

CONTROL OF EXTERNAL POWER IN UPPER-EXTREMITY REHABILITATION

A. Bennett Wilson, Jr., B.S.M.E.

Executive Director

Committee on Prosthetics Research and Development,
National Academy of Sciences-National Research Council,
Washington, D.C.

Because of recent developments in bioengineering and widespread interest, the Committee on Prosthetics Research and Development, with financial support from the Vocational Rehabilitation Administration and the Veterans Administration, sponsored a Conference on the Control of External Power in Upper-Extremity Rehabilitation at Airlie House, near Warrenton, Va., during the period April 8-10, 1965. The purpose of the conference was to develop an expert summary of all aspects of the control problem and their possible solutions, as related to upper-extremity functional regain. The proceedings of the conference will be published by the National Academy of Sciences-National Research Council. Besides providing an interchange of up-to-date information among persons directly concerned with the development of externally-powered prosthetic and orthotic devices and the application of such devices to patients, the hoped-for outcomes of the conference will be long-range goals and guiding principles useful to governmental agencies—chiefly VRA and VA—sponsoring work in the field through grants and contracts.

The conference was convened by Dr. John Lyman, Director of the Biotechnology Laboratory, Department of Engineering, University of California, Los Angeles, who served as conference chairman. Dr. George T. Aitken, orthopaedic surgeon of Grand Rapids, Mich., who is Chairman of the Committee on Prosthetics Research and Development, gave an overview of the interrelationships concerned with the problem in a lecture entitled *The Man-Machine*. In his presentation, Dr. Aitken pointed out that at present the severely handicapped person equipped with an upper-extremity prosthetic or orthotic device cannot operate the device and perform some other task, such as mental arithmetic, at the same time. Dr. Aitken expressed the hope that, with the application of modern knowledge

and technology, it will soon be possible to have prosthetic and orthotic devices which will not require the full attention of their users.

More than 100 persons from seven countries in Europe and North America participated in the conference. Because of time limitations, it was not possible for each project to report directly. Panels covered the six major subject areas of the conference: sources of control signals, transducers, actuators, signal processing, sensory feedback, and the selection and training of patients.

Attempts to utilize electric power to operate prostheses were begun as early as the close of World War I when workers in Germany developed experimental artificial hands actuated by an electromagnet. Because of the operating characteristics of electromagnets, especially those available at that time, very little success was achieved, and the experiments became only of academic interest.

From 1945 to 1952 the International Business Machines Corporation, with funds supplied by VA and its own funds, carried out an extensive development program on complete electric arms, with emphasis on devices for the more severely handicapped. Evaluation showed that excellent engineering had produced devices that provided the functions sought, but the patient could not operate the prosthesis subconsciously, even though a number of ingenious control systems were used. Because of the need for funds for projects considered to be of higher priority, it was decided to curtail the engineering program and concentrate on the control problem. This function was assumed by the Bioengineering Laboratory at UCLA. It was also hoped that developments in the military and space programs would eventually help in the development of powered artificial limbs.

About the time the IBM project was terminated, work at the University of Heidelberg began to produce promising artificial arms powered by compressed carbon dioxide. The American Institute for Prosthetic Research (New York City), with the cooperation of the Heidelberg group, began experiments to refine the German design and adapt it for American use. The two projects have collaborated ever since. AIPR has been supported continuously by VRA.

Under the auspices of VRA, there were also initiated during the 1950's research and development projects at Rancho Los Amigos Hospital (Downey, Calif.), Baylor University, and the University of Michigan, primarily for the purpose of applying external power to braces for paralyzed upper extremities.

Some work in external power was going on in England and Europe (besides that in Heidelberg), notably the work of the late Dr. Nightingale in England, the Vaduz hand (Liechtenstein and later Paris), and the work of Kobrinskii in Russia. But it remained for the "Thalidomide tragedy" to spur efforts in this field to their present-day level.

Wilson: External Power in UE Rehabilitation

Work in Great Britain has been greatly intensified. An ambitious program has been launched in Sweden. The University of Heidelberg has received increased fiscal support. Several projects have been launched in Canada. Work has been initiated in Italy and Yugoslavia, though these efforts can hardly be attributed to the Thalidomide tragedy.