

**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, 1970<sup>a</sup>**

**PURPOSE**

The Committee on Prosthetics Research and Development undertakes activities which serve research in the fields of prosthetics, orthotics, and sensory aids when such activities are compatible with the purposes and functions of the National Academy of Sciences.

Governmental agencies, such as the Department of Health, Education, and Welfare, the Veterans Administration, the Department of Defense, and others, have responsibilities in providing services to amputees and other individuals having orthopedic and sensory disabilities. Several nongovernmental agencies also have interests in these fields.

The volume of business in the provision of artificial limbs, orthopedic appliances, and sensory aids for the blind and the hard of hearing is insufficient to support the types and extent of research necessary to maintain progress commensurate with other technical fields. Hence, it has become necessary for governmental agencies and private foundations to support research and development either by conducting research within their own organizations or by contracts with universities and industrial laboratories, or by both means.

The Committee on Prosthetics Research and Development seeks to:

maintain awareness of developments in all aspects of prosthetics/orthotics and sensory aids;

correlate and coordinate research sponsored by the Veterans Admin-

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<sup>a</sup> This report was prepared as part of the work under Contract V1005M-1914 between the Veterans Administration and the National Academy of Sciences; and under Contract Nos. SRS-70-11 and SRS-70-10 (the latter a combination contract with the Children's Bureau) between the Social and Rehabilitation Service, Department of Health, Education, and Welfare and the National Academy of Sciences.

istration, Social and Rehabilitation Service, National Institutes of Health, Army, Navy, and others;

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

ensure that successful new devices and techniques are made available promptly to the organizations concerned with the education of medical and paramedical personnel in the fields of prosthetics and orthotics;

provide wide dissemination of the results of the research by the 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 membership of the Committee consists of physicians and engineers and representatives of other disciplines actively interested in furthering the development of improved prosthetic and orthotic devices and sensory aids and their utilization. Appointments to the Committee, which are 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.

Over the years five permanent Subcommittees have been developed by the Committee on Prosthetics Research and Development as an aid in achieving its objectives (Fig. 1). These Subcommittees are: Funda-

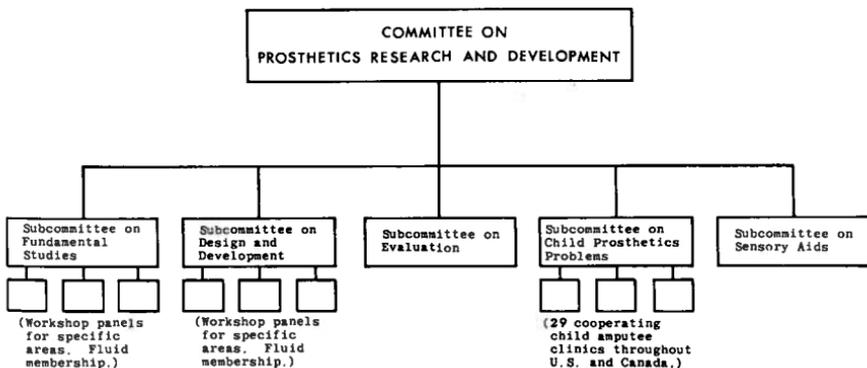


FIGURE 1

mental Studies, Design and Development, Evaluation, Child Prosthetics Problems, and Sensory Aids.

The Subcommittee on Fundamental Studies seeks to stimulate research for basic information which will aid in the design of improved prosthetic and orthotic devices. The Subcommittee operates through small working panels which focus on specific subject areas. These panels involve persons directly interested in and/or engaged in research in the subject area. Exploration of information currently available is sought and efforts made to stimulate research in areas where required information is lacking.

To attain its objectives, the Subcommittee on Design and Development arranges frequent meetings and workshops of individuals working in specific areas of the prosthetics-orthotics fields. Some of the so-called workshop panels active during the past years have been those on lower-extremity prosthetics, upper-extremity prosthetics (including special meetings on powered devices), lower-extremity orthotics, and spinal orthotics. A workshop panel on upper-extremity orthotics was also constituted and will hold an initial meeting early in the new fiscal year. Through the medium of these specialized groups, the Subcommittee effects an active exchange of information and ideas between the various groups engaged in design and development, and provides leadership in the solution of critical problems. New ideas and suggestions are evaluated from the standpoint of engineering feasibility and the endeavors of those working on promising designs are encouraged.

The problems of evaluation of new prosthetic and orthotic devices and techniques are a major continuing concern of the Committee on Prosthetics Research and Development. Hence, the Subcommittee on Evaluation encourages and coordinates a wide-ranging system so that the status and merits of individual items can be determined in an appropriate manner.

The Subcommittee on Child Prosthetics Problems stimulates research in prosthetics for child-amputee patients and disseminates the results of this research to those engaged in the treatment of this section of the amputee population. Under the auspices of this Subcommittee, the Child Amputee Research Program is carried on through 29 participating child amputee clinics which have met standards of practice established by the Subcommittee. The *Inter-Clinic Information Bulletin* 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. During the past year the parent committee charged the Subcommittee on Child Prosthetics Problems with the responsibility of enlarging its interests and activities to include orthotics for the juvenile patient.

The Subcommittee on Sensory Aids endeavors to be fully aware of

current activities in the development of sensory aids for the blind and hard of hearing, to encourage activities of merit, and to provide advisory services to interested agencies—government and private.

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, an editorial assistant, an administrative assistant, and two secretaries.

## OPERATIONAL CONCEPT

### General

Appointments to the Committee on Prosthetics Research and Development are normally for a period of 3 years as are appointments to the five subcommittees. The membership of workshop panels and special groups appointed to consider specific problems are more temporary and fluid.

The Committee's procedures in carrying out its responsibilities depend upon the requirements of the specific areas of interest. Ongoing business of a continuing nature is conducted by the Committee as a whole and by its subcommittees which report directly to the Committee. The work of certain of the subcommittees is closely interrelated; for example, Design and Development and Evaluation; Design and Development and Child Prosthetics Problems; and Evaluation and Child Prosthetics Problems. Liaison between these groups with related interests is maintained by the staff, the chairman of CPRD, and interlocking liaison representation.

Problems requiring special knowledge or technical competence are referred to selected *ad hoc* groups for study and report. Appointments to such *ad hoc* committees typically include some members of the Committee but are not restricted to the Committee membership. Rather, members are chosen for their special knowledge of the problem under review. A large number of qualified persons affiliated with the prosthetics-orthotics research program are available to the Committee on Prosthetics Research and Development for appointment to such *ad hoc* committees and are willing to serve.

The reports and recommendations of the subcommittees and *ad hoc* committees are reviewed by the Committee on Prosthetics Research and Development, which meets twice yearly, or as necessary, to conduct its business.

### Governmental Relationships

The Committee on Prosthetics Research and Development is responsible for the provision of advisory services through the Academy—Research Council to the Veterans Administration, the Social and

Rehabilitation Service, the Maternal and Child Health Service (formerly the Children's Bureau), the last two being agencies of the Department of Health, Education, and Welfare. Liaison representatives designated by these governmental agencies take part, without vote, in Committee deliberations. The Army Medical Biomechanical Research Laboratory, the Navy Prosthetics Research Laboratory, and the Veterans Administration Prosthetics Center are among the participating laboratories cooperating with the Committee on Prosthetics Research and Development. Individuals from these laboratories frequently participate in the Committee's activities.

### **Interdivisional Relationships**

Liaison with the Committee on Prosthetic-Orthotic Education, Division of Medical Sciences, National Academy of Sciences—National Research Council, is maintained on a continuing basis, the chairman of that Committee being a liaison member of the Committee on Prosthetics Research and Development. Moreover, a number of individuals are members of both committees. Copies of all Committee on Prosthetics Research and Development publications are transmitted to the Committee on Prosthetic-Orthotic Education. The journal *Artificial Limbs* is a joint undertaking of the two committees.

## **ACTIVITY REPORTS**

### **General**

During the period July 1, 1969, through June 30, 1970, the Committee on Prosthetics Research and Development continued to provide advice and assistance in the coordination of governmental and privately sponsored research in the fields of prosthetics-orthotics and sensory aids. At the request of the sponsoring agencies, the Committee made specific recommendations on 32 proposals for new and 29 proposals for renewal of research and development projects and conducted 20 site visits.

### **CPRD Meetings**

The twentieth meeting of the Committee was held in Washington, D.C., on November 4-5, 1969, and the twenty-first meeting was held in Cleveland, Ohio, on April 21-22, 1970, both meetings being under the chairmanship of Dr. Colin A. McLaurin. The meetings were well attended by members and by representatives from SRS (Prosthetics, Orthotics, and Sensory Aids Study Section), Veterans Administration, the Maternal and Child Health Service, Committee on Prosthetic-Orthotic Education, Committee on the Interplay of Engineering with Biology and Medicine, and the American Orthotic and Prosthetic Association—American Board for Certification. Consideration was given to reports from the Committee's five subcommittees and from the representatives of the sponsoring agencies. Plans were made for activities for

the immediate future as well as long range, including the scheduling of a number of special events. Comprehensive reports of the meetings were prepared and distributed.

*Subcommittee on Fundamental Studies*

Early in the reporting period an *ad hoc* committee was appointed to study the structure and functions of the Subcommittee on Fundamental Studies and to make recommendations which would lead to an enlargement of the scope of the Subcommittee's work and increase the output of useful fundamental data. The *ad hoc* committee recommended the formation of a workshop panel to deal initially with six areas of fundamental research. These areas are:

- human locomotion
- lower-extremity kinematics
- control of externally powered devices
- tissue physiology
- upper-extremity kinematics
- history of hardware design

The Subcommittee on Fundamental Studies is now being reconstituted and the organization of the recommended workshop panels has begun. To date, attention has been concentrated primarily on human locomotion and three meetings on this subject have been held. Accelerated activity in the realm of fundamental studies is anticipated for the next fiscal year.

*Subcommittee on Sensory Aids*

The Subcommittee on Sensory Aids met October 24, 1969, in Washington, D.C., at which time prime consideration was given to devices for the blind (reading machines and mobility aids). Extension of the Subcommittee's activities to other areas and to evaluation was discussed. The Mauch Visotoner, a reading device for the blind, is now ready for evaluation and plans were made for this project.

A second meeting of the Subcommittee was held on the West Coast March 6-7, 1970. In conjunction with this meeting, visits were made to developmental laboratories in San Francisco, Palo Alto, and Santa Monica. Ten proposals for research in sensory aids were reviewed for the sponsors and specific recommendations were made.

*Subcommittee on Design and Development*

The ninth meeting of the Subcommittee on Design and Development was held on August 1, 1969, in Santa Monica, Calif. Reports on the activities of the various workshop panels which had held meetings under the aegis of the Subcommittee during the preceding year were presented by the respective chairmen. Further meetings of the panels were scheduled for the ensuing period.

This Subcommittee continued an active program of workshop panels and special events. A new departure during the reporting period was the focusing of attention on special areas of research such as externally powered terminal devices and elbows and the control of these devices. Patients were fitted with currently available hardware and their functional capability and reactions reviewed.

Specific events conducted under the aegis of this Subcommittee were:

*Panel on Upper-Extremity Prosthetics*

The Seventh Workshop Panel on Upper-Extremity Prosthetics was held July 30–31, 1969, in Santa Monica, Calif. The purpose of this meeting was to examine all currently available externally powered terminal devices and to develop a realistic view of the current state of developments in this field. Seven externally powered hands and one externally powered hook were fitted to patients and the outcomes of the fittings evaluated by the Panel as a whole. From this workshop, recommendations emerged concerning future design and development efforts in this area.

The Eighth Workshop Panel on Upper-Extremity Prosthetics was held at Downey, Calif., March 31–April 2, 1970. The purpose of this meeting was to study the *control* of externally powered devices. The results of five experiments involving switch and myoelectric control of powered elbows and terminal devices were reviewed and recommendations for future activity made.

*Workshop on Bracing of Children with Paraplegia Resulting from Spina Bifida and Workshop on Bracing of Children with Cerebral Palsy*

The two workshops were held sequentially at the University of Virginia on October 2–4, 1969. The current state of treatment procedures for these two entities and needed research, particularly in relation to bracing, were discussed. Some novel bracing designs presented at the meeting were recommended for broader applications.

*Panel on Lower-Extremity Prosthetics Fitting*

The Eighth Workshop Panel on Lower-Extremity Prosthetics Fitting was held at Miami Beach, Fla., on December 14, 1969. The prime purpose of this meeting was to assess the current status of above-knee prosthetic fitting techniques. Procedures currently taught by the three prosthetics schools were reviewed together with the current fitting practices in the field. Problems associated with current above-knee fitting techniques were identified and recommendations made for research to resolve these difficulties.

*Panel on Lower-Extremity Orthotics*

The Seventh Workshop Panel on Lower-Extremity Orthotics was held March 9–12, 1970, at Rancho Los Amigos Hospital in Downey, Calif.

At this meeting 19 lower-extremity brace designs were fitted to patients. Most of these designs were recent developments and the majority of the fittings was done by the developers. The effectiveness of the fittings was reviewed by the panel as a whole and recommendations were made for future action with respect to each brace.

#### *Subcommittee on Evaluation*

The project involving the evaluation of synthetic balata to form below-knee sockets directly on the stump was completed early in 1970 and a report prepared.

An evaluation of three adult-sized electric elbows was initiated with a course of training in October 1969. The data-collection phase of this project is now well advanced.

The evaluation of the Veterans Administration Prosthetics Center PTB weight-bearing brace which had been delayed for various reasons was reactivated. This study should be completed early in the next fiscal year.

Evaluation of a number of the lower-extremity orthotic devices and techniques which have emerged from Design and Development is now under consideration.

#### *Subcommittee on Child Prosthetics Problems*

Two meetings of the Subcommittee on Child Prosthetics Problems were held during the reporting period, one on November 3, 1969, and the other on June 11, 1970.

At the November 1969 meeting, an *ad hoc* committee was appointed to study the implications of the proposed expansion of the Subcommittee's activities to include bracing for children. This matter was also discussed with the clinic chiefs in June 1970 and a decision reached for the Subcommittee to undertake evaluation of advanced bracing items through selected clinics.

In association with the June 1970 meeting, the annual Meeting of Child Amputee Clinic Chiefs was held over a 2½ day period. The clinic chiefs' sessions included a symposium on "The Child with an Acquired Amputation." The series of papers presented during this symposium is to be published.

#### *Cooperative Clinical Research Program*

Twenty-nine clinics, specializing in the treatment of the child with limb deficiencies, are now participating in the program which is conducted by the Subcommittee on Child Prosthetics Problems (Fig. 2). Direct contact has been made with some 40 additional centers offering specialized programs in this field. It is anticipated that many of these clinics will join the cooperative program over the next several 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

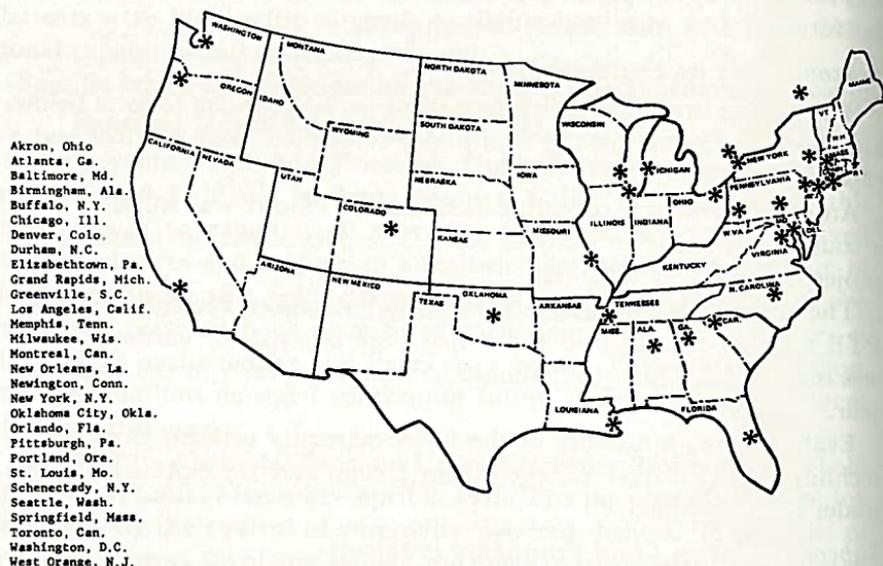


FIGURE 2

*Inter-Clinic Information Bulletin*

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 2400 copies of this bulletin are distributed monthly to physicians, prosthetists, and others interested in the care of the child amputee.

*Monograph on Proximal Femoral Focal Deficiency*

The five papers on proximal femoral focal deficiency which were presented at the Meeting of Child Amputee Clinic Chiefs in 1968 were published during the year. Approximately 1200 copies of this publication have been distributed to interested treatment centers and medical schools.

*Symposium on Surgical and Prosthetic Management of Lower-Extremity Congenital Limb Deficiencies*

Papers on the treatment of lower-extremity anomalies other than PFFD which were presented at the 1969 Clinic Chiefs' Meeting are being prepared for publication.

## Special Meetings and Activities

### *Dysvascular Amputee Seminar*

A postgraduate seminar on "The Dysvascular Amputee—Surgical and Prosthetic Management" was held on December 15-17, 1969, at the Americana Hotel in Miami Beach, Fla. 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.

### *Amputee Management Seminar*

The Kessler Institute for Rehabilitation presented a 2-day seminar on amputee management, April 24–25, 1970. Cochairmen of the event were Henry J. Kessler, M.D., and Knud Jansen, M.D., Chairman of the International Committee on Prosthetics and Orthotics of the International Society for Rehabilitation of the Disabled. The Committee on Prosthetics Research and Development was cosponsor of the seminar, together with the Kessler Institute.

### *Electrical Stimulation of Paralyzed Muscles*

On May 4, 1970, CPRD sponsored a small conference on "Functional Electrical Stimulation" (the stimulation of paralyzed muscles). The purpose of the conference was to determine the status of research in this area and to develop recommendations for future action by sponsoring agencies and research groups. The conference was held at the Texas Institute for Rehabilitation and Research, Houston, Texas, under the chairmanship of Dr. William A. Spencer. All North American research groups active in the functional electrical stimulation field as well as one in Yugoslavia were represented at the meeting.

The conference concluded that functional electrical stimulation was a promising development and warranted continued emphasis and study. A steering committee is to be appointed by CPRD to consider an evaluation program involving the surface electrode system developed at Ljubljana, Yugoslavia.

### *Conference on the Establishment of Bioengineering Centers.*

Under the chairmanship of Dr. Colin A. McLaurin, CPRD conducted a small conference of individuals operating or interested in operating bioengineering research centers. The purpose of the meeting, which was held in Washington, D. C., on June 19–20, 1970, was to discuss the need for bioengineering centers devoted to research involving the neuromusculoskeletal system and criteria for their development. An expanded meeting to include several groups which are preparing plans for model centers will be convened early in the new fiscal year to develop further a proposal for the establishment of such centers.

### ARTIFICIAL LIMBS

During the fiscal year, three issues of *ARTIFICIAL LIMBS* were published. The Spring 1969 issue was distributed in December 1969, the Autumn 1969 issue in May 1970, and the Spring 1970 issue in June 1970.

Articles in the Spring 1969 issue were: "Prosthetics and Orthotics—USA—1969," "Amputations Below the Knee," "Clinical Evaluation of the Engen Plastic Hand Orthosis," "Causes of Death in a Series of 4738 Finnish War Amputees," "The Mechanical Properties of Bone" "Dynamic Structure of the Human Foot," and "The Influence of the Foot-Ankle Complex on the Proximal Skeletal Structures."

The Autumn 1969 issue contained: "Toward a New Professionalism," "Recent Advances in Below-Knee Prosthetics," "The NYU Transparent Socket Fabrication Procedure," "A Method for Location of Prosthetic and Orthotic Knee Joints," "Radiographic Evaluation of Stump-Socket Fit," "Clinical Study of the Application of the PTB Air-Cushion Socket," "Evaluating the Temporary Pylon and Permanent Prosthesis in a Rehabilitation Amputee Clinic," "Fabrication Procedures for the Open-Shoulder Above-Elbow Socket," "Myoelectric Immediate Postsurgical Procedure: A Concept for Fitting the Upper-Extremity Amputee," "A Myoelectrically Controlled Powered Elbow," and "A Feeding Device."

Included in the Spring 1970 issue were: "A Polyproblem," "Limb Prosthetics—1970," "A Material for Direct Forming of Prosthetic Sockets," "Direct Forming of Below-Knee PTB Sockets with a Thermoplastic Material," "Direct Forming of Below-Elbow Sockets," and "Evaluation of Polysar Below-Elbow Fitting Procedures."

#### *Prosthetics-Orthotics Exhibit*

An exhibit prepared cooperatively with the American Orthotic and Prosthetic Association, the Prosthetic and Sensory Aids Service of the VA, and Social and Rehabilitation Service of HEW, which depicts research, development, education, and clinical application of prosthetics and orthotics in North America was shown at the 11th World Congress of the International Society for Rehabilitation of the Disabled in Dublin, Ireland, in September 1969, at the Annual Scientific Assembly of AOPA, Miami Beach in October 1969, and at the American Physical Therapy Association Convention, Washington, D.C., in June 1970.

#### *American Academy of Orthopaedic Surgeons*

The staff continued a strong relationship with the American Academy of Orthopaedic Surgeons through its Committee on Prosthetics and Orthotics. Assistance is being provided in the preparation of a new text on orthotics and the development of a graphical presentation of musculoskeletal disabilities.

*International Activities*

At the request of the Division of International Activities of the Social and Rehabilitation Service, the Assistant Executive Director made return visits to Yugoslavia and Poland in the Summer of 1969. The results of work previously initiated in these countries were reviewed and assistance given in plans for continued research.

The Assistant Executive Director was a program participant at the joint convention assembly of the Canadian Association of Prosthetists and Orthotists, the Conference of Canadian Prosthetics-Orthotics Research Groups, and the Annual Meeting of Canadian Amputee Clinic Chiefs, held at the University of New Brunswick in Fredericton on May 20-22, 1970. This was the first joint meeting of the three groups.

The Executive Director and Assistant Executive Director assisted in the editing of the proceedings of The Third International Symposium on External Control of Human Extremities, held in Dubrovnik, Yugoslavia, August 25-31, 1969.

*Site Visits*

During the fiscal year, the Executive and Assistant Executive Directors made site visits to the Institute of Medical Sciences, San Francisco; Stanford Research Institute and Veterans Hospital, Menlo Park; Rand Corporation, Santa Monica; West Coast Laboratories of Bolt, Beranek and Newman, Van Nuys, Calif.; The Applied Physics Laboratory of the Johns Hopkins University, Silver Spring, Md.; and Moss Rehabilitation Center, Philadelphia, Pa.

The Assistant Executive Director made visits to numerous child amputee centers. Some of these 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: Hospital for Special Surgery and Institute for Rehabilitation Medicine in New York City; Florida Crippled Children's Commission in Tampa and Orlando, Fla.; Gillette State Hospital, St. Paul, Minn.; Children's Orthopedic Hospital, Seattle, Wash.; Shriners Hospital for Crippled Children, San Francisco, Calif.; Children's Hospital, Denver, Col.; Mobile Rehabilitation Center, Mobile, Ala.; Birmingham Child Amputee Clinic, Birmingham, Ala.; Duke University Medical Center, Durham, N.C.; University of Alberta Amputee Clinic, Edmonton, Alta.; and the Ontario Crippled Children's Centre, Toronto, Ont., Canada.

*Proposals Reviewed on Behalf of SRS and VA*

For the Social and Rehabilitation Service the Committee on Prosthetics Research and Development reviewed 27 new and 13 continuation proposals in the fields of prosthetics and orthotics. One application for continuing support of proposed research in prosthetics and other aspects

of rehabilitation was reviewed on behalf of the International Division, SRS. Ten proposals for new and continuation projects in prosthetics and orthotics research were reviewed for the Veterans Administration plus ten proposals for new and continuation projects in sensory aids.

### *Miscellaneous*

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

Close liaison was maintained with the American Orthotic and Prosthetic Association by personal contact and by staff participation in various Association activities.

## **FUTURE PLANNING**

### **General**

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. Particular emphasis will be placed on the development of an enlarged and intensified program in the field of sensory aids. The reorganized and redirected Subcommittee on Sensory Aids established during the current year will be the vehicle for this intensification. Research efforts in orthotics will also be expanded, particularly in the areas of hemiplegia, paraplegia, and quadriplegia, for both adults and children. The solution of problems related to the treatment of specific children's orthopedic disabilities such as myelomeningocele and cerebral palsy which were initiated during the current year will be given continuing attention. Similarly, the initial ventures into spinal orthotics and the bracing of the paralyzed upper extremity initiated during the present year will be continued and intensified.

CPRD will continue its efforts to stimulate research and endeavor to maintain a balanced program; to ensure that the sponsored schools of prosthetics and orthotics, the University Council on Orthotic-Prosthetic Education, and the American Orthotic and Prosthetic Association are promptly informed concerning new developments within the overall program; and to ensure widespread dissemination of information by continuing the 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 a minimum of twice a year for the conduct of ongoing business and receipt of the reports of the standing subcommittees (Child Prosthetics Problems, Design and Development, Evaluation, Fundamental Studies, and Sensory Aids). The active programs of established workshop panels in both design and development and fundamental studies will be continued and a number of special activities conducted.

The first of these special activities will be the events marking the 25th anniversary of the initiation of the artificial limb program in the United States. To mark this occasion, CPRD will hold a series of meetings during the week of October 12, culminated by a public demonstration on October 16, 1970. It is hoped that, in addition to the majority of the key workers in the field, many of those who were formerly associated with the program but are no longer active can be present.

A second activity will be the probable initiation of a program of evaluation on an international basis related to the system of functional electrical stimulation developed in Ljubljana, Yugoslavia, as part of an International Activities Division research project.

A third special activity will be a broad review of current activities and the development of research plans and priorities for the next 3 to 5 years. These projections will be in the areas of fundamental studies, design and development, and evaluation. These plans will supplant the report "Prosthetics and Orthotics" which was prepared in 1966 as a guide for the nationwide program in prosthetics and orthotics research.

A fourth contemplated activity will be a meeting of the chiefs of child amputee clinics participating in the cooperative program sponsored by CPRD which has become a highly successful annual event. The purpose of this meeting is to coordinate the clinical research efforts of the participating clinics and to discuss mutual problems, particularly those related to the management of the child with severe limb deficiencies.

## **PUBLICATIONS**

*Annual Summary Report of Activities for Year Ending June 30, 1969.* (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 1968-1969.)

*Proximal Femoral Focal Deficiency—A Congenital Anomaly*, National Academy of Sciences Publication SBN 309-01734-3. (Proceedings of a symposium held June 13, 1968, under the sponsorship of the Subcommittee on Child Prosthetics Problems.)

*Report of Workshop on Spinal Orthotics*, March 28-29, 1969. (In press.)

*Research in Limb Prosthetics and Orthotics*—Report of an International Conference, April 28—May 2, 1969.

*Report of Meeting of Subcommittee on Child Prosthetics Problems*, May 8, 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. (In preparation.)

*Report of Sixth Workshop Panel on Lower-Extremity Orthotics*, May 22, 1969.

*Report of Seventh Workshop Panel on Upper-Extremity Prosthetics*, July 30-31, 1969.

*Report of Meeting of Subcommittee on Design and Development*, August 1, 1969.

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- 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. (In press.)*
- Report of Meeting of Subcommittee on Sensory Aids, October 24-25, 1969.*
- Report of Meeting of Subcommittee on Child Prosthetics Problems, November 3, 1969.*
- Report of Twentieth Meeting of the Committee on Prosthetics Research and Development, November 4-5, 1969.*
- Report of Workshop on Total Hip Replacement and Skeletal Attachment for External Prostheses, November 6-7, 1969. (In preparation.)*
- Report of Eighth Workshop Panel on Lower-Extremity Prosthetics Fitting, December 14, 1969.*
- Report of Ad Hoc Committee on Children's Orthotics Problems, December 17, 1969.*
- Report of Meeting of Subcommittee on Sensory Aids, March 6-7, 1970.*
- Report of Seventh Workshop Panel on Lower-Extremity Orthotics, March 9-12, 1970.*
- Report of Eighth Workshop Panel on Upper-Extremity Prosthetics, March 31-April 2, 1970. (In preparation.)*
- Report of Twenty-First Meeting of Committee on Prosthetics Research and Development, April 21-22, 1970. (In preparation.)*
- Evaluation of Synthetic Balata for Fabricating Sockets for Below-Knee Amputation Stumps, Report E-3, 1970.*
- Report of Tenth Meeting of Subcommittee on Evaluation, May 12-13, 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. (In preparation.)*
- Inter-Clinic Information Bulletin. (Published monthly for the Subcommittee on Child Prosthetics Problems, 11 issues.)*
- Artificial Limbs, Vol. 13, No. 1, Spring 1969.*
- Artificial Limbs, Vol. 13, No. 2, Autumn 1969.*
- Artificial Limbs, Vol. 14, No. 1, Spring 1970.*
- Artificial Limbs, Vol. 14, No. 2, Autumn 1970. (In preparation.)*

### APPENDIX A

#### Major Projects in the United States Coordinated by the Committee on Prosthetics Research and Development

July 1, 1970

#### PROSTHETICS AND ORTHOTICS

<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>	<i>Sponsoring Agency<sup>b</sup></i>
Army Medical Biomechanical Research Laboratory, Forest Glen, Md. Orlyn Oestereich Fred Leonard	Development of Prosthetic and Orthotic Materials and Devices	U.S. Army

<sup>b</sup> Abbreviations: SRS—Social and Rehabilitation Service, Dept. of Health, Education, and Welfare. VA—Veterans Administration Prosthetic and Sensory Aids Service. MCHS—Maternal and Child Health Service, Dept. of Health, Education, and Welfare.

<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>	<i>Sponsoring Agency</i>
Baylor University, Houston, Tex. Lewis Leavitt	Kinesiological and Quantitative Evaluation of Prosthetic Fit and Gait Analysis in Amputees and Vocational Implications	SRS
California, Univ. of, Los Angeles Harlan Amstutz	Functional Long-Leg Brace Research	SRS
	Prosthetic Orthotic Evaluation Procedures	SRS
John Lyman . . . . .	Fundamental and Applied Re- search Related to the Design and Development of Upper- Extremity Externally Powered Prostheses	VA
	Fundamental Studies of Patient- Prostheses/Orthoses Exter- nally Powered Control Interfaces	SRS
Arthur Moss Yoshio Setoguchi	Child Amputee Prosthetics Project	MCHS
California, Univ. of, San Francisco and Berkeley Charles Radcliffe Howard Eberhart James Morris	Design of Prosthetic and Orthotic Devices and Biomechanical Studies of Locomotion	VA
California, Univ. of, San Francisco Verne 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, Ohio Victor Frankel	Pathomechanics of Disorders of the Locomotor System	SRS

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<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>	<i>Sponsoring Agency</i>
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 Hyatt	Biophysical Evaluation of Healing Bone	SRS
Harvard Medical School, Boston, Mass. Richard Warren	Survey of Lower-Extremity Amputations	VA
Illinois, Univ. of, Chicago Jorge Galante	A Study of Spinal Orthotics in Idiopathic Scoliosis	SRS
Iowa, Univ. of, Iowa City Adrian Flatt	A Clinical Research Study of Congenital Hand Anomalies	MCHS
Iowa State Univ., Ames Allan Potter	Myoelectric Brace Development	SRS
Johns Hopkins Univ., Baltimore, Md. Gerhard Schmeisser Woodrow Seamone	Development and Evaluation of Externally Powered Upper Limb Prosthesis	VA
Louisiana State University, Baton Rouge Eugene Tims	Development of Instrumentation for Insensitive Limbs	SRS
Massachusetts Institute of Technology, Cambridge Igor Paul	Performance Testing of Artificial Joints	SRS
Mauch Laboratories, Dayton, Ohio Hans Mauch	Research and Development in the Field of Artificial Limbs	VA
Miami, Univ. of, Coral Gables, Fla. Augusto Sarmiento	The Development of Functional Methods of Treatment of Tibial, Femoral, and Forearm Fractures	SRS

<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>	<i>Sponsoring Agency</i>
	Evaluation of Prosthetic-Orthotic Devices	SRS
	Study of the Development of Refined Fitting Procedures for Lower-Extremity Orthotics	VA
Michigan, Univ. of, Ann Arbor 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 Asbelle	Lower-Extremity Prosthetic and Orthotic Development	U.S. Navy
New York University, New York 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
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 Fryer Robert Thompson	Demonstration of Prosthetic and Orthotic Devices and/or Techniques	SRS
	Prosthetic-Orthotic Research	VA

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<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>	<i>Sponsoring Agency</i>
Rancho Los Amigos Hospital, Downey, Calif. Donald McNeal	Investigation of Electronic Systems for Neuromuscular Disabilities	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 Institute for Rehabilitation and Research, Houston Thorkild 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 Brand	Study of the Prevention of Deformity in Insensitive Limbs	SRS
Veterans Administration Prosthetics Center, New York, N.Y. Anthony Staros	Research, Development, and Testing of Prosthetic and Orthotic Devices and Techniques	VA
VA Hospital, San Francisco, Calif. Wesley Moore Albert Hall	Study of Below-Knee Amputation for Vascular Insufficiency	VA
VA Hospital, Seattle, Wash. Ernest Burgess Joseph Zettl	Immediate Postoperative Prosthesis Fitting and Ambulation	VA
Virginia, Univ. of Charlottesville Warren Stamp David Lewis	Fitting of Lower-Extremity Prosthetics	SRS

### SENSORY AIDS

<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>	<i>Sponsoring Agency</i>
Albert Einstein College of Medicine, New York N.Y. Herbert G. Vaughan Herbert Schimmel	Electrocortical Prosthesis Feasibility Study	SRS

<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>	<i>Sponsoring Agency</i>
Association for Computing Machinery New York, N.Y. T. D. Sterling	Investigation of Optimum Employment Procedures in Computing (Blind)	SRS
Bionic Instruments, Bala Cynwyd, Pa. Thomas A. Benham J. Malvern Benjamin	Development of Obstacle Detectors for the Blind	VA
Department of Children and Family Services, Springfield, Ill. Thomas J. Murphy	Postural Determinants of the Blind	SRS
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
Haskins Laboratory, New Haven, Conn. Franklin S. Cooper Jane Gaitenby	Research on Audible Outputs of Reading Machines for the Blind	VA
VA Hospital, Hines, Ill. John D. Malamazian Harvey L. Lauer	Clinical Application of Reading and Mobility Aids for the Blind	VA
Maryland, Univ. of, College Park Joseph W. Wiedel Paul A. Groves G. Donald Causey . . .	Tactual Mapping: Design, Production, Reading, and Interpretation	SRS
Earleen Elkins	Development of Improved Techniques for the Analysis of Hearing Aid Performance	VA
Massachusetts Institute of Technology, Cambridge Robert W. Mann	Sensory Aids Development and Evaluation	SRS
Mauch Laboratories, Dayton, Ohio Hans A. Mauch Glendon C. Smith	Development of Personal Reading Machines for the Blind	VA
Michigan, Univ. of, Ann Arbor Geraldine T. Scholl	Vocational Adjustment Followup Study of Groups of Visually Handicapped	SRS

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<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>	<i>Sponsoring Agency</i>
National Accreditation Council for Agencies Serving the Blind and Visually Handicapped, New York, N.Y. 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 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
Northwestern University, Evanston, Ill. Raymond Carhart Wayne O. Olsen	Development of Test Procedures for Evaluation of Binaural Hearing Aids	VA
Puerto Rico, Univ. of, Rio Piedras Carlos Albizu-Miranda	Psychological-Social Factors in the Vocational Rehabilitation of the Blind (Census)	SRS
San Francisco Bay Area Speech and Hearing Society, San Francisco, Calif. George Hospiel	Measurement of Acoustic Parameters for Speech Compression Transportation	SRS

**Projects in the Dominion of Canada which Cooperate Closely with the Overall Program**

<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>
Prosthetics Research and Training Program, Ontario Crippled Children's Centre, Toronto 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

<i>Organization and Responsible Investigator</i>	<i>Major Area(s) of Investigation</i>
Rehabilitation Institute of Montreal, Montreal Maurice Mongeau	Development of Externally Powered Upper- Extremity Prosthetic Devices, with Special Reference to Children
Prosthetics/Orthotics Re- search and Development Unit, Manitoba Re- habilitation Hospital, Winnipeg James Foort	Development of a Variety of Prosthetic Devices with Special Reference to Lower- Extremity Requirements
The University of New Brunswick Bio-Engi- neering Institute, Fredericton R. N. Scott	Orthotics and Prosthetics Systems Research with Special Emphasis on the Employment of Electromyographic Signals as Controls

## APPENDIX B

### SUBCOMMITTEE ON CHILD PROSTHETICS PROBLEMS

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- CLAUDE N. LAMBERT, M.D., 1725 West Harrison Street, Chicago, Illinois 60612
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- COLIN A. McLAURIN, Sc.D., (ex officio) Project Director, Prosthetic Research and Training Unit, Ontario Crippled Children's Centre, 350 Rumsey Road, Toronto 17, Ontario, Canada
- YOSHIO SETOGUCHI, M.D., Medical Director, Child Amputee Prosthetics Project, UCLA Rehabilitation Center, 1000 Veteran Avenue, Los Angeles, California 90024

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- JAMES B. RESWICK, Sc.D., Director, Engineering Design Center, Professor of Mechanical Engineering, Case Western Reserve University, University Circle, Cleveland, Ohio 44106
- ROY SNELSON, Chief Orthotist, Rancho Los Amigos Hospital, Inc., 7601 East Imperial Highway, Downey, California 90242

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- WILLIAM M. BERNSTOCK, Assistant Chief, Research and Development Division, Prosthetics and Sensory Aids Service, Veterans Administration, 252 Seventh Avenue, New York, New York 10001
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(in process of reorganization as of June 30, 1970)

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