Design and Development will be continued. New areas of activity initiated during the current year, particularly in the area of spinal and upper-limb orthotics, will be given increased emphasis.

Ongoing projects under the auspices of the Subcommittee on Evaluation will be continued and completed. New projects will be activated as potentially significant devices and techniques emerge from the development program.

New or Reactivated Items

During the current fiscal year new vigor and emphasis have been generated in a number of areas.

The reactivated Subcommittee on Sensory Aids is entering upon an expansive and dynamic phase of its activities. The operations of this group will take on added momentum not only in providing stimulus

for development of improved devices for the blind and deaf but also in the evaluation of items which after years of research have reached the patient-application phase.

The reorganized and expanded Subcommittee on Fundamental Studies will likewise operate at an increased tempo and with an expanded scope through the system of workshop panels recently established.

Research efforts in orthotics under the auspices of both the Subcommitee on Design and Development and the Subcommittee on Child Prosthetics Problems will be expanded, particularly in the areas of braces for the treatment of hemiplegia, paraplegia, and quadriplegia for adults and children; plus special attention to bracing needs for specific children's orthopaedic disabilities, such as myelomeningocele, cerebral palsy, and Legg-Perthes disease.

The work initiated at the request of SRS during the current year, with regard to specialized rehabilitation engineering centers, will be intensified during fiscal year 1972. Implementation of the proposed future work outlined in "Rehabilitation Engineering—A Plan for Continued Progress" will receive major attention.

The Initiation of New Endeavors

In addition to the continuing or expanded activities described above, it is anticipated that new ground will be broken in a number of areas during the coming year.

A basic consideration in the application of prostheses or braces to the limbs or trunk of a human being is the effect of these devices on the tissues with which they come in contact. A conference planned for the coming year on the effects of pressure on human tissues is expected to yield significant data which will pave the way for further studies in this area.

Another area characterized by a great dearth of fundamental information is the functions of the spine under both normal and abnormal conditions. The activation of fundamental studies in this area should yield information of major significance in guiding treatment of spinal problems.

Two additional areas of outstanding interest are those related to anatomical joint replacement and structural implants of various kinds placed in the human body. These items also will be given special attention in fiscal year 1972.

In essence, then, the Committee on Prosthetics Research and Development proposes to continue its efforts to stimulate research and maintain a balanced program; to ensure that the sponsored schools of prosthetics and orthotics education, the University Council on Orthotic-Prosthetic Education, and the American Orthotic and Prosthetic Association are

properly informed concerning new developments within the overall program; and to ensure widespread dissemination of information by continued publication of *Artificial Limbs,* the *Inter-Clinic Information Bulletin,* and appropriate special reports.

Meetings of the Committee on Prosthetics Research and Development will be held at least twice a year for the conduct of ongoing business and receipt of reports of the standing subcommittees (Child Prosthetics Problems, Design and Development, Evaluation, Fundamental Studies, and Sensory Aids). An active program of workshop panels will be continued under the auspices of the Design and Development and Fundamental Studies subcommittees, and this approach to the solution of problems will be inaugurated under the Subcommittee on Sensory Aids.

PUBLICATIONS

Annual Summary Report of Activities for Year Ending June 30, 1970 (Report to the Veterans Administration, the Social and Rehabilitation Service, and the Children's Bureau, from the Committee on Prosthetics Research and Development covering the Fiscal Year 1969-1970.)

Report of Workshop on Spinal Orthotics, March 28–29, 1969.

Congenital Defects of the Lower Limbs—Surgical and Prosthetics Management, National Academy of Sciences, Proceedings of a symposium held May 9, 1969, under the sponsorship of the Subcommittee on Child Prosthetics Problems.

Report of Workshop on Bracing of Children with Paraplegia Resulting from Spina Bifida and Workshop on Bracing of Children with Cerebral Palsy. October 2–4, 1969.

Report of Eighth Workshop Panel on Upper-Extremity Prosthetics, March 31–April 2, 1970.

Report of Twenty-First Meeting of Committee on Prosthetics Research and Development, April 21–22, 1970.

The Child with an Acquired Amputation, National Academy of Sciences, Proceedings of a symposium held June 9, 1970, under the sponsorship of the Subcommittee on Child Prosthetics Problems. (In preparation)

Report of Meeting of Subcommittee on Child Prosthetics Problems, June 11, 1970.

Report of the Workshop on Knee-Disarticulation Prosthetics, June 22–23, 1970.

Report of First Workshop Panel on Upper-Extremity Orthotics, July 8–10, 1970.

Report of the Conference on Model C-4 VA-Bionic Laser Typhlocane, September 3, 1970. (In preparation)

Report of Tenth Meeting of Subcommittee on Design and Development, September 8–11, 1970.

Report of Eleventh Meeting of Subcommittee on Evaluation, September 11, 1970.

Report of Fourth Meeting of Subcommittee on Sensory Aids, September 14–15, 1970.

Report of Meeting of Subcommittee on Fundamental Studies, October 5, 1970.

Report of Meeting of Subcommittee on Child Prosthetics Problems, October 16, 1970.

Report of Twelfth Meeting of Subcommittee on Evaluation, November 9, 1970.

Report of Fifth Meeting of Subcommittee on Sensory Aids, December 12, 1970.

The Veterans Administration Prosthetics Center Patellar-Tendon-Bearing Brace—Clinical Applications, Report E-2, 1970.

Externally Powered Prosthetic Elbows—A Clinical Evaluation, Report E-4, 1970.

Report of Conference on Cast-Bracing of Fractures, January 27–28, 1971. (In press)

Report of Sixth Meeting of Subcommittee on Sensory Aids, February 26–27, 1971. (In preparation)

Report of Conference on Cosmesis and Modular Limb Prostheses, March 3–8, 1971. (In preparation)

Report of Meeting of Subcommittee on Child Prosthetics Problems, March 6, 1971.

Rehabilitation Engineering—A Plan for Continued Progress, April 1971.

Report of Twenty-Second Meeting of Committee on Prosthetics Research and Development, May 17, 1971. (In preparation)

Inter-Clinic Information Bulletin. (Published monthly for the Subcommittee on Child Prosthetics Problems, 13 Issues.)

Artifical Limbs, Vol. 14, No. 2, Autumn 1970.

Artificial Limbs, Vol. 15, No. 1, Spring 1971.

Artificial Limbs, Vol. 15, No. 2, Autumn 1971.

APPENDIX A

MAJOR PROJECTS IN THE UNITED STATES COORDINATED BY THE COMMITTEE ON PROSTHETICS RESEARCH AND DEVELOPMENT

PROSTHETICS AND ORTHOTICS

Organization and Responsible Investigator	Major Area(s) of Investigation	Sponsoring Agency[b]
Army Medical Biomechanical Research Laboratory Washington, D.C. Orlyn C. Oestereich Fred Leonard	Development of Prosthetic and Orthotic Materials and Devices	U. S. Army
Baylor University Houston, Tex. Lewis A. Leavitt	Kinesiological and Quantitative Evaluation of Prosthetic Fit and Gait Analysis in Amputees and Vocational Implications	SRS
California, University of Los Angeles, Calif. Harlan C. Amstutz	Functional Long-Leg Brace Research	SRS
	Prosthetic and Orthotic Evaluation Procedures	SRS
John Lyman	Fundamental and Applied Research Related to the Design and Development of Upper-Extremity Externally Powered Prostheses	VA
	Fundamental Studies of Patient-Prostheses/Orthoses Externally Powered Control Interfaces	SRS
Arthur Moss Yoshio Setoguchi	Child Amputee Prosthetics Project	MCHS

[b] Abbreviations:

MCHS — Maternal and Child Health Service
NEI — National Eye Institute
NINDS — National Institute of Neurological Diseases and Stroke
OE — Office of Education
SRS — Social and Rehabilitation Service
All of the above are within the Department of Health, Education, and Welfare
VA — Veterans Administration, Prosthetic and Sensory Aids Service

Organization and Responsible Investigator	Major Area(s) of Investigation	Sponsoring Agency[b]
California, University of San Francisco and Berkeley, Calif. Charles W. Radcliffe Howard D. Eberhart James M. Morris	Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion	VA
California, University of San Francisco, Calif. Verne T. Inman	Electrical Stimulation of Afferent Fibers as a Means of Reducing Spasticity	SRS
	UC-BL Dual-Axis Ankle-Control System	SRS
H. J. Ralston	Dynamics of the Human Body during Locomotion	SRS
R. F. Steidel	An Engineering Analysis of the Human Spinal Column	SRS
Cambridge Hospital Cambridge, Mass. Richard Warren	Immediate Postoperative Fitting	VA
Case Western Reserve University, Cleveland, O. Victor H. Frankel	Pathomechanics of Disorders of the Locomotor System	SRS
Donald Gann	Cybernetic Orthotic/Prosthetic Systems Development	SRS
Olgierd Lindan	Application of Medical Engineering to Automation of Selected Aspects of Patient Care and Rehabilitation	SRS
Duke University Durham, N. C. Leonard Goldner	Pneumatic Prosthesis Research Project	SRS
Emory University Atlanta, Ga. J. V. Basmajian	Radiographic Study of Hip Dysplasia in Cerebral Palsy	MCHS
Georgetown University Washington, D.C. George W. Hyatt	Biophysical Evaluation of Healing Bone	SRS
Harvard Medical School Boston, Mass. Richard Warren	Survey of Lower-Extremity Amputations	VA
Illinois, University of Chicago, Ill. Jorge O. Galante	A Study of Spinal Orthotics in Idiopathic Scoliosis	SRS
Iowa State University Ames, Iowa Allan Potter	Myoelectric Brace Development	SRS
Johns Hopkins University Baltimore, Md. Gerhard Schmeisser Woodrow Seamone	Development and Evaluation of Externally Powered Upper-Limb Prosthesis	VA

Organization and Responsible Investigator	Major Area(s) of Investigation	Sponsoring Agency[b]
Louisiana State University Baton Rouge, La. Eugene F. Tims	Development of Instrumentation for Insensitive Limbs	SRS
Massachusetts Institute of Technology Cambridge, Mass. Igor Paul	Performance Testing of Artificial Joints	SRS
Mauch Laboratories, Inc. Dayton, Ohio Hans A. Mauch	Research and Development in the Field of Artificial Limbs	VA
McDonnell Douglas Astronautics Co. Huntington Beach, Calif. S. S. Viglione	Detection and Prediction of Epileptic Seizures	SRS
Miami, University of Coral Gables, Fla. Augusto Sarmiento	The Development of Functional Methods of Treatment of Tibial, Femoral, and Forearm Fractures	SRS
	Evaluation of Prosthetic-Orthotic Devices	SRS
	Study of the Development of Refined Fitting Procedures for Lower-Extremity Prosthetics	VA
Michigan, University of Ann Arbor, Mich. G. E. Sharples	Child Amputees: Disability Outcomes and Antecedents	MCHS
Moss Rehabilitation Hospital Philadelphia, Pa. Richard Herman	Rehabilitation Biomedical Engineering: Orthotics Design	SRS
	Upper-Extremity Prosthetics	SRS
	Neuromotor Control Systems: A Study of Physiological and Theoretical Concepts Leading to Therapeutic Application	SRS
Navy Prosthetics Research Laboratory Oakland, Calif. D. W. Rohren Charles C. Asbelle	Lower-Extremity Prosthetic and Orthotic Development	U. S. Navy
New York University New York, N. Y. Leon Bennett	Stump Stress Analysis (Mathematical Model)	VA
Sidney Fishman	Clinical Evaluation of Prosthetic and Orthotic Appliances	SRS
	Fit and Alignment Studies of Spinal Braces and Lower-Extremity Prostheses	SRS
	Child Prosthetic and Orthotic Studies	MCHS

Organization and Responsible Investigator	Major Area(s) of Investigation	Sponsoring Agency[b]
Richard Lehneis	Bioengineering Design and Development of Lower-Extremity Orthotic Devices	SRS
Ralph Lusskin	The Control of Adventitious Bone Formation with Plastic Implants	SRS
Northwestern University Chicago, Ill. Charles M. Fryer	Demonstration of Prosthetic and Orthotic Devices and/or Techniques	SRS
Robert G. Thompson	Prosthetic-Orthotic Research	VA
Rancho Los Amigos Hospital Downey, Calif. Donald McNeal	Investigation of Electronic Systems for Neuromuscular Diabilities	SRS
Vert Mooney	Orthotic and Prosthetic Evaluation Center	SRS
Roy Snelson	Feasibility Study of the Use of Transparent Sockets and Modular Prostheses in Clinical Practice	SRS
Texas A&M Research Foundation College Station, Tex. Paul H. Newell, Jr.	The Improvement of Prosthetic and Orthotic Devices through Materials Research, Analysis, Design, Clinical Testing, and Team Evaluation	VA
Texas Institute for Rehabilitation and Research Houston, Tex. Thorkild J. Engen	Research Developments of Lower Extremity Orthotic Systems as They Relate to Patients with Various Functional Deficits	SRS
U. S. Public Health Service Hospital Carville, La. Paul W. Brand	Study of the Prevention of Deformity in Insensitive Limbs	SRS
VA Hospital Richmond, Va. Charles L. McDowell	Immediate Postoperative Application of Upper-Extremity Orthoses	VA
VA Hospital San Francisco, Calif. Wesley Moore Albert Hall	Study of Below-Knee Amputation for Vascular Insufficiency	VA
VA Hospital Seattle, Wash. Ernest M. Burgess Joseph H. Zettl	Immediate Postoperative Prosthesis Fitting and Ambulation	VA
VA Prosthetics Center New York, N. Y. Anthony Staros	Research, Development, and Testing of Prosthetic and Orthotic Devices and Techniques	VA
Virginia, University of Charlottesville, Va. Warren G. Stamp David W. Lewis	Fitting of Lower-Extremity Prosthetics	SRS

SENSORY AIDS[c]

Organization and Responsible Investigator	Major Area(s) of Investigation	Sponsoring Agency[b]
Albert Einstein College of Medicine New York, N. Y. Herbert G. Vaughan Herbert Schimmel	Electrocortical Prosthesis Feasibility Study	SRS
Argonne National Laboratory University of Chicago Argonne, Ill. Arnold P. Grunwald	A System for Compact Storage of Information on Magnetic Tape Readable by Touch as Braille Characters by Means of a Portable Reading Machine	OE
Association for Computing Machinery New York, N. Y. T. D. Sterling	Investigation of Optimum Employment Procedures in Computing (Blind)	SRS
Atlanta Public Schools Atlanta, Ga. Ernest L. Bentley	A Demonstration of Reader Services for the Visually Impaired Utilizing the Telephone as the Medium	OE
Biodynamics, Inc. Cambridge, Mass. Charles R. Budrose	Design, Fabrication, and Evaluation of a Braille Learning Aid	OE
Bionic Instruments Bala Cynwyd, Pa. Thomas A. Benham J. Malvern Benjamin	Development of Obstacle Detectors for the Blind	VA
Cybernetics Research Institute Washington, D.C. Haig Kafafian	Study of Man–Machine Communications Systems for Disabled Persons	OE
Department of Children and Family Services Springfield, Ill. Thomas J. Murphy	Postural Determinants of the Blind	SRS
Gallaudet College Washington, D.C. James M. Pickett	Research on Frequency Transposition for Hearing Aids	OE
Hadley School for the Blind Winnetka, Ill. Donald W. Hathaway	Development of a Braille Medical Dictionary	SRS
	Development of Correspondence Courses for Personal Reading Aids for the Blind	VA
Hartford, University of West Hartford, Conn. Bernard Z. Friedlander	Automated Language Tests and Enrichment for Deaf Infants	MCHS
Haskins Laboratory New Haven, Conn. Franklin S. Cooper Jane Gaitenby	Research on Audible Outputs of Reading Machines for the Blind	VA

[c] This is an expanded listing and includes projects not presently coordinated by CPRD.

Organization and Responsible Investigator	Major Area(s) of Investigation	Sponsoring Agency[b]
Johns Hopkins University Baltimore, Md. Louise Sloan	Use of Optical Aids	NEI
Louisville, University of Louisville, Ky. Emerson Foulke	The Development of Accelerated Speech as a Useful Communication Tool in the Education of Blind and Other Handicapped Children	OE
Maryland, University of College Park, Md. G. Donald Causey Earleen Elkins	Development of Improved Techniques for the Analysis of Hearing Aid Performance	VA
Joseph W. Wiedel Paul A. Groves	Tactual Mapping: Design, Production, Reading, and Interpretation	SRS
Massachusetts, University of Amherst, Mass. I. B. Thomas	Speech Analyzing Aids for the Deaf	NINDS
Massachusetts Institute of Technology Boston, Mass. Robert W. Mann	Sensory Aids Development and Evaluation	SRS
Mauch Laboratories, Inc. Dayton, O. Hans A. Mauch Glendon C. Smith	Development of Personal Reading Machines for the Blind	VA
Michigan, University of Ann Arbor, Mich. Geraldine T. Scholl	Vocational Adjustment Follow-Up Study of Groups of Visually Handicapped	SRS
National Accreditation Council for Agencies Serving the Blind and Visually Handicapped New York, N. Y. Ray L. Troutman	Development of Standards and Evaluation Criteria for the Production of Reading Materials for the Blind and Visually Handicapped	OE
Alexander F. Handel	Strengthening Services for the Visually Handicapped through the Application of Standards	SRS
National Industries for the Blind New York, N. Y. Robert C. Goodpasture	Development of a Sheltered Workshop Laboratory to Serve Agencies for the Blind	SRS
New York Medical College New York, N. Y. Stanley Taub	Development of a Removable Prosthetic Larynx	SRS
North Carolina Museum of Arts Raleigh, N. C. Charles W. Stanford, Jr.	Development and Operation of Mary Duke Biddle Gallery for the Blind	SRS

Organization and Responsible Investigator	Major Area(s) of Investigation	Sponsoring Agency[b]
Northeastern University Boston, Mass. Ladislav Dolansky	Demonstration of the Instantaneous Pitch-Period Indicator (Amplitude, Intonation, Duration) in Classroom of Deaf Children	OE
Northwestern University Evanston, Ill. Raymond Carhart Wayne O. Olsen	Development of Test Procedures for Evaluation of Binaural Hearing Aids	VA
Queens College Flushing, N. Y. J. H. Kerman	Tactile Communication of Speech to the Deaf	NINDS
San Francisco Bay Area Speech and Hearing Society San Francisco, Calif. George Hospiel	Measurement of Acoustic Parameters for Speech Compression Transportation	SRS
Stanford University Stanford, Calif. James C. Bliss John G. Linvill	Research and Development of Tactile Facsimile Reading Aid for the Blind	OE
Tennessee, University of Knoxville, Tenn. Carl W. Asp	Effectiveness of Low-Frequency Amplification and Filtered-Speech Testing for Pre-School Deaf Children	OE
VA Hospital Hines, Ill. John D. Malamazian Harvey L. Lauer	Clinical Application of Reading and Mobility Aids for the Blind	VA
West Virginia University Morgantown, W. Va. In-Meei Neou	Educational and Vocational Aids for the Blind	OE
Western Blind Rehabilitation Center, VA Hospital Palo Alto, Calif. Loyal E. Apple	Clinical Application Program in Reading, Mobility, and Other Aids for the Blind	VA

PROJECTS IN THE DOMINION OF CANADA WHICH COOPERATE CLOSELY WITH THE OVERALL PROGRAM

Organization and Responsible Investigator	Major Area(s) of Investigation
Prosthetic/Orthotic Research Unit Ontario Crippled Children's Centre Toronto, Ont. Colin A. McLaurin	Development of a Wide Variety of Upper-Extremity and Lower-Extremity Body-Powered and Externally Powered Prosthetic and Orthotic Devices for Children
Rehabilitation Institute of Montreal Montreal, Que. Maurice Mongeau	Development of Externally Powered Upper-Extremity Prosthetic Devices, with Special Reference to Children

Organization and Responsible Investigator	Major Area(s) of Investigation
Prosthetics/Orthotics Research and Development Unit Manitoba Rehabilitation Hospital Winnipeg, Man. James Foort	Development of a Variety of Prosthetic Devices with Special Reference to Lower-Extremity Requirements
The University of New Brunswick Bio-Engineering Institute Fredericton, N. B. R. N. Scott	Orthotics and Prosthetics Systems Research with Special Emphasis on the Employment of Electromyographic Signals as Controls

(List of Projects as of June 30, 1971)

APPENDIX B

SUBCOMMITTEE ON CHILD PROSTHETICS PROBLEMS

GEORGE T. AITKEN, M.D., *Chairman:* (Orthopaedic Surgeon, Mary Free Bed Guild Children's Hospital), College Avenue Medical Building, 50 College Avenue, S. E., Grand Rapids, Michigan 49503

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G. E. (NED) SHARPLES, Ph. D., Assistant Professor, Maternal and Child Health Program, Department of Health Development, School of Public Health, The University of Michigan, Ann Arbor, Michigan 48103

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SUBCOMMITTEE ON SENSORY AIDS

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