Spring 1970

Artificial Limbs

A Review of Current Developments

COMMITTEE ON PROSTHETICS RESEARCH AND DEVELOPMENT

COMMITTEE ON PROSTHETIC-ORTHOTIC EDUCATION

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A Polyproblem

COLIN A. McLAURIN[1]

POLYSAR X-414 is not a very smart plastic. It has practically no memory. Nor is it very determined. With very little thermal excitation, it becomes quite docile and can be easily pushed around. Leave it alone and it is quite content to remain that way indefinitely. What is the value, then, of a plastic so devoid of those most admirable "human" qualities—knowledge and determination?

The answer is that, lacking these qualities. it is not constantly fighting the man working with it. The magic is not in the material, but in the hands of the prosthetist. If the prosthetist is knowledgeable in what he wants to achieve and this material helps him, or at least doesn't hinder him, then the material is a useful addition to the prosthetist's armamentarium.

For many years, prosthetists have been looking for a material that could be readily molded to the stump and still have the necessary strength and durability for use as a socket. Our profession is of course much too small to develop such a material for its own use. It came, like many useful developments, by accident. The basic material for Polysar X-414 was being developed for golf-ball cores. The fact that it becomes workable by hand as it cools from 140 deg F to 115 deg F was too much to pass up. It was first thought that it could be used in place of plaster casts in treating bone fractures. Although this application has not materialized fully, other applications in medicine have.

This issue of *Artificial Limbs* contains several articles on its application to limb prosthetics. The extent to which the material will be utilized remains to be seen, but it does illustrate how one chance product from an unassociated industry can affect the prosthetics and orthotics professions.

Indeed, virtually all the materials used in our work are borrowed from another industry: polyester from boats, aluminum alloys and chrome-moly steels from aircraft, miniature electrical components,

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and, when they are practical, high-strength boron and carbon laminates from the space age.

With so much borrowed from other industries, one might ask, What is it that is unique about our field? What is the hard core of knowledge that is ours alone, and which forms the framework to which we can apply new materials and new technology?

Simply stated, it is our business to provide handicapped individuals with functional aids, based on a knowledge of both physiology and engineering.

There was a time when the prosthetist or the orthotist was first an artisan: he had practised skills in wood carving, in leather working, and in metal forming. When he became accomplished in these skills, usually after many years of apprenticeship, he was allowed to fit artificial limbs to patients. But no one is perfect. If our knowledge of the required shape or his ability to fashion the material is limited, then we must make concessions—or at least the amputee must. This is known as "fitting the amputee to the socket," and we are all guilty, by circumstance of this misfit.

The engineering required in prosthetics, once the criteria have been established, is little different from other engineering, and the physiology required is borrowed from biology. The difficulties and the unique challenge arise when we try to marry the two. Engineering requires hard, cold facts dealing in forces and dimensions. The facts in physiology, however, are not expressed in concise terms familiar to the engineer. The textbooks don't tell us that the bearing capacity of soft tissue is so many pounds per square inch, with a duty cycle of three minutes in every twenty. We don't know the rate at which the body can receive information without tiring and without involving the eyes or ears, and the answers to many other questions remain obscure.

There are two ways of improving the situation. One is to increase our knowledge of stump physiology so we may know more about what shape is optimal, or we may improve the technical process. A material like Polysar helps to improve the technical process in several ways. If a material is easily formed, then we are less likely to accept imperfections; we are less hesitant to discard and start again, since it is easy to change the shape if it isn't quite right. An extra bonus appears if by doing a job faster (and cheaper) we spend our time and money on learning more about what the shape should be. And that is what this prosthetics business is all about: defining shapes based on our knowledge of the physiology of the individual stump.

Our task or profession is thus a dual one. With limited knowledge and the materials at hand, we must try to design and develop appliances as best we can. We must also be diligent in our search for the biomechanical and physiological facts by supporting fundamental studies.

Both of these approaches must be supplemented by rigorous evaluation programs, so that the user may know the value of our work, so that we can profit by our mistakes, and so that new materials like Polysar X-414 can find their rightful place. (*Ed.*: Polysar X-414 is a registered trademark of the Polymer Corporation Limited.)