# ANNUAL SUMMARY REPORT [a]
# ACTIVITIES FOR YEAR ENDED JUNE 30, 1969

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


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## PURPOSE

The Committee on Prosthetics Research and Development engages in 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.

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Governmental agencies, such as the Veterans Administration, Department of Defense, and several divisions within the Department of Health, Education and Welfare have responsibilities to amputees and other individuals with orthopaedic and sensory disabilities. A number of private foundations also have interests in these fields.

In the areas of artificial limbs, orthopaedic appliances, and sensory aids for the blind and the hard of hearing, the volume of business is insufficient to support extensive research by commercial enterprises. In order to maintain progress commensurate with other technical, medical, and paramedical fields, therefore, it has become necessary for governmental agencies and private foundations to support research and development within their own organizations or by setting up research contracts with universities and industrial organizations, or by utilizing both these means of achieving progress.

Operating within this framework, the Committee on Prosthetics Research and Development seeks to: 1. maintain awareness of developments in all aspects of prosthetics/orthotics and sensory aids; 2. correlate and coordinate research sponsored by the Veterans Administration, Social and Rehabilitation Service, National Institutes of Health, Army, Navy, and others; 3. 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; 4. 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; and 5. provide wide dissemination of the results of the research by the publication of the program journal *Artificial Limbs* and other technical reports.

## ORGANIZATION

The Committee on Prosthetics Research and Development operates under the aegis of the Division of Engineering. Committee membership is drawn from the engineering and medical professions and from other disciplines interested in furthering the development and utilization of prosthetic and orthotic devices and sensory aids. Appointments to the Committee, which are normally for a 3-year period, are made by the Chairman of the Division of Engineering, subject to the approval of the President of the National Academy of Sciences.

Five permanent Subcommittees are used by the Committee on Prosthetics Research and Development in pursuing its objectives: 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 is responsible for the organization of small working panels for the exchange of ideas and the stimulation



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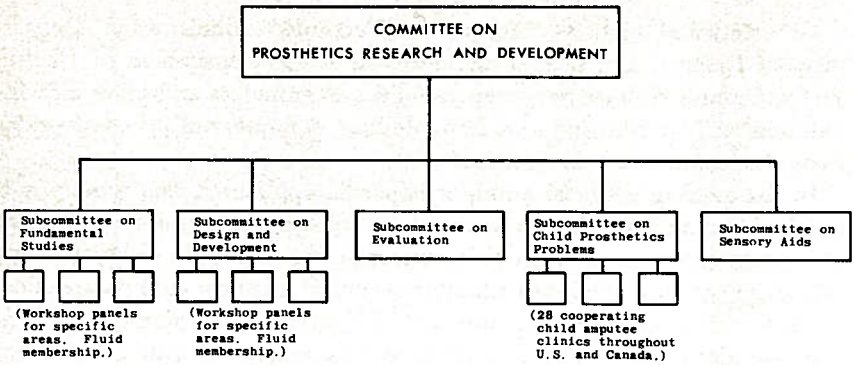


FIGURE 1

of research. These panels focus on specific subject areas and involve persons directly interested in basic studies.

By arranging frequent meetings of groups of persons directly concerned with the design and development of prosthetic and orthotic devices at the working level, the Subcommittee on Design and Development stimulates an active interchange of information and ideas between design and development groups, provides leadership in attacking critical problems, evaluates new ideas and suggestions from the standpoint of engineering feasibility, and encourages the endeavors of competent designers.

Evaluation, always a difficult task, is a major continuing responsibility of the Committee on Prosthetics Research and Development. To enable the Committee to fulfill this responsibility more efficiently, the Subcommittee on Evaluation was created to study evaluation problems in detail in order to advise the Committee concerning the status of specific devices and techniques and to coordinate the activities of laboratories engaged in evaluation.

The Subcommittee on Child Prosthetics Problems stimulates studies and disseminates the results of research in prosthetics for child-amputee patients. Under the auspices of this Subcommittee, the Child Amputee Research Program is carried on through some 28 participating child-amputee clinics. The Subcommittee publishes, through New York University, a monthly *Inter-Clinic Information Bulletin,* the material for which is assembled and edited by the Assistant Executive Director of the Committee on Prosthetics Research and Development.

The Subcommittee on Sensory Aids was created to provide advisory service to interested agencies—governmental and private—concerning the development of sensory aids for the blind and the hard of hearing.

The Committee on Prosthetics Research and Development is served by a a staff of full-time personnel employed by the Academy-Research Council consisting of an executive director, an assistant executive director, a staff engineer, an editorial assistant, an administrative assistant, and a secretary.

## OPERATIONAL CONCEPT

### General

The responsibilities of the Committee on Prosthetics Research and Development are carried out in a variety of ways, depending upon requirements and circumstances. Generally, committee business is conducted by the Committee as a whole and 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.

Problems requiring special or technical knowledge are referred to selected *ad hoc* committees for study and report. Appointments to such *ad hoc* committees are not restricted to the membership of the Committee on Prosthetics Research and Development, but rather members are chosen for their special knowledge of the problem at hand. For such *ad hoc* committee assignments, the Committee on Prosthetics Research and Development has available a large number of persons affiliated with the prosthetics research program who are qualified for appointment and willing to serve.

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

### Governmental Relationships

The Committee on Prosthetics Research and Development is responsible for advisory services through the Academy—Research Council to the Veterans Administration, the Children's Bureau, and the Social and Rehabilitation Service, the last two being agencies of the Department of Health, Education and Welfare. Liaison representatives have been designated by these Government agencies and 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. From time to time individuals from these laboratories 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 countinuing 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, 1968, through June 30, 1969, the Committee on Prosthetics Research and Development continued to advise and assist in the coordination of Government-sponsored and privately sponsored research in the fields of prosthetics, orthotics, and sensory aids. At the request of the sponsoring agencies concerned, the Committee made specific recommendations on 28 proposals for research and development projects, and conducted four site visits.

### CPRD Meetings

The nineteenth meeting of the Committee was held in Washington, D.C., on October 29, 1968. The Committee on Prosthetic-Orthotic Education, the Children's Bureau, the Social and Rehabilitation Service, and the Veterans Administration were represented. Reports were received from each of the subcommittees and from representatives of the sponsoring agencies. Plans for a continuation of activities were made including provision for a number of special events. A comprehensive report of the meeting was prepared and selectively distributed.

### Subcommittee on Fundamental Studies

For a variety of reasons no meetings of the Subcommittee on Fundamental Studies were held during the fiscal year 1968–1969. However, the Subcommittee sponsored a Workshop on Spinal Orthotics held on March 28–29, 1969, in San Francisco. The purpose of the workshop was to define the current status of spinal orthotics with a view to identifying areas of needed research in the field. Among some of the papers presented were those related to biomechanics of the spine, and disc degeneration and herniation as related to low-back pain. A list of recommendations for needed research was formulated.

A special seminar on transcutaneous skeletal attachments is planned for November 6 and 7, 1969. Other special conferences which will be scheduled in the future are related to: 1. human locomotion and 2. the effect of pressure on tissues.

### Subcommittee on Design and Development

No meetings of the Subcommittee per se were held during the fiscal year. However, the workshop panels operating under this Subcommittee were extremely active, as follows:

*Panel on Lower-Extremity Orthotics*

The Sixth Workshop Panel on Lower-Extremity Orthotics was held on May 22, 1969, at Anaheim, Calif. The prime foci of the meeting were the function of the knee joint and attempts to duplicate this function with me-

chanical devices. New ideas concerning the design of knee joints for braces evolved from the meeting.

*Panel on Lower-Extremity Prosthetics Fitting*

On December 16–18, 1968, the Panel on Lower-Extremity Prosthetics Fitting conducted a symposium on below-knee prosthetics at the Veterans Administration Prosthetics Center in New York City. Participating in the symposium were physicians, prosthetists, and engineers prominent in research, education, and clinical application. The primary mission of the symposium was to review and assess current practices and the results of research projects and to make recommendations to the educational programs. At the same time, research currently under way was reveiewed, and recommendations for future work were offered. Two significant outcomes of the meeting were: 1. different methods of fitting the below-knee amputee were interrelated as variants of the patellar-tendon-bearing (PTB) technique (Fig. 2), and 2. the three prosthetics schools agreed to conduct a pilot course at the postgraduate level on the newer fitting procedures in this system.

On March 31, 1969, a workshop on the management of knee-disarticulation and hip-disarticulation amputees was held at the University of California, Berkeley. Current methods of treating patients with amputations at these levels were reviewed and plans made for intensified research efforts to improve practice.

*Panel on Upper-Extremity Prosthetic Components*

The Sixth Workshop Panel on Upper-Extremity Prosthetic Components was held Octoer 21–23, 1968. The program was organized to permit detailed

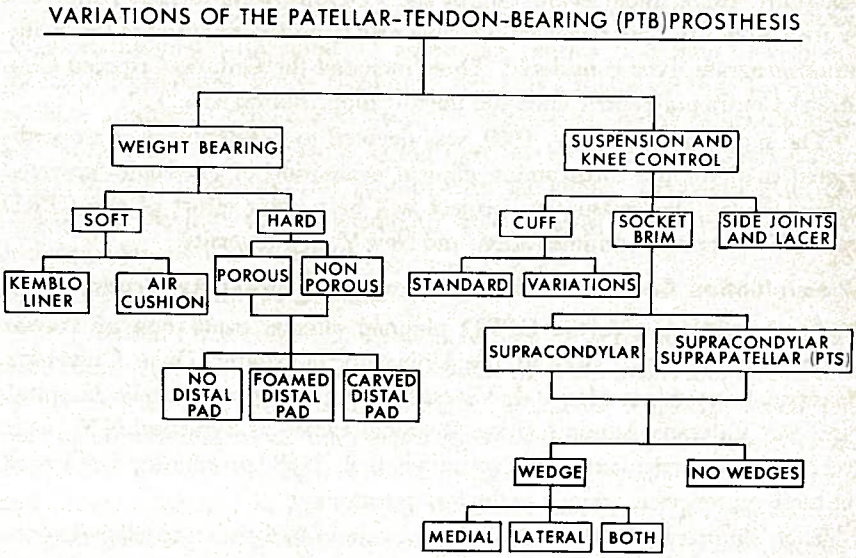


FIGURE 2

examination of seven externally powered elbow systems plus a review of other upper-extremity prosthetic items. Because of the recent acceleration in the development of externally powered components, the panel was charged with the responsibility of expediting their transition into evaluation.

As a result of their deliberations, the panel recommended that a sponsor be sought to fund and supervise the fabrication of an equal number of the Gilmatic electric elbows and AMBRL electric elbows for the purpose of evaluation.

A similar intensive review of externally powered prehension devices is planned. A number of patients have been fitted with currently available devices and the outcomes of these fittings will be examined in July 1969.

### Subcommittee on Evaluation

Meetings of the Subcommittee on Evaluation were held on September 27 and December 7, 1968, and on May 27, 1969.

The September 27th meeting was called for the express purpose of considering a plan for the evaluation of the below-knee fitting technique which uses the moldable plastic Polysar (TM), and employs air pressure to shape the socket. A plan for the evaluation study was developed and five clinical facilities were selected as potential participants in the field fittings.

At the December 7th meeting the results of the pilot study on clinical field evaluations being conducted by CPRD were reported. These results were essentially positive. It was reported that the clinical applications study of Polysar below-knee sockets had been initiated and was proceeding smoothly. Items under evaluation by the Veterans Administration and New York University were reviewed. Possible new items for inclusion in the evaluation program were considered. These included the Ontario Crippled Children's Centre polycentric knee and the so-called "Boston Arm."

The meeting of May 27, 1969, was devoted to development of a coordinated plan for the forthcoming clinical evaluation of externally powered elbow units. This evaluation project will be a joint effort of the CPRD staff, the Veterans Administration, and New York University.

### Preevaluation Course in Polysar Below-Knee Socket Applications

In connection with the CPRD planned clinical evaluation of Polysar below-knee sockets, clinics at the University of Miami, Duke University, Rancho Los Amigos Hospital, Veterans Administration Sawtelle Hospital, and the Veterans Administration Regional Office at Syracuse, N.Y., were recruited as participants. On November 6–8, 1968, prosthetists from each of these centers were trained in the fitting technique.

Each clinic is to fit 10 patients (five new and five satisfied patellar-tendon-bearing prostheses wearers) and keep accurate records of the results.

### Subcommittee on Child Prosthetics Problems

Two meetings of the Subcommittee on Child Prosthetics Problems were held during the reporting period, one on October 28, 1968, and the other on May 7–8, 1969. In conjunction with the second of these sessions, the chiefs of the child amputee clinics participating in the cooperative programs sponsored by the Subcommittee met for a 1½-day program. Major consideration was given at the first meeting to the report of the *Ad Hoc* Committee on the Planning of Specialized Child Amputee Fitting Centers and the possible implementation of the recommendations contained in this report. At the second meeting the purchase of advanced experimental prosthetic components for trial fittings through the clinics was the prime item of business. Additional prospective evaluation projects to be conducted at New York University and through the cooperating clinics were also considered and plans were made for implementation.

At the meeting of the child amputee clinic chiefs, a feature of the program was a symposium on lower limb congenital anomalies at which papers were presented by four outstanding authorities in this field. The proceedings of this symposium will be published during the next fiscal year as a numbered series report of the National Academy of Sciences. An additional highlight of the meeting was the presentation of a series of reports by experts from abroad on the topic "Treatment of the Child with Severe Limb Deficiencies."

### Cooperative Clinical Research Program

Twenty-eight 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. In addition, contact is being maintained with some 32 additional centers that have developed specialized programs for the child amputee. It is anticipated that a number of these additional centers will meet the criteria set by the Subcommittee and will qualify as participants in the next few years. The Assistant Executive Director maintains close contact with the clinics participating in the cooperative program and is frequently able to assist in the establishment and development of new centers.

### Inter-Clinic Information Bulletin

The Assistant Executive Director continued to serve as editor of the publication *Inter-Clinic Information Bulletin*. This magazine, sponsored by the Subcommittee on Child Prosthetics Problems, is now in its eighth year of publication. More than 2,100 copies of each issue are printed and distributed monthly by New York University to physicians, prosthetists, and others interested in the care of the child amputee. This publication is maintained by voluntary contributions of articles by the clinics participating in the cooperative program.

## Monograph on Proximal Femoral Focal Deficiency

The five papers on proximal femoral focal deficiency presented at the 1968 Child Amputee Clinic Chiefs' Meeting were assembled and prepared for publication during the year. At year's end this material was in the publications office and it will be issued as a numbered series report of the National Academy of Sciences.

## Special Meetings and Activities

*Workshop on Fracture Bracing*

A workshop on fracture bracing was held at Duke University on February 28, 1969. Papers on the process of bone healing were presented and reports were received from surgeons participating in research on the effects of early ambulation with cast braces of patients with lower limb fractures. As a result of the meeting, it was recommended that CPRD take steps to initiate a clinical study of the application of orthotics and prosthetics principles to the management of fractures of the long bones.

*Medical Orientation*

On March 3 and 4, 1969, a program entitled "Medical Orientation for Prosthetists, Orthotists, and Engineers" was conducted by Frank W. Clippinger, Jr., M.D., and other members of the faculty of the Medical School at Duke University. Participants included engineers, prosthetists, and orthotists prominent in the prosthetics-orthotics research program.

*Seminar on Orthotics*

The Fifth Annual Post-Graduate Seminar conducted by the Miami University School of Medicine in cooperation with the National Academy of Sciences, the Veterans Administration, and Jackson Memorial Hospital, was held in Florida December 9–11, 1968. The major portion of the program was devoted to orthotics, with one morning spent reviewing the latest techniques of immediate postsurgical fitting of prostheses. Individuals deeply involved in research and clinical practice in these areas comprised the faculty.

*American Academy of Orthopaedic Surgeons*

The Executive Director maintained liaison with the Committee on Prosthetics and Orthotics of the American Academy of Orthopaedic Surgeons. In several meetings conducted during the reporting period, the Committee developed a system for the biomechanical definition of muscular skeletal disability and recommended a field evaluation of the system which could eventually be extremely useful in education and research and in everyday practice.

*Artificial Limbs*

The Autumn 1967 issue of the program journal *Artificial Limbs* was distributed in July 1968. The Spring 1968 issue went out in October 1968,

and the Autumn 1968 issue was distributed in February 1969. The Spring 1969 issue was assembled and sent to the printer in June 1969 for publication.

Significant articles in the published issues were: "External Power in Prosthetics and Orthotics, an Overview;" "The Application of Prosthetics-Orthotics Principles to Treatment of Fractures;" "The Geriatric Amputee;" "The Acceptance and Rejection of Prostheses by Children with Multiple Congenital Limb Deformities;" and two articles on the immediate postsurgical prosthetics fitting of upper-extremity amputees. Featured in the Spring 1969 issue are articles on "Amputations Below the Knee," "The Mechanical Properties of Bone," "Dynamic Structure of the Human Foot," and "The Influence of the Foot-Ankle Complex on the Proximal Skeletal Structures."

*Human Limbs and Their Substitutes*

Hafner Press has announced that the reprint edition of *Human Limbs and Their Substitutes* is now available. The reprint edition is a reproduction of the original publication except for the addition of a foreword by the Chairman of the Committee on Prosthetics Research and Development and a bibliography prepared by the Executive Director.

*International Conference on Research in Limb Prosthetics and Orthotics*

The International Conference on Research in Limb Prosthetics and Orthotics was held during the week of April 28, 1969. A total of 60 individuals participated, including 30 research leaders from 18 foreign countries. The status of research in the subject fields was intensively reviewed and recommendations made for future work. A full report on the conference is in preparation.

*International Activities*

At the request of the Office of International Activities of the Social and Rehabilitation Service, the Assistant Executive Director made a return visit to Yugoslavia in October 1968 to review the results of work previously initiated in that country and to assist in developing procedures for continued research. The Assistant Executive Director has been invited to serve again as a consultant in Yugoslavia and Poland by the Office of International Activities during the summer of 1969.

On August 14, 1968, the Committee on the North American Prosthetics and Orthotics Exhibit of the International Society for Rehabilitation of the Disabled, of which the Executive Director is Chairman, met in Washington, D.C. This exhibit will be displayed at the Eleventh World Congress of ISRD to be held in Dublin, Ireland, September 14–19, 1969, and at other select locations. A further meeting of the committee on exhibits was held in New York City, November 8, 1968, for continuation of planning. A portion of the general exhibit will be designed for use in the recruitment of students in prosthetics and orthotics.

The Executive Director served as a faculty member for the seminar "Priorities in Prosthetic and Orthotic Practice," held in Dundee, Scotland, June 16–20, 1969. He was also asked to serve on the organizing committee for the Third International Symposium on External Control of Upper Extremities, to be sponsored by the Yugoslav Committee for Electronics and Automation. This symposium will be held in Yugoslavia in August 1969.

The Executive Director also served as editor of an issue of *Prosthetics International,* the publication of the International Committee on Prosthetics and Orthotics of ISRD, devoted to immediate postsurgical fitting of prostheses.

*Site Visits*

The Assistant Executive Director made two site visits to the child amputee clinic at Shriners Hospital for Crippled Children, Portland, Oreg. This clinic has made application to become a participant in the cooperative program sponsored by the Subcommittee on Child Prosthetics Problems and has been accepted.

Visits were also made to child amputee clinics at Massachusetts General Hospital, and Children's Hospital in Boston; Shriners Hospitals in Philadelphia and Minneapolis; Gillette State Hospital in St. Paul; and Children's Hospital in Milwaukee. All these clinics are prospective future participants in the cooperative program.

*Proposals Reviewed on Behalf of SRS and VA*

For the Social and Rehabilitation Service the Committee on Prosthetics Research and Development reviewed 14 new and nine continuation proposals in the field of prosthetics and orthotics and five new proposals relating to research in sensory aids. Five applications for support of proposed research in prosthetics were reviewed on behalf of the International Division, SRS. Eight proposals for new and continuation projects in prosthetics and orthotics research were reviewed for the Veterans Administration.

*Miscellaneous*

The staff responded to over 1,000 requests for publications or technical information. Close liaison was maintained with the American Orthotic and Prosthetic Association by personal contact and staff participation in various Association activities.

## FUTURE PLANNING

### General

The Committee on Prosthetics Research and Development proposes to continue its endeavors in the coordination and correlation of governmentally and privately sponsored research projects in the fields of prosthetics, orthotics, and sensory aids. Particular attention will be given in the forthcoming year

to bringing about a more active and better organized program in the field of sensory aids and to expanding the research efforts being made in orthotics. CPRD proposes to continue its efforts to stimulate research and maintain a balanced program in these areas; to ensure that the sponsored prosthetics and orthotics education schools, the University Council on Orthotic-Prosthetic Education, and the American Orthotic and Prosthetic Association are promptly informed concerning new developments within the program; and to ensure widespread dissemination of information by continued publication of *Artificial Limbs,* the *Inter-Clinic Information Bulletin,* and appropriate special reports.

In addition to the continuance of the ongoing program of established subcommittees and panels, as described in this report, the Committee proposes a number of special activities during the forthcoming year. The first of these would be a conference on prosthetics and orthotics research which would be a followup of the International Conference held April 28—May 2, 1969, as well as the highly successful Conference on Prosthetics and Orthotics held in Washington, D.C., December 12–13, 1966. At this conference it is proposed that a broad overview of current activities be taken and plans made for the succeeding 3 to 5 years. The second would be a meeting of chiefs of child amputee clinics participating in the cooperative program sponsored by CPRD, which has become an 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. The third in this special series of events planned for fiscal year 1969–70 involves the exhibit on prosthetics and orthotics which is currently being prepared. It is proposed that this exhibit be displayed at the Eleventh International Congress of the International Society for Rehabilitation of the Disabled in Dublin, Ireland, September 1969; the Annual Assembly of the American Academy of Orthopaedic Surgeons in Chicago, Ill., January 1970; the President's Committee on Employment of the Handicapped Meeting in Washington in May 1970; and the Meeting of the American Physical Therapy Association, also in Washington in June 1970.

Special meetings to be held under the aegis of the Subcommittee on Fundamental Studies will include one on human locomotion and another on the effects of pressures and shears on human tissues.

## PUBLICATIONS

*Annual Summary Report of Activities for Year Ending June 30, 1968.* (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 1967–1968.)

*Report of Meeting of Subcommittee on Fundamental Studies,* May 27, 1968.

*Report of Workshop on Pressure and Force Measurement,* May 27–28, 1968.

*Report of Eighteenth Meeting of Committee on Prosthetics Research and Development,* June 12, 1968.

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

*Report of Meeting of Subcommittee on Evaluation,* September 27, 1968.

*Report of Workshop Panel on Upper-Extremity Prosthetic Components,* October 21–23, 1968.

*Report of Meeting of Subcommittee on Child Prosthetics Problems,* October 28, 1968.

*Sensory Aids for the Blind,* National Academy of Sciences Publication No. 1691. (Report of a Conference held March 30–31, 1967, under the sponsorship of the Committee on Prosthetics Research and Development.)

*Report of Nineteenth Meeting of Committee on Prosthetics Research and Development,* October 29, 1968.

*Report of Meeting of Subcommittee on Evaluation,* December 7, 1968.

*Report of a Symposium on Below-Knee Prosthetics,* December 16–18, 1968.

*Report of Workshop on Fracture Bracing,* February 28—March 1, 1969.

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

*Report of Workshop on Knee-Disarticulation and Hip-Disarticulation Prostheses,* March 31, 1969.

*Clinical Evaluation of Prosthetic and Orthotic Devices and Techniques,* a pilot program under the sponsorship of the Committee on Prosthetics Research and Development, Report E–1, 1969.

*Report of Meeting of Subcommittee on Child Prosthetics Problems,* May 8, 1969. (In preparation.)

*Congenital Defects of the Lower Limbs—Surgical and Prosthetics Management,* National Academy of Sciences Numbered Publication. (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. (In preparation.)

*Report of Meeting of Subcommittee on Evaluation,* May 27, 1969.

*Inter-Clinic Information Bulletin.* (Monthly publication of the Subcommittee on Child Prosthetics Problems, 12 issues.)

*Artificial Limbs,* Vol. 12, No. 1, Spring 1968.

*Artificial Limbs,* Vol. 12, No. 2, Autumn 1968.

*Artificial Limbs,* Vol. 13, No. 1, Spring 1969. (In press.)

## Appendix A

## PARTICIPATING AND COOPERATING PROJECTS

## PROSTHETICS AND ORTHOTICS

(Listed below are major projects in the United States coordinated by the Committee on Prosthetics Research and Development)

| *Organization and principal investigator* | *Major area (or areas) of investigation* | *Sponsoring agency* |
|---|---|---|
| Albert Einstein College of Medicine, New York City— Richard M. Herman. | Neuromotor Control Systems.... | SRS. |
| Army Medical Biomechanical Research Laboratory, Washington, D.C.— Orlyn Oestereich. Fred Leonard. | Development of Prosthetic and Orthotic Materials and Devices. | U.S. Army. |
| Attending Staff Association of the Rancho Los Amigos Hospital, Downey, Calif.— Vert Mooney. | Application of Orthotic Devices in the Treatment of Lower-Extremity Fractures and Degenerative Arthritis. | SRS. |
| Worden Waring..... | Investigation of Myoelectric Control of Functional Braces. | SRS. |
| Baylor University, Houston—Lewis A. Leavitt. | Evaluation of Fit and Analysis of Gait of Lower-Extremity Amputees. | SRS. |
| California, University of, San Francisco and Berkeley, Biomechanics Laboratory— Verne T. Inman. | Dual-Axis Ankle Control System. | SRS. |
| | Electrical Stimulation of Afferent Fibers as a Means of Reducing Spasticity. | SRS. |

| *Organization and principal investigator* | *Major area (or areas) of investigation* | *Sponsoring agency* |
|---|---|---|
| H. J. Ralston | Dynamics of the Human Body During Locomotion. | SRS. |
| Charles W. Radcliffe. Howard D. Eberhart. James M. Morris. | Design of Prosthetic and Orthotic Devices, including Spinal Braces, and Biomechanical Studies of the Lower Extremities. | VA. |
| California, University of, Los Angeles, Biotechnology Laboratory—John Lyman. | Fundamental and Applied Research Related to the Design and Development of Upper-Extremity Externally Powered Prostheses. | VA, SRS. |
| California, University of, Los Angeles, School of Medicine—Charles O. Bechtol. | Functional Long-Leg Brace | SRS. |
| | Endoskeletal Upper-Extremity Prosthesis. | SRS. |
| California, University of, Los Angeles, Child Amputee Prosthetics Project—Charles O. Bechtol. Yoshio Setoguchi. | An Interdisciplinary Research, Teaching, and Service Program in the Management of the Child Amputee. | CB. |
| Case Western Reserve University, Cleveland—James B. Reswick. | Biomedical Research on Cybernetic Systems for the Disabled. | SRS. |
| Victor H. Frankel | Pathomechanics of Disorders of the Locomotor System. | SRS. |
| Charles Long, II | Basic and Clinical Study of Normal and Abnormal Human Motion. | SRS. |
| Olgierd Lindan | Application of Medical Engineering to Patient Care and Rehabilitation. | SRS. |

| *Organization and principal investigator* | *Major area (or areas) of investigation* | *Sponsoring agency* |
|---|---|---|
| Duke University Medical Center, Durham, N.C.— J. Leonard Goldner. Edward A. Kiessling. | Development and Evaluation of Pneumatic Prostheses. | CB, SRS. |
| Emory University, Atlanta, Georgia— Martin B. Ewing. | Radiographic Study of Hip Dysplasia in Cerebral Palsy. | CB. |
| Esslinger, John O., Birmingham, Mich. | Skeletal Attachments of Prostheses. | VA. |
| Georgetown University, Washington, D.C.— George W. Hyatt. | Biophysical Evaluation of Healing Bone. | SRS. |
| Gilmatic, Northridge, Calif.— Gilbert M. Motis. | Development of Upper-Extremity Prosthetic Components. | VA. |
| Harvard University, Boston-- Richard Warren. | Survey of Lower-Extremity Amputations for Ischemia. | VA. |
| Illinois, University of, Medical School, Chicago— Jorge Galante. | A Study of Spinal Orthotics in Idiopathic Scoliosis. | SRS. |
| Iowa State University, Ames, Iowa— Alan G. Potter. | Development of a Myoelectrically Controlled Brace for the Hand. | SRS. |
| Iowa, University of, Iowa City, Iowa— Adrian Ede Flatt. | A Clinical Research Study of Congenital Hand Anomalies. | CB. |
| Maryland, University of, Baltimore— Fred Gornick. | Electrochemical Muscle Studies. | SRS. |

| *Organization and principal investigator* | *Major area (or areas) of investigation* | *Sponsoring agency* |
|---|---|---|
| Massachusetts Institute of Technology, Boston—Robert W. Mann. | Development of a Myographically Controlled Artificial Arm. | SRS and Liberty Mutual Ins. Co. |
| Mauch Laboratories, Inc., Dayton, Ohio—Hans A. Mauch. | Research and Development in Lower-Extremity Prosthetic Devices. | VA. |
| Miami, University of, Coral Gables, Florida—Augusto Sarmiento. | The Development of Functional Methods of Treatment of Tibial, Femoral, and Forearm Fractures. | SRS. |
| Michigan, University of, Ann Arbor, Mich.—James W. Rae, Jr. | Biomedical Engineering in Physical Rehabilitation. | SRS. |
| Michigan, University of, School of Public Health, Ann Arbor, Michigan—Ned Sharples. | Disability Outcomes and Antecedents. | CB. |
| Michigan Crippled Children Commission—George T. Aitken. Charles H. Frantz. | Clinical Testing of Prosthetic Devices and Techniques for Child Amputees; and the Development of Improved Clinical Management Procedures. | CB. |
| Moss Rehabilitation Center, Philadelphia—Leonard D. Policoff. | Biomedical Engineering Research and Development. | SRS. |
| Navy Prosthetics Research Laboratory (U.S. Naval Hospital, Oakland, Calif.)—D. W. Rohen. | Immediate Postsurgical Fitting of Prostheses; and Lower-Extremity Prosthetic and Orthotic Development. | U.S. Navy. |

| *Organization and principal investigator* | *Major area (or areas) of investigation* | *Sponsoring agency* |
|---|---|---|
| New York University Medical Center—Richard Lehneis. | Bioengineering Design and Development of Lower-Extremity Orthotic Devices. | SRS. |
| Ralph Lusskin..... | Control of Adventitious Bone Formation With Plastic Implants. | SRS. |
| New York University, School of Engineering and Science, Research Division, Prosthetic Devices Study—Renato Contini. | Determination of the Pressure Distribution Between Lower-Extremity Sockets and Stumps. | VA. |
| | Body Segment Parameters..... | SRS. |
| New York University, Post-Graduate Medical School, Prosthetic and Orthotic Studies—Sidney Fishman. Walter A. L. Thompson. | Development of Devices and Techniques to Facilitate Diagnosis of Problems and Improve Fitting of Lower-Extremity Prostheses and Orthoses. | SRS. |
| Sidney Fishman..... | Evaluation of Prosthetic Devices and Techniques for Child Amputees. | CB. |
| Northwestern University Prosthetic Research Center, Chicago—Robert G. Thompson. | Design and Development of Devices and Techniques for the Improvement of Prosthetic Practices, Especially for Geriatric and Problem Cases. | VA. |
| Northwestern University Prosthetics-Orthotics Program, Chicago—Charles M. Fryer. | Evaluation of Orthotic Devices... | SRS. |
| Pennsylvania State University, Univ. Park, Pa.—Chauncey A. Morehouse. | Evaluation of Knee Stability and Its Relationship to Knee Injuries. | SRS. |



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| *Organization and principal investigator* | *Major area (or areas) of investigation* | *Sponsoring agency* |
|---|---|---|
| Prosthetics Research Study, Seattle— Ernest M. Burgess. Joseph H. Zettl. Robert L. Romano. | Immediate Postsurgical Prosthesis Fitting and Ambulation. | VA. |
| Rochester, University of, Rochester, New York— Robert C. Dickerson. | Effectiveness of Treatment for Orthopedic Conditions of Childhood. | CB. |
| Texas Institute for Rehabilitation and Research, Houston— Thorkild J. Engen. | Research Developments of Lower-Extremity Orthotic Systems as They Relate to Patients with Various Functional Deficits. | SRS. |
| Carlos Vallbona | Evaluation of a Reduced Gravity Simulator for Early Ambulation of the Disabled. | SRS. |
| Veterans Administration Hospital, San Francisco— Wesley S. Moore. Albert D. Hall. | Study of Below-Knee Amputation for Vascular Insufficiency. | VA. |
| Veterans Administration Prosthetics Center, New York City— Anthony Staros. | Research, Development, and Testing of Prosthetic and Orthotic Devices and Techniques. | VA. |
| Virginia, University of, Charlottesville, Va.— David W. Lewis. | Evaluation of Pressure Distribution between Stump and Socket in Lower-Extremity Prosthetics. | SRS. |
| Yale University School of Medicine, New Haven, Conn.— Wayne O. Southwick. | Factors Influencing Rehabilitation of Elderly Patients Having Hip Surgery. | SRS. |

| *Organization and principal investigator* | *Major area (or areas) of investigation* | *Sponsoring agency* |
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(Listed below are projects in the Dominion of Canada which cooperate closely with the overall program)

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|---|---|
| Prosthetic Research and Training Program, Ontario Crippled Children's Centre— Colin A. McLaurin. | Development of a Wide Variety of Upper-Extremity and Lower-Extremity Body-Powered and Externally Powered Prosthetic and Orthotic Devices for Children. |
| Rehabilitation Institute of Montreal— Maurice Mongeau. | Development of Externally Powered Upper-Extremity Prosthetic Devices, with Special Reference to Children. |
| Prosthetics/Orthotics Research and Development Unit, Manitoba Rehabilitation Hospital— James Foort. | Development of a Variety of Prosthetic Devices with Special Reference to Lower-Extremity Requirements. |
| The University of New Brunswick Bio-Engineering Institute— R. N. Scott. | Orthotics and Prosthetics Systems Research with Special Emphasis on the Employment of Electromyographic Signals as Controls. |

## SENSORY AIDS

| *Organization and principal investigator* | *Major area (or areas) of investigation* | *Sponsoring agency* |
|---|---|---|
| Albert Einstein College of Medicine, New York City— Herbert G. Vaughan. Herbert Schimmel. | Feasibility Studies: Electrocortical Prothesis. | SRS. |
| American Center for Research in Blindness and Rehabilitation, Newton, Mass.— Leo H. Riley. Ruth Morris. | Clinical Determination of Performance Attainable by Blind Individuals with the Battelle Optophone. | VA. |
| | Evaluation of the Ultrasonic Aid for the Blind. | VA. |

| *Organization and principal investigator* | *Major area (or areas) of investigation* | *Sponsoring agency* |
|---|---|---|
| Bionic Instruments, Inc., Bala Cynwyd, Pa.— Thomas A. Benham. J. Malvern Benjamin. | Improvement of Mobility Aids for the Blind. | VA. |
| Haskins Laboratories, Inc. New York City— Franklin S. Cooper. Jane Gaitenby. | Fundamental Studies of Speech and Speechlike Sounds as Outputs for Various Types of Reading Machines for the Blind. | VA. |
| Institute of Medical Sciences, San Francisco— Paul Bach-y-Rita. | Tactile Television System..... | SRS. |
| Massachusetts Institute of Technology, Center for Sensory Aids Evaluation and Development— Robert W. Mann. | Evaluation of a Wide Variety of Devices from the Very Simple to the Very Complex. | SRS. |
| Mauch Laboratories, Inc., Dayton, Ohio— Hans A. Mauch. Glendon C. Smith. | Further Development of the Mauch Personal-Type Reading Machine for the Blind. | VA. |
| New York Medical College— Stanley Taub. | Development of a Removable Prosthetic Larynx. | SRS. |
| Stanford Research Institute, Menlo Park, Calif.— James Bliss. | Optical to Tactical Image Converter for the Blind. | SRS. |

## Appendix B

### SUBCOMMITTEE ON CHILD PROSTHETICS PROBLEMS

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