Philosophy of Research

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Webster defines research as "studious inquiry; usually, critical and exhaustive investigation or experimentation having for its aim the revision of accepted conclusions, in the light of newly discovered facts."

In the past, the University has been the stronghold of pure research—loosely defined as "a search for knowledge for its own sake happily pursued without purposeful intent." Nowadays, most such institutions can be fiscally persuaded to conduct investigations with the specific purpose of solving a given problem. This "applied research" is also actively pursued by nearly all branches of industry, who, in their quest for new ideas, employ brainstorming to milk ideas from inarticulate technical men, or even brutally attack a problem by assembling a battery of experts in a "think tank."

The word "research" seems to have a magic effect in raising funds, but no matter what term is used, to those engaged in the prosthetic field the goal is to better the lot of the amputee by seeking improvements in prosthetic design and practice.

Of thirty-three agencies in the United States in prosthetic or orthotic research, several are involved in obtaining specific physical data on both normal subjects and amputees. These studies come close to the field of pure research, and provide a background of well-documented information that can be useful in the design and development of new devices and techniques.

The studies include measurements of the body and distribution of the mass, pressure sensitivity, perspiration loss, energy consumption, gait patterns, and attempts to establish locomotion formulae based on the theory of least work. In locomotion, energy is expended in flexing, extending or resisting motion at each joint, and this theory presupposes that the human body, handicapped or otherwise, will assume a pattern that involves the least total amount of energy. In addition, with particular reference to the upper extremity, investigations are being conducted on possible control sites, electrical and otherwise, and methods by which a sense of position and force may be transmitted from the prosthesis to the body. The search for such numerical data can be conducted independently in laboratory situations. Although it provides invaluable design criteria, information in creating new products must have other sources of knowledge to become effective.

A designer requires, in addition to available experimental data, some means of association with the problem; a facility for fabricating prototypes;

and a local amputee population for preliminary test wearing. It is possible for one man to work out a new device entirely on his own, and since this avoids any communication problem it has advantages in efficiency. It does, however, impose limitations in scope, since the diverse knowledge of the many professions remains unused. A small group, including all the representative disciplines, can develop, through association, a team approach and can function with considerable efficiency with informal means of communication. Thus a development center can operate effectively when flanked by an active clinic on the one hand, as an amputee information source, and by a school on the other for effective dissemination of its products.

Amputee information can be effectively gained by association with the patient in all phases of existence from amputation and training to his routine wearing, and the up-to-date rehabilitation center with an active open-minded clinic provides an unequalled opportunity for acquiring the information. Much of the data can be documented and subsequently analyzed, but unfortunately much essential information can only be estimated, and such things as pressure patterns in the socket and comfort can only be guessed. However, it is in this realm that a good clinic team of doctors, therapists, prosthetists and amputees can pool their knowledge to form some statement of the problem.

Once a specific problem has been stated, design and development can begin. Early designs are usually based on some intuitive concept, but before they take any practical form, a working knowledge of possible materials and fabrication techniques must be coupled to an understanding of engineering mechanics and structural analysis. Prototypes invariably lead to modifications, especially after fitting to the patient, and often unsurmountable obstacles necessitate a complete revision. Since a change in one part can affect the entire design, it is often necessary to consider as many as fifty or more possible solutions before making a decision, and a finished product requiring twenty drawings may have involved thousands of preliminary sketches.

The development of new techniques in fittings are even less formal, and although they may stem from some initial concept, the procedure is usually a cut and try process as the research prosthetist and associates work with a patient towards a satisfactory solution. The development of the diagonal type hip disarticulation socket, for example, began with an understanding of the functions of a socket in weight bearing, lateral support and suspension, from which an estimate of the necessary parts of the socket could be made. Then followed a series of cast taking, fitting and checking with several patients, with constant minor revisions, until fitting principles could be established.

Any new device or technique should be proved before it can be released for general use, and this, of course, is the main role of evaluation agencies. Such evaluation has several specific objectives. A device can be tested to see if it lives up to the functional claims; it can be tested for durability; and, most important, it can be checked for amputee acceptance. The first two categories are fairly straightforward, and can employ bench testing and other simulated experiments with some degree of accuracy. Patient acceptance, however, is an extremely nebulous and difficult problem. Test wearing by professional amputees in a laboratory situation, and by selected patients on a trial basis, can be informative, but conclusive evidence usually results from widespread use in various areas by different types of amputees, prosthetists and clinics. A product may be accepted as satisfactory in New York and be quite unacceptable in Minneapolis, and the reasons for this may be due to climate, work habits, prosthetic capacity, or just plain prejudice.

There is, however, one essential point about evaluation, and that is that the results must be forwarded to where they can be used. This usually means some line of communication between the evaluating agency and the design and development groups, so that appropriate modifications may be made, or entirely new design concepts undertaken.

Once a design or fitting method has been proven, it still has to be made available to the amputee. Devices can usually be produced and distributed by the prosthetic manufacturer with little delay. The dissemination of new techniques usually requires re-education of the prosthetist and other members of the clinic team, and it is in this role that the prosthetic schools play an invaluable part. The effective introduction of fitting methods such as the patellar-tendon-bearing total contact below-knee prosthesis could not be in wide use today if it were not for the schools. These formal training periods are agumented by lectures at meetings of the American Orthotics and Prosthetics Association, and by seminars and lectures sponsored by the Committee for Prosthetic Education and Information for the benefit of the medical profession.

The process of research is not an isolated attempt at a new gadget, but a blending of the knowledge of the many members of the prosthetic team, each interdependent and informally organized so that there is a constant flow of information from the patient through the specialists to a device or technique. After fitting a device to the amputee, new information becomes available and the cycle is repeated. Thus the total knowledge builds upon itself like a snail shell and each improvement opens new scope for further work.

A well balanced group, working together in one area, can become an efficient unit in advancing prosthetics. In spite of meetings with other groups, however, there is a tendency to become mentally ingrown. Very little documented evidence is acquired, and much valuable information never becomes available to other agencies. The process is essentially "playing by ear," and although effective in a complex situation, a more scientific approach could be suggested to provide wide scope in a long term situation. Such an approach must be based on more specific terminology and means of communication.

Julian Huxley has shown how our modern society has developed largely through the growth of communication. The term applies in the general sense, including the effectiveness of language, knowledge accumulation through books, transportation and electronics. Modern technical achievements have similarly depended upon widespread scientific knowledge and the means by which new information may be made readily available.

The same reasoning is also true in prosthetics, but there are unfortunate complications. The varied disciplines involved do not have a common language, and many of the physiological characteristics of a human being are difficult to express in engineering terminology. In addition, the physician, prosthetist and engineer have different ways of viewing a problem. The development of scientific theory has been essentially the formulation of order from a chaotic arrangement of facts.

The apparently erratic motions of the planets is easily explained when viewed as elliptical orbits around the sun. Similarly, the complex motions in walking become less formidable when approached as problems in engineering mechanics in the co-ordinate system.

It has been our unfortunate habit to describe a prosthesis by a list of parts, and those familiar with them associate certain characteristics with each part. The total effect, however, is also dependent upon the way they are assembled or aligned. It would be better to describe the prosthesis by the total functional characteristics so that a direct comparison of all models could be made. In time, desirable charactertistics could be determined through clinical observation and laboratory experiments. These characteristics would then become design criteria—providing specific data so that design engineers unfamiliar with prostheses could function efficiently. Any new designs could be evaluated by direct comparison without reference to individual fittings.

With such a system, the benefits to research would be enormous, but it would require not only the blue printing of the system but a radical change in our teaching methods. Although the schools have played a most impressive part in the advancement of prosthetics, guidance in the understanding of principles rather than presentation of facts might prove more valuable in the long run.

Whatever methodology or approach is used, the most important ingredient is the personnel involved. They must not only be competent in their respective fields, but should possess, in the words of Charles F. Kettering, "a friendly, welcoming attitude towards chance."

VA Announces New Appointments

Dr. John Lyford, III, director of professional services at the Veterans Administration area medical office in Atlanta, Ga., has been named director of domiciliaries for the VA's Department of Medicine and Surgery, Washington, D. C. He will head the VA's 16,000-bed domiciliary program in 18 domiciliaries nation-wide, as well as the agency's new restoration center program.

Dr. James S. Glotfelty, director of the Long Beach, Calif., Veterans Administration hospital, has been appointed director of the Oakland, Calif., VA hospital. He succeeds Samuel H. Franks who has been transferred to the West Haven, Conn., VA hospital as director.

Richard G. Jones, assistant director of the West Haven, Conn., VA hospital has been named director of the VA hospital at Walla Walla, Wash., to succeed Dr. Justine E. Gaines, who is retiring.