

## HIGHLIGHTS OF OTHER VA RESEARCH PROGRAMS

### PROSTHETICS

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#### **John O. Esslinger, M.D. Birmingham, Michigan**

In February 1968, a manuscript was submitted for publication in *Orthopaedics and Related Research* covering the years since 1952 when the project on "semi-buried implants for the attachment of external prostheses" was conceived.

Two new studies began on the modified Teflon bone plug, and they are presently being followed. Some personnel from the Metallurgy Department of the Ford Motor Company were met with to discuss the development of a procedure which would make it possible to examine soft tissue in which Vitallium wire screening had been inbedded. Since Vitallium is such a hard metal it was necessary to mount the specimens in epoxy resins. This will hopefully enable the people at Ford to obtain sections using their diamond knife microtome. The sections will then be stained and photomicrographs obtained.

#### **Gilmatic, Northridge, California Gilbert M. Motis**

Major activities have concerned the Solenoid elbow lock and its switch involvements. Now a "pad" type switch is available which may be placed into the socket for muscle operation. Because of its construction, it is not necessary to alter the socket in any way. The switch may be installed on a trial basis in the area of the biceps muscle and moved about until the operating results are satisfactory to the amputee.

The switch operates a relay delay system so that continuous switch contact adjusts the system to a low current drain to save battery consumption. A battery charger, also a part of the system, permits the amputee to "plug-in" at night to restore the battery. A complete unit was sent to the Bioengineering Research Service of the VA Prosthetics Center for evaluation.

The "Extendo-flex" unit is now being machined for tests on three amputees and will be available soon.

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A motor-driven elbow unit is now in process to provide two field test models. These will duplicate the bench model which was successful on all load and current drain tests.

**Mauch Laboratories, Inc., Dayton, Ohio**  
**Hans A. Mauch**

The clinical tests of the Swing and Stance Control System for above-knee amputees have been continued with generally favorable results. The causes for the oil contamination revealed in these tests were isolated, and remedies were found. A recirculation program for the correction of the systems involved was started in November 1967 and is 60 percent complete.

In preparation for the first production run of the Swing and Stance Control System, an effort is underway to eliminate whatever minor shortcomings have become known from the clinical tests and from other systems returned to the developer for checkups.

A wooden setup for this hydraulic knee system, which comes closer to established commercial designs than the present setup and which is still strong enough for the high stresses encountered with a stance control system, has been developed. It employs a modified geometry for the kinematics of the hydraulic system which will provide a number of benefits for the dynamics of walking and stair descent. It will also permit shortening of the hydraulic system by 1 in. which improves cosmesis of the shank. Amputee testing of one prototype has been underway since January 1968 with very good results. The expected benefits have been confirmed. Two setups with shortened hydraulic systems will be shipped to the Veterans Administration in New York for additional testing in April 1968.

All the preliminary work for the production prototype Hydraulic Ankle was completed in December 1967. Trial assemblies and bench tests indicated that all principal design goals have been achieved. Amputee tests carried out in January 1968 had very satisfactory results, but additional bench tests and investigations revealed the need for further improvements, particularly regarding better toe-slap damping and speedier return of the plantar-flexed foot after toe-off. A number of design changes were introduced and tested during February and March with generally satisfactory results. It appears now that parts for shakedown test units can be ordered at the end of April or the beginning of May 1968.

**National Academy of Sciences-National Research Council**  
**Washington, D.C.**

**Herbert Eftman, Ph. D.**

During the period from September 1, 1967, through March 31, 1968, the Committee on Prosthetics Research and Development continued to advise and assist in the coordination of prosthetics and orthotics research sponsored by both governmental and private agencies. At the request of

the sponsoring agencies concerned, the Committee made specific recommendations on 29 proposals for research and development projects and conducted three site visits.

Major activities were:

### *CPRD Meeting*

The seventeenth meeting of the Committee was held at the National Academy of Sciences, Washington, D.C., on October 21, 1967. All members and two past members were present. Liaison representatives from the Children's Bureau, the Social and Rehabilitation Service, and the Veterans Administration participated in the meeting. The work of the previous year was reviewed in detail, and recommendations for future activities were made. A comprehensive report was prepared, and 37 copies were distributed.

### *Workshop on the Human Foot and Ankle*

In keeping with its major purpose of renewing familiarity with work that has been done in basic research and stimulating investigations in areas where knowledge is limited or lacking, the Subcommittee on Fundamental Studies conducted a Workshop on the Human Foot and Ankle in Boston, Mass., March 1-2, 1968. There were some 30 participants. It was hoped that the workshop, the first to be sponsored by the recently established Subcommittee on Fundamental Studies, would set a pattern for other workshops to follow. Hoped-for outcomes of such workshops are documents calling attention to gaps in present knowledge and delineating specific problems where research is required. At the workshop in Boston, major presentations were made on the Mechanical Properties of Cartilage, the Biomechanics of the Foot and Ankle, and the Influence of the Foot-Ankle Complex on the Proximal Skeletal Structure. Three adult and three child cases were considered and discussed in detail. In addition, consideration was given to a method of treating tibial fractures by the application of a cast permitting freedom of motion.

### *Subcommittee on Design and Development*

The seventh meeting of the Subcommittee on Design and Development was held in Washington, D.C., on October 20, 1967. The work of the various panels sponsored by the Subcommittee was reviewed. It was thought that it would be desirable to hold future meetings of the Subcommittee at least three or four times per year, at major research and development centers.

### *Panel on Lower-Extremity Prosthetics Fitting*

The Panel on Lower-Extremity Prosthetics Fitting held its seventh meeting at Rancho Los Amigos on January 6, 1968. Major topics considered were air-cushion sockets, patellar-tendon supracondylar sockets. Münster below-knee sockets, pressure studies, alignment studies, fluid-lined sockets, the direct

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forming of sockets, transparent sockets, and the fitting of knee-disarticulation cases. Informal commitments were made by individual panelists to carry on further work with specific items.

### *Panel on Lower-Extremity Prosthetics Components*

The Panel on Lower-Extremity Prosthetics Components held its third meeting in Miami Beach, Fla., December 17, 1967. Major topics considered by the panelists were foot-ankle units, torque absorption units, modular construction, components for immediate postsurgical fitting, cosmetic covers, knee devices, prostheses for hip-disarticulation and hemipelvectomy cases, and the "get it into production" problem.

### *International Activities*

At its meeting during October 1967, the Committee on Prosthetics Research and Development decided to participate with the Veterans Administration and the Social and Rehabilitation Service in organizing an exhibit for the XI World Conference of the International Society for Rehabilitation of the Disabled to be held in Dublin during 1969.

At the request of the Social and Rehabilitation Service, the Assistant Executive Director departed from the United States on March 17, 1968, to participate for some 6 weeks in a prosthetics evaluation study in Yugoslavia. Following this, he will visit prosthetics research and development centers in Poland, Germany, and the United Kingdom.

### *Prosthetics and Orthotics*

*Prosthetics and Orthotics*, the report of a Conference held under the sponsorship of the Committee on Prosthetics Research and Development during December 1966, appeared as an unnumbered National Academy of Sciences publication during 1967. This 41-page publication has had to be reprinted because of widespread demand. The Conference reported on was held at the request of the Vocational Rehabilitation Administration for the purpose of developing information for use in planning research and development activities in prosthetics and orthotics for the next 5 years and longer.

### *Artificial Limbs*

The Autumn 1966 issue of the Journal *Artificial Limbs* was distributed during October 1967, and the Spring 1967 issue was distributed during March 1968. The manuscript for the Autumn 1967 issue was sent to the printer during March 1968. Material for the Spring 1968 issue is being assembled.

The Spring 1967 issue contains an article entitled "Limb Prosthetics—1967" by the Executive Director. This article is an updated version of "Limb Prosthetics Today" which appeared originally in *Artificial Limbs* for Autumn 1963. This article was reprinted in *Physical Therapy* and in the Danish *Journal of Physical Therapy*, soon after it appeared in *Artificial Limbs*, and

the printers of *Artificial Limbs* received orders for about 15,000 reprints.

Orders for more than 10,000 copies of the reprint of the revised version have already been given by the prosthetics schools, the American Orthotic and Prosthetic Association, and the Committee on Prosthetic-Orthotic Education.

### *Demonstration*

The staff of the Committee on Prosthetics Research and Development arranged for a demonstration of the fabrication of transparent experimental sockets for research groups interested in such a technique. The demonstration was conducted by personnel of the Army Medical Biomechanical Research Laboratory who developed the method.

### *Visit to the University of Utah*

At the request of the Advanced Research Projects Agency's project at the University of Utah, an *ad hoc* committee visited the group on February 27, 1968, in order to advise them concerning the application of newly developed computer techniques in prosthetics and orthotics research and development.

### *Liaison with AEC*

Liaison was effected with the Atomic Energy Commission, who requested assistance in finding new uses for a recently developed steel with unusual qualities. Engineering drawings of parts that might be improved by use of the new steel were forwarded to the AEC for fabrication of parts for testing. One set of parts is now being tested.

### *Thermography*

The CPRD made arrangements for two groups of research personnel to visit Barnes Engineering Corporation, Stamford, Conn., to explore the feasibility of employing special heat-measuring equipment (Barnes Thermograph) in prosthetics and orthotics research.

### *Report from Yugoslavia*

The Executive Director assisted in the editorial work for "External Control of Human Extremities," a report of an international symposium sponsored by the Yugoslav Committee for Electronics and Automation held in 1966, and published under the International Program of SRS.

### **New York University, New York**

#### **Renato Contini**

A program of test socket modifications has been instituted. The initial phase of this program consisted of permanent modification to the brim of two sockets in an effort to measure brim pressure as a function of contour. The medial region of the brims was built up approximately  $\frac{1}{16}$  in. This area was chosen since one subject consistently produces high pressures on the ramus (30 to 50 p.s.i.) while those of a second subject are relatively low

(below 10 p.s.i.). Apparently this modification had no large effect on the pressures, local or otherwise. The baseline data used for comparison had been collected some weeks earlier.

The fabrication of a series of removable contoured shims is planned. These shims will be designed to fit over the original brim and will blend into adjacent areas so as to present smooth and unbroken surfaces to the stump tissue. The shims will permit the comparison of pressure data resulting from several configurations. These data will be collected during the same test period rather than several consecutive days or weeks. (Variations in pressure on a daily, weekly, and monthly basis were discussed in the preliminary report on this study, published in BPR 10-8 Fall 1967.)

A modification to the distal end of one socket is about to be tested. The extent of the modification was determined by injecting a foam-in-place Silicone rubber through the valve insert. The result is a cast of the excess space or relief provided at the distal end of the socket. This soft cast has been duplicated using a hard casting epoxy. This removable duplicate will be smoothed and blended into the socket walls. Duplicate tests will be run on the same day to determine the effects of this modification.

A series of bench tests have shown that the transducers being used are sensitive only to pressures or forces which act perpendicular to the face of the diaphragm, or the piston. Shear or slippage at and parallel to the socket wall has no effect on the outputs of the transducers. The output of the transducer with the flush diaphragm varies markedly when sampling a large or discontinuous pressure gradient. Since the stumps of above-knee amputees are fleshy, there is no reason to question the data obtained with these units.

**Northwestern University, Chicago, Illinois**  
**Robert G. Thompson, M.D.**

*Electric Power Assist Unit*

This unit, designed to be used with a body-powered above-elbow, shoulder-disarticulation or forequarter prosthesis, is complete in itself and is attached to an existing prosthesis and control (harnessing) system.

A Model II unit, which was fitted to an 18-year-old male, forequarter amputee, is used to externally power the prosthesis rather than serve as a power assist because of the difficulty the amputee has in obtaining 70 deg. of flexion with body power. The amputee has been wearing the unit for 20 months with excellent function and control. The only problem to arise was premature battery failure due to a defective cell. Efforts to evaluate this unit on other amputees during this past year were unsuccessful. Of the four patients who were suitable candidates for the unit, two expired before fitting and two declined fitting. Two units are available for evaluation by interested centers.

### *Powered Hand Splint*

A quadriplegic has been using a hand splint powered by an electric power assist unit for 10 months. Pinch force is approximately 4 lb. The drive mechanism and battery are contained in an aluminum case 1½ in. x 2 in. x 10 in. in size which is mounted to the wheelchair. The unit is controlled by switches operated by the opposite arm.

In attempting to utilize the AMBRL two-level switch it was found that the available control motions interfered with the limited body motions that the patient used for everyday activities. It appears that the switches operated by the opposite arm is the best method of control inasmuch as the patient is able to accomplish most grasping tasks without aid from the hand used to operate the switches.

A second unit has been constructed using a less expensive motor and simplified drive mechanism. This unit is to be installed on a new patient when he receives his splint.

### *Powered Wrist Rotator*

This wrist unit, capable of pronation and supination, is simple in design, weighs 9 oz. and is laminated to the end of the forearm of a prosthesis in a manner similar to a standard wrist unit. The unit was fitted to a bilateral below-elbow amputee who controlled it by an AMBRL two-level switch mounted on a chest strap. After about 15 minutes of practice the amputee had good control of the unit.

Two units have been constructed, for a bilateral below-elbow amputee and a bilateral above-elbow amputee. However, noise is a major problem and will have to be diminished before the units are fitted to the amputees.

### *Powered Wrist Rotator/Terminal Device*

The preliminary design for a combination electrically powered wrist rotator and terminal device has been completed. This unit will give powered supination, pronation, and prehension.

### *Ball and Socket Shoulder Joint*

A small testing machine has been designed to measure the dynamic and static coefficients of friction of various combinations of materials suitable for use in a shoulder joint. This information will be useful in instances where friction is desired and the "stick-slip" phenomenon is a deterrent to good function. This project is continued on a low priority basis.

### *EMG Signal Processor*

This processor incorporates Bottomley's concept of "autogenic backlash." It processes the EMG signal into an extremely low ripple analog signal which is related to EMG activity but which maintains a rapid dynamic response. The stability of this electrical signal enables it to be used in proportional systems, logic networks, position control systems, and any other analog

system using electrical inputs of between  $\pm 9$  volts. This unit has been miniaturized for mounting directly on the body. It is planned that this unit will be a basic module in various myoelectric systems.

#### *Wheelchair Speed Controller*

A speed controller which is at least 93 percent efficient has been developed to power the standard electric wheelchair. This unit uses pulse-width modulation of the motor armature current to achieve efficient speed control. The unit operates at 12 volts and supplies 40 amperes of current when the chair is stalled.

The unit has been tested temporarily on a chair and is intended for use on a head-operated chair. The speed controller has also been operated by myoelectricity.

#### *Three-Mode Controller*

A three-mode controller (one set of electrodes) has been developed for prosthetic and orthotic use. The design of this controller is based upon the ideas of Scott at New Brunswick University. However, several modifications have been made. A null space has been inserted between the two active modes of control. Also, the unit is less susceptible to noise since the mode initiated by intermediate EMG signals operates only when the zone is entered by a signal which is decreasing. This controller is currently being tested on a quadriplegic patient. Proportional control using pulse-width modulation has also been added to the basic three-mode controller and three different variations of the three-mode device are currently under investigation.

#### *Seven-Mode Controller*

A seven-mode controller which uses two sets of electrodes has been successfully demonstrated in the laboratory. This controller is not difficult to operate and the device could give a high level amputee easy control of hand opening-closing, supination-pronation, and elbow flexion-extension. A simple nudge switch could be used to obtain six additional control modes. The system is now being evaluated.

#### *Pierced Skin Technique for Electrodes*

Wire electrodes are looped through tunnels in the skin in much the same manner that earrings are inserted through pierced ear lobes. The idea is to achieve a definite mechanical linkage to the body and at the same time develop electrical contact. Two of these electrodes have been inserted in a subject but preliminary results were not encouraging.

#### *Above-Knee Pneumatic Sockets*

One above-knee amputee continues to wear the above-knee prosthesis with the inflatable air bag incorporated into the lateral wall of the socket. However, because of the satisfactory fit of the socket initially and relatively constant stump volume the amputee has not used the air bag.

An above-knee suction socket was constructed in which the lateral wall was rigid for support of the femur, and a Silastic inflatable liner encompassing approximately three-fourths of the area of the stump was incorporated into the remainder. Due to the negative pressure produced in the distal socket during swing phase, air is introduced into the air chamber of the socket through an intake check valve. During stance phase, the pressure against the stump produced by the inflated area is controlled by expulsion of air through a secondary adjustable check valve into a reservoir chamber. Because of the automatic pumping action at every step, constant controlled pressure can be maintained and an air tight seal at the junction of the Silastic and the polyester is not imperative.

One amputee has been wearing the socket on a very limited basis. An extended trial period will be necessary before any conclusions can be reported.

### *Below-Knee Sockets*

Four below-knee amputees have been fitted with PTS prostheses: two hard sockets and two with soft inserts. In our limited experience, the sockets with the soft inserts allowed easier entry of the stump into the socket.

Two of the amputees who were fitted with PTS prostheses requested modification to PTB prostheses. The amputee with the soft socket disliked the restriction of the quadriceps tendon which prohibited full extension of the shank. In the case of the amputee with the hard socket, the prosthesis was found too difficult to don.

A bilateral below-knee amputee was fitted with PTS prostheses but due to considerable intermittent volume change in the stump on the newly amputated side and because of lack of sensation at the distal end of the stump the amputee experienced recurrent stump breakdown; therefore, it was necessary for the amputee to be fitted with a conventional PTB prosthesis with hinges and thigh corset.

Thermoplastic polymer rubber material was tested as a means of direct forming of below-knee sockets. Two methods were investigated: 1. direct forming against the stump and 2. direct forming against a model of the stump. The thermoplastic material requires reinforcement. Direct application of polyester resin to the thermoplastic material on the stump caused no skin irritation; however, the resin fumes caused some discomfort.

### *Immediate Postsurgical Fittings*

During the 12-month period of April 1, 1967 through March 31, 1968, 26 immediate postsurgical fittings have been carried out: 15 below-knee, 10 above-knee, and 1 Syme's.

Three methods for constructing the above-knee brim have been studied: 1. prefabricated plastic brim, 2. prefabricated plaster brim, and 3. molding of the plaster brim using the PRS above-knee casting jig.

Studies on improving suspension methods for above-knee immediate postsurgical fittings is continuing.

Since the below-knee procedure of immediate postsurgical fittings is fairly well standardized, this Center is beginning to phase out of the below-knee program as a research item; however, we are continuing to serve, on a consulting basis, the Veterans Administration Research Hospital or other facilities who request our assistance.

#### *Early Postsurgical Fittings*

Three early postsurgical fittings have been accomplished: 1 quadrilateral amputee (bilateral below-elbow, bilateral below-knee), 1 bilateral amputee (right below-knee, left Chopart), and 1 unilateral below-knee amputee. The quadrilateral amputee's below-elbow stumps were fitted with plaster sockets incorporating terminal devices. The below-knee stump of the bilateral amputee and the unilateral below-knee amputee were fitted with plaster sockets with pylon and foot attached. The temporary prostheses allowed the amputees to begin early prosthetic training during the interim of definitive fitting. In all instances significant stump shrinkage was evidenced within two days of fittings.

#### *Polycentric Knee*

Production engineering of the polycentric knee sponsored by the Veterans Administration is nearly completed. Approximately 25 models will be produced for distribution to various centers for evaluation.

#### *Thigh Kicker for Hip-Disarticulation and Hemipelvectomy Prostheses*

To initiate flexion of the thigh immediately following toe-off a torque around the hip joint is produced by compression of a spring between the socket and the thigh from heel strike to mid-stance. A Northwestern University polycentric knee prevents this torque from causing the knee to buckle prior to foot-flat. Initiation of thigh flexion prior to full extension of the shank produces a quicker, smoother gait with increased clearance between the prosthetic foot and the floor.

Two prototypes of a spring mechanism to initiate thigh flexion in a hip-disarticulation or hemipelvectomy prosthesis have been made. A set of drawings has been made to incorporate one method into a pylon construction for the thigh, and a prototype of this model is being made and assembled.

Using the polycentric knee for stability it has also been possible to align the prosthesis to provide for easier knee flexion thus reducing the spring force required for initiating thigh flexion.

**University of California at Los Angeles  
Biotechnology Laboratory  
John Lyman, Ph. D.**

Current research activity is part of a continuous goal to achieve optimal control loops for externally powered prostheses. The research is divided into the following sub-projects:

*Development of an Arm Simulator*

A low inertia simulator capable of three dimensional movement (flexion-extension, shoulder rotation, and shoulder elevation) has been designed and constructed, with its adjacent control circuit. Preliminary experiments in using the device in evaluating various control loop configurations revealed that further improvement will be required in its power amplifier. An instrumentation system has been set in order to use the arm simulator in studying operator ability to use the various control system configurations such as position, velocity, and bang-bang.

*Application of Fluidics to Prostheses Control*

Supplementary to the current investigation of suitable electronic circuits, a pneumatic control system utilizing fluidic devices was designed. The system comprises a newly developed force to pressure transducer, a fluidic sign detection and amplitude conversion circuit, and a simple actuator system attached to the shoulder joint of an AIPR arm, thus providing a concept for controlling movements of 1 deg. of freedom. This basic movement control unit in turn is intended to become a portion of a movement pattern generating system whose logic description also has been developed. The devised movement coordination system is to be operated through two transducers and provides for an automatic subsequence for the task of arm flexion; it allows for independent corrections of direction or distance respectively, and it inhibits opposing control signals automatically. Further development of this concept, in order to control and coordinate movements of more than 2 deg. of freedom, is intended after experimental studies on the performance of the system so far devised have been made. Simultaneously investigation of the feasibility for utilizing stepping (motor) devices to improve the positioning accuracy and the "hold" function of the actuator system is suggested.

*Control Signal Sources*

An evaluation study of the harness control transducers that were previously developed is underway. A comparative analysis between strain gage harness transducer and EMG signal sources is being made. The object is to determine, on the basis of information rate availability, which system is more suitable for prosthesis control.

*Arm Movement Analysis*

A detailed study of arm motions is in progress. This includes the analysis of certain motion patterns, the "control laws" which are involved, and a way to describe these by mathematical equations. The study will be executed on a hybrid computer. A literature survey was completed; experiment design and computer program have been completed.

**University of California at San Francisco and Berkeley**

**Charles W. Radcliffe, Howard D. Eberhart, and James M. Morris**

The polycentric/pneumatic unit has been completely redesigned along the lines outlined in the proposal for FY 1968. A single prototype unit has been constructed and is being prepared for fitting to an above-knee amputee on the UC-BL staff. The redesigned unit includes a more compact pneumatic cylinder with improved needle valve design, a high-strength welded sheet-metal main shank structure, all molded nylon bearings, high-rigidity lightweight linkage, and a system of socket coupling specifically designed for use with a rigid polyurethane foam socket extension.

Fifty units of the improved design for the UC-BL pneumatic swing-control unit have been installed in the new cast-aluminum shank with rigid polyurethane cosmetic shank cover; these units have been delivered to the Veterans Administration Prosthetics Center for further testing. The revised instruction manual is now in press.

A prototype has been constructed of the UC-BL pylon-type above-knee prosthesis with single-axis knee joint. The shank unit for the new model was formed on epoxy-aluminum dies and shows promise of a stronger and lighter unit at a much lower cost. Design and testing of accessory components, such as the metal knee, improved expansion couplings, ankle rotation devices, and built-in alignment devices, are planned.

A prototype polycentric linkage has been constructed for use with a prosthesis for a knee disarticulation. Design studies will be continued; a study of improved fitting techniques will be carried out concurrently.

A sample molded SACH foot, incorporating a cast-aluminum keel structure and a horizontal plane of attachment above the malleoli, has been prepared at UC-BL. This design incorporates the recommended SACH foot contours in the toe section, arch, and heel as well as a conical quick disconnect for use with a 1½-in.-diameter-aluminum pylon. In addition, a master wood pattern for a size 11 SACH foot incorporating the recommended shape factors has been prepared and forwarded to VAPC. It is anticipated that this master pattern will be used as a guide to proper SACH foot shape by manufacturers of molded SACH feet.

Biomechanical studies of the lower extremities and trunk are continuing. The ultimate aim is to provide a comprehensive picture, in three dimensions, of the biomechanical roles of all body segments in normal human locomotion.

**VA Hospital, Seattle, Washington**

**Ernest M. Burgess, M.D., and Joseph H. Zettl**

Clinical research of immediate postsurgical prosthetics management and application of this concept of amputee management and rehabilitation continued.

Efforts were directed to develop further and improve present surgical techniques, specifically in our investigation of the geriatric amputee with ischemia. Various preoperative assessment techniques of extremity blood flow are being studied to allow for more accurate amputation level selection.

Technical refinements consisted of clinical evaluations of new interface materials, such as Silastic foam pads. Polyurethane foam will be considered for the same purpose as soon as contouring difficulties can be overcome. The above-knee suspension system is under study for possible improvement of its effectiveness. Also preformed adjustable quadrilateral above-knee socket brims of plaster of paris are being evaluated further and clinically tested.

Follow-up data and pertinent information on all available patients are carefully gathered, recorded, and maintained.

Major educational activities were conducted in cooperation with the Veterans Administration. Two seminars on Immediate Postsurgical Prosthetics Management were held in Miami and in Houston.

**SENSORY AIDS**

**Howard Freiberger, A.M.**

Electronics Engineer, Research and Development Division  
Prosthetic and Sensory Aids Service, Veterans Administration  
New York, N.Y. 10001

**Fabrication of Obstacle Detectors for the Blind**

**Bionic Instruments, Inc., Bala Cynwyd, Pennsylvania 19004**

**Thomas A. Benham, J. Malvern Benjamin, Jr., D. Ridgeley Bolgiano,  
and E. Donnel Meeks, Jr.**

An article was submitted to the Bulletin entitled "A Review of the Veterans Administration Blind Guidance Device Project." This article, which appears elsewhere in this issue, covers the development of the C4 laser cane from its inception. Also included is a review of various other guidance devices for the blind that have been suggested and tried.

New developments have evolved around the construction of C4 canes. There was also some development work in one-piece and collapsible boron-stiffened canes.