COMMITTEE ON PROSTHETICS RESEARCH AND DEVELOPMENT  
COMMITTEE ON PROSTHETIC-ORTHOTIC EDUCATION  
DIVISION OF MEDICAL SCIENCES—NATIONAL RESEARCH COUNCIL  
NATIONAL ACADEMY OF SCIENCES—NATIONAL ACADEMY OF ENGINEERING  
ANNUAL SUMMARY REPORT  
ACTIVITIES FOR YEAR ENDED JUNE 30, 1973  

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DIVISION OF MEDICAL SCIENCES, NATIONAL RESEARCH COUNCIL  

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PURPOSE

The Committee on Prosthetics Research and Development (CPRD) seeks to advance knowledge and raise the level of practice in prosthetics, orthotics, and sensory aids by engaging in activities to stimulate research activity in these areas. The Committee on Prosthetic-Orthotic Education (CPOE), which was combined with CPRD in 1972, seeks to assemble and distribute information to
administrators, physicians, paramedical personnel, and other practitioners working in these fields. These tasks are undertaken within the framework of the policies and functions of the National Academy of Sciences.

Several government agencies have concern and responsibility in the care of amputees and individuals with orthopedic disabilities and sensory deprivations, notably the Social and Rehabilitation Service and the Maternal and Child Health Service within the Department of Health, Education, and Welfare; the Veterans Administration; and the Department of Defense.

Because of the relatively small total volume of business in artificial limbs, orthopedic appliances, and assistive devices for the blind and deaf, private enterprise has not engaged in extensive research in these areas. Thus, there has been a continuing need for government agencies and private foundations to support research and development so that progress commensurate with modern technology may be made. Traditionally, this support has been provided by means of research contracts with universities and industrial organizations, by intramural programs within government institutions, or by a combination of these methods.

In this total program the Committee on Prosthetics Research and Development and the Committee on Prosthetic-Orthotic Education endeavor to encourage and coordinate research and development activities. Specifically the Committees seek to:

- keep abreast of all new developments in prosthetics, orthotics, and sensory aids;
- correlate and coordinate research sponsored by the Social and Rehabilitation Service, the Veterans Administration, 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;
- make recommendations for needed 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 technical reports.

In fulfilling these functions the Committee on Prosthetics Research and Development has been supported in part by the Veterans Administration since July 1947, and by the Social and Rehabilitation Service and its antecedents (Vocational Rehabilitation Administration
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and the Office of Vocational Rehabilitation) since July 1957. The Committee on Prosthetic-Orthotic Education, now combined with CPRD, has also been previously supported by the Veterans Administration and the Social and Rehabilitation Service.

ORGANIZATION

The Committee on Prosthetics Research and Development operates within the Division of Medical Sciences 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 three-year period, are made by the Chairman of the Division of Medical Sciences 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: 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 (Fig. 1).

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

![Figure 1](image-url)
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persons directly interested in and/or engaged in research in those areas. Identification and coordination of currently available information are 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-limb prosthetics, upper-limb prosthetics, lower-limb orthotics, upper-limb 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 passed along 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 32 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/Committee on Prosthetic-Orthotic Education 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, a staff surgeon (1/2 time), two editorial associates, an administrative assistant, and four secretaries. (A staff engineer for sensory aids was added August 1, 1972. Dr. John Lyman from UCLA joined CPRD as a temporary consultant on February 1, 1973, and will continue to serve in this capacity until October 30, 1973.)

OPERATIONAL CONCEPT

General

The Committee on Prosthetics Research and Development/Committee on Prosthetic-Orthotic Education 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. 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/Committee on Prosthetic-Orthotic Education. 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 and Orthotics Program. 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, CPRD/CPOE provides advisory services to the Veterans Administration, and the Social and Rehabilitation Service of the Department of Health, Education, and Welfare. Liaison representatives designated by these governmental agencies participate without vote in the deliberations of the Committee. Government laboratories cooperating with CPRD/CPOE 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.

**SUMMARY OF ACTIVITIES**

**for period**

_July 1, 1972—June 30, 1973_

During the period covered by this report the activities of CPRD/CPOE broke new ground in various areas. At the same time the ongoing and highly productive system of workshop panels sponsored by the various subcommittees was continued.

The addition of Dr. Gustav F. Haas to the staff as a full-time specialist in sensory aids gave an additional emphasis to work in this area, while the return of Dr. E. E. Harris on a part-time basis facilitated an evaluation program of nerve and muscle stimulators. Dr. John Lyman's appointment as special consultant has permitted a comprehensive review of the status of externally powered prostheses and orthoses.

A brief description of the activities of the parent committees and of the subcommittees follows.

On March 15, 1972, the Committee on Prosthetics Research and Development was transferred from the Division of Engineering to the Division of Medical Sciences, National Research Council, National Academy of Sciences. The Committee on Prosthetic-Orthotic Education continued in the Division of Medical Sciences in which it had been located since its establishment.

In view of this new alignment the chairman of the Division of Medical Sciences appointed an _ad hoc_ committee to review past and present activities of CPRD and CPOE and to develop objectives and
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a plan of organization for continued activity of the two groups. The first meeting of this ad hoc committee was held October 13, 1972, and a second one on December 15, 1972.

Because of the organizational transition in process no individual meetings of CPRD and CPOE were held during the reporting period.

SUBCOMMITTEE ON FUNDAMENTAL STUDIES

The Subcommittee on Fundamental Studies seeks to stimulate research which will provide basic information prerequisite to the design of improved prosthetic and orthotic devices, and to provide a better understanding of treatment processes.

Panel on Locomotion and Gait Studies

The Panel on Locomotion and Gait Studies continued its efforts to standardize data-collection procedures so that data obtained by different laboratories studying gait could be compared.

SUBCOMMITTEE ON SENSORY AIDS

The Subcommittee on Sensory Aids seeks to encourage and coordinate activities directed to the blind and near-blind, the deaf, and hard of hearing. The subcommittee is increasingly being involved in the evaluation of devices designed to benefit one or more of the constituent groups.

Clinical Evaluation of Mobility Aids for the Blind

CPRD has played a major role in the evaluation of the Bionic Laser Cane developed under the auspices of the Veterans Administration and, on November 13–14, 1972, held a conference to try to develop guidelines for the conduct of future projects for evaluation of mobility aids. Present also were key figures in the evaluation of the Kay spectacles. As a result of this meeting a Task Group on the Objective Measurement of Mobility Performance has begun operation.

Clinical Evaluation of Reading Aids for the Blind

With the availability of the Optacon from Stanford Research Institute and the Stereotoner from Mauch Laboratories, Inc., it is planned to develop an orderly system for the evaluation of reading machines for the blind. The Subcommittee on Sensory Aids Panel on Evaluation of Inkprint Readers, at its first meeting on December 1, 1972, recommended an evaluation procedure to the Veterans Administration and discussed further work.

Eighth Meeting of the Subcommittee

The eighth meeting of the subcommittee was held on December 2,
The results of ongoing activities were reviewed. Other topics included a report on staff activities, discussion of the upcoming hearing-aid performance evaluation for the Veterans Administration, and evaluation methodology of sensory aids to the blind.

**Hearing-Aid Performance Evaluation**

The Veterans Administration has requested CPRD to form a panel of consultants to advise on hearing-aid performance criteria to be used in the selection of aids for VA purchase. In this connection, the subcommittee intends to pinpoint the areas of research that need to be pursued to identify hearing-aid characteristics that are desirable for various types of hearing impairment. At its first meeting on June 25-26, 1973, the panel arrived at FY 74 choices for VA purchase on the basis of test data and clinical experience.

**Low-Vision Aids**

The subcommittee is continuing to work with the American Foundation for the Blind, the National Society for the Prevention of Blindness, and the National Accreditation Council for Agencies Serving the Blind and Visually Handicapped, to improve service delivery to the large but neglected population that can benefit from low-vision aids.

**Aids to the Deaf-Blind**

At the request of the Social and Rehabilitation Service, the Staff Engineer for Sensory Aids is cooperating with the National Center for Deaf-Blind Youths and Adults in expediting the development of aids for this population.

**Miscellaneous**

The Staff Engineer for Sensory Aids has visited three Veterans Administration Blind Rehabilitation Centers, and civilian schools for the deaf, blind, and deaf-blind, to assess needs for research and development of devices. A national survey of all sensory aids research, development, and evaluation studies is being conducted.

**SUBCOMMITTEE ON DESIGN AND DEVELOPMENT**

Under the sponsorship of the Subcommittee on Design and Development periodic conferences are held in five areas: upper-limb prosthetics, lower-limb prosthetics, upper-limb orthotics, lower-limb orthotics, and spinal orthotics. From time to time the subcommittee also sponsors conferences and seminars on topics of special interest. During the period of this report, meetings held were:
Upper-Limb Prosthetics

The Tenth Workshop on Upper-Limb Prosthetics was held in Atlanta, Ga., Sept. 21–22, 1972. At this meeting the focus was on the immediate and early fitting of upper-limb prostheses. Surgeons and prosthetists active in this area presented papers on their techniques and results. A report which will serve as a guide for others wishing to enter this field is being prepared for publication.

Lower-Limb Orthotics

The Eighth Workshop on Lower-Limb Orthotics was held in Los Angeles, Calif., Oct. 2–4, 1972. Emphasis at this meeting was on above-knee (knee/ankle) orthoses and orthotic knee joints providing knee stability. A variety of designs in current use was presented and recommendations for future activity were prepared. A report has been distributed.

Above-Knee and Below-Knee Prostheses

A Workshop on Above-Knee and Below-Knee Prostheses was held in Seattle, Wash., Jan. 27–29, 1973. At this meeting current procedures in the construction of prostheses for above- and below-knee amputees were reviewed. Stump-casting socket fabrication and prosthetic alignment factors were examined, both with respect to "standard" practice as taught in the prosthetics educational programs and to a number of innovations developed in the field. Two advanced casting techniques for below-knee amputations were selected for evaluation, and further development of other promising techniques was encouraged. A report of the workshop has been prepared and distributed.

SUBCOMMITTEE ON CHILD PROSTHETICS PROBLEMS

The Subcommittee on Child Prosthetics Problems maintained an active research program in prosthetics for children throughout the year and took steps to initiate a research program in children's orthotics. Thirty-two clinics specializing in the treatment of the child with limb deficiencies are now participating in the cooperative research program. Three clinics have been recruited for the initial venture into orthotics. The Assistant Executive Director maintains close contact both with clinics in the program and with those which may participate in the future.

The Assistant Executive Director continued to serve as editor of the publication Inter-Clinic Information Bulletin, which is published in
cooperation with New York University. Approximately 3500 copies are distributed monthly to physicians, prosthetists, therapists, and others interested in the care of the child amputee.

On June 14, 1972, staff members met with a group of selected orthopedic surgeons to plan a Conference on The Child With an Orthopaedic Disability—His Orthotic Needs and How to Meet Them. This conference was subsequently held in Annapolis, Md., Nov. 19–21, 1972, under the joint sponsorship of Howard University and CPRD, with funding through Howard University by the Maternal and Child Health Service. A broad spectrum of children's orthopedic problems was examined in depth, orthotic devices available for use in these conditions were reviewed, and proposals and recommendations were made for future research and treatment programs. The report of this conference has been prepared and distributed.

An executive meeting of the subcommittee was held Nov. 20, 1972.

Clinic chiefs participating in the cooperative research program met at Henrietta Egleston Children's Hospital in Atlanta, Ga., April 25–27, 1973, at which time a symposium, which focused primarily on the delivery of services for children with limb deficiencies, was conducted. An executive meeting of the subcommittee was held on April 27, 1973.

SUBCOMMITTEE ON EVALUATION

The fourteenth meeting was held in Annapolis, Md., on Aug. 21–22, 1972. A wide variety of subjects was discussed including the results of the clinical use of the technical analysis forms (American Academy of Orthopaedic Surgeons), prescription forms (CPOE), and disability classification forms (Institute of Rehabilitation Medicine). The status of ongoing clinical evaluations was also reviewed, the items being: three ankle/foot orthoses, the Ljubljana functional electrical stimulator, and the VA externally powered upper-limb prostheses. A report on the laboratory study of 12 ankle/foot orthoses at Moss Rehabilitation Hospital was also presented.

An orientation course for the Application and Evaluation of the Medtronic-Rancho Implanted Peroneal Stimulator was held at Rancho Los Amigos Hospital, Downey, Calif., Aug. 10–11, 1972. This implant system, designated NMA (Neuromuscular Assist), will undergo clinical evaluation in a number of selected treatment centers.

The fifteenth meeting was held in Washington, D.C., Apr. 9, 1973. The main purpose of this meeting was to discuss plans for a
pending clinical evaluation of two new spinal orthoses. The status of ongoing projects and new items recommended for evaluation also was discussed. Plans were made to initiate several new studies, including three upper-limb prosthetic components.

**Evaluation of Upper-Limb Prosthetic Components**

At the subcommittee meeting on Apr. 9, 1973, plans were made to evaluate three upper-limb prosthetic components:

1. **Winnipeg Cable-Recovery Unit.** The Veterans Administration Prosthetics Center agreed to purchase some of these units for fitting and evaluation on VA patients in Atlanta, Ga. CPRD will monitor.

2. **Rehabilitation Institute of Montreal (RIM) Wrist-Flexion Unit.** RIM will provide some of the units for fitting and evaluation at Duke University Medical Center. CPRD will monitor.

3. **Ontario Crippled Children’s Centre (OCCC) Open-Shoulder Socket.** CPRD will attempt to initiate a case study to evaluate this and other methods of suspension for above-elbow amputee sockets.

Plans are also being made to evaluate: 1. the Fillauer Three-Step Casting Technique, and 2. the Zettl/Traub Premodified Casting Technique by amputee subjects and staff at Rancho Los Amigos Hospital in Downey, Calif. The existing capability at this center for analysis of results by means of transparent sockets and temperature-recording instrumentation will be used. Both techniques are designed to facilitate the preparation of sockets for below-knee amputees.

**COMMITTEE ON PROSTHETIC-ORTHOTIC EDUCATION**

**The Task Force on Standardization of Prosthetic-Orthotic Terminology**

The prime concern of the Task Force is with standardization of prosthetic and orthotic nomenclature. However, a number of derivative considerations cannot be ignored: 1. the application of descriptive terms to the prescription of devices for patients; 2. the use of selected terminology and prescription information in the negotiation of fee schedules and contracts of third-party payees such as the Veterans Administration, the Social and Rehabilitation Service of the Department of Health, Education, and Welfare, Blue Cross—Blue Shield, and the Social Security Administration (although SSA was reported as being in the process of developing its own system); and 3. the need for a comprehensive information retrieval system based on a standardized prosthetic and orthotic terminology.

The Fourth Workshop of the Task Force on Standardization of Prosthetic-Orthotic Terminology was held on July 28, 1972, in
Washington, D.C. In prosthetics, the extensive list of terms developed and defined at earlier workshops was reviewed, and the CPRD/CPOE staff agreed to check the list for completeness and to develop definitions for all listed terms—which would then be submitted to selected members of the Task Force for further review. Prosthetic headings and flow charts developed at a previous workshop were also considered, and a prosthetics prescription similar to one produced for orthotics was drafted.

In orthotics, while considerably more work needed to be done in compiling and defining orthotic terms, a technical analysis form for the lower limb had undergone extensive clinical trials and would soon be ready for routine use. The analysis form for the upper limb was less well advanced, but the forms were being readied for clinical trials at selected centers. The previously developed orthotics prescription chart and directions for its use were reviewed and slight revisions suggested. Appropriate prescription charts are now included in the technical analysis forms for both lower and upper limbs.

Standard prosthetic and orthotic nomenclature is essential to the work of the ad hoc Committee on Information Retrieval. These terms are needed: 1. for inclusion in existing retrieval systems such as the Medical Literature Analysis and Retrieval System (MEDLARS) of the National Library of Medicine, and 2. for development of a complementary system to permit retrieval of literature not analyzed and included in MEDLARS. In this latter connection a list of prosthetic descriptors has been developed and a three-digit code system assigned to these terms. Work has progressed so that immediate action may now be taken to: 1. review and test the proposed terminology list, and 2. prepare definitions and cross references for the terms.

On Nov. 28, 1972, the Assistant Executive Director and the Staff Surgeon met with the Chairman of the ad hoc Committee on Information Retrieval and other interested parties, including a representative of the Prosthetics and Orthotics Research and Development Unit of the Sanatorium Board of Manitoba that operates a data-retrieval system in Winnipeg, Manitoba, Canada. A prime purpose of this meeting was to relate the United States effort under CPOE to activities in this area elsewhere in the world. A further meeting on data-retrieval systems was held in New York City on May 14, 1973. At this meeting a representative of the prosthetic-orthotic community of the United Kingdom was present. Steps were taken to develop a system that might be universally acceptable to the English-speaking world.
Orthotics-Prosthetics Publications

Since both CPOE and CPRD issue numerous publications reporting the results of workshops and special meetings, a meeting was held in Washington, D.C., Apr. 30, 1973, to consider possible means of making these publications more useful, particularly to the educational community. Representatives of the sponsors (SRS and VA) and of the American Orthotic and Prosthetic Association and the American Academy of Orthotists and Prosthetists attended the meeting in addition to representatives from the three universities conducting prosthetic-orthotic education programs.

Newsletter... Amputee Clinics

Newsletter... Amputee Clinics, the bimonthly publication of CPOE, has been well-received in the 3 years since its inception. A steady increase in circulation (from 1500 to approximately 4000), plus a better-than-average response to frequent survey questionnaires, evidence reader interest and enthusiasm.

The Newsletter is an effective vehicle for communication between amputee clinic chiefs and others involved in the care and management of amputee patients. Six issues published during the period July 1, 1972—June 30, 1973, reported on such diverse clinical problems as the psychological effects of amputee clinics on patients and the current status of immediate postsurgical prosthetic fittings.

CLINICAL EVALUATION OF PROSTHETIC AND ORTHOTIC DEVICES AND TECHNIQUES

On Sept. 1, 1966, a contract was entered into between the National Academy of Sciences and the Vocational Rehabilitation Administration to establish a program under the Committee on Prosthetics Research and Development for the clinical evaluation of prosthetic and orthotic devices and techniques. Support for this program was extended by the Social and Rehabilitation Service to the most recent period of Sept. 1, 1972—Aug. 31, 1973.

During the seven years of its operation, the clinical evaluation program has provided an effective medium of transition for prosthetic, orthotic, and sensory-aid devices and techniques from design and development into education and patient usage. Seven major projects have been completed:
1. Clinical Evaluation of the Engen Plastic Hand Orthosis
2. Clinical Evaluation of the Veterans Administration Prosthetics Center Patellar-Tendon-Bearing (VAPC PTB) Orthosis
3. Clinical Evaluation of Synthetic Balata for Fabricating Sockets for Below-Knee Amputation Stumps
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4. Clinical Evaluation of the Army Medical Biomechanical Research Laboratory (AMBRL), Boston, and Rancho Los Amigos Hospital Externally Powered Prosthetic Elbows

5. Clinical Evaluation of the University of California Biomechanics Laboratory (UC–BL) Shoe Insert, the UC–BL Dual-Axis Ankle Orthosis, the VAPC Single-Bar Above-Knee Orthosis, and the New York University (NYU) Insert Orthosis

6. Clinical Evaluation of a Comprehensive Approach to Below-Knee Orthotics


Final reports have been published on items 1—7 as National Academy of Sciences Publications E–1 through E–7. In addition, the results of these evaluations have been published in various journals for the information of people in the field.

Comparative Evaluation of Ankle-Foot Orthoses

A comparative study including biomechanical analyses of the following 12 ankle-foot orthoses (AFOs) is being performed at Moss Rehabilitation Hospital in Philadelphia with coordination from CPRD.

- AMBRL Posterior-Bar AFO
- AMBRL Two-Rod AFO
- Conventional “Short-Leg Brace”
- IRM Spiral AFO
- NYU Insert AFO
- Rancho Polypropylene AFO
- Solid-Ankle Rigid-Laminate AFO
- Teufel Ortholen AFO
- TIRR Polypropylene AFO
- UC–BL Dual-Axis AFO
- VAPC Single-Bar AFO
- VAPC Shoe-Clasp AFO

The objectives are to determine more clearly functional characteristics, prescription criteria, and relative merits of each orthosis. The study commenced in January 1971. Work on kinematic analysis has been completed, and work is now under way on force analyses of the 12 AFOs.

Clinical Evaluation of a Comprehensive Approach to Below-Knee Orthotics

This evaluation commenced in January 1972 and was completed...
in September 1972. Sixty-seven patients were fitted, 11 of them bilaterally, at the following eight centers:

- New York University Prosthetics and Orthotics
- Northwestern University Prosthetic-Orthotic Center
- University of California at Los Angeles Prosthetic-Orthotic Education
- University of Virginia Department of Orthopaedics
- Veterans Administration Hospital, Cleveland
- University of Miami Department of Orthopaedics and Rehabilitation
- Veterans Administration Prosthetics Center Patient Clinic
- Rancho Los Amigos Hospital

The objective of the evaluation was to assess a comprehensive approach to the delivery of orthotic treatment by effectively matching the biomechanical deficits of patients with the biomechanical advantages of orthoses. Toward this end, use of the following three forms and three ankle-foot orthoses was evaluated:

- AAOS Lower-Limb Technical Analysis Form
- CPOE Orthotic Prescription Chart (Tentative)
- IRM Patient Classification for AFOs
- IRM Spiral AFO
- TIRR Polypropylene AFO
- VAPC Shoe-Clasp AFO

Results indicated that the forms are potentially very worthwhile for patient analysis and prescription but that they need some revision and more clinical exposure before recommendations can be made for their use. All three AFOs were found to be good and suitable devices for routine patient usage and their inclusion in the prosthetic-orthotic educational program is recommended. Also, a prescription guide was prepared to help delineate when each of the three orthoses should be used clinically.

**Clinical Evaluation of the Ljubljana Functional Electronic Peroneal Brace**

This evaluation commenced in April 1971 and was completed in November 1972. Seventy-two patients were fitted at the following five centers:

- Highland View Hospital, Cleveland
- University of Miami Department of Orthopaedics and Rehabilitation
- Moss Rehabilitation Hospital, Philadelphia
- Northwestern University Prosthetic-Orthotic Center
- Rancho Los Amigos Hospital

Results indicated that the orthosis does work to prevent “drop-
foot” condition, i.e., it stimulates the peroneal nerve during swing phase to cause dorsiflexion of the ankle and prevent toe drag during gait. Likewise, it successfully demonstrated the potential value of using electrical stimulation clinically. However, the device itself has too many mechanical problems to be used as it is, and the Ljubljana group is now in the process of redesigning it.

Clinical Evaluation of the Rancho/Medtronic Implantable Peroneal Stimulator

Based on the demonstrated performance of the Ljubljana externally applied stimulator for the peroneal nerve, an evaluation was started in August 1972 to assess an implantable unit developed by Rancho Los Amigos Hospital and Medtronic, Inc., to accomplish the same purpose but more with the elimination of some of the problems inherent with surface electrodes. The centers participating in this study are:

- George Washington University Department of Orthopedics
- Highland View Hospital, Cleveland
- Moss Rehabilitation Hospital, Philadelphia
- Northwestern University Prosthetic-Orthotic Center
- University of Miami Department of Orthopaedics and Rehabilitation
- University of Indiana Department of Orthopedics
- Texas Institute for Rehabilitation and Research, Houston

Comparative Evaluation of Upper-Limb Orthoses

CPRD was asked to evaluate comparatively four upper-limb orthotic systems which are available commercially. The prosthetic-orthotic schools are not sure about the curriculum content (each school is teaching something different) and clinicians feel unsure about their prescriptions.

An ad hoc committee was formed and a meeting was held in August 1972 with the schools, clinicians, and developers present to discuss the situation and to help sort out the relative merits of each system.

FUTURE PLANS

Continued Comparative Evaluation of Ankle-Foot Orthoses

The kinematic analysis phase of this study has been completed, and testing has begun on the kinetic analysis phase. CPRD will continue to work with Moss Rehabilitation Hospital to make the
results of these motion and force analyses available in such a form that they will be useful clinically.

Continued Clinical Evaluation of the Rancho/Medtronic Implantable Peroneal Stimulator

About one hundred of these units are being made available for clinical trial. With time needed to select suitable patients and with a trial wear period necessary, it is anticipated that the evaluation will run through 1973. An orientation course for members of the participating clinics was held Aug. 10–11, 1972. Interim progress meetings were held Feb. 2, 1973, and June 2, 1973, to assess the results obtained thus far.

Continued Comparative Evaluation of Upper-Limb Orthoses

Further work and a second meeting are necessary before recommendations can be made on the four upper-limb orthotic systems to the prosthetic-orthotic schools and clinicians in the field. It is anticipated that the second meeting of the ad hoc committee will be held in the summer of 1973.

Clinical Evaluation of Two Spinal Orthoses

A clinical evaluation is planned on the VAPC Lumbo-Sacral A-P and M-L Control Orthosis and the UC-BL Laminated Semi-Flexible Body Jacket with Inflatable Pads. A planning meeting was held Dec. 8, 1972, and an orientation session for the centers involved was held on June 4–7, 1973.

Evaluation of Vacuum-Forming Techniques in Prosthetics and Orthotics

New techniques whereby thermoplastic materials are heated and vacuum-formed over models appear most promising for application in prosthetics and orthotics. Shapes, such as prosthetic sockets and orthotic shells, can be made rapidly and efficiently, saving much time and effort which now goes into the hand lay-up and lamination of thermosetting plastics.

Vacuum-forming techniques make possible the forming of transparent sockets not otherwise feasible. Clear sockets offer the possibility to observe pressure distribution on the stump. Also, by saving time and effort, the patient can be provided a device more promptly, and the prosthetist or orthotist can devote more attention to functional aspects and less to fabrication aspects of the device. All these factors have very important and useful implications for clinical practice.
It is the goal of CPRD to explore vacuum-forming techniques, evaluate them as necessary, and assist in promulgating their use if indicated, especially in the prosthetic and orthotic schools where savings in fabrication and teaching time can be applied beneficially to instructing students more about biomechanics and function than "how to do it" shop procedures.

A Workshop on Vacuum-Forming Equipment and Techniques was held at Moss Rehabilitation Hospital on June 3. Information and experiences were discussed by participants who have been using this technique. Arrangements were made for representatives from the Education Program to attend a 2-day instructional course at Orthomedics, Downey, Calif., July 2–3, 1973.

**Evaluation of Modular, Endoskeletal Prostheses**

As explained in the report of the CPRD Conference on Cosmesis and Modular Limb Prostheses, March 3–7, 1971, endoskeletal prostheses for upper- and lower-limb amputees offer some very definite advantages over existing conventional systems. New endoskeletal systems are now being developed in the United States and abroad. There is need for CPRD to undertake evaluation of these new prostheses so that orderly development and introduction into clinical practice can ensue.

Evaluation of endoskeletal prostheses will involve consideration of both structural and cosmetic aspects, and will have to be coordinated with efforts overseas. Also being considered is the United States changeover from English to metric units. If this can be done early in development, it should alleviate the chore later on and allow greater cooperation and usefulness internationally.

**Evaluation of the Effect of Weight of Prostheses on Amputee Acceptance**

For many years there has existed a controversy over the effects of total weight and distribution of weight of lower-limb prostheses in amputee performance and acceptance. With the availability of modular prostheses, vacuum forming of sockets and other components of the prosthesis, and improved methods of obtaining data, the costs of such a project now seem to be reasonable. With the assistance of the group at Moss Rehabilitation Hospital, CPRD proposes to initiate a study of this type concerning the below-knee amputee. If this study is successful, it will be expanded to include the above-knee amputee.

**Lower-Limb Orthotics**

The Eighth Workshop on Lower-Limb Orthotics was held in Los Angeles, Calif., Oct. 2–4, 1972. Emphasis at this meeting was on
above-knee (knee/ankle) orthoses and orthotic knee joints providing knee stability. A variety of designs in current use was presented and recommendations for future activity were prepared. A comprehensive report of the workshop was prepared and has been distributed.

SPECIAL MEETINGS AND ACTIVITIES

Rehabilitation Engineering Centers

The Executive Director and members of the Committee on Prosthetics Research and Development participated in meetings of the Rehabilitation Engineering Advisory Committee of the Social and Rehabilitation Service Oct. 12, 1972, and June 6, 1973.

On Oct. 12, 1972, CPRD personnel also participated in an orientation session for Rehabilitation Engineering Centers.

Educational Activities

The Assistant Executive Director continued to serve as honorary secretary of the University Council on Orthotics-Prosthetics Education (UCOPE) and the Conference on Orthotics-Prosthetics Education (COPE). A combined meeting of these two groups was held in St. Louis, Mo., Oct. 24, 1972, while a meeting of UCOPE alone was held in Washington, D.C., May 1, 1973. These meetings focused primarily on mutual financial problems and served to coordinate course offerings.

Hemophilia

In collaboration with the University of Miami, the Committee on Prosthetics Research and Development sponsored a Workshop on the Comprehensive Management of Musculoskeletal Disorders in Hemophilia. This meeting was held in Miami, Fla., on Oct. 12–14, 1972, and an NAS-numbered publication is in preparation.

American Orthotic and Prosthetic Association (AOPA)

Continued close liaison was maintained with AOPA, the American Board for Certification (ABC), and the newly formed American Academy of Orthotists and Prosthetists (AAOP) by personal contact and by staff participation in various Association activities. The Assistant Executive Director attended the AOPA National Assembly on Oct. 22–25, 1972, in St. Louis, Mo., and the Region I Seminar in Hartford, Conn., May 3–4, 1973.

Workshop on Injuries of Adolescents in Sports and Recreation

The Committee on Prosthetics Research and Development, in
collaboration with the American Academy of Orthopaedic Surgeons and the Rainbow Foundation, sponsored a Workshop on Injuries of Adolescents in Sports and Recreation, held in Cleveland, Ohio, Dec. 4–5, 1972. A report is being prepared.

Postgraduate Course on the Advance in Orthotics—1972

On Dec. 11–13, 1972, the Executive Director, Assistant Executive Director, Staff Surgeon, and Staff Engineer participated in a postgraduate course entitled “The Advance in Orthotics—1972.” The course was presented by the University of Miami Medical School and was co-sponsored by CPRD, the Veterans Administration, and the American Academy of Orthotists and Prosthetists.

Neural Organization and Its Relevance to Prosthetics

The Executive Director participated in a symposium on Neural Organization and its Relevance to Prosthetics on Mar. 1–3, 1973, in Houston, Tex. The symposium, whose main topic was neuromuscular stimulation, was sponsored by the University of Texas Medical School and Graduate School of Biomedical Sciences, and the Houston Neurological Society.

Workshop on the Role of Engineering in Spinal-Cord Injury Programs

Leaders from the spinal-cord injury programs sponsored or conducted by the Veterans Administration, the National Institutes of Health, and the Social and Rehabilitation Service, together with private practitioners, and representatives from the VA, NIH, SRS, and DOD, met at the Castle Point VA Hospital, Poughkeepsie, N.Y., May 3–5, 1973. Information was interchanged and ways explored by which engineering could be most helpful in research and in the management of patients with lesions of the spinal cord. More than 60 individuals participated. Present management methods and current research efforts were reviewed and recommendations for future action were made. A comprehensive report will be published.

Workshop on the Integrity of Endoskeletal Prostheses

Because of reports by experienced prosthetists that instances of physical failure had occurred with the various types of endoskeletal lower-limb prostheses now available, a special workshop was organized. This workshop, which involved 10 prosthetists and engineers, was held on Apr. 25, 1973, in Atlanta, Ga., in conjunction with the annual conference of the chiefs of child amputee clinics. A report of the failures and suggestions for remedial action is being prepared.
International Activities

The Assistant Executive Director attended the ISPO Symposium on Lower-Limb Prosthetics and Orthotics in Sydney, Australia, Aug. 20–24, 1972, and presented two papers. He also attended an ISPO committee meeting held in conjunction with the symposium.

The Assistant Executive Director also attended the ISRD Symposium held in Sydney, Aug. 27–Sept. 1, 1972. En route to and from these meetings, he visited rehabilitation centers and limb-shops in Japan, Australia, and New Zealand.

On Oct. 19–21, 1972, the Executive Director, the Chairman, and selected members of CPRD served on the faculty of the 7th Annual International Course in Prosthetics and Orthotics of the Swiss Association of Prosthetics and Orthotics (APO) held in Davos, Switzerland. They also participated in the international working group on Specifications for Lower-Limb Modular Prostheses held in Ascot, England, Oct. 29–Nov. 4, 1972.

Other international activities which involved staff and/or Committee member participation were: a meeting of the ISPO Executive Board, Davos, Switzerland, Oct. 21, 1972; a meeting on Functional Electrical Stimulators, Ljubljana, Yugoslavia, Nov. 8–12, 1972; and a Conference on Technology and the Handicapped, Ottawa, Canada, Mar. 5–7, 1973.

The Assistant Executive Director was invited to present a paper on nomenclature and classification for congenital limb deficiencies at a Workshop on Nomenclature and Classification in Congenital Limb Deficiencies held in Dundee, Scotland, on June 22–23, 1973. He also served as chairman of an international working group on the same subject which convened just prior to the workshop. In this workshop significant steps were made in the development of terminology which might be internationally acceptable.

The Assistant Executive Director served as a member of the faculty for a Course on Lower Extremity Prosthetics for Physicians and Surgeons, held in Estoril-Cascais, Portugal, July 2–7, 1973. This course, conducted under the auspices of the International Society for Prosthetics and Orthotics, was attended by 35 physicians, including five from Spain, one from France, and one from Brazil, in addition to the group from Portugal. This was the first prosthetics course held for physicians in this area.

Proposals Reviewed on Behalf of Sponsors

A total of 38 proposals in the fields of prosthetics, orthotics, and
sensory aids were reviewed and appraised by the Committee at the request of sponsors (18 new proposals, 20 continuations).

Site Visits

At the request of sponsoring agencies staff members of CPRD, together with Committee members and experts in the pertinent fields, made the following on-site visits:

- Mr. Charles N. Bengston (a manufacturer of special devices for upper-limb amputees)
- University of Miami
- Case Western Reserve University
- Denver Research Institute
- University of Utah
- Vanderbilt University
- Northwestern University Prosthetics Research Laboratory
- University of California Biomechanics Laboratory (Berkeley)
- Texas A&M University
- Harvard—Massachusetts Institute of Technology
- University of Iowa

The Executive Director and the Staff Engineer for Sensory Aids visited Mauch Laboratories in Dayton, Ohio, in connection with projects on prosthetic devices and reading machines for the blind. In addition, the Staff Engineer for Sensory Aids visited American Institutes for Research in Palo Alto, Calif. (evaluation of reading aids), Haskins Laboratories in New Haven, Conn. (development of synthetic speech outputs for reading machines), and the University of Maryland in College Park, Md. (hearing-aid performance analysis).

The Assistant Executive Director also made visits to several Child Amputee Centers, some already participating in the cooperative research program coordinated by the SCPP and some prospective participants. These centers were: Georgia Juvenile Amputee Clinic, Atlanta, Ga.; Amputee Clinic, D.C. General Hospital, Washington, D.C.; Children's Health Center, San Diego, Calif.; Children's Hospital, Vancouver, Canada; Children's Hospital, Oklahoma City, Okla.; Shriners Hospitals for Crippled Children, Winnipeg, Canada, and Salt Lake City, Utah.

Miscellaneous

The staff responded to more than 1500 requests for publications and technical information.
PUBLICATIONS


Inter-Clinic Information Bulletin. (Published monthly under the sponsorship of the Subcommittee on Child Prosthetics Problems; 12 issues.)

## APPENDIX A
### MAJOR PROSTHETICS AND ORTHOTICS PROJECTS

The following listing of projects active during fiscal year 1973 is expanded from last year's and includes projects not coordinated by CPRD. No claim is made for completeness, however, and suggestions for additions or corrections are invited. No attempt has been made to include the large number of foreign projects, though we are familiar with the SRS PL 480 international program and other programs overseas. (One French project is listed because it is funded directly by the Veterans Administration.) See Appendix B for an explanation of the abbreviations used below.

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<th>Sponsoring Agency</th>
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<td>California, University of Berkeley and San Francisco, Calif. Charles W. Radcliffe</td>
<td>Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion</td>
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<td>California, University of Los Angeles, Calif. Harlan C. Amstutz</td>
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<td>Yoshio Setoguchi (2)</td>
<td>Child Amputee Prosthetics Project</td>
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<td>John Lyman</td>
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<td>Reflex Control for Artificial Limbs</td>
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<td>Summation of Human Locomotion</td>
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<td>Control Logic for Upper-Limb Prostheses</td>
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<td>Daniel Graupe</td>
<td>Procurement of Cybertype Systems</td>
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<td>Cyber Corporation Washington, D.C.</td>
<td>Clinical Evaluation of &quot;Cybertype&quot; and &quot;Cyberbrailer&quot; for the Severely Disturbed and Blind</td>
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<td>A Study of Spinal Orthotics in Idiopathic Scoliosis</td>
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<td>Study of the Development of Refined Fitting Procedures for Lower-Extremity Prosthetics</td>
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Organization and
Responsible Investigator
San Francisco, Calif.
Wesley Moore

Seattle, Wash.
Ernest Burgess

Veterans Administration
Research and Development
Division
New York City
Eugene F. Murphy

Project Title
Study of Below-Knee
Amputations for Vascular
Insufficiency
Immediate Postoperative
Prosthesis Fitting and
Ambulation
Intramural and Extramural
Research and Development in
Prosthetics, Orthotics, and
Sensory Aids
Research, Development, and
Testing of Prosthetic and
Orthotic Devices and
Techniques
Fitting of Lower-Extremity
Prosthetics

Sponsoring
Agency
VA
VA
VA
VA
SRS

PROJECTS IN CANADA WHICH COOPERATE CLOSELY WITH THE
PROSTHETICS AND ORTHOTICS PROGRAM IN THE U.S.A.

Organization and
Responsible Investigator
Prosthetic/Orthotic Research Unit,
Ontario Crippled Children’s Centre
Toronto, Ontario
Colin A. McLaurin

Rehabilitation Institute of Montreal
Montreal, Que.
Maurice Mongeau

Prosthetics/Orthotics Research and
Development Unit, Manitoba
Rehabilitation Hospital
Winnipeg, Man.
F. R. Tucker and Reinhart Daher

The University of New Brunswick Bio-
Engineering Institute
Fredericton, N.B.
R. N. Scott

University of British Columbia
Vancouver, B.C.
James Foort

Shriners Hospital(s)
Winnipeg, Man.
David A. Winter and Douglas A. Hobson

Major Area(s) of Investigation
Development of a Wide Variety of Upper-
Extremity and Lower-Extremity Body-
Powered and Externally Powered
Prosthetic and Orthotic Devices for
Children
Development of Externally Powered
Upper-Extremity Prosthetic Devices, with
Special Reference to Children
Development of a Variety of Prosthetic
Devices with Special Reference to Lower-
Extremity Requirements
Orthotics and Prosthetics Systems Research
with Special Emphasis on the
Employment of Electromyographic
Signals as Controls
Research in Lower-Limb Prosthetics and
Orthotics and Study of Special
Equipment for Severely Disabled
Children
Wide Variety of Rehabilitation Devices for
Children
APPENDIX B

MAJOR SENSORY AIDS PROJECTS

The following listing of projects active during fiscal year 1973 is expanded from last year's and is based on a survey of federal and state agencies as well as private foundations and individual researchers. No claim, however, is made for completeness, and suggestions for additions or corrections are invited. Projects outside the United States were listed only as they came to our attention, and information on others would be especially welcome for future editions.

When it is known that only a portion of a project pertains to sensory aids, the word "part" appears in parentheses after the title.

<table>
<thead>
<tr>
<th>Organization and Responsible Investigator</th>
<th>Project Title</th>
<th>Spurring Agency</th>
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<tbody>
<tr>
<td>Albert Einstein College of Medicine, Bronx, N.Y.</td>
<td>Early Diagnosis of Hearing Loss with Evoked Responses</td>
<td>MCHS</td>
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<tr>
<td>Isabelle Rapin</td>
<td>Educational Evaluation of the Optacon (Optical-Tactile Converter) as a Reading Aid for Blind Elementary and Secondary Students</td>
<td>OE</td>
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<tr>
<td>American Institutes for Research, Palo Alto, Calif.</td>
<td>The Reading of Print Materials by the Blind</td>
<td>VA</td>
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<tr>
<td>Robert A. Weisgerber</td>
<td>Program for Facilitating the Education of the Visually Handicapped through Research in Communication</td>
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<tr>
<td>Arkansas Enterprises for the Blind, Little Rock, Ark.</td>
<td>Evaluation of Ultrasonic Binaural Sensor (Kay device)</td>
<td>SRS</td>
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<tr>
<td>Allan Ward</td>
<td>Laser Cane Blind Mobility Aid</td>
<td>VA</td>
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<tr>
<td>Bionic Instruments, Inc., Bala Cynwyd, Pa.</td>
<td>Development of a Wearable Master Hearing Aid Device for Clinical Studies</td>
<td>NINDS</td>
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<tr>
<td>J. Malvern Benjamin</td>
<td>Development of Computerized Speech Training Aids for the Deaf</td>
<td>OE</td>
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<tr>
<td>Edward Starr</td>
<td>Spellex—A Talking Typewriter for the Blind</td>
<td>CMRC</td>
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<tr>
<td>Raymond S. Nickerson</td>
<td>Spelled-Speech Print-Reading Machine</td>
<td>CNRC</td>
</tr>
<tr>
<td>Kenneth N. Stevens</td>
<td>British Columbia, University of Vancouver, Canada</td>
<td>VF</td>
</tr>
<tr>
<td>Michael P. Beddoes</td>
<td></td>
<td>WF</td>
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Organization and Responsible Investigator

California, University of
Los Angeles, Calif.
Donald D. Dirks
CBS Laboratories
Stamford, Conn.
Emil L. Tovick

Central Institute for the Deaf
St. Louis, Mo.
Ira J. Hirsh
Chicago, University of
Chicago, Ill.
Arnold P. Grunwald
Childrens Hospital Research Foundation
Washington, D.C.
Ann B. Barnet
Florida, University of
Gainesville, Fla.
William W. Dawson
C. K. Adams
R. D. Willis

Foundation for Hearing Aid Research
Woodstock, N.Y.
Edgar Villchur
Franklin Institute Research Laboratory
James L. Gumnick
Gallaudet College
Washington, D.C.
J. M. Pickett
Georgia Institute of Technology
Atlanta, Ga.
Thomas P. Barnwell
The Hadley School for the Blind
Winnetka, Ill.
Donald W. Hathaway
Hädikappinstitutet
Bromma 3, Sweden
Jan-Ingvar Lindström
Hartford, University of
West Hartford, Conn.
Bernard Z. Friedlander

Project Title
Loudness Discrimination and Amplification Relationships (human)
Design Concepts and Electronic Configurations for Wearable Master Hearing Aid Device for Clinical Studies
Auditory Communication and Its Disorders
Use Test of Braille Machines, Tape Generation Equipment and Techniques
Sensory Evoked EEG and Behavioral Responses in Children
Study Materials in Conjunction with a Sensory Prosthesis (cats)
Experimental Analysis of Visual Performance Evoked by Electrical Stimulation of Visual Cortex in Primates
Signal Processing to Improve Speech Intelligibility in Perceptive Deafness
An Engineering Evaluation of Optacon
Wearable Visual Aid for Speech Communication in the Hearing Impaired
Research Initiation—Pitch Encoding in Speech Signals
Development of Correspondence Courses for Personal Reading Aids for the Blind
Laser Cane for the Blind
Automated Language Tests and Enrichment for Deaf Infants

Sponsoring Agency
NINDS
NINDS
NINDS
OE
NICHHD
NINDS
NSF
FHAR
OE
SRS
NSF
VA
MCHS

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Organizations and Responsible Investigator

Haskins Laboratories, Inc.
New Haven, Conn.
Franklin S. Cooper

Huntington Memorial Hospital
Pasadena, Calif.
Robert H. Pudenz

Illinois Department of Public Health
Springfield, Ill.
Phil B. Shattuck

Illinois Visually Handicapped Institute
Chicago, Ill.
Thomas J. Murphy

Johns Hopkins University
Baltimore, Md.
Moise H. Goldstein

Rachael E. Seitz

Louise Sloan

Louise Sloan
Lexington School for the Deaf
Jackson Heights, N.Y.
Jules M. Greenstein

Marquette University
Milwaukee, Wi.
Russell J. Niederjohn

Maryland, University of
College Park, Md.
G. Donald Causey

Massachusetts Eye and Ear Infirmary
Boston, Mass.
C. H. Dohlman

Massachusetts General Hospital
Boston, Mass.
Daniel Pollen

Massachusetts Institute of Technology

Project Title

Research on Audible Outputs of Reading Machines for the Blind
Study Electrical Stimulation of the Visual System (human, mammals, nonhuman)
The Application of Tympanometry for Identification of Early Middlle Ear Pathology In Elementary School Children
Evaluation of Ultrasonic Binaural Sensor (Kay device)
Study of Cutaneous and of Visual Patterned Stimulation Communication Aids for the Profoundly Deaf Infants (part)
New Approaches to Speech Instruction of Deaf Children (part)
Neurosensory Interdisciplinary Research Program; Closed circuit Television Reading Aid Studies in Physiological Optics
Methods of Fostering Language Development in Deaf Infants
Research Initiation—Voiced and Continuous Speech Research
Development of Improved Techniques for the Analysis of Hearing Aid Performance
Intrinsic and Extrinsic Ocular Disease Investigations Cornea Research (human) (part)
Feasibility Study of a Visual Prosthesis for the Blind Utilizing Direct Electrical Stimulation of the Visual Cortex
Sensory Aids Development and Evaluation

Sponsoring Agency

VA
NINDS
IDPH
LMCH
NU
SRS
NINDS
NINDS
NINDS
NEI
OE
NSF
VA
NEI
NINDS
SRS

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<th>Organization and Responsible Investigator</th>
<th>Project Title</th>
<th>Sponsoring Agency</th>
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<tbody>
<tr>
<td>Samuel J. Mason</td>
<td>Evaluation of Ultrasonic Binaural Sensor</td>
<td>SEI</td>
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<td>Derek Rowell</td>
<td>Pattern Recognition of Conventional Symbol Systems (part)</td>
<td>SRS</td>
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<tr>
<td>M. Eden</td>
<td>Development of Personal Reading Machines for the Blind</td>
<td>NSF</td>
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<tr>
<td>Mauch Laboratories, Inc. Dayton, Ohio</td>
<td>Evaluation of Optacon (optical-tactile convertor) Reading Machine (Joint Project with St. Dunstan's and Royal National Institute for the Blind)</td>
<td>VA</td>
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<td>Hans A. Mauch</td>
<td>Development of Test Procedures for Evaluation of Binaural Hearing Aids</td>
<td>NINDS</td>
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<td>Medical Research Council Cambridge, England</td>
<td>Center for Research in Human Learning: Language Behavior (children, adults) (part)</td>
<td>NICHD</td>
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<td>D. E. Broadbent</td>
<td>Perceptual Masking in Normal and Impaired Hearers (human)</td>
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<td>Minnesota, University of Minneapolis, Minn. James J. Jenkins</td>
<td>Research Initiation—Optimization of the Visual Vocoder for Speech Therapy</td>
<td>NSF</td>
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<td>James J. Jenkins</td>
<td>Development of a Tactual Output Image Sensor for the Blind</td>
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<td>National Accreditation Council for Agencies Serving the Blind and Visually Handicapped New York, N.Y. Alexander F. Handel</td>
<td>Information Transfer Problems of the Partially Sighted</td>
<td>NINDS</td>
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<tr>
<td>Northwestern University Auditory Research Lab. Evanston, Ill. Raymond Carhart</td>
<td>Development of a Sensory Prosthesis (human, monkeys)</td>
<td>NSF</td>
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<td>Ohio State University Columbus, Ohio</td>
<td>Research Initiation—Optimization of the Visual Vocoder for Speech Therapy</td>
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<tr>
<td>Richard M. Campbell</td>
<td>Development of a Tactual Output Image Sensor for the Blind</td>
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<tr>
<td>Pomorska Akademia Medyczna Szczecin-Pomorzany, Poland O. Palacz</td>
<td>Information Transfer Problems of the Partially Sighted</td>
<td>NSF</td>
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<tr>
<td>Rand Corporation Santa Monica, Calif. S. M. Genensky</td>
<td>Development of a Sensory Prosthesis (human, monkeys)</td>
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<tr>
<td>Rochester, University of Rochester, N.Y. Robert W. Doty</td>
<td>Development of Personal Reading Machines for the Blind</td>
<td>VA</td>
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</table>
Organization and Responsible Investigator

Dr. Robert Royal National Institute for the Blind
London, England
D. E. Broadbent

St. Barnabas Medical Center
Livingston, N.J.
Gerald Fonda
St. Dunstan's London, England
D. E. Broadbent

San Diego State College
San Diego, Calif.
Carol A. Galambos
Smith-Kettlewell Institute
San Francisco, Calif.
Carter C. Collins
Paul Bach-y-Rita

Frank A. Saunders

Stanford Research Institute
Menlo Park, Calif.
J. W. Hill
Stanford University
Stanford, Calif.
John G. Linvill
The Swedish Association of the Blind
Stockholm, Sweden
B. Linqvist
Syracuse University
Syracuse, N.Y.
Martin Rothenberg

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Feasibility Study of a Visual Prosthesis for the Blind Utilizing Direct Electrical Stimulation of the Visual Cortex
Evaluation of Optacon (optical-tactile convertor) Reading Machine (Joint Project with St. Dunstan's and Medical Research Council)
Evaluate Closed Circuit TV as a Low Vision Aid
Evaluation of Optacon (optical-tactile convertor) Reading Machine (Joint Project with Medical Research Council and Royal National Institute for the Blind)
Study of Auditory and Visual Systems in Infants
Portable Seeing Eye
Tactile Vision Prosthesis
Tactile Television System for the Blind
Development of The Neurophysiological Basis for Design of Portable Seeing Aid
An Electrotactile Sound Detector for the Deaf (human)
Tactile Perception of Dynamic Spatial Patterns
Integrated Electronics for Medical Applications; Large Scale Integration (part)
Evaluation of Optacon (Optical-Tactile Converter) Reading Machine
Voice Quality and Laryngeal Frequency

Sponsoring Agency
NINDS
SEI
NICHHD
NEI
SEI
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NEI
NINDS
NSF
NIGMS
SAB
NINDS
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<table>
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<tr>
<th>Organization and Responsible Investigator</th>
<th>Project Title</th>
<th>Sponsoring Agency</th>
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<tr>
<td>Telesensory Systems, Inc.</td>
<td>Manufacture of Optacon for a Field Trial Within Elementary and Secondary Schools</td>
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<tr>
<td>Palo Alto, Calif.</td>
<td>The Effectiveness of Low-Frequency Amplification and Filtered Speech Testing for Preschool Deaf Children</td>
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<tr>
<td>James C. Bliss</td>
<td>Cvl ical Application Program in Reading and Mobility Aids for the Blind</td>
<td>VA</td>
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<tr>
<td>Tennessee, University of Knoxville, Tn.</td>
<td>Clinical Application Program in Reading and Mobility Aids for the Blind</td>
<td>VA</td>
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<tr>
<td>Carl W. Asp</td>
<td>Clinical Application Program in Reading and Mobility Aids for the Blind</td>
<td>VA</td>
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<tr>
<td>VA Hospital, Central Blind Rehabilitation Center Hines, Ill. John D. Malamazian</td>
<td>Clinical Application Program in Reading and Mobility Aids for the Blind</td>
<td>VA</td>
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<tr>
<td>VA Hospital, Eastern Blind Rehabilitation Center West Haven, Conn. G. M. Gillispie</td>
<td>Clinical Application Program in Reading and Mobility Aids for the Blind</td>
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<tr>
<td>VA Hospital, Western Blind Rehabilitation Center Palo Alto, Calif. Loyal E. Apple Wayne State University Detroit, Mi. John H. Gaeth</td>
<td>Joint Project for the measurement of Hearing Aids and the Advisement and Counseling of Children and their Parents</td>
<td>MMCH</td>
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<td>Western Michigan University Kalamazoo, Mi. Donald Blasch</td>
<td>Evaluation of Ultrasonic Binaural Sensor (Kay device)</td>
<td>SRS</td>
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### ABBREVIATIONS:

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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>BCT</td>
<td>The B. C. Telephone Company</td>
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<td>CMRC</td>
<td>The Medical Research Council of Canada</td>
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<tr>
<td>CNRC</td>
<td>The National Research Council of Canada</td>
</tr>
<tr>
<td>FHAR</td>
<td>Foundation for Hearing Aid Research</td>
</tr>
<tr>
<td>HEW</td>
<td>U.S. Department of Health, Education, and Welfare</td>
</tr>
<tr>
<td>IDPH</td>
<td>Illinois Department of Public Health</td>
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<td>LEI</td>
<td>Lilly Endowment, Incorporated</td>
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<td>LMCH</td>
<td>Lake-McHenry Regional Program for the Hearing Impaired</td>
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<td>SRS</td>
<td>Evaluation of Ultrasonic Binaural Sensor (Kay device)</td>
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<td>Evaluation of Ultrasonic Binaural Sensor (Kay device)</td>
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</table>

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APPENDIX C

SUBCOMMITTEE ON CHILD PROSTHETICS PROBLEMS

GEORGE T. AITKEN, M.D., Chairman: (Orthopaedic Surgeon,
Bulletin of Prosthetics Research—Fall 1973

Mary Free Bed Guild Children's Hospital), College Avenue Medical Building, 50 College Avenue, S.E., Grand Rapids, Michigan 49503
CHARLES H. EPPS, JR., M.D., Director, Handicapped Children's Clinic, D.C. General Hospital, Washington, D.C. 20003
SIDNEY FISHMAN, Ph.D., Coordinator, Prosthetics and Orthotics, NYU Post-Graduate Medical Center, 317 East 34th Street, New York, New York 10016
CAMERON B. HALL, M.D., 11600 Wilshire Boulevard, Suite 206, Los Angeles, California 90025
DOUGLAS A. HOBSAN, P.Eng., Technical Director, P/O Program, Shriners Hospital for Crippled Children, 633 Wellington Crescent, Winnipeg 9, Manitoba, Canada
LEON M. KRUGER, M.D., Chief, Department of Orthopedics, Wesson Memorial Hospital, Springfield, Massachusetts 01105
CLAUSE N. LAMBERT, M.D., 1725 West Harrison Street, Chicago, Illinois 60612
ROBERT E. TOOMS, M.D., Campbell Clinic, 869 Madison Avenue, Memphis, Tennessee 38104

SUBCOMMITTEE ON DESIGN AND DEVELOPMENT
JAMES B. RESWICK, Sc.D., Chairman: Rancho Los Amigos Hospital, 7601 East Imperial Highway, Downey, California 90242
DUDLEY CHILDRESS, Ph.D., Director, Prosthetic Research, Northwestern University Medical School, 401 East Ohio Street, Chicago, Illinois 60611
JOHN LYMAN, Ph.D., Head, Biotechnology Laboratory, Department of Engineering, University of California, Los Angeles, California 90024
HANS A. MAUCH, Mauch Laboratories, Inc., 3035 Dryden Road, Dayton, Ohio 45439
CHARLES W. RADCLIFFE, Professor of Mechanical Engineering, 5144 Etcheverry Hall, University of California, Berkeley, California 94720
ROY SNEISON, C.P.O., Project Director, Amputee and Problem Fracture Service, Rancho Los Amigos Hospital, 7601 East Imperial Highway, Downey, California 90242
ROY WIRTA, Sr. Research Scientist, Kusen Center for Research and Engineering, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pennsylvania 19141

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SUBCOMMITTEE ON EVALUATION
FRANK W. CLIPPINGER, JR., M.D., Chairman: Professor, Department of Orthopaedic Surgery, Duke University Medical Center, Durham, North Carolina 27710
ARTHUR W. GUILFORD, JR., Chief Orthotist, Rancho Los Amigos Hospital, 7601 East Imperial Highway, Downey, California 90242
CHARLES W. RADCLIFFE, Professor of Mechanical Engineering, 5144 Etcheverry Hall, University of California, Berkeley, California 94720
G. E. SHARPLES, Ph.D., Assistant Professor, Child Amputee Research Project, M505S-SPH II, The University of Michigan, 1420 Washington Heights, Ann Arbor, Michigan 48104

SUBCOMMITTEE ON FUNDAMENTAL STUDIES
VICTOR H. FRANKEL, M.D., Chairman: Division of Orthopaedic Surgery, University Hospitals, 2065 Adelbert Road, Cleveland, Ohio 44106
JOSEPH M. CESTARO, C.P.O., President, J. E. Hanger, Inc., 40 Patterson Street, N.E., Washington, D.C. 20002
DONALD B. KETTELKAMP, M.D., Department of Orthopaedic Surgery, University Hospitals, The University of Iowa, Iowa City, Iowa 52240
JAMES M. MORRIS, M.D., Associate Professor of Orthopaedic Surgery, Biomechanics Laboratory, University of California Medical Center, San Francisco, California 94122
JOSEPH P. VAN DER MEULEN, M.D., Department of Neurology, Los Angeles County, USC Medical Center, 1200 North State Street, Los Angeles, Calif. 90033
ROY WIRTA, Sr. Research Scientist, Krusen Center for Research and Engineering, Moss Rehabilitation Hospital, 12th Street and Tabor Road, Philadelphia, Pennsylvania 19141

SUBCOMMITTEE ON SENSORY AIDS
NEWMAN GUTTMAN, Ph.D., Chairman: Indian Hill Laboratory, Bell Telephone Laboratories, Naperville, Illinois 60540
JOHN E. DOWLING, Ph.D., Associate Professor of Ophthalmology, Woods Research Building, The Johns Hopkins School of Medicine, Baltimore, Maryland 21205
RICHARD E. HOOVER, M.D., Assistant Professor of Ophthalmology, The Johns Hopkins School of Medicine, Baltimore, Maryland 21201
JOHN LYMAN, Ph.D., Head, Biotechnology Laboratory, Room
Bulletin of Prosthetics Research—Fall 1973

3116, Engr. I, University of California, Los Angeles, California 90024

WILLIAM B. MARKS, Ph.D., Assistant Professor of Biophysics, Department of Biophysics, The Johns Hopkins University, Homewood Campus, Baltimore, Maryland 21218

PATRICK W. NYE, Ph.D., Haskins Laboratories, 270 Crown Street, New Haven, Connecticut 06510

CARL EDWIN SHERRICK, JR., Ph.D., Department of Psychology, Green Hall, Princeton University, Princeton, New Jersey 08540

CARROLL T. WHITE, Ph.D., Naval Electronics Laboratory Center, Code 3400, San Diego, California 92152