CEMBER, 1966

RTHOPEDIC & PROSTHETIC APPLIANCE JOURNAL

urnal of the
imb and Brace Profession

George H. Lambert, C.P.O.
President, 1966-1967
American Orthotic and Prosthetic Association

publisher: American Orthotic and Prosthetic Association

The 1967 NATIONAL ASSEMBLY of the

AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION

will be held

OCTOBER 7 to 11, 1967

at the

FONTAINEBLEAU HOTEL
MIAMI BEACH, FLORIDA

For Program Details and Registration Information
write to

The American Orthotic and Prosthetic Association
919 - 18th Street, N.W., Suite 130
Washington, D.C. 20006

The Assembly is open to all who are interested in the rehabilitation of the orthopedically disabled

Orthopedic and Prosthetic

Appliance Journal

(Title registered U. S. Patent Office)

VOLUME 20 DECEMBER, 1966 NUMBER 4

Second class postage paid at Washington, D. C., U.S.A.

CONTENTS

LESTER A. SMITH
Editor

STOCKTON V. BANKS
Managing Editor

William A. Tosberg, Chairman, Editorial Committee

The *Orthopedic and Prosthetic Appliance Journal* is issued in March, June, September and December. Subscription price payable in advance is five dollars a year in the Western Hemisphere, rate elsewhere is six dollars a year. Publication does not constitute official endorsement of opinions presented in articles. The *Journal* is the official organ of its publisher, The American Orthotic and Prosthetic Association. All correspondence should be addressed to: Editor: *Orthopedic and Prosthetic Appliance Journal*, 919 18th St,. N.W,. Washington, D. C. 20006. Telephone, Area Code 202, 296-4160.

THE AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION

(Formerly the Orthopedic Appliance and Limb Mfgrs. Assn.)

919 18th Street, N.W., Washington, D. C. 20006

Area Code 202-296-4160

OFFICERS

George H. Lambert, Sr., C.P.O., President, Baton Rouge, Louisiana

Basil Peters, C.P.O., President-Elect, Philadelphia, Pennsylvania

Alvin L. Muilenburg, C.P.O., Vice President, Houston, Texas

M. P. Cestaro, Secretary-Treasurer, Washington, D.C.

Fred J. Eschen, C.P.O., Past President, New York, New York

REGIONAL DIRECTORS

Region I—**John Glancy,** C.O.
Boston, Massachusetts

Region II—**John Gallo,** C.O.
New York, New York

Region III—**Rudy Bindi,** C.O.
Baltimore, Maryland

Region IV—**Thomas L. Maples,** C.P.
New Orleans, Louisiana

Region V—**Cletus E. Iler**
Saginaw, Michigan

Region VI—**Alfred Denison,** C.P.
Chicago, Illinois

Region VII—**Everett F. Haines,** C.P.
Des Moines, Iowa

Region VIII—**David C. McGraw,** C.P.O.
Shreveport, Louisiana

Region IX—**Leroy E. Noble,** C.O.
Whittier, California

Region X—**Matthew Laurence,** C.P.O.
Oakland, California

Region XI—**William L. Bartels,** C.O.
Portland, Oregon

Herbert B. Warburton, Executive Director

AMERICAN BOARD FOR CERTIFICATION IN ORTHOTICS AND PROSTHETICS, INC.

Bert R. Titus, C.P.O., President
Durham, North Carolina

Edward T. Haslam, M.D., Vice
President, New Orleans, Louisiana

John A. Metzger, C.O., Secretary-
Treasurer, Long Beach, California

William E. Brownfield, C.P.O.
Boise, Idaho

Robert G. Thompson, M.D.
Chicago, Illinois

Newton C. McCullough, M.D.
Orlando, Florida

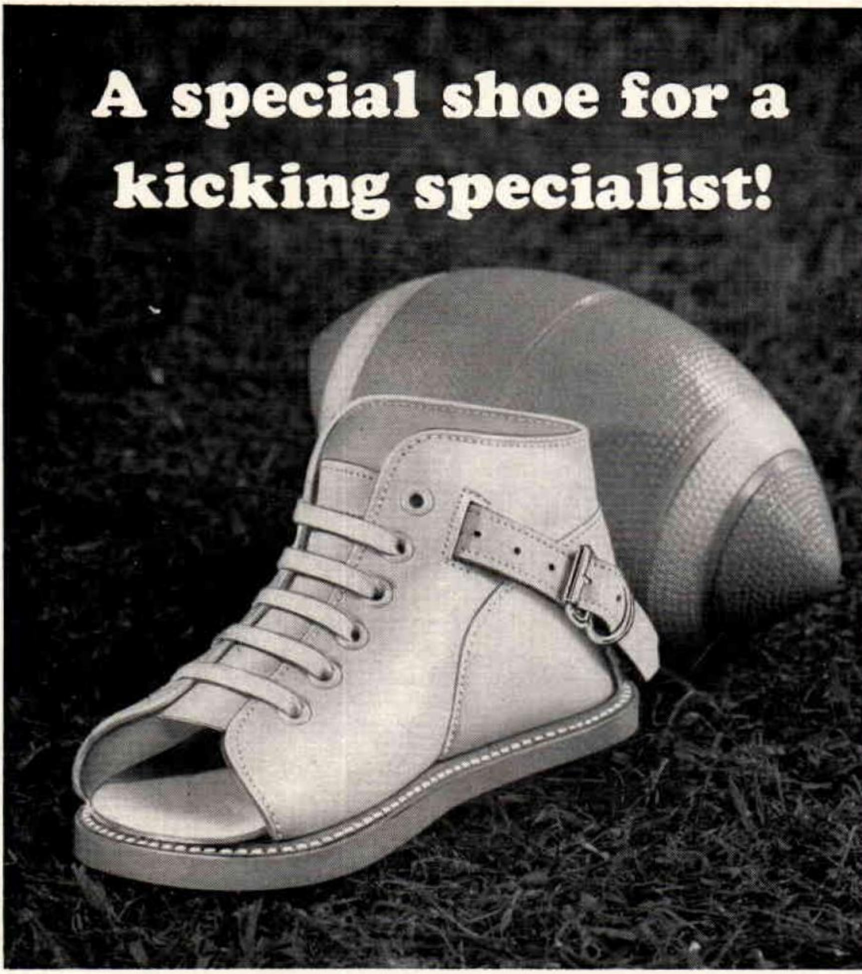
Paul E. Leimkuehler, C.P.
Cleveland, Ohio

Durward R. Coon, C.P.O., Past
President, Detroit, Michigan

Herbert B. Warburton, Executive Director

INDEX TO ADVERTISERS

DECEMBER, 1966



The therapy is to apply a pair of Sabel shoes and a brace and let baby kick his way back to good foot and leg form.

Why Sabel? Because this is the shoe, developed over 40 years, that has all the ingredients to aid in a successful program. The extra thick sole provides a firm base for the bracework. The uppers are soft, glove leather lined and designed to eliminate every point of foot irritation. The shoe is scientifically designed for your bracework and for little kicking specialists.

SABEL'S

EQUINO-VARUS

TRADE MARK REG. U. S. PAT. OFF

SABEL DIVISION, R. J. POTVIN SHOE CO., BROCKTON, MASS.

orthopedic appliances
of every variety

surgical hosiery
in any weight, or made-to-order

specialties
wrist splints, universal cervical collars, collars with chin support for men, women and children.

2659

greater rewards in profitability and stature for the ethical dealer

Truform is a one-market line, designed solely to meet the requirements of the ethical dealer. No line provides greater protection and support for his ethical image, or greater rewards for his professional competence.

Truform is recommended and endorsed by physicians and supported by ethical advertising. It provides professional training for fitting technicians.

Truform is the foremost ethically-respected name to identify your services with. It offers you the best merchandised line for meeting all your requirements—for stature, sales and profit.

You can depend on TRUFORM for your complete line of—*Orthopedic Appliances • Surgical Supports • Elastic Hosiery • Specialties.*

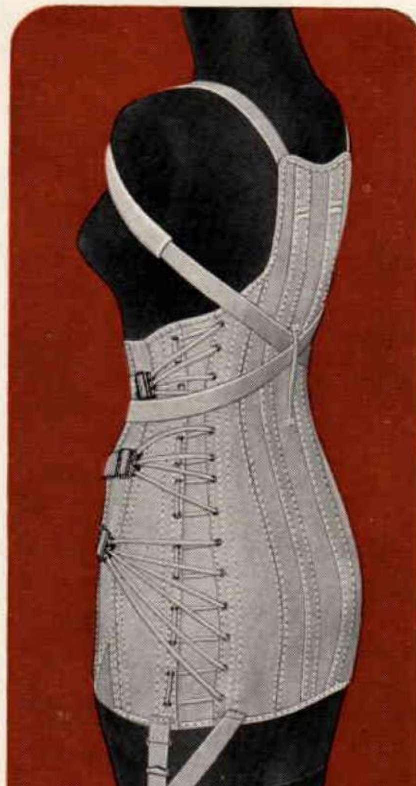
Write for free copy of the Red Book, illustrating the full *Truform* line.

Truform Anatomical Supports sold only by Ethical Appliance Dealers

TRUFORM

anatomical supports

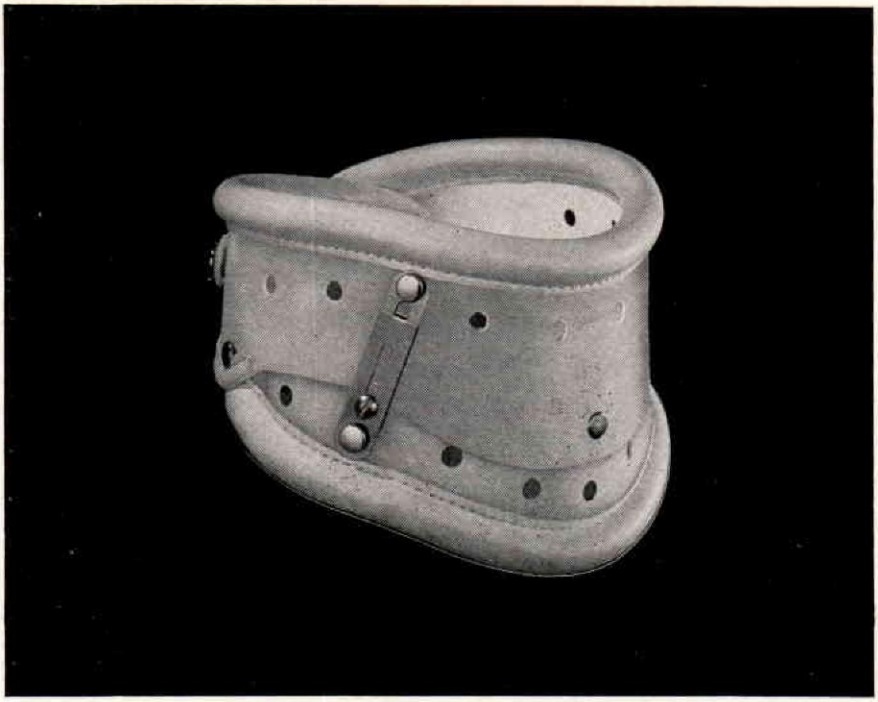
3960 Rosslyn Drive, Cincinnati, O. 45209
New York • San Francisco • Texarkana



surgical supports
for both men and women

THE MYO COLLAR

The first, the finest, the most widely accepted adjustable cervical collar. Proven design, top-quality materials, precision workmanship.



Well-ventilated, lightweight, comfortable, completely washable. Plastic or Velcro® straps. Stable price structure. Another quality product of:

FLORIDA
BRACE
CORPORATION

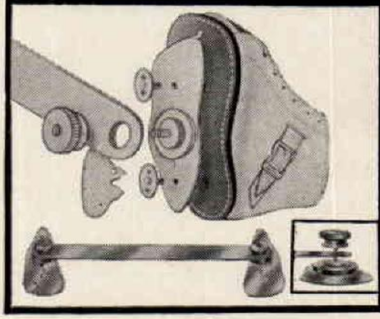
601 Webster Ave. • Box 1299
Winter Park, Florida 32790
Telephone: 305 644-2650

SPLINTING IS NOW SIMPLER...

...EASIER...LESS COSTLY

with the

TARSO®
SPLINT ADAPTOR
by MARKELL



the splint screws on in a minute!

We set two little inconspicuous screw holes into the sole of each Tarso Pronator® and Tarso Medius® open toe boot. Using the screws and wrench that we supply free of charge, you can attach a splint, or remove it, in just about a minute.

This is the Splint Adaptor: It is ideal for intermittent or continuous splint application. Splints don't have to be riveted on, and attachment is easier and stronger than it is with the relatively costly clamp-on splints.

The sturdy inexpensive #140 Tarso Splint is available with drilled-to-fit holes for use with the Splint Adaptor. Steel screws and bushings assure that splints will fit tight and stay tight.

Splint Adaptor shoes are beautifully made of top grain leather and fully lined with soft seamless glove leather. Soles are Goodyear welted for firmness and shape retention. Tongues are semi-detached for wider opening and smoother fit. These shoes are designed to be used for all pre-walker applications. The Splint Adaptor is included in case it is needed, at no additional cost to the patient.

TARSO PRONATOR® Open Toe Boot Mild Abduction Last

#5790

TARSO MEDIUS® Open Toe Boot Straight Last

#1643

TARSO PRONATOR® Open Toe Boot Full Abduction Last

#1934

Tarso® Shoes by Markell are in-stock and are sold through the finest shoe stores and brace and limb houses throughout the United States and in Canada.

Write for our catalog and price list.

MARKELL SHOE COMPANY, INC.

504 SAW MILL RIVER ROAD, YONKERS, NEW YORK

JOURNAL PUBLISHING PROCEEDINGS OF THE ASSEMBLY

The *Journal* will publish a majority of the papers delivered at the Orthotics and Prosthetics Assembly, Palm Springs, California, October 16 - 20, 1966.

This issue of the *Journal* contains two of these papers:

"The Pursuit of Excellence," by Robert G. Thompson, M.D., the address given at the Certification Luncheon session of the American Board for Certification in Orthotics and Prosthetics, October 17, 1966.

"Canadian Experience with the Soviet Myoelectric Upper-Extremity Prosthesis," by Gustave Gingras, M.D., F.R.C.P. (C), delivered at the Assembly, October 19, 1966.

In a forthcoming issue the *Journal* will publish these papers:

"Summary of Research Developments in Upper Extremity Orthotics at Baylor University College of Medicine," by Thorkild J. Engen, C.O.

"Myoelectric Controls Systems," by Worden Waring, Ph.D. and Daniel Antonelli, E.E., Human Systems Design Center, Rancho Los Amigos Hospital, Downey, California.

The Pursuit of Excellence*

by ROBERT G. THOMPSON, M.D.

American Board for Certification in Orthotics and Prosthetics, Inc.
and Assistant Professor in Orthopedic Surgery
Northwestern University Medical School
Chicago, Illinois

The origin of the phrase, "The Pursuit of Excellence," is probably buried in antiquity but it is believed to have been first spoken by the Greek philosopher, Aristotle. These words, however, have been used to stimulate individuals down through the ages and they are as apropos today as they were twenty-five hundred years ago. It has been said recently that we are living in the age of the "great goof-off;" the half-done job. People in the main are going through the motions of producing, but not in the interest of doing their very best or in performing their job for the self-satisfaction they may obtain by producing a superior product or a superior service. It would appear as though the majority of workers today are more interested in how much money they can coerce out of their employer for the least effort on their own part.

* This paper was presented at the annual Certification luncheon of the American Board for Certification in Orthotics and Prosthetics, Inc. October 17, 1966, at Palm Springs, California.

The country of which you and I are citizens is probably the greatest and strongest nation of the earth. America was founded and made great by people who believed in doing the very best that their frequently limited resources of skill and education would allow. Today we are, if one can correctly interpret the signs around us, worshiping the cult of mediocrity. Do not rise above your fellows or you may become unpopular; individuals excelling in intellectual attainments are given the derisive term of "egg head." However, I would advise you that nations, towns, families and individuals are not made superior by mediocre performances, but are only made strong and great by the constant striving to achieve superior performance. The glory that was Rome at the time of Christ soon faded to the decadence and weakness and the failure that was Rome in the Third Century. When Roman leadership and citizenry alike became more interested in circuses and the pursuit of pleasure than in the pursuit of excellence, the empire was on the downward path. You who are here today are in a unique position to pursue excellence in your chosen profession.

Beyond that period of approximately twenty to twenty-five years ago, the "limb industry" (as it was then known) was noted "to have an unsavory reputation enjoyed by some members of the industry, and a mutual feeling of suspicion and distrust among the industry members as well as among the agencies with whom these members were associated. In many instances, members of the limb industry were looked upon as ambulance chasers and frequently thought of as vultures awaiting every opportunity to pounce upon a dainty morsel."[1] A number of your colleagues, however, were not content to allow such a status to be preserved and they, through the cooperation and interest of certain orthopaedic surgeons, were instrumental in setting up the American Board for Certification in Orthotics and Prosthetics, on September 9, 1948.[2]

The founders of your Board realized that if the limb industry was to be improved, all its members would have to have, at the very least, a common springboard from which to lift themselves to new heights in their chosen vocation. The members of the American Board also realized that initially certain realistic minimal requirements would need to be spelled out so that all who aspire to Certification would know how to prepare themselves adequately. The candidate is required to have certain minimal general educational requirements: that is, a high school education. He is also required to have specialized training in the art of prosthetics and orthotics, which up to this time has been available only through apprenticeship training programs. He is, over a four-year period, to measure, make and fit sufficient numbers of each type of prosthesis and orthosis to sufficiently perfect himself in this art so that he can perform these services for the disabled individual without supervision by other prosthetists or orthotists. Certain auxiliary information is also to be acquired such as a knowledge of anatomy, physiology, pathology, bio-mechanics, and last but not least, psychology, so that he has some insight into the amputee's total problems and is not merely a mechanic who is fabricating an artificial addition to an amputation stump.

Since each of us may have a different concept of what is adequate preparation, (even though the regulations specifically state what is required) each individual candidate is then tested by examiners who are generally acknowledged to have high standards and superior knowledge of the field. Recently, while reviewing qualifications of candidates who were applying for these examinations, it seemed to me that the four years of apprenticeship was a most critical part of the preparation for certification.

The application forms detailing this experience, in my opinion, leave a great deal to be desired. Most of the figures supplied by the candidates, which indicate how many of each prosthesis or orthosis have been fitted, seemed to be guesses and in many cases poor guesses at that.

I would propose that the American Board for Certification supply all prospective candidates with a booklet that would be maintained by the candidate during his four years of apprenticeship, with sufficient space to record on a daily or weekly basis each prosthesis or orthosis which he has fitted, fabricated and checked out. These entries would then be certified on the same daily or weekly basis by his sponsor or certifying orthotist or prosthetist. Such a pamphlet, which was called "Record of Professional Assignments," was used by medical officers during World War II, to record and certify their on-going training experiences while working in service under the supervision of board-certified individuals. Such records were then made a part of the candidate's application to the individual medical specialty board and thus provided the board with a much better picture of the applicant's service experience. I believe it would also give the candidate a better idea as to precisely how many prostheses or orthoses he has made and in what areas he is weak, so that during his four years he could then fabricate the required number of each type of prosthesis or orthosis. I know that this type of record would make the task of the Credentials Committee a great deal easier when evaluating these applications.

Although at this time the minimal educational requirement is that of a high school diploma, (which indicates that the candidate has spent four years in an accredited high school) it is further hoped that, in order to improve the education of the individual orthotist and prosthetist, a program such as the Associate in Arts degree, with its emphasis on prosthetics and orthotics, be made a real source which can be expanded to provide many well-trained, knowledgeable prosthetists and orthotists.

From time immemorial, three vocations, law, theology and medicine, have been considered to be professions: law, which deals with man's relationship to other men; theology, which deals with man's relationship to his god; and medicine, with man's knowledge of the intimate workings of his own body. Your forebears in prosthetics and orthotics long held the opinion that since your vocation is intimately allied to medicine, this field should be considered a paramedical specialty and that the practice, the art and the science of prosthetics and orthotics should have a professional status.

At this point, let us examine the professional individual and see where he differs from the non-professional one. First and foremost, the man in a profession is considered an educated individual. Your American Board for Certification has attempted to fulfill this first requirement by demanding that each applicant complete a standard four-year high school program. However, as I have indicated before, in the not too distant future this requirement may well be upgraded to at least two years of college with an Associate in Arts degree, or even a four-year Bachelor of Science college program. Those of us in the profession of medicine recognize that education cannot and does not stop with the issuance of an M.D. diploma. In most cases, the issuance of the diploma represents only the commencement of a lifelong process of education. Self-improvement by regular reading, participation in short formal university courses, regular attendance at your annual and regional prosthetic-orthotic meetings and regular attendance at amputee and orthotic clinics, are all a part of the educational process and I consider education to be a most important part of the pursuit of excellence.

Another equally important attribute of a member of a profession is his willingness—nay, his desire—to teach his art and science to others. The medical profession has long been outstanding in this area since the promulgation of the Hippocratic Oath, which states in part, "To consider dear to me . . . him who taught me this art; . . . to look upon his children as my own brothers, to teach them this art if they so desire without fee or written promise; to impart to my sons and the sons of the master who taught me and the disciples who have enrolled themselves and have agreed to the rules of the profession . . ." Many practitioners of medicine have for years given freely of their time in formal and informal teaching of medical students, interns, residents and other graduate physicians. It would seem as though we are most eager to pass on our secrets and techniques of examination and treatment to our students. Contrast this to what existed in the limb industry a few years ago. Trade secrets were jealously guarded and passed from father to son, patients were sought and obtained, restricting the use of new ideas and products, individuals were forced to their sometimes limited resources in solving difficult problems without recourse to friendly "curbstone consultations" as these are called in the medical profession. The profession of prosthetics and orthotics is now beginning to pursue excellence in this area by willingly sharing knowledge, by giving and taking freely of consultations without thought of recompense one to another. In my experience as a participant in amputee clinics during the past fourteen years, I have been impressed that recently there has been an increasing free exchange of knowledge and information between each of the attending prosthetists and orthotists. I note this as very definite evidence of the increasing professional status of the practitioner of prosthetics and orthotics.

The certified prosthetist and orthotist is likewise in a unique position, in regard to his ability, to upgrade himself both in knowledge and in monetary compensation because of his approachment to professional status. As far as I am aware there are no "unions" of prosthetists and orthotists and I would certainly decry this ever coming to pass. It has been my experience that in industries where trade unions have become dominant, the unions are in many cases very restrictive of an individual's ability to advance himself. It is probably true that trade unionist activity has increased the take-home pay of individuals employed in industries covered by these unions, but at the price of an individual's ability to improve his own status. Individuals employed in union shops are often warned (by the union stewards) that they canot exceed the norm or the average output of the worker in that particular industry. If they do attempt to increase their individual productivity, very often they are subject to restrictive fines by the unions. It would seem to me very difficult for any individual to be able to exhibit merit in such a situation sufficient to allow him to rise to the level to which his ability and education would otherwise promote him. The certified prosthetist or orthotist is able to further his own fortune, both monetarily and in knowledge, depending primarily on his own initiative and ability in the profession which he has chosen. This marks you, in my opinion, as a group which is pursuing excellence.

To further the profile of the professional individual, one finds by and large that the person in the profession has a very clearly defined sense of ethics. A great deal of time could be spent on discussing this subject but essentially ethics are used to give one the ability to judge the rightness and wrongness of any situation. As all of you know, many situations cannot be decided as either being definitely black or white; there are most often many shades of gray between these extremes. Generally, however, the true professional will come to decisions which are more often right than wrong, depending on, in many situations, his purely innate sense of the ethical approach.

The rightness or wrongness of any situation in orthotics and prosthetics, if there are any doubts in your mind, certainly may be quite clearly resolved by consulting your own Code of Ethics.[3] There are certain things that one does and there are certain things that one does not do. If there is any further question in your mind about the shades of gray that I speak of, one can always fall back on the golden rule to decide the rightness of any decision. This is not to imply that all practitioners of medicine and surgery practice or use ethical principles to the same high degree. We know we have black sheep in our profession as we know also that there are a few black sheep in your profession. However, we can certainly strive for excellence in this area by putting aside what might be a temporary monetary gain by such things as excessive advertising, ambulance chasing, overselling of certain components or prosthetic devices, and publicly decrying the ability of our colleagues.

I think, as a final note, that a further mark of the professional individual is that of self-confidence. As doctors of medicine and surgery, those who pursue excellence gradually develop the self-confidence that comes with the known ability to solve the problems associated with any given situation, and the thorough knowledge that in oneself is the ability to master any situation that may arise. The self-confidence that the practitioner of prosthetics and orthotics reveals in clinic discussions gradually promotes a closer relationship with the other clinic members and increases the amount of respect that is accorded each prosthetist or orthotist. These amputee and orthotic clinic groups are truly becoming team operations, with the knowledge and ability of the prosthetist and orthotist being recognized as important to the patient's welfare as the contributions of the physician, surgeon and therapist.

In my opinion, both the apprentice and the certified prosthetist or orthotist are in a unique position to pursue excellence. They should strive to serve the disabled of mankind in a manner befitting a true profession. In your striving, however, you should not forget the mark of the true professional—an educated individual pursuing excellence by a continuous learning process, pursuing excellence in his ethical relationship with others in his profession, and pursuing excellence by teaching his art freely and without primary thought to temporary monetary gain.

REFERENCES

1. Harmon, Frank, "II. Rehabilitation Agencies and Certification," *Orthopedic and Prosthetic Appliance Journal;* 11:28; December, 1957.

2. "The History of Prosthetic and Orthotic Education," *The Mark of Merit;* 3; No. 1; 1963-1964.

3. "Code of Ethics for the Artificial Limb and Brace Profession," *Orthopedic and Prosthetic Appliance Journal*; 18:48; March, 1964.

Canadian Experience with the Soviet Myoelectric Upper-Extremity Prosthesis

by GUSTAVE GINGRAS, M.D., F.R.C.P. (C)

Rehabilitation Institute of Montreal, Canada

Presented at the 1966 AOPA Assembly,
Palm Springs, California

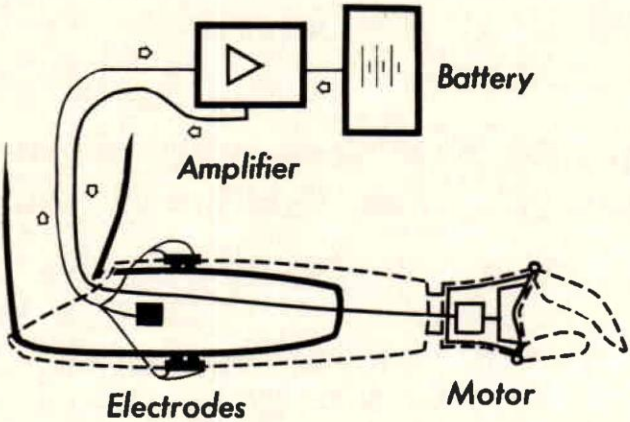
The prosthetic requirements of the upper extremity amputee are quite often extensive and complex in terms of functionality. Furthermore, the higher the level of amputation, the more body functions are needed to power a conventional prosthetic device while at the same time, the number of available controlling muscles decreases. Artificial effectuators may be used to produce mechanical functions in prosthetic systems, supplied from an external source of energy in the form of electricity or compressed gas. Combining humans and machines in this way requires a control system to interconnect the two, if the human and technical elements are to operate compatibly. Using muscle action potentials for control signals provides an excellent means of establishing communication between man and machine.

Several laboratories on this Continent and elsewhere experimented with external power in connection with myoelectric control for prosthetic devices. However, a group of Soviet researchers produced the first practical device. Perhaps their greatest merit is due to their decision that myoelectric control was practicable. The device is a simple hand prosthesis, performing the function of fingertip prehension. The control signals are provided by two muscles of the forearm, preferably one of the finger extensors and one of the flexors. The servo-mechanism loop is completed through the visual observation of the amputee-operator.

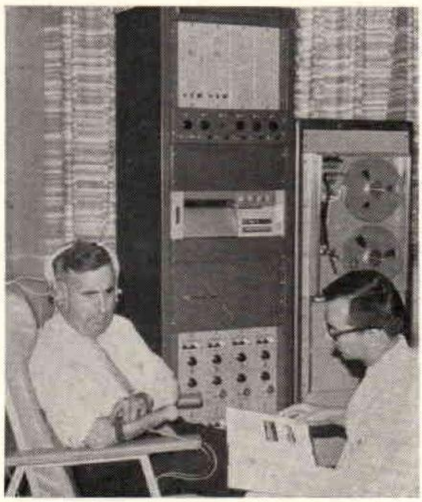
To date, the Rehabilitation Institute of Montreal has equipped 12 below-elbow amputees, 11 male and one female adults of various amputation history, with the Soviet device. Three of these amputees are bilateral cases. Working with this prosthesis provided the Institute with immediate clinical experience, greatly reducing the time delay required by independent research.

The Rehabilitation Institute of Montreal, responsible for the care of more than 30 thalidomide children, followed the developments and the literature on myoelectric control. A team travelled to Moscow to visit the Central Prosthetic Research Institute, and in the fall of 1964, through a grant from the Province of Quebec, purchased the manufacturing rights and ten prototypes. The purpose of this undertaking was to evaluate the possibilities of the Soviet device with a view of applying myoelectric control to prostheses for congenital amputees.

The functional components consist of a hand shell made of plastic material, housing the drive motor in the metacarpal area. The fingers and thumb are hinged corresponding to the metacarpo-phalangeal joint. The interphalangeal joints are fixed in a slightly flexed position. In the Soviet prototype, spring loaded electrode cups containing abrasive electrolytic paste



1. Diagram of the prosthesis with external power and myoelectric control.

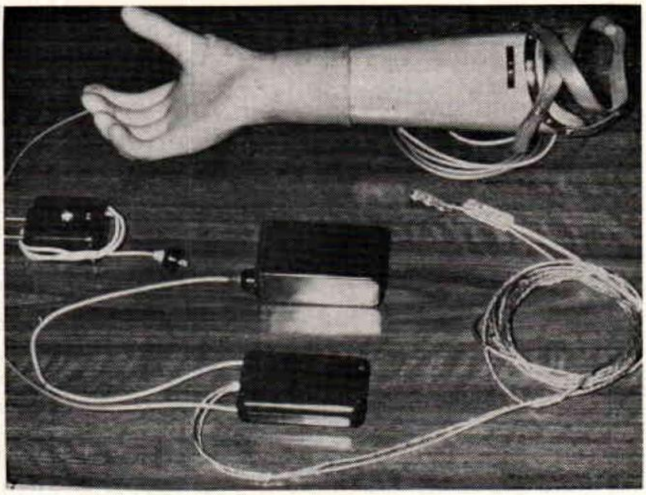


2. Blind amputee patient using acoustic signals to train controlling muscles for independent operation.

are installed over selected control muscles. Movement of the fingers and the thumb is caused by a lever, one end of which is connected to a slider block. The latter is driven back and forth by a leadscrew.

The system is powered by a rechargeable battery of 13.75 volts weighing 320 grams. The capacity of the battery is sufficient to sustain operation of the hand for 15 hours depending on the frequency of use. A small charger restores energy to the battery overnight.

Power is directed to the motor by two small relays, which control operation in opposite directions. Each of the relays is energized by a control channel consisting of a set of electrodes, myoelectric preamplifier, an integrator and a power amplifier; the latter directly connected to the relay coils. Muscle potentials are detected by the electrodes, amplified, and smoothed to produce a DC voltage approximately proportional to the activity in the control muscles. The control amplifier is designed to differentiate between the muscle signals and extraneous (electronic) noise, effectively rejecting the latter. Even with the present surface electrodes, little trouble is experienced in establishing a satisfactory signal pick-up. Most of the Institute's patients find they can operate the device without skin preparation, although using a small amount of conductive jelly helps to eliminate a short warming-up period in the morning. The control unit containing the two channels, including the relays, originally encased in a plastic box, weighs 170 grams.



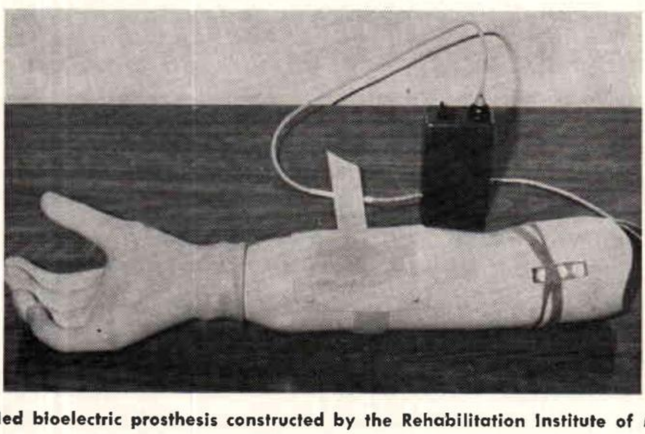
3. Prototype of bioelectric prosthesis.

The average pinch force available at the fingertips is 1.5 kilogram, which may be increased to a maximum of 2 kg., by repeating the closing command. The mechanical noise generated by the operation of the drive is audible but hardly objectionable; in fact, it provides the amputee with an indication of activity of the hand even when visual observation is not possible. An average below-elbow prosthesis with this drive weighs 0.9 Kg., exclusive of the battery.

When a set of possible sites have been identified, a multichannel device is used to determine the amount of interference or cross-talk between the muscles. The most promising pair, not necessarily anatomic antagonists, are finally selected and electrode locations established in the socket. With visual display, a significant improvement can be achieved by the amputee, greatly increasing the degree of independence of the control points.

To display myoelectric activity, an indicating meter appears to be a better choice than the oscilloscopic display or electromyographic signals.

A sightless subject was successfully trained to operate the hand by using audio-signals.



4. Modified bioelectric prosthesis constructed by the Rehabilitation Institute of Montreal.

Clinical Aspects

Patients are evaluated without the prosthesis in the activities of daily living. When the myoelectric arm has been completed the patient is trained and instructed to apply it without assistance and initiate operation. Training then consists of basic operation of the hand in different arm positions, prehension and release of small and large objects, activities demanding dexterity, speed, and co-ordination between eyes and hand. Functional activities, grooming, feeding, etc., are carried out before discharge.

No comparison between the prosthetic hooks and artificial hand is intended when the relative merits of the U.S.S.R. prosthesis are listed, however, the absence of harness and muscular effort to operate the prosthesis is a definite advantage. The cosmetic appearance is acceptable, and grip is satisfactory.

Canadian Modifications of the Soviet Prosthesis

The study of the Soviet prosthesis was commenced in December 1964. The original amplifier and battery had several weaknesses, principally due to the quality of component parts. The substitution of these with Canadian and American hardware has considerably reduced the number of failures. Component parts were obtained for a new battery pack, and newer methods for the installation of the battery on the patient were developed.

The original configuration of the prosthesis was redesigned to minimize wiring and to provide an adjustable wrist unit. The amplifier has been integrated into the socket, and all wiring made internal, leaving only the power supply wire visible. The twin electrodes on the prototype have been replaced by a triple unit eliminating the need for a separate reference electrode.

Current experimentation with micro-miniature electronics will produce a very convenient control package which will fit readily into any standard unit without the unsightly protrusions necessary with the present large amplifiers.

Conclusions and Current Work

Even the short experience with the modified Soviet prosthesis, and the heterogenous group of patients, indicates that many benefits may be derived from the use of myoelectric control.

Technically, the device requires still further development to produce an efficient and universally acceptable prosthesis at a reasonable cost. The hand at present is only available in the male adult size. Hands and interchangeable terminal devices are required in smaller sizes, to accommodate female and young patients.

Future designs will provide the means of controlling motor-function prosthesis either with electric power or in combination with other forms of external energy. Hybrid combinations of myoelectrics with pneumatic, and conventional prosthetic devices, are possible and may be beneficial for some patients.

Current work at the Institute includes the design and development of a full electric arm for every young amputees, with special reference to the thalidomide children.

Research activities into the capabilities of the human operator and human information processing techniques are very important at the present time. With the complex prostheses of the future, good understanding of the human motor system, and sophisticated controls will be necessary to establish the bridges of communication between man and machine.

Amputation: Crippling Help

by NORMAN L. HIGINBOTHAM, M.D.

Attending Surgeon, Bone Service

Memorial Hospital for Cancer and Allied Diseases
New York

A few statistics from Memorial Hospital demonstrate the magnitude of the amputation problem. In the last 35 years, 1,116 patients in the bone service have been subjected to some form of amputation, from the removal of a digit to hemicorporectomy. This is a good deal of mutilating surgery. It calls for a lot of rehabilitation.

Amputation for cancer poses a quite different problem from amputation for trauma or infection. Most are major, or high, amputations. The cancer patient is usually fully aware of his diagnosis. He lives in constant fear. His hope must be bolstered. He must be kept occupied.

It is an unfortunate custom for many surgeons to operate and then rest on their laurels—ensured of the gratitude of patient and family for a lifesaving procedure. They usually are little aware of, or interested in, rehabilitation. This apathy must be combatted.

Surgeons should be encouraged to refer patients to rehabilitation services. In cooperation with these services, surgeons must practice diligent and conscientious follow-up tactics.

The amputation patient's first question is, "Can I get an artificial limb?" Then, "Can I get instruction in its use? Where?" We must be in a position to provide tangible answers.

Let us not lose sight of the cancer patient who has a poor chance, percentagewise. Given our medical inexactitude, the "low percenter" may outlive the "high percenter" and do a better job of living and working. A prosthesis should be provided as though a cure were expected.

All too often, amputees are referred to the few existing large rehabilitation centers. These are likely to be beyond a patient's means. But most large hospitals provide occupational therapy. Most have physiotherapy units. Many have both. These units can constitute a nucleus for a hospital's development of a completely integrated rehabilitation service.

Our goal must be easy availability of rehabilitative services at all stages of disease. We must eliminate red tape and useless forms that stand between the patient and rehabilitation. No case is final until the patient is dead.

Reprinted by permission of the publisher and author from *Medical World News*, December 31, 1965.

Research and Development of the Norton-Brown Spinal Brace

by PAUL L. NORTON, M.D.

Massachusetts General Hospital

EDITOR'S NOTE: The *Journal* is indebted to Association member Herman E. Kraus, 185 Harrison Avenue, Boston, Massachusetts, for providing transcripts and assisting in editing the following group of three articles on the Norton-Brown Spinal Brace. The papers were originally presented at the Annual Meeting of Region I of the American Orthotics and Prosthetics Association.

An investigation of spinal bracing was begun about 1952, as a part of the work of a committee developed to study bracing in its entirety. This committee consisted of Dr. Joseph Barr, Dr. Thornton Brown, Karl W. Buschenfeldt, Dr. Paul Norton, and several others, with a consultant from the Veterans Bureau by the name of Dr. James Murphy, an engineer, who was the watchdog on us since the study was done under the auspices of the Veterans Administration. The investigation began in an effort to find out (1) What back braces did or were supposed to do; and, (2) What were the forces between the brace and the back:

In discussing this in committee we fluctuated between 5 to 50 lbs. of force, with nobody knowing what they were talking about. I remember well that at one of the early meetings the comment was made that the best brace would be a leather strap with a tack stuck in it. (I gave Karl Buschenfeldt credit for this, although he flatly denies this and says that Murphy was the father of it). The thought was that the tack would cause the patient to brace himself. After about four years of investigation we came to that conclusion.

The investigation started out in an easy, simple way (like falling into sin). We started by taking photographs of some well-proportioned models—these were males, without a backache—in various degrees of forward bend and side bend. It was obvious rather quickly that several things happened: (1) It showed that if we were using a long brace with secure fixation on the thorax, in forward bend the lower end of the brace was levered away from the lumbosacral area and had no control over that part: and (2) That braces which were slung low on the pelvis like the Goldthwait, adhered very well in that area but tended to pull away at the upper end.

The problem then became more complicated. We wished to know more about what was going on in the spine. The photographs were all right up to a point, but we wanted more accurate control so that we could define the motion with a degree of accuracy. So we began to use X-ray control, and here we used a special casette. The casette holder was designed by Karl Buschenfeldt. It was built so that we could control the amount of angulation in it by means of a protractor and a plumb line. We very quickly ran into a roadblock here in that the X-ray Department pointed out to us that the amount of X-ray exposure was going to be prohibitive. To carry out this technique accurately would mean that each model would have to wear all of the braces that we were using through all the various degrees of bend. This would mean an exposure that they absolutely refused to countenance. So there we were, up a blind alley at that point.

To get around this problem, we finally fell back on the use of wires drilled into the lumbar spinous processes, and also one into the posterior iliac wing. You can well imagine that the volunteers for this type of testing weren't too numerous. We had only four. Three of them were medical and one was an engineering student. This was a very productive area of investigation. It taught us a great many things that we really didn't know, and I'll come back to that a little later.

Another area of study was pressure relationships. This started off originally with the idea that the pressures developed were going to be the important things in this study. Karl Buschenfeldt made some pneumatic gauges out of some old scraps from refrigerator valves. These worked very well, but were not accurate enough in the smaller ranges for our purposes.

It became necessary for us to go over to strain gauges. Here again, it being a pioneering effort, we didn't know just what we wanted, and we called upon the Mechanical Engineering Department of M.I.T. to bail us out. A Chinese electronics specialist came to our rescue. There was a certain amount of lack of communication in language, so that our ideas of what to use in the strain gauge were not accurately carried out, but we did construct gauges. They were clumsy, but far more accurate than pneumatic gauges and they, for the first time, gave us some accurate measures of the forces that were produced up and down the spine with the different types of braces in different degrees of bend.

The pressure studies showed that measurements made on the different types of braces—measured in pounds on the shoe of the strain gauge—varied in a range from 20 lbs. up to as high as 80 lbs. Yet it was obvious that pressures of this magnitude on the soft parts (the paraspinal muscles) had very little effect on restricting motion. However, when pressures were applied on bony prominences, it was a horse of quite another color. Now, as I said before, the first thing we noticed was that with the conventional types of braces, with paraspinal uprights, in any degree of bend there was an immediate departure of the back from the brace, either at the upper or lower end, depending on whether we were using a short brace or a long one.

This was confirmed by studies as we went on. The finding that set us off on the new trail was the demonstration of the effect of pain on spinal motion. This was done by means of a relatively simple experiment in which the victim was placed face down on a table with a frame over him. We had one of the strain gauges set up on a long screw mounted to the frame. The shoe was placed on an appropriate area, such as the posterior superior spine, a spinous process, or soft parts; and was screwed down in increments of a quarter of an inch to so many turns of the screw. It really was a modified electronic rack. By calibrating the amount of forward thrust of the shoe against the readings on the recorder, it was possible to plot the build-up of pressure at the various levels. It was evident that there was a very rapid build-up of pressure on the bony prominences.

Now, this type of thinking, that is to produce pain to stop motion, was completely foreign to the training of all bracemakers up until this time. Men had been trained with the thought of supporting the back; that braces should be comfortable; that you should stay away from bony prominences at all costs. This new concept is rather heretical in its conception and it was with a great deal of difficulty, I must confess, that it was accepted at the start.

I think that this covers the basic principles. There is a tremendous amount of work that has gone into this. This research lasted about four years, probably four and a half. It reached the stage where my colleague's wife confided to her friends that I was public enemy No. 1 for keeping her husband out nights (we worked on this generally at night). But, over the period of time, our testing of the various types of braces showed that the long braces, securely fixed to the thorax, produced more lumbosacral motion than no brace at all in the same degree of forward bend. This was a little bit startling but it is perfectly reasonable that when you bend forward, you are bending through all your spinal joints as well as your hips. So the forward bend is a composite motion of trunk and thigh flexion, and the motion in the trunk is taking place over many segments. Now, if you eliminate some of them or compromise them by cutting down on the motion in the upper back, (the dorsolumbar area) you must bend somewhere and if you can't bend easily through the hips, you are going to bend through the lumbosacral area.

In spite of this finding, the long type of brace is still used by some surgeons to immobilize the lumbosacral junction following spinal fusion.

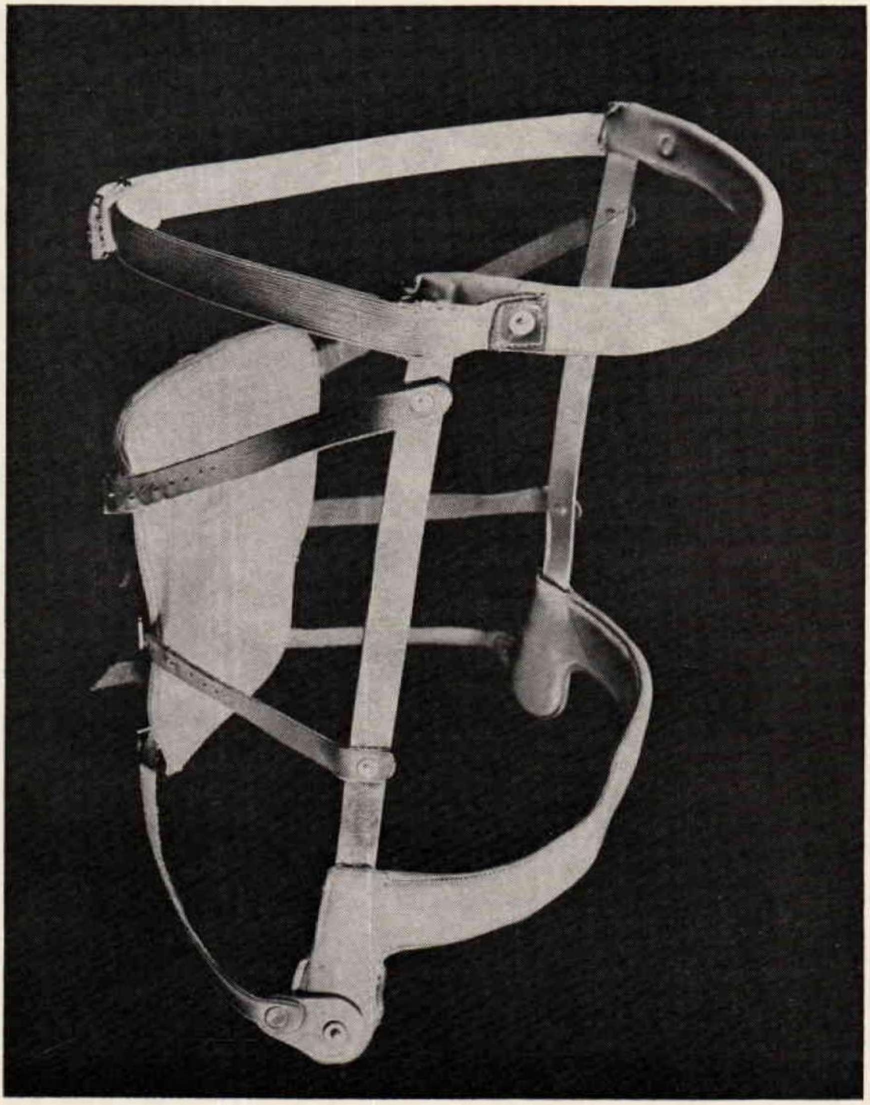
We had many other studies. We did force plate studies, testing the shift of gravity with various types of supports. We also went into an investigation as to the type of abdominal support: what effect it had; whether small pad or large pad; placed low, in the middle, or high. It seems so many people come in with braces in which the abdominal pad is riding up over the ribs and we thought it was important to find out just where the pad should be and where it would be most effective. The outcome of this study was that, for the pad to be effective, it had to be low. We found that the straps should be narrow, so that when the thigh was flexed the straps would lie in the crease of the groin. If you put a broad strap on some patients, the minute the patient sits down the thigh hits on the strap and the brace rides up and down on the back.

The design of the brace—this gradually grew on us and we finally ended with a brace that, (1) had no paraspinal uprights; (2) the uprights were in the mid-axillary line; (3) the axis of motion of the hip and the axis of motion of the bottom strap were positioned so as to be at the same point over the tip of the trochanter; and (4) the bottom cross-band was positioned so that it would impinge deliberatelly on a bony prominence. Ideally, one would like to have the band pressing on a spinous process of the vertebra which one wants to stop from moving. We were chagrined in one case, one of our victims had a very small spinous process of his 5th lumbar and when we put the wires in, we missed L-5. We figured that if this happened to us it would happen to the bracemaker too if he were to measure a patient with a small spinous process and there would be confusion.

The posterior superior spines are always subcutaneous, one can always palpate them, even in the well-padded females, one can spot them by the dimples on the skin. The cross-bar is placed low down towards the tail, below the posterior superior spine, so that in a bend the upper edge of the bar will ride into the spinous processes. We started out by placing the band on the top of the process but found that in the first minute the band was over the top and there was no discomfort associated with it at all so we deliberately dropped the bottom bar down and pitched it in a bit to be sure that the end sank into the posterior superior spine with a good bite.

The upper cross-bar is placed at a level from 3 to 4 inches below the inferior angle of the scapula, depending on the length of the torso. In the long individual, one would place it about 4 inches down, and on a shorter individual, 3 inches. This type of brace has the advantage of putting the bite where you want it and of not tying up any more of the spine than you need to immobilize.

The pad we finally designed was a fairly large one, actually 9 inches in most of the cases. This had two advantages: first, by being held snugly with the bottom strap, it gave effective support; and secondly, it was long enough so that it would dig into the region of the xyphoid if the individual slumped.



Norton-Brown Spinal Brace (Courtesy Orthopedic Services of Rhode Island)

Now, there are so many facets to this investigation that I find myself somewhat confused in trying to cover them all. There are several areas where rather important discoveries were made and probably one of the most interesting ones, beyond the fact that the long braces did produce more motion in the lumbosacral area than no brace at all, the next finding of interest was that in the wire studies we found that the patients (or the victims, let us say) sitting in the slumped position, in a relaxed posture, had more spinal flexion or bend than the same individuals bending over and touching the floor. This is rather important in the protection of a spinal fusion. When this paper was given in Los Angeles, Dr. Vernon Nickel said, "You know, that explains what we have been doing. We have, for several years, stopped all our patients from sitting, following spinal fusion. We either made them stand up or lie down, and this explains why."

Now, one other fact that I ought to mention that came out of this study, and this is basic, not only to the problem of bracing the low back but also, to my way of thinking, in the etiology of disc lesions in this area. It is that forward bend differed quite markedly in the individuals tested. Now, my colleague was able to bend forward and touch the palms of his hands on the floor, with his knees straight, one would say, "now there's a fellow who is quite limber. He can bend over and touch the floor." Whereas, when I bent over I was lucky if I could get just below my knees. So, one would say, "this poor devil is hamstrung and he has very little mobility." Actually, the wires showed that because I was hamstrung and muscle bound, I was getting my bend through the back. I was limited in getting down through the hips so I made it up in the back. Whereas, my co-worker had very loose hamstrings, he would go over into a forward bend without getting motion in his spine at all. Now, this brings up the point that the individual who is hamstrung, if he is working in heavy industry, lifting, is a perpetual candidate for trouble. For if he bends forward to his elastic limits, then he needs very little in increased load before something has to give. Dr. Thornton Brown later demonstrated that if too much stress is placed on the back, structures are susceptible to injury, particularly with fractures into the centrum and disruption of the mechanics of the disc.

The time spent on measuring the pressures was tremendous; this was due to the poor design of the brace. Actually, we didn't know what we wanted at the start. We just wanted to have them built and modified to overcome various difficulties as we went along. The design of the gauges was such that we had to take them apart every time we wanted to take off one brace and put on another. This would no longer be the situation today because these gauges, which weigh probably about ¼ pound a piece with the wiring, are now made up in the shape of a disc about the size of a tencent piece and, I hope, someday that we will be able to repeat some of this experimentation to get around certain technical objections to the study. In other words, we were measuring at specified points and not over a long consecutive strip on the skin.

One other device we used was a gadget that measured the degree of bend of the trunk. It might be interesting to know how these recordings were made. We used a four-channel Sanborn recorder, something like an overgrown cardiograph and we had a switch box which allowed us to measure 14 stations, by simply flicking the switches we could pick off 14 points, one of which was set up to give us the degree of bend of the trunk in relation to the thighs. We had three other areas to record at the same time.

Now, to come back to the point I made before about the difficulty we had with having the recordings comparable. We found, for example, that we would set up an experiment and set the gauges in place. We would have the individual bend forward and when he came back up straight, instead of the baseline being back at zero, it would have shifted. It took time to realize what had happened was that in this area of the spine there was some give to it and that the pressure of the shoes was forcing the individual to move away. When we realized this, we began to think in terms of local pressure as a device for preventing the individual from bending. It is like the story of the fellow who got into trouble by killing somebody and finally ended up by playing cards. We went down the primrose path in this fashion and designed a rather crude looking brace which embodied some of these concepts, that is, the rapid application of pressure over a bony prominence so designed as to limit the degree of bend through the individual's own muscles.

Clinical experience has shown that the brace has been quite effective and, even making allowances for mis-application or mis-use, it has been well accepted. I might mention that as time has gone on there have been modifications added to this and within the broad concepts of what it is designed to do, individuals who study the problem may find variations that they will like particularly. The basic thing is that this is not designed to be a piece of apparatus that is worn in comfort. It is a hair shirt. It is designed to produce pain if the individual exceeds the allowable amount of bend that one decides upon.

The first thing that we did in some of the cases of a spine fusion was to use a latch-graft. This is the locking graft, which is shaped like the letter H and is wedged under the spinous process at L-4, 5 and hooked under the spinous of S-1. It can be modified by drilling a hole and pegging the spinous process of L-5 up through it. This type of graft is usually secure when the spine is in extension. It is put in when the spine is flexed and then the back extends and locks it into place. Now, so long as you hold the spine in extension, the graft is secure but the problem is that as the spine flexes, particularly in the sitting position, it opens and one begins to get motion and may run the danger of pseudarthrosis. The third cross-bar was put in to make the act of slumping painful. The way this is done is that the brace itself is made first, that is, with the upper and lower cross-bars, and as soon as the patient can get up it is fitted, and then the third cross-bar is placed with the patient in the erect sitting position. In that position, the cross-bar goes right across the incision and should just touch the skin so that if that person sits erect, he will not be uncomfortable. He may not even know the brace is on, but God help him if he slumps. It is just like getting stabbed, and it is a very effective way of stopping him. This type of brace will not be comfortable in a soft chair. In anything where there is a lot of give, the patient will be very unhappy about it. But he must be warned about this and must be conditioned to accept it. Once you have explained to him what you are out to do and get his cooperation, you find very little in the way of complaints. A lot of difficulty with the bracing I think, is the lack of communication between the patient and the bracemaker and the doctor as to just what you are trying to do and just how you propose to do it.

Another modification was to put on some cow-horns. I first did this in a rheumatoid arthritic who was completely unhappy with a Taylor brace and refused to wear it. Much to my surprise, it proved to be a very effective and comfortable rig, and I use it now almost exclusively.

I think at this point I might as well stop and have Karl Buschenfeldt take over and then we can come back if any questions are asked.

Measuring and Fitting Techniques of the Norton-Brown Brace

by KARL W. BUSCHENFELDT, C.O.

Stoughton, Massachusetts

We have just enjoyed a most instructive paper from Dr. Norton on how to find out what a brace is doing, and what it ought to do. For many years we have constructed braces without knowing their efficiency. Frequently, we receive prescriptions for different types of braces for the same back conditions, and wonder why. What is the brace doing in each case? This is one of the reasons why the investigation by Dr. Norton's committee was started.

I am going to take you back a few more years to the time when I had the opportunity and pleasure to read Dr. Taylor's paper, written when he first designed the Taylor back brace. I am speaking about the Taylor brace because I believe that most of us know it as one of the braces as much and as often used for back ailments as any other back brace.* Dr. Taylor called it a spinal assistant. His paper left a deep impression on me.

Before quoting from his paper, I would like to give a short biography of Dr. Taylor. He studied under Dr. Ginoshen at New York Medical College, where he received instruction about the diseases of the spine known at that time. No appliances had been used in the treatment of spinal disease. Fresh air and exercise only were prescribed at that time. Dr. Taylor designed a brace for his first patient in March 1857. This case was followed with two other cases in varying stages of that disease* during that year and both patients died. He had a fourth patient whose condition was so critical that it aroused him to make use of a brace.

And now I am going to quote from Dr. Taylor's paper:

"I talked with physicians and surgeons, visited the shops of instrument makers with no results. Those who felt the need for support always talked on vertical support and all instruments were constructed with that idea, but it was that idea only with no fixed point below or above. I wrestled with the idea to get fixed points which would include extremities and spinal column. The real light broke through when I finally adopted the term of protection to a diseased vertebra. I think the term in mind determined the case and thought and its consequences. I remember how my mind hovered around it as one looks for something strange, until I became totally possessed by it."

I am quoting this just to show that some hundred years ago acknowledged surgeons were spending time and effort in order to find a support for

* The Taylor brace is described in the **Orthopaedic Appliances Atlas**, Vol. I, pp. 183-185, which states: "The most familiar spinal brace of American origin, and the one most widely used even today, is that described by **Charles** Fayette Taylor in 1863, popularly known **as** the 'spinal assistant.' " (Editor)

back ailments. Continuing from his quotation about the construction of the brace—

"Thus the spinal assistant was composed of two uprights because with no other form is it possible to prevent lateral deviation while exerting anterior and posterior force. The first instrument had only several cross pieces, belly band and apron. The upright was made with two hinges that bent backward but not forward, in order to allow the muscles to act when they wanted to but to protect the affected vertebra in case the muscles should tire and relax."

I took the liberty of constructing a copy of Dr. Taylor's first back brace the way I could interpret it from his paper. But at the same time, I would like to impress here that it was considered as a support, and not as a corrective brace. It had three crossbars, a hinge, a pelvic band and a large sided apron. Now, he says in his paper that he wanted his patient to be able to go into hyperextension and prevent flexion; that is the reason for the hinge. Here again I am going to quote from Dr. Taylor's paper to demonstrate to you that Dr. Taylor was not happy with that brace at the time.

"The second apparatus had its uprights extended upward and later were curved over the shoulder. I very soon found it necessary to arrange stop stools and ultimately, as you know, the hinge arrangement became the means of wiring the uprights into sections for convenience of adjustment or alteration, or making it longer or shorter. The hip band, so-called, had two vertical pieces to still further prevent motion at the affected vertebrae and jostling of the apparatus."

In order to properly demonstrate the changes of this brace, I again used a cast, and tried to demonstrate Dr. Taylor's design of his second brace. At a later date he extended the uprights upward curving them over the shoulder to the mid-portion of the trapezius muscle using chest and clavicle metal pieces in connection with the shoulder straps.

Here I would like to point out that where the metal pelvic band extended downward in order to try to gain more stabilization of the lumbosacral area, Dr. Taylor again felt that changes should be made, and here I quote again: "I suspect some modifications of the combined chest pieces and shoulder straps, probably in the insertion of a curved piece of steel to raise the cross bar straps slightly above to prevent unpleasant pressure on the sternum, will ultimately supersede the chest piece, but these are only details relating to the efficiency and comfort, but with no modification of the principle as first conceived and related."

Up to the present time many changes have been made in the construction of this type of brace, but not in its principle. A plain pelvic band has replaced the U-shaped pelvic band which Taylor used in his later braces. You note that our present pelvic band conforms more to the design of the first brace. The uprights today are not hinged nor are extensions used, but are made of rigid and semi-rigid materials, spring steel or 24 S.T. aluminum, depending upon the amount of support necessary. A small anterior pad has replaced the apron and to my knowledge no chest bands are used today but only shoulder straps.

In the measuring and fitting of that type of brace I believe that we should consider what that brace is supposed to do. What is it meant for? Is it for support or is it used for correction? You should consider age,

*** Potts disease, osteitis of the vertebrae, usually of tuberculous origin. The Taylor brace was designed to treat Pott's Disease of the Spine. (Editor)**

sex, and most important, what it is meant to do. It will change the length of uprights, it will also change the placement of pelvic bands and crossbars. If it is a supportive brace, you will probably not use the narrow Taylor upright, but you may need complete padding from the upper cross bar down to the pelvic band in order to have a little broader surface and you may find that the pressure on the muscles will create a problem of discomfort. If you want to use that brace for correction in the dorsal area, then you should not pad it to that extent where it will be comfortable and act like an easy chair, but rather pad it so that when the patient does go into flexion it will press and be very uncomfortable. The most important thing to know is what that brace is supposed to do for the patient.

The Norton-Brown brace, in my opinion, is the only brace which was the end result of a very thorough investigation of what a brace is meant to do, the stabilizing of the lumbo-sacral joint, and in the measuring and fitting of this type of brace the location and length of the pelvic band, lower chest band and the length of the lateral uprights have definite purpose. With this brace the bony landmarks are valuable in the measuring and fitting. Dr. Norton has already said where the pelvic band is placed, the upper cross-bar approximately 3 inches below the lower angle of the scapula because it is rather easy to locate and when you have a patient with a painful back you cannot look for either the 9th or 10th dorsal vertebra. The lower pelvic band is just below the posterior-superior spines.

I have tried to point out some of the changes in back bracing which have taken place during previous years without definite proof as to the value of these changes, and I am thoroughly convinced that changes are taking place regardless of efficiency of a certain type of brace. For changes have already taken place in connection with the Norton-Brown brace. Complete corset fronts are added without emphasis which, in my opinion, is important in maintaining the three-point pressure principle. Taylor-type extensions have been added to some of the braces from the upper cross bar to the shoulder straps. Complete posterior uprights have been added to this type of brace extending from the lower pelvic band to the upper angle of the scapula, again with shoulder straps included. In asking questions about changes of this type, I have had different answers from the medical profession. In one or two cases it is a question of localizing edema post-operatively, probably using the posterior uprights with the complete padding, which may prevent some of the edema but, again, I am just mentioning the fact that changes are taking place continually in back braces and I seriously feel that Dr. Norton's investigations should have been continued. I am sure we all realize that Dr. Norton didn't have the time, nor Dr. Brown, to continue until 12 o'clock at night to try to give us the information we are all looking for, but I hope that we will again, at a later time, have further investigations, for in back bracing I believe this is of great importance to the patient and to us. Thank you.

Question Period

Question: Dr. Norton, how long do you like to have them wear this brace? How soon do you have them return to you after they have been fitted?

Now, that brings up a good point. When you know you are going into surgery, the measurements should be made on a patient pre-operatively and the first cross-bar should be fitted after the individual is up in the brace. It should be fitted in the erect sitting position in a firm chair so that the cross bar comes over the incision and just touches the skin. It should not be uncomfortable, if they are honest. If slumping takes place, they are going to beat you but be firm ahead of time. The device produces a conditioned reflex, and after a while people will walk around and sit like West Point cadets. The bracing is carried on for a period of six months.

Question: Doctor, I have never been able to get it clear to myself, the business of sitting erect is a conscious effort on the part of the back musculature or you may slump at any time, is it not. I don't understand what makes this a conditioning treatment if the person has to be conscious at all times of sitting erect. Isn't this exhausting?

No, you could train yourself to do this. Take a military cadet at West Point or Annapolis, at the end of the four years of brainwashing into sitting erect, even at mealtimes, they come out of there like Ford cars and it will last. I've known graduates of a military academy who are just as straight as ramrods up until the late 80's. It is a conditioned reflex and it has to be kept up long enough to become automatic. Six months, with the prodding of a sore back, will accomplish wonders.

Question: You spoke about a female wearing this next to the skin. Does this also hold true in a male patient rather than over a tee shirt?

Well, you can have a thin tee shirt, I don't think that can hurt but not anything slippery or extra padding. This should be avoided.

Question: Doctor, as to the site of the upper bar. As you, in your paper, pointed out, any inclusion of the upper back just increases the lumbar flexion. I have been using, as I understand, between the 7th and 8th, where most of our forward flexion occurs, and not always getting it over the 9th dorsum, is this correct?

Yes, it depends a lot on the length of the thorax, this is just empirically 3 or 4 inches below the angle of scapula but the point is not to immobilize any more back than you have to.

Question: But what I meant was after I get over the 7th or 8th dorsum, regardless of back length, unless I can find out exactly where I am, won't I get counter-forward pressures from above?

Yes, you'll get up too high. Try to keep the brace as short as possible to do the job.

Question: Did your studies prove out this? That the most forward flexion occurs in the upper part of the spine between the 7th and 8th dorsum?

We didn't go up on that. The only bit of work we did on that actually was some of our X-rays on the Taylor brace. We used two Taylor's, the regular Taylor and a set up reinforcement. It was extremely hard to remedy motion in the dorso-lumbar junction. We didn't study the motion up in the dorsal area.

Question: How do you control the brace from riding up when they flex?

Well, number one, is to keep the groin strap narrow; number two, is to make sure that the actual motion of the hip and the brace are the same; number three, probably the most important of all, is to keep the groin strap tight.

Question: Dr. Norton, in your experiences have you had more trouble with female patients than males accepting this brace? The areas of failure we have seen have been more in females than in males.

Well, number one, they backed us down in a hurry on the original brace when we had disc. The women didn't like that at all because it showed under their dresses, and as a result of this we had to get rid of the disc and use the extended portion. Beyond that, I couldn't say we had had more trouble with the women than the men.

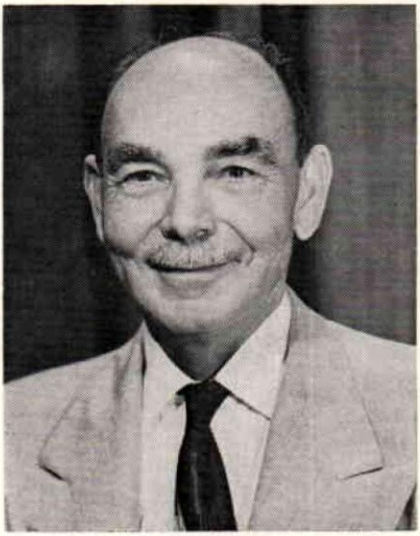
Question: What about the obese patient, is the brace as effective?

No, not as effective as with a thin person, but it will still work if you sell them the idea of really getting up and around.

Question: Dr. Norton, when you said your investigation of the Taylor back brace created more flexion on the spine than in a person who did not wear a brace, were you referring to the lumbo-sacral level of the spine or the overall?

No, the lumbo-sacral joint.

MEMBERS OF PANEL ON NORTON-BROWN BRACE



Karl W. Buschenfeldt, C.O.

David L. Brook, M.D.

Clinical Evaluation of the Norton-Brown Brace

by DAVID L. BROOK, M.D.

Chief of Orthopedics, Veterans Administration Hospital
Providence, Rhode Island

Clinical Instructor in Surgery, Boston University School of Medicine
Boston, Massachusetts

The whole problem of disorders of the lower back is largely a subjective matter which gives rise to wide variations in opinion and interpretation from doctor to doctor, from patient to patient, and even from doctor to patient. The symptoms are always subjective, the physical signs are frequently sparse and the etiology, diagnosis, and treatment often controversial. In order, therefore, to keep one individual's evaluation of a specific modality of treatment in this nebulous field in its proper perspective, it is necessary to have a clear understanding of the criteria and expectations with which he prescribed treatment as well as the means used to judge its effectiveness. Before presenting our experience with the Norton-Brown[1] brace, it is necessary to elaborate on our indications for using it.

Over a period of three years, we have prescribed this brace for about 60 patients. Table One shows how the prescriptions were distributed throughout our patients during that time. These braces were not prescribed with any particular study in mind, but rather on the basis of a preconceived impression that their greatest usefulness would be found in patients whose symptoms were judged to be due to lumbar extension or hyperlordosis. It should be noted that this is at variance with the experimental findings accumulated during the design of the brace. We have no strain gauge or X-ray studies to prove our contention that the brace prevents hyperextension, but clinical experience seems to confirm this point. The Norton-Brown brace appeared to us to be an improvement on the Williams brace and we began using it on this basis.

Consideration of the prescription of the brace for any given patient was made only after a practical period of other forms of treatment. This treatment routinely consisted of bedrest, possibly with traction, followed by physiotherapy stressing Williams'[2] principles, as well as general reconditioning. If the patient was unable to carry out the physiotherapy program because of the signs and symptoms of nerve root compression, the offending disc was excised and then physiotherapy was begun or resumed, whichever was the case. If, after all these measures had been employed, we still had a patient who, although obviously improved, could not foresee continuing physiotherapy on an outpatient basis or returning to productivity within a reasonable time, we tried a sample brace on him. He would be allowed to wear it home over the weekend, or between clinic visits, and only if he convinced us that the brace seemed to help him off the plateau he had arrived at in the progress of his rehabilitation would we prescribe for him a brace of his own. No patient was ever told that he had to wear a brace. This method of prescription after a trial period was originally an economy measure, but as it turned out, most patients learned rather quickly that the brace was only a temporary adjunct to the therapy or rehabilitation program.

TABLE ONE

Category*	No. of Pts.	Braces Prescribed	
Lumbo-sacral strain, acute	39	2	5%
Lumbo-sacral strain, chronic	100	8	12%
Herniated I.V. Disc:			
Treated conservatively	89	21	23%
Operated	26	17	65%
Pseudarthrosis	4	4	100%
Spondylolisthesis	10	6	60%

* All patients had symptoms severe enough so as to require hospitalization.

Since the brace was prescribed only for those patients who convinced us that it was effective, it would seem that a glance at Table One would reveal how useful the brace was as a part of our armamentarium in the treatment of low back disorders. It is apparent, however, that any conclusions based on the number of braces prescribed would be valid only if all patients were "cured." Theoretically, to cure a patient with acute or chronic back pain would mean that we must render him pain-free and eliminate any danger of exacerbation no matter what the patient chose to do with his back thereafter. Unfortunately this is seldom achieved and may be truly impossible in many instances, and both the patient and the physician must accept some compromise. In medico-legal language this compromise is frequently termed a "disability" and we must use some discretion to make certain our prescription does not tend to exaggerate this disability in the eyes of the laity. Nevertheless, most back problems involve either delay or possibly some reduction in the earning capacity of the patient. In some cases permanent reductions in earning power must be accepted in order to prevent real or theoretical recurrent injury. The time a man is out of work because of acute or chronic back injuries varies according to his age, general physical condition, motivation, and his ability to apply himself in his rehabilitation program. Theoretically, these variables should be carefully controlled if one is to evaluate any form of treatment in this area, but many of these factors are beyond the scope of the physician. Even such intangibles as the personalities of the physician, the therapist, or the orthotist may influence the outcome of the "back case." The point is that subjective evaluation, as unscientific as it may be, is unavoidable and at the present state of the art, may be a necessity if we are to communicate the results of our endeavors.

The intriguing feature of the Norton-Brown brace, in our experience, has been that when it is applied to a patient whose continuing discomfort is due to lumbo-sacral hyperlordosis, he feels better in the brace the moment it is applied for the first time. This point has been so dramatic that some of our residents have taken to trying the brace on a patient during the course of their work-up in order to ascertain how much of the patient's symptoms are on a postural basis. Whether the patient requires a brace of his own for protection, as a reminder of what he should accomplish with his own muscles, or to get back to work before his rehabilitation has been completed, or whether it is to be used on a long term basis by the older patient who has little capacity or potential for corrective exercises, is a matter for individual consideration.

In conclusion, I would like to say that the Norton-Brown brace seems to satisfy us and some of our patients. Quite frequently it has served as the extra measure or extra ingredient in the formula that has spelled the difference between success and discouragement in an area which often taxes our art to the limit.

ADDENDUM: Since this paper was originally presented, it is only fair to say that we are not at present [November 1966] prescribing this brace as often as in the past. This is not meant as a reflection on the brace. On the contrary, what we learned about the importance of posture during the days when we employed the brace more frequently lead us to take advantage of the V.A.'s unique facilities and increase our periods of bed rest and intensify our corrective and reconditioning exercise programs. Nevertheless, the Norton-Brown brace remains the only appliance we consider using when we feel an appliance is required for conditions involving the lumbo-sacral area.

REFERENCES

1. Norton, P. L. and Brown, T. "The Immobilizing Efficiency of Back Braces." *The Journal of Bone and Joint Surgery.* 39-A:111-139, 1957.

2. Williams, P. C. "Conservative Management of Lesions of the Lumbosacral Spine." *American Academy of Orthopaedic Surgeons Instructional Course Lectures.* 10:90-121, 1953.

Historical Development of Lower-Extremity Prostheses †

by O. FLIEGEL, M.D. and S. G. FEUER, M.D. *
Brooklyn

In studying the history of the construction of artificial limbs to substitute for lost legs, which has been transmitted to us by written words, objects of art and handicraft, objects found in excavations, and so forth, and learning of the development of the artificial leg through the centuries, one gains knowledge of the foundation on which modern prosthetics is based. Such an historical review, furthermore, permits one to appreciate what modern scientific prosthetics and rehabilitation have accomplished to date for the limbless.

The loss of the means of locomotion is a tragic disaster for the animal. Such a loss deprives it from hunting, from protecting itself against the vicissitudes of weather and climate, and exposes it to the likelihood of a miserable death. Man, with his inventive brain, found ways and means to help himself and to escape the fate of the animal. It has been stated that, ". . . the history of artificial limbs is probably as old as humanity, as it is supposed that a maimed fellow would try to find a remedy for his imperfections."[1] A branch of a tree, used as a stick or a crude crutch, substituted for a lost leg and helped man to regain his power of locomotion. These crude primitive aids were, of course, a far cry from the conception of an artificial limb.

The Era of Antiquity

It is not known when and where the first prosthesis was produced. The earliest mention of an artificial leg seems, according to Major, to be in Indian literature.[2] He states that in the *Rig-Veda,* the oldest book of the *Vedas* (Veda period of India, about 1500 to 800 B.C.), the use of artificial eyes and artificial teeth, as well as artificial legs, was recorded. One wonders that no other records from the ancient Orient, referring to artificial limbs, have been found, although it must be assumed that war injuries, the cruel punishment of errant citizens, and the inhuman maiming of war prisoners which were practiced in that era, as well as the endemic diseases which caused the loss of parts of extremities, must have propagated the idea of the production of artificial limbs.

Our research on this subject, as far as ancient Chinese history is concerned, was fruitless. Correspondence with the China Institute in America

† Reprinted by permission of the authors and publisher from **Archives of Physical Medicine and Rehabilitation**, Vol. 47, No. 5, May 1966, pp. 275-285.

Chief, Surgical Service, Veterans Administration Outpatient Clinic.

*Chief, Physical Medicine and Rehabilitation, Veterans Administration Outpatient Clinic, and Clinical Assistant Professor, Rehabilitation Medicine, Downstate Medical Center, University of the State of New York.

and with Professor Joseph Needham of Cambridge reported that they had not come across any evidence in this branch of traditional Chinese medicine on the use of artificial limbs after amputation; it was further reported that their studies had not yet been all-exhaustive and they would not be at all surprised if they ultimately did find some evidence or reference to this type of practice. Correspondence with scholars and teachers of the Old Testament failed to produce any information on this subject other than the fact that chopping of toes and thumbs as a cruelty practiced on captured Jewish prisoners of war is mentioned.

Following this era the earliest historical record of a prosthesis seems to be that from Herodotus (485-425 B.C.).[3] In Book IX of his great historical work, he tells the story of the Seer Hegesistratos of Elis who was imprisoned by the Spartans and held with one foot immobilized in the stocks. After obtaining a knife, he amputated his foot through—"apetame ton tarson" (original Greek text)— what we believe to be the Chopart joint— thus enabling him to put weight on the heel after his escape from prison. The story further tells that he ultimately supplied himself with a wooden foot.

Although the Greco-Roman physicians from Hippocrates to Celsus and Galen described amputations, they made no mention of any prosthetic devices. There is no doubt that peg legs were known and used in this era as evidenced by several historical discoveries. Beaufort[4] described a vase from the Louvre which displays the figure of a man supporting himself with a long stick attached to a peg leg at the knee; the foot of the other extremity is substituted by a wooden capsule. This vase was found in southern Italy and it is said to be the product of the fourth century, B.C. In 1862, the fragment of an Ionian vase was found (fig. 1)[5] decorated with the figure of a naked man, sitting in a chair and holding in his left hand a lyre; the

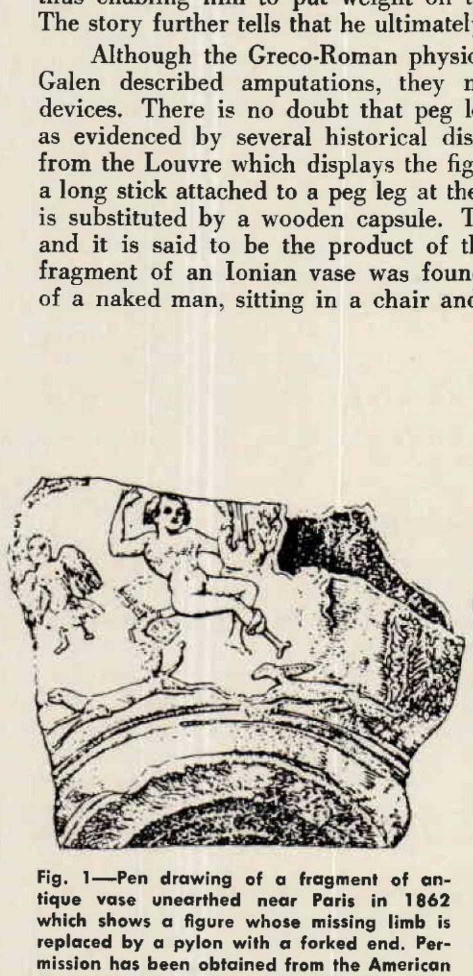


Fig. 1—Pen drawing of a fragment of antique vase unearthed near Paris in 1862 which shows a figure whose missing limb is replaced by a pylon with a forked end. Permission has been obtained from the American Academy of Orthopaedic Surgeons to reproduce this figure from the Orthopaedic Appliances Atlas.[5]

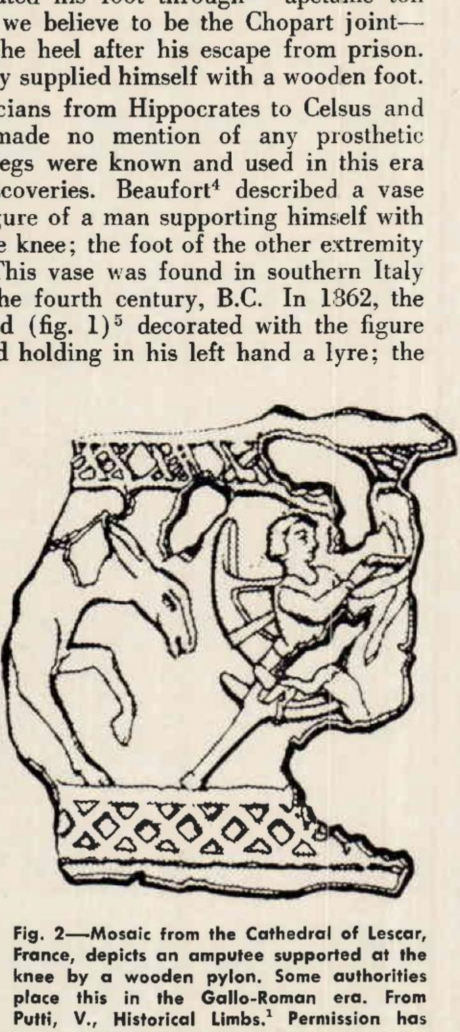


Fig. 2—Mosaic from the Cathedral of Lescar, France, depicts an amputee supported at the knee by a wooden pylon. Some authorities place this in the Gallo-Roman era. From Putti, V., Historical Limbs.[1] Permission has been obtained from the American Academy of Orthopaedic Surgeons to reproduce this figure from the Orthopaedic Appliances Atlas.[5]

distal half or two thirds of the right leg is apparently missing and substituted by a peg leg. The archeologist, De Longperier, described a mosaic from the Cathedral of Lescar, France, dating back to the Gallo-Roman era which shows a figure with a peg leg attached at the knee (fig. 2).[6]

Of particular interest, as far as the history of American prosthetics is concerned, was the discovery of an old Peruvian pottery mentioned by Gillis in his *Monograph on Amputations* (1954);[7] it depicts the figure of a man with a leg amputated at the tibiotarsal junction and holding in his right hand a pointed cap to be adjusted to the stump of his leg.

Preuss, in 1911,[8] reported the existence of several chapters in the *Talmud* in which artificial limbs are mentioned. In the tractate *Shabbath*[9] Rabbi Meir and Rabbi Jose discussed the problem of whether or not the Sabbath law, which forbids the carrying of objects, was applicable to the wooden leg of a man who had lost his limb. This prosthesis was described as a log of wood, hollowed out to receive the stump, which had a receptacle for pads upon which the stump could rest. This part of the *Talmud*, called the *Mischna*, was completed in the second century, A.D. It is not clear whether the above discussion refers to a prosthesis for an above-knee stump or a long below-knee stump or, according to the interpretation of Preuss, to a forefoot amputation.

In an article published in 1939,[10] Popp stated that "wooden artificial legs were often mentioned in the sagas of the Nordic mythology." According to the *Gettir-Saga*, Oemund Ufeigsson lost a leg below the knee in battle; he later walked on a wooden leg from which he derived the name Trefote (the wooden foot).

The oldest artificial leg ever unearthed was found in 1858 in a tomb of Capua and was sent to the Museum of the Royal College of Physicians and Surgeons in London. Unfortunately, it was lost in 1941 during an air raid. It was supposed to date back to 300 B.C., the time of the Samnite wars. Photographs and descriptions are preserved. The leg is described in the following manner:

"Roman artificial leg; the artificial limb accurately represents the form of the leg; it is made with pieces of thin bronze, fastened by bronze nails to a wooden core. Two iron bars, having holes at their free ends, are attached to the upper extremity of the bronze; a quadrilateral piece of iron, found near the position of the foot, is thought to have given strength to it. There is no trace of the foot and the wooden core has been entirely crushed away. The skeleton has its waist surrounded by a belt of sheet bronze edged with small rivets, probably used to fasten a leather lining."[11]

Summarizing our knowledge of artificial limbs in the era of antiquity, we have found evidence that wooden legs in the form of peg legs were built and used from earliest recorded times. The wooden leg was designed mostly for loss of limb below the knee. The survival rate for those with above-knee amputations probably was small, if amputations ever were attempted in this region. The knowledge that we have of primitive surgery and inadequate wound treatment makes this hypothesis rather sound. It seems quite logical to assume that only a small minority of the maimed obtained artificial limbs and that this minority probably represented the privileged classes or those who were mechanically inclined and fabricated their own prostheses. A few carpenters and armorers tried their hands in producing artificial limbs. The physicians and surgeons, as such, seem to have had no interest in the care of the patient after amputation or they did not feel the necessity of being concerned with the problem of the prosthetic device.

The Era of the Middle Ages

Very little progress in the development of artificial legs is recorded in this era. Those who could afford it, probably provided themselves with wooden peg legs. The peg leg is the simplest, cheapest substitute for a lost leg; it lacks delicate metal parts which might be more subject to wear and tear. The peg leg, as mentioned previously, has been in use from the earliest centuries of history right up to the present date. It is considered the artificial limb of the poor. But, in the Middle Ages, the poorest were unable to obtain even this peg leg; they hopped around on crude crutches or propelled themselves on movable benches or discs. The privileged classes of this era, represented mostly by the knights, were inclined to conceal their battle disabilities rather than to wear wooden legs. Putti[1] shows the photograph of and describes an iron lower limb (fig. 3), the knee of which is in flexion and the ankle in plantar flexion, both joints without any freedom of motion; it was built in the fashion of an armor of that period and imitated the position of a leg of a knight on horseback. It should be remembered that during the same era when no progress was made in the construction of lower extremity prostheses, artificial iron arms were constructed with ingenious finger motions which enabled the knight to hold his lance or sword.

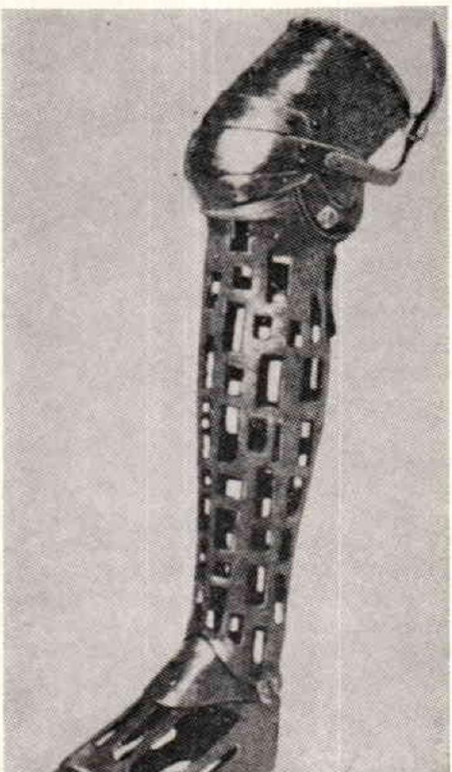


Fig. 3—Sixteenth-century lower limb designed for aesthetic purposes. It was apparently intended to conceal the mutilation of a mounted knight. Redrawn from Putti, V., Historic Artificial Limbs.[1] Permission has been obtained from the American Academy of Orthopaedic Surgeons to reproduce this figure from the Orthopaedic Appliances Atlas.[5]

Summarizing the status of the artificial leg in the Middle Ages, we have observed that there was little or no progress in the development of the lower extremity prosthesis. The peg leg was the "leg of the day." The poorest people did not receive any help from society; they used makeshift substitutes for their lost limbs and lived outside the realm of society usually as beggars or peddlers. Such conditions remained unchanged up to the first centuries of modern times (fig. 4).

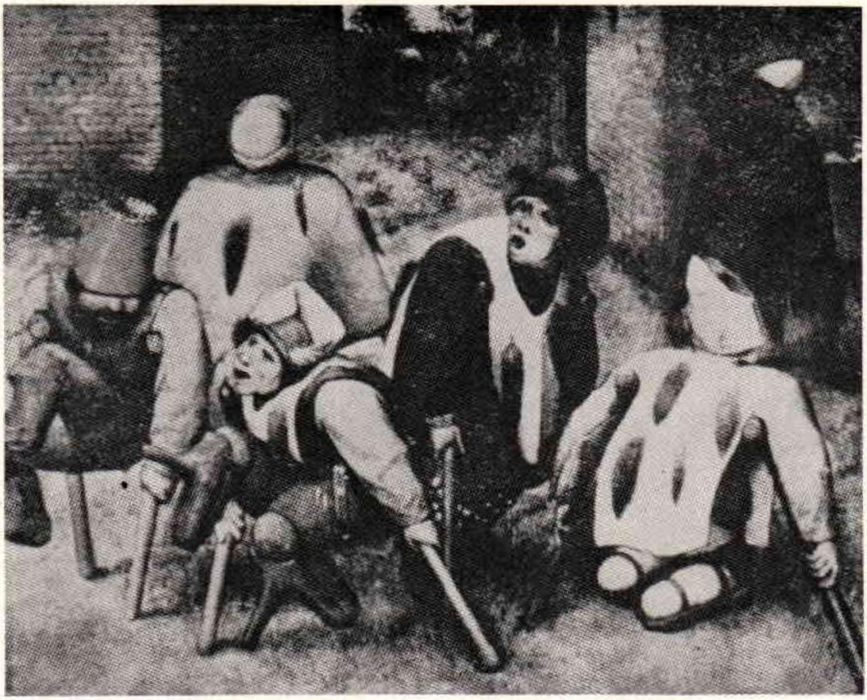


Fig. 4—This sixteenth-century painting by the famous artist, Pieter Breughel, hangs in the Louvre and is known as "The Cripples." It portrays with stark realism a street scene which probably was not an unusual sight in the time the artist lived.

Modern Times (1600 to 1900)

In the sixteenth century, a break-through occurred in the surgical management of the amputee and the fabrication of prostheses. This was achieved mainly because of the brilliant mind and surgical skill of Ambroise Paré. He improved the surgical technic for amputations and re-introduced the ligation of vessels to obtain adequate hemostasis (Celsus, several centuries earlier, had suggested this procedure). Paré recommended preferred sites for amputations, improved the treatment of wounds, and designed prostheses for his patients. He was the first surgeon to work in close collaboration with the tradesman who was the forerunner of the modern-day prosthetist. The first known artisan was an individual known by the name of "le petite Lorrain," an apparently skilled locksmith. Paré's prosthesis (fig. 5) with the movable knee and tarsal section of the foot, knee lock, and other controls, was fabricated in the fashion of armor. It was crude and heavy but "contained many of the essential principles of present day prostheses."[12] Many of his drawings and descriptions are not unlike some of those of prostheses in common usage today. For this reason he is rightly called the founder of "modern principles of amputations."[5]

After Paré and until the end of the eighteenth century, there apparently was no other attempt made to construct an improved above-knee artificial limb. It seems that no great demand for such a limb existed since above-knee amputations were rarely performed, although, with the introduction of Morel's tourniquet (1684), amputations in general were performed more frequently in Europe with a wide scale of indications for them.

In 1696 the Dutch surgeon, Verduin,[13] constructed a below-knee prosthesis with a wooden foot and a copper socket; two lateral steel bars, hinged at the knee joint, reached up to above the middle of the leather thigh-cuff (fig. 6). It took several decades until Verduin's leg received general recognition. With some modifications, it became the most widely used below-knee prosthesis.

Following Verduin other below-knee prostheses were designed by Ravaton (1755), Charles White (1776), Bruenninghausen (1796), Ruehl and others.

The mechanic, Gavin Wilson of Edinburgh, at the end of the eighteenth century, was the first after Paré to attempt to solve the problem of the above-knee prosthesis.[14] His prosthesis was fabricated of hardened leather with a knee joint which could be flexed in sitting but was designed with a stiff knee joint in ambulation. Furthermore, this prosthesis was the first one constructed with what is known today as an "ischial seat."

The author of the book, *"One Leg, the Life and Letters of Henry William Paget, First Marquess of Angelesey* (1768-1854),[15] wrote:

"He wore what was known as a 'clapper leg,' so called because locomotion was accompanied by a clapping sound. In due course, a limbmaker

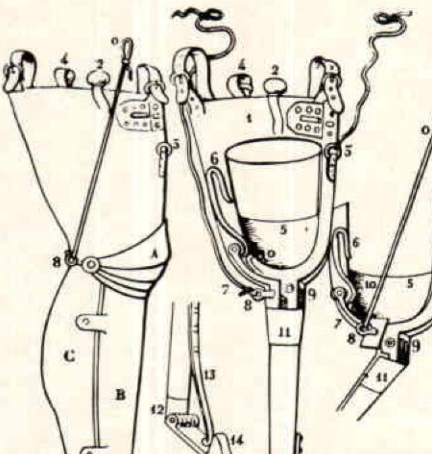


Fig. 5—Artificial leg described by Ambroise Paré in 1561. The sheet metal plates which give the appearance of armor, disguises a peg leg for a thigh amputation. It is fitted with a joint at the knee to permit the wearer to sit on his horse, and a knee lock to make it rigid for walking. Retouched from the Orthopaedic Appliances Atlas.[5] Permission has been obtained from the American Academy of Orthopaedic Surgeons.

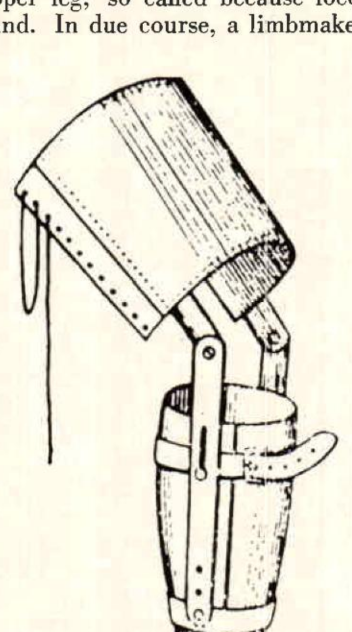


Fig. 6—A Dutch surgeon, Verduin, in 1696, constructed this leg, which somewhat resembles the modern type of below-knee prosthesis. Permission has been obtained from the American Academy of Orthopaedic Surgeons to reproduce this figure from the Orthopaedic Appliances Atlas.[5]

named James Potts of Chelsea, who had invented an artificial leg articulated at the knee, ankle and toe joints, provided him with one of these limbs."

This limb, made in 1816, became known as the "Anglesea leg." It consisted of a wooden socket and shank, a steel knee joint, and a wooden foot with articulation in the metatarsophalangeal joints which permitted dorsiflexion of the distal portion of the foot; artificial tendons ran from the femoral condyles to the heel and from the lower leg to the metatarsophalangeal joints of the foot, facilitating the push off of the foot (fig. 7). A similar limb with an articulated knee joint was designed by Potts for above-knee amputees. The Anglesea leg with some modifications was used in England until the first World War.

At about this period the artificial limb became romanticized in the literature. Thomas Hood (1759-1845) in his *Miss Kilmansegg and Her Precious Leg,* published in 1840 in the New Monthly magazine, [11, 16] concludes his delightful poem about Miss Kilmansegg and the loss of her precious leg with the following selection:

But when it came to fitting the stump

With a proxy limb—then flatly and plump

She spoke in the spirit olden;

She couldn't—she shouldn't— she wouldn't have wood

Nor a leg of cork, if she never stood,

And she swore an oath, or something as good,

The proxy limb should be golden.

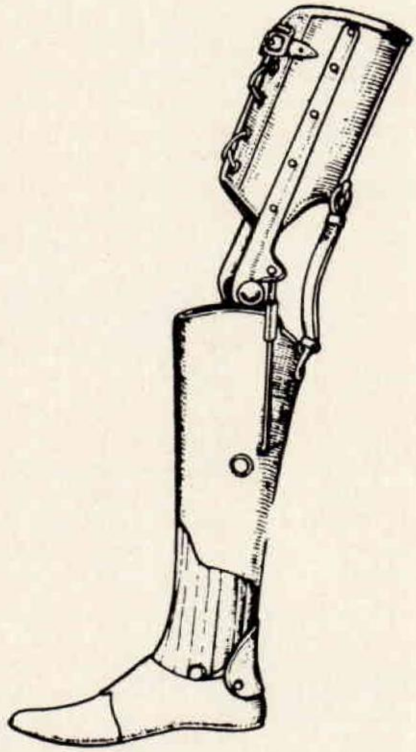


Fig. 7—Later model of the Anglesea leg, originally made in 1816. Permission has been obtained from the American Academy of Orthopaedic Surgeons to reproduce this figure from the Orthopaedic Appliances Atlas.[5]

At the World's Fair in London in 1851 the only artificial limb which received honorable citation was that of Dr. Palmer of Philadelphia. It is said that its construction was a modification of the limb designed by William Selpho of New York which, in turn, represented an improvement of the Anglesea leg. The Palmer leg, made of wood, had movable knee and ankle joints, the coordinated action of which was controlled by artificial tendons; the toe joint depended on spring action. This prothesis, after numerous modifications, became widely used in America, England, and France up to the time of World War I and was known as the "American Leg." The introduction by Marks of the use of rawhide for covering the outer surface of the wooden parts improved the strength and durability of the limb.

The more widely accepted use of general anesthesia, in about the middle of the nineteenth century, together with the experiences gained during the

Civil War in the United States and the increased use of Lister's procedures exerted tremendous influences on surgery. With the marked improvement in the technic of amputation, more frequent usage was accepted when indicated, whereas, previously, some of these procedures for amputation had been taboo, more or less. Thus, the demand for prostheses increased, augmented by the growing number of civilian industrial accidents. The limbmaker was no longer an especially skilled carpenter or blacksmith; he became a trained prosthetist who worked in shops specializing in the fabrication of artificial limbs. The firm of Marks and Hanger became widely known for its contributions in the improvement of the manufacture of artificial limbs. While others tried to design ankle and foot joints which imitated the natural motion, Marks constructed the rubber foot and Hanger the cordless ankle, using rubber bumpers for control of motion. Neither type allowed lateral motion but they increased the safety and stability of the wearer.

There were physicians in this era other than Palmer and Bly who were interested in prosthetics. Beaufort in France,[4] called by a German author "the undefatigable inventor of inexpensive and practical artificial limbs for the poor," constructed among other limbs a foot with a rocking sole, a modification of which became known as the "Dollinger foot." It was widely used for amputees during World War I. There was Heather Bigg of London who, in 1885, published a textbook entitled *Amputations and Artificial Limbs* which included anatomical studies on alignment of the parts of the prosthesis. There was Hermann of Prague who, in 1868, wrote a treatise, *Mechanism of Gait With an Artificial Leg and a New Construction of an AK and BK Prosthesis;* he also introduced aluminum to replace the steel parts of the prostheses.

The majority of surgeons, however, were quite uninterested in their amputee patients after healing was completed. The limbmaker alone had to assume the responsibility and treat the amputee at his own discretion. There was no rapport between surgeon and limbmaker, the latter often lacking fundamental knowledge of basic anatomy. In 1881 the then well-known German professor, Max Schede,[4] appealed to the medical profession with the following:

"Did our learned forefathers consider it unworthy to descend from the proud loftiness of science into the workshop of the mechanic to give him that aid which can come but from a conscientious physician? We only note the conspicuous fact that in a time when nearly every surgeon considers himself obligated to add new and unnecessary and useless instruments to the armamentarium chirurgicum, only a few consider it worthwhile to devote some afterthoughts to the further fate of the amputee."

The Era of the Twentieth Century

It was not until World War I that Schede's words took fruitful root. In Europe and in the United States special amputee centers were established where surgical and prosthetic care was given the wounded. In these centers the surgeon and limbmaker met at the "bedside" of the patient to discuss optimum sites prior to amputation and the management of the patient immediately after surgery; their joint concern was to select and fabricate the best artificial limb possible to suit his particular needs.

As stated previously, World War I produced the American leg which was improved by use of the solid rubber foot or the articulated "bumper foot," popular in Europe.

The Englishman, Marcel Desoutter, made a fundamental contribution to the suspension method of fabricating an above-knee prosthesis. Up to this period the conventional suspension was the shoulder suspension with its extending effect on the artificial knee. To overcome its disadvantages (discomfort and the unsightly shrugging motion of the shoulder to prevent slipping of the stump from the posthesis), he introduced the concept of pelvic suspension. This ultimately led to today's pelvic band with the single-axis metal hip joint which affords improved stability, although it is somewhat at the expense of freedom of motion of the hip joint. This new type of suspension in turn stimulated improvements of the artificial knee which became freed from the control of the shoulder suspension. The knee joint then became equipped with braking and friction devices. The same Marcel Desoutter introduced in 1912 the first all aluminum lightweight prosthesis. Subsequently, aluminum became the favorite material in England for use in prostheses.

In Germany the Schede-Haberman leg[4] with its "physiological" knee joint promised improved stability and a "soft and natural gait." Professor Putti at the Institute Rizzoli in Bologna conducted scientific investigation of materials suitable for use in the construction of prostheses. Putti, deeply interested in historic artificial limbs, had old Italian tombs of known amputees opened to study the construction and mechanism of prostheses of the past.

In France Broca and Ducroquet[17] reported their experiences gained in connection with the Federation des Mutiles where hundreds of disabled men had been examined and fitted with prostheses during World War I. They stressed two essential principles of efficient prosthetics, namely: (1) Accurate imitation of the external form of the natural limb is incompatible with good function, and (2) to give, for aesthetic reasons, every patient the same appliance, would only lead to disappointment of physician, limbmaker and amputee.

In the years after World War I numerous mechanical devices for improvement of artificial legs were invented, patented, and tried out in Europe as well as in the United States. Some proved to be of value; many were ephemeral products.

World War II exerted a tremendous stimulus to the further development of prosthetic devices.[5] Thomas and Haddan,[12] a surgeon and prosthetist, respectively, demonstrated improved end results of team co-operation. In 1945, under the auspices of the United States government, the National Academy of Sciences of the United States started a prosthetic research program on a broad basis. The Armed Forces, the Veterans Administration, The National Institutes of Health, the Vocational Rehabilitation Administration, universities, and private industry were called upon to participate in this program. Today more than 20 laboratories co-operate in this "Artificial Limb Program," with bioengineers, physicists, physicians, prosthetists, physiotherapists, and mechanics on their staffs. The Committee on Prosthetic Research and Development acts as the co-ordinating link in this great enterprise of prosthetic research, development, and teaching.

As a result of these closely knit joint ventures, new and more satisfactory prostheses have evolved, some of which will be discussed in the following paragraphs.

In 1863 the United States Patent Office granted a patent to Dubois Parmelee of New York for a new type of prosthesis which he described as follows:

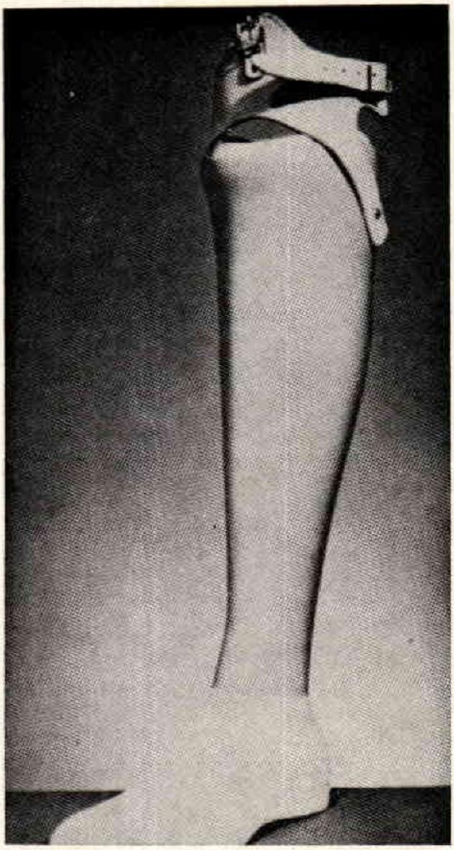


Fig. 8—Patellar tendon bearing below-knee prosthesis with SACH foot. (Reproduced with permission from Prosthetics Research Program, Veterans Administration, Washington, D.C.)

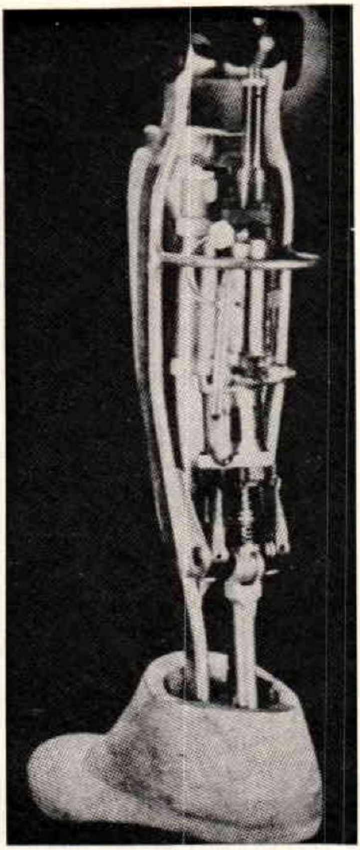


Fig. 9—The Hydra Cadence Leg without cosmetic cover. (Reproduced with permission from the Prosthetics Research Program, Veterans Administration, Washington, D.C.)

"The first part of this invention relates to the bucket socket of artificial legs or arms intended to receive the stump; it consists of the fastening of such bucket to the stump by means of atmospheric pressure in such a manner that the straps usually employed for this purpose can be dispensed with and at the same time a perfect fit of the bucket is obtained."[5]

After some trial usage in Canada, England, and California the idea of the suction socket was given up. About seventy years later the method was reactivated in Germany and developed to such a degree of efficiency that it produced what became the standard socket for above-knee prosthesis in Germany during World War II. After the end of the war the suction socket was tested and adopted in the United States. Definite indications and contraindictions for its use were established and substantial modifications were made such as the quadrilateral shape of the socket and improved valves. When a suction socket is contraindicated now the conventional socket is used; it is designed in the same quadrilateral shape. In the last few years, after extensive laboratory and clinical testing, the "Total Contact Socket" has been adopted in American prosthetics as an improvement of the suction socket, to be used when skin irritation, ulcers, and edema develop in the area of the stump exposed to the "vacuum" part of the regular suction socket.

The old Verduin leg of 1696 has served as a mother pattern for the modern below-knee prosthesis up to the present time. The conventional below-knee artificial limb consists of a wooden socket and shank (made of aluminum or other preferred material), attached by a hinged metal bar to a leather thigh corset. This type of below-knee prosthesis has been simplified recently by the development of the PTB (patellar-tendon bearing) prosthesis (fig. 8), which omits the hinged metal side bars and the leather thigh corset. The socket, made of plastic laminate and lined with a thin layer of sponge rubber and leather, accommodates the stump up to the region below the patella where contact is made along the patella tendon and tibial condyles. A cuff or strap fastens the leg to the distal thigh above the patella.

Of further interest and improvement has been the introduction of hydraulic and pneumatic devices (fig. 9).

The old-type Syme prosthesis has been replaced by the less bulky and better fitting Canadian type or similarly constructed American type.

The introduction of the Canadian prosthesis for hip disarticulation and hemipelvectomy seems to have solved the problem of effectively fitting amputees who need this type of prosthesis (fig. 10).

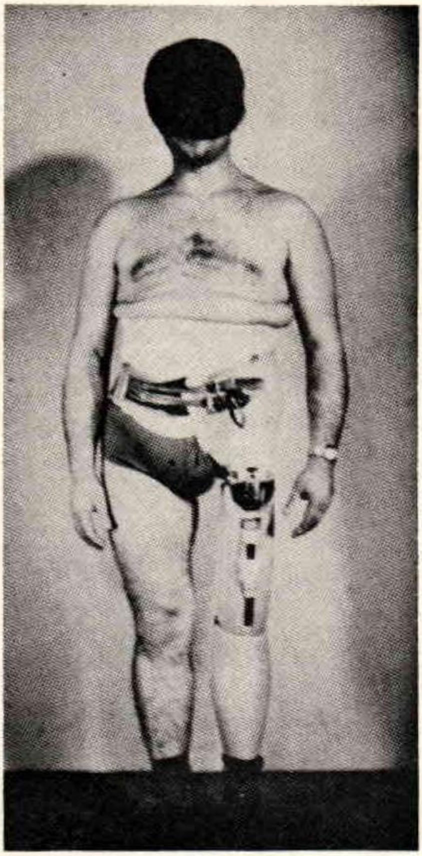


Fig. 10—Modified abdominal support and Canadian type hip disarticulation prosthesis for amputee after hemipelvectomy. (Reproduced with permission from Prosthetics Research Program, Veterans Administration, Washington, D.C.)

SUMMARY

The peg leg, the invention of the earliest times of history, has proved its usefulness through the centuries up to the present. The development of modern prosthetics was initiated by the ingenious surgeon, Ambroise Paré. The advent of general anesthesia, antisepsis, asepsis, and modern technology stimulated the further development of prosthetics. World War I and World War II as well as the increase of industrial casualties led to the creation of scientific prosthetics. Nationwide and worldwide organizations are today engaged in furthering prosthetic research and rehabilitation of the amputee. The goal of the prosthetic science is the somatic, psychic, and economic rehabilitation of the amputee. The lost limb is not the primary concern of prosthetists; rather, it is the limbless human being, to whose complete rehabilitation modern prosthetics devote their efforts.

REFERENCES

1. Putti, V.: Historic Artificial Limbs. New York, Paul B. Hoeber, Inc., 1930, pp. VII, 4, 25, 40-43.
2. Major, R. H.: A History of Medicine. Springfield, Ill., Charles C. Thomas, 1945, Vol. 1, p. 67.
3. Herodotus, and de Selincourt, A. (Trans.): The Histories, The Penguin Classics. Harmondsworth, Middlesex, Penguin Books, Ltd., 1954, pp. 566-567.
4. Beaufort: Cited by Schede, F.: Küntsliche Biene and Füsze. In Gocht, H.; Radike, R., and Schede, F.: Künstliche Glieder, Deutsche Orthopadie. Ed. 2, Stuttgart, Ferdinand Enke, Publisher, 1920, Vol. 2, pp. 397, 399, 412-416, 473, 546-548.
5. American Academy of Orthopaedic Surgeons: Orthopaedic Appliances Atlas: Artificial Limbs: A Consideration of Aids Employed in in the Practice of Orthopaedic Surgery. Ann Arbor, Mich., J. W. Edwards, 1960, Vol. 2, pp. 2, 3, 5, 10.
6. De Longperier: Cited by Gocht, H.; Radike, R., and Schede, F.[4]
7. Gillis, L.: Amputations. New York, Grune & Stratton, 1954, p. 10.
8. Preuss, J.: Biblisch-talmundische Medizin: Beiträge zur Geschichte Heilkunde und der Kultur überhaupt. Berlin, S. Karger, 1911, pp. 273-274.
9. Epstein, I: (Ed., Trans.): The Babylonian Talmud, Shabbath. London, Soncino Press, 1938, Vol. I, pp. 312-316.
10. Popp, H.: Zur Geschichte der Prothesen. Med Welt 13:961-964 (July 8) 1939.
11. Shufeldt, R. W.: Improvements in Artificial Limbs Since the Civil War—As Seen in Examples in the Army Medical Museum. Medical Reviews 24:643-649 (Nov.) 1918.
12. Thomas, A., and Haddan, C. C.: Amputation Prosthesis: Anatomic and Physiologic Considerations, With Principles of Alignment and Fitting Designed for the Surgeon and Limb Manufacturer. Philadelphia, J. B. Lippincott Company, 1945, pp. 5, 11-12.
13. Verduin: Cited by Gocht, H.; Radike, R., and Schede, F.[4]
14. Wilson, G.: Cited by Gocht, H.; Radike, R., and Schede, F.[4]
15. Marquess of Anglesey: One-Leg: The Life and Letters of Henry William Paget, First Marquess of Anglesey, K. G., (1768-1854). New York, William Morrow and Company, 1961, pp. 153-154.
16. Jerrold, W. (Ed.): The Complete Poetical Works of Thomas Hood. (Oxford Edition), London, Henry Frowde, 1906, pp. 563-600.
17. Broca, A., Ducroquet, and Elmslie, R. C. (Ed., Trans.): Artificial Limbs. London, University of London Press, Ltd., 1918, p. XIII (Preface).

Acknowledgments: We gratefully acknowledge the valuable assistance of Mrs. F. Konz, Librarian, Veterans Administration, Brooklyn O.P.C., the Brooklyn Veterans Administration Hospital, and the Research and Development Division of the Veterans Administration Regional Office, New York City, in the preparation of this manuscript.

We are especially grateful to Dr. B. W. Rosenburgh, Clinic Director, and to the Administrative Staff of the Outpatient Clinic, Veterans Administration, Brooklyn, New York City, for their encouragement and fullest co-operation.

Veterans Administration Outpatient Clinic, Brooklyn, N.Y.

Dynamic Shoulder Abduction Splint*

by JOSEPH J. PANZARELLA, JR., M.D.
Associate Director, Specialized Service, Out Patient Dept.

SAMAR BANERJEE, M.D.
Fellow, IPMR

and

HANS R. LEHNEIS, C.P.O.
Chief, Orthotic Service
New York

Institute of Physical Medicine and Rehabilitation,
New York University Medical Center

The purpose of this splint is to provide a dynamic modification of a static abduction splint. Many times with injuries involving the shoulder, immobilization causes restriction of shoulder motion. A dynamic splint will provide support for the weakened or paralyzed abductors, while allowing movement in internal and external rotation, horizontal abduction and adduction. This type of orthosis would be indicated in conditions such as paralysis of the deltoid muscles, brachial plexus injuries and certain post-operative conditions.

The device was developed in the treatment of a patient who had a deltoid palsy and who was developing contractures while the deltoid muscle was recovering. The splint allowed the patient to support the arm in 90° abducted position while actively utilizing internal and external rotation (fig. 1), and horizontal abduction and adduction of the shoulder (fig. 2).

The adaptations made to the static abduction splint were (fig. 3):

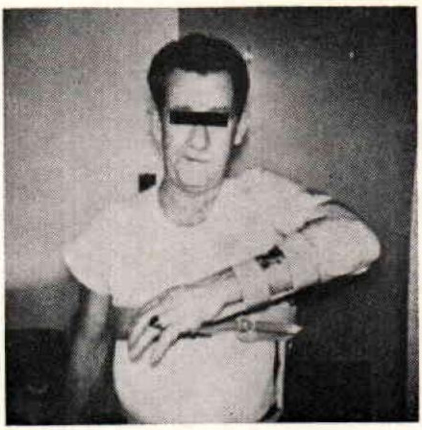


FIG. 1—90° active external rotation of the involved shoulder possible with the adaptation made to the abduction splint.

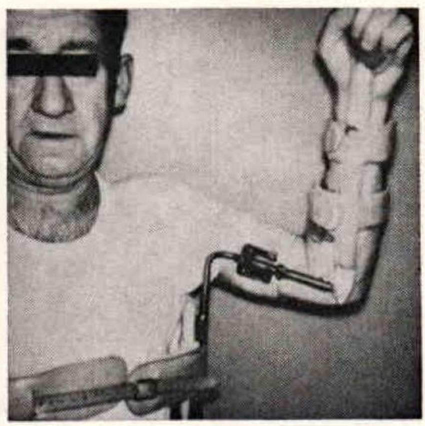


FIG. 2—45° horizontal adduction at the involved shoulder with the splint.

* Reprinted by permission of the editor and authors from *Archives of Physical Medicine & Rehabilitation*, May 1966, pp. 310-311.

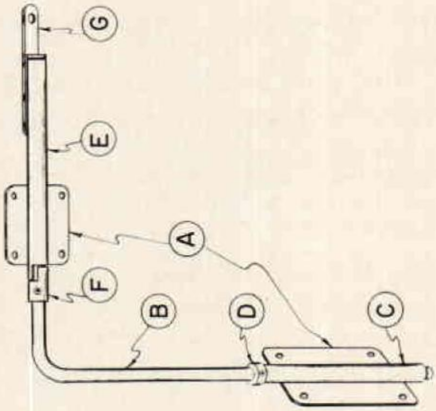


Fig. 3—Dynamic adaptation for shoulder abduction splint.

A. Two attachment plates for installation on the existing splint.

B. A 3/8″ rotation rod.

C. A 1/2″ O.D. tubing providing humeral horizontal abduction and adduction in connection with the rotation rod *B*.

D. An adjustable vertical support collar.

E. A 1/2″ O.D. tubing for external humeral rotation from the horizontal position in connection with the rotation rod *B*.

F. An internal humeral rotation stop adjusted to prevent internal humeral rotation below the horizontal.

G. A free motion elbow joint.

Summary

An orthotic device has been described which permits patients with involvement of the abductor mechanism of the shoulder to maintain range of motion while providing adequate support and protection for the shoulder abductors. The device consists of a simple dynamic adaptation to the conventional airplane (abduction) splint providing horizontal abduction, adduction, external and internal rotation range.

Acknowledgements: We wish to acknowledge the contributions made by Messrs. Robert G. Wilson, M.S., and Robert W. Hinchberger, C.O., who were responsible for the mechanical drawings and orthotic fitting, respectively. We also want to thank Dr. Allen S. Russek for his valuable comments.

A Device for Tracing Contour of Amputation Stumps and Extremities: The Contour-Tracer *

by LOUIS B. NEWMAN, M.E., M.D.

Chief, Physical Medicine and Rehabilitation Service, Veterans Administration Research Hospital; Professor of Physical Medicine and Rehabilitation, Northwestern University Medical School
Chicago

There is a definite need to determine the exact size and shape of a stump or extremity in order to ascertain quickly any changes in contour and size, and at the same time to have tracings of the periodic reevaluations.

A number of methods are presently used, such as the water displacement method, measuring the circumference of the stump or extremity at a number of points, and photography. None of these methods gives a simple rapid objective evaluation of the exact size and contour of the stump or extremity. In amputees it is extremely important to know when shrinkage and shaping have been fully accomplished so that the stump can be measured, a proper fitting prosthesis fabricated, and gait-training instituted.

With the contour-tracer, described in this article, which we have used for many years, the exact size and shape of the stump or extremity can be readily secured by means of a simple tracing, which can be periodically repeated for permanent record purposes in order to evaluate objectively any changes.

The contour-tracer consists of a right-angle device made of plastic or wood, into which has been inserted at the proper angle a ball-point or similar

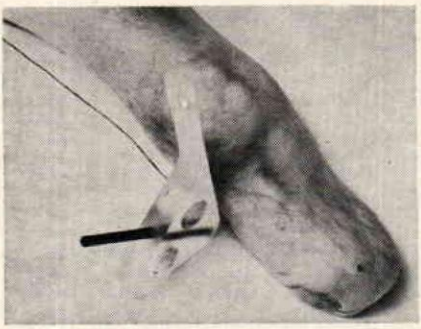


FIG. 1—Contour of below-knee amputation stump being outlined with the Contour-Tracer; anteroposterior aspect.

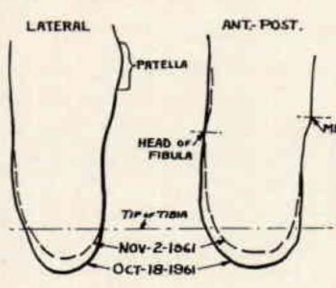


FIG. 2—Tracings of right below-knee amputation stump; both lateral and anteroposterior aspects made at two different times. Note markings of bony landmarks.

* Reprinted by permission of the author and editor from *Archives of Physical Medicine & Rehabilitation*, May 1966, pp. 312-313.

type pen. The pen is activated by a small coiled spring in order to produce uniform pressure on the paper when tracing.

The same tracer can be used to outline a limb to secure a pattern for a brace, splint, or other assistive device.

Procedure

To secure the anteroposterior tracing of the extremity or stump, have the patient lying on the table in a supine position. For the lateral tracing of the stump, have the patient lying on the side from which the tracing is to be made. A hard surface of wood, plastic, or similar material is placed under the extremity or stump. A sheet of paper upon which the tracing is to be made is placed between the stump and the board. The skin is powdered so that the tracer can glide easily and smoothly over the skin.. Figure 1 shows the contour of the below-knee amputation stump being traced with the contour-tracer in the anteroposterior aspect.

Gently glide the contour-tracer around the periphery of the stump or extremity with only slight contact with the skin. As the tracer is moved along, an outline will be made on the paper of the exact size and contour of the part. Repeated evaluations are made on the same sheet of paper, thereby indicating any changes. Landmarks, such as bony prominences, scars, or other skin blemishes, are indicated on the tracings so that the repeated tracings can be superimposed on each other. Figure 2 shows tracings of a below-knee amputation stump made with the contour-tracer on two different dates, showing both the lateral and antero-posterior outlines.

This same device can be used in tracing an entire extremity to determine and record the degree and changes in edema, muscle atrophy, contractures and deformities. It is also used to outline an extremity prior to fabricating a brace or other assistive device.

A method was described by the author [1] years ago for tracing the exact size and shape of surface lesions such as decubitus ulcers, varicose ulcers, wounds and other skin lesions.

Acknowledgment: I am grateful to the Medical Illustration Service at the Veterans Administration Research Hospital, Chicago, for the fine photographs.

Veterans Administration Research Hospital
333 East Huron St.
Chicago, Ill. 60611

Reference

1. Newman, L. B.: Tracing Device for Surface Lesions. *Arch. Phys. Med.* 29: 42-43 (Jan.) 1948.

Description of Plaster Cast Cutter

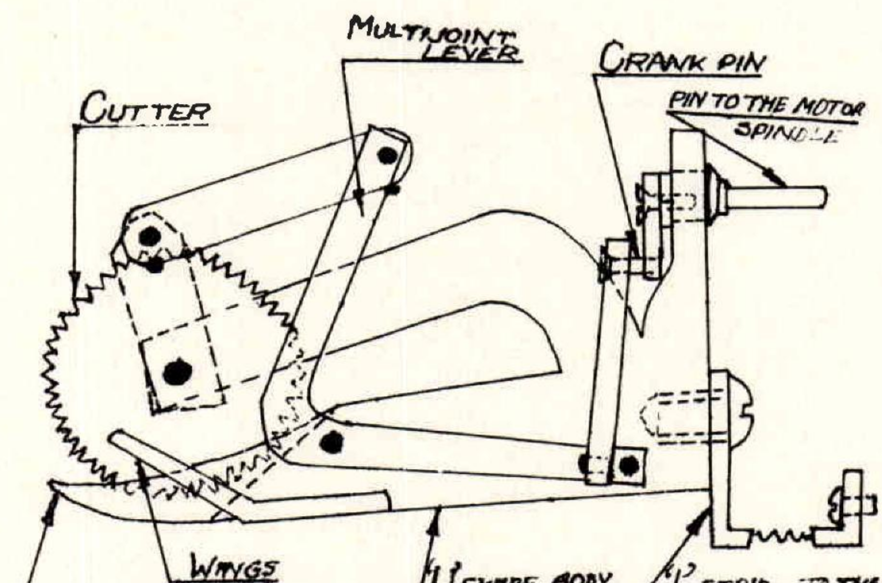
by D. G. KAMATH

New Delhi, India

The cast cutter attachment here described can be operated by an electrically driven hand drill gun or a fractional motor. The attachment is designed for easy cutting by pressing the cutter directly against the plaster cast. It is devised in such a way that the cutting edge of the vibrator cutter does not come in direct contact with the skin of the patient because a beak-like projection, which is underneath the cutter, separates the skin from the cast.

The cast cutter consists of a circulator vibrator made up of surgical steel $1\frac{1}{2}''$ in diameter and $.025''$ thick, which is moved by means of an eccentric pin. This pin is attached to a multijoint lever as shown in the illustration. Every joint has a brass bush in it to keep friction to a minimum while moving. This lever is attached to the motor spindle or to the drill by a crank shaft like pin. The fractional motor used for operating the cutter is of .25 H.P. with 2800 R.P.M.

The whole attachment is mounted on a U-shaped metal bar which extends from the centre to the base of the cutter via the outer attachment to



the motor. The lower end of the U is slotted and has the shape of a beak. The beak tip is rubber covered. The cutter moves in the slot of this beak. There are two wing-shaped metal plates, size 1" x 1/2" x 1/8", welded on either side of the beak at a 60° angle. The whole device is fixed to the body of the motor by means of the metal strip shown in the illustration. This metal strip is screwed to the base of the plaster cutter with 1/4" screws. Gross weight of the attachment is 200 grams.

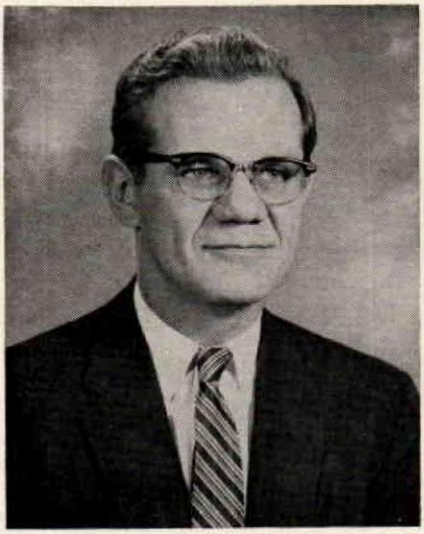
When the beak is introduced between the patient's skin and the plaster cast, it not only lifts the cast, but also holds the cast in tight position all around the limb, which enables easy cutting of the cast by the vibrating cutter. This lever mechanism permits the cutter only 60° torque and not the full rotation, when it is driven by the motor.

The whole mechanism works very smoothly and cuts the plaster which is inserted between the beak and the cutter. The rubber tips of the beak avoid any injury to the patient. The cut edges of the plaster are pressed and channelized by the wings attached to the side of the beak. In order to prevent the cut ends of the cast from becoming "fuzzy," the wings press them down.

This mechanism has been put to limited trial, especially with the help of electrically operated hand drill guns and the motor shop hand drill.

New Officers of the American Orthotic and Prosthetic Association

A photograph of the Association's new President, George H. Lambert, C.P.O., Baton Rouge, Louisiana, appears on the cover of this issue of the Journal.



President-Elect Basil Peters, C.P.O.
Philadelphia, Pennsylvania

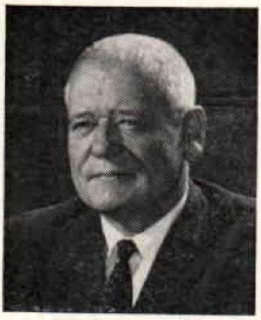
Vice President Alvin L. Muilenburg, C.P.O.
Houston, Texas

Secretary-Treasurer M. P. Cestaro
Washington, D.C.

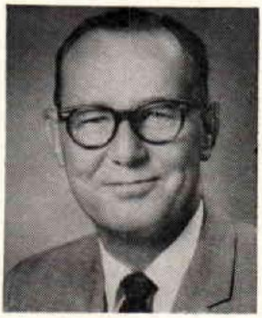
The American Board for Certification In Orthotics and Prosthetics, Inc.

OFFICERS

President Bert R. Titus, C.P.O.
Durham, N. C.

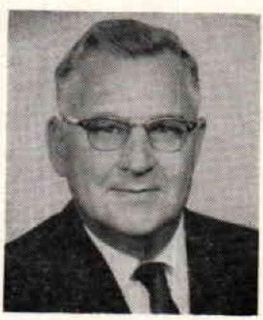


Vice President Edward T. Haslam, M.D.,
New Orleans, Louisiana



Secretary-Treasurer John A. Metzger,
C.O., Long Beach, California

NEW BOARD MEMBERS



Newton D. McCullough, M.D.
Orlando, Florida

Paul E. Leimkuehler, C.P.
Cleveland, Ohio

New Facilities Certified

By action of the Facilities Committee of the American Board for Certification, the following facilities have been granted Certification since the publication of the 1966 *Registry of Certified Facilities and Individuals:*

COLORADO

Englewood:

HALL ORTHOPEDIC INC. — O
508 E. Hampden Street — 789-2529
Ray J. Hall, C.O.

DELAWARE

***Wilmington:**

AMSTERDAM BROTHERS, INC. — P&O
700 W. 4th Street — 652-0300
Arthur J. Amsterdam, President

DISTRICT OF COLUMBIA

****Washington:**

WALTER REED GENERAL HOSPITAL — O
The Brace Shop — 576-3603
(Private Patients Not Accepted)
Raymond R. Krone, C.O.

* Extension of title to include Orthotics.
** Reinstatement.

Prosthetists and Orthotists Certified in 1966

The Committee on Examinations of the American Board for Certification announces that the following candidates have received Certification as a result of successfully passing the 1966 Examinations of the Board. (The two men listed as Certified Prosthetists and Orthotists had previously received Certification in one of these two fields.)

CERTIFIED PROSTHETISTS-ORTHOTISTS

Patrick J. Marer	408	Alfred Stanke	409

CERTIFIED PROSTHETISTS

Heinz Brinkman	547	Hugh J. Panton	554
John H. Daggs	548	Deane A. Seavey	555
Daniel O. Haney	549	Gregory F. Scott	556
James C. Hennessy	550	Bernard C. Simons	557
Robert W. Lundquist	551	William F. Sinclair	558
William H. Merritt	552	James R. Verhoff	559
Robert A. Nelson	553	George W. Wheeler	560

CERTIFIED ORTHOTISTS

Ronald F. Altman	695	Paul T. Lindbergh	699
Jack E. Greenfield	696	Louis C. Morris	700
Sherron Huddleston	697	Birney D. Plecker	701
George E. Kelso	698	Charles A. Sigars	702

A Message from the President of the Association

by GEORGE H. LAMBERT, SR., C.P.O.

This is the first opportunity I have had since our National Assembly in October to address myself to all of you in our orthotic and prosthetic field, and related areas.

I think, however, that it is especially appropriate for me to do so now for two reasons. In the first place, we have just entered the New Year. It is my hope and desire that 1967 will see both the fulfillment of your personal objectives, and major progress toward our professional goals. Secondly, this year marks the 50th Anniversary of our Association.

The coincidence of these two events is a natural time for us to think about the future. Since the American Orthotic and Prosthetic Association is a recognized professional organization, charged with working for and supporting the advancement of our practitioners, I want to talk about such matters even though though the *Journal* would not ordinarily be the place to do so. However, I believe the various practitioners, organizations, and agencies that have an interest in our work and our development will also be interested in our thinking about those subjects.

In my opinion, we have come quite a distance since 1917, when the Surgeon General of the War Department convened a small group of our predecessors to marshal their resources behind the war effort, and thereby inspired establishment of our professional association. In the intervening years, we have encountered many problems, and have survived in spite of them. Certainly, we have grown in numbers, status, and professionalism. Nevertheless, it does not seem to me that we can or should say that we have reached the end of the road in any area, and then sit complacently by while the world moves past us.

I thing this New Year which is our 50th Anniversary opens up a whole new road that stretches just as far ahead of us as we want to travel down it. Since we can stop at any point, the distance we go will depend entirely on the imagination, initiative, and energy we put into our efforts to constantly move ahead by solving our problems effectively.

During the period since the National Assembly, the Association's Officers and Executive Director have been working constantly to develop progressive and even unique programs that will provide solutions to existing problems. They are either in operation or ready to be put into operation. I want to describe some of them to you so that you will be familiar with the way we are going. All of the programs will require the cooperation of related professions, organizations, and agencies.

Unquestionably, our most important problem, and certainly our most permanent one, is that of manpower. All of us have and are experiencing the lack of this critical resource. The situation can only become more acute with the advent of Medicare and eventually the return of Viet Nam veterans to civilian life. We must take positive, decisive action to interest young people in the challenges and opportunities of our profession, and to compete effectively for them in the open employment market. In the next few weeks, an attractive, hard-hitting program built around the VRA-supported recruiting film, "Men and Mobility," will be ready for presentation to the membership, which will be asked to take a fundamental part in putting the program over at the community level.

Education goes hand-in-hand with recruitment, particularly when the latter effort is aimed at the high-school student level. In today's job-market, the opportunity to continue education is a competitive factor. The times, as well as our own self-interest, require not only that we support existing educational courses involving our profession, but that we actively encourage their establishment. Our most critical need is to develop capable supportive workers. I am very pleased to report to you that a set of guidelines for educational courses to meet that need is almost completed. A State education agency and a technical college have already indicated their desire to participate in this program, and many more throughout the country will be invited to do so.

The last two years are considered to have been the most active in history in the health field from the governmental standpoint. New government programs, whether they originate at the federal or state level, always require periods of adjustment. We experienced this kind of impact during the past year in connection with Medicare. Apparently, there will be no substantive slowing up of government action in the health field, and your officers believe that we must take a concrete and positive interest in these programs as they are being developed. Therefore, we intend to study and analyze legislative proposals affecting our areas of professional interest that are presented to the Congress and the State Legislatures, and to express our opinions about them. We will also do everything possible from the National Office to help our local groups which become involved with state government agencies.

One of the strongest efforts we must make as orthotists and prosthetists is to inform the public as to who we are, what we are, and what we do. The effort, which was tried out at the National Assembly, was featured on the back cover of the Association's *Almanac* for December. This single attempt to tell the story of our profession through reputable press coverage on a national basis reached a reading public of more than 10,000,000 people, and returns of the various stories' use by newspapers are still coming in. While any one of us might have written some parts of the stories differently, the important element is that, over all, the press releases were sympathetic, inspirational, and—most important—demonstrated that we of the orthotic and prosthetic profession have a story to tell the public, and that the public press is willing to tell it.

We must continually strengthen our relations with the practitioners in other professions and the organizations and agencies with whom we work and share mutual interests in serving the needs of rehabilitation. We propose to cooperate with all to advance the common end of improving the service we are uniquely qualified to perform, and we solicit the interest and attention of those with whom we work in achieving that goal.

These are some of the directions which I, as your President during our 50th Anniversary Year, believe we must take. I ask for the help of each one of you in laying the foundation for the program.

Members Amend Corporation By-Laws

The voting members of the American Orthotic and Prosthetic Association and the American Board for Certification approved a number of by-law changes affecting both organizations at their Annual Meetings at the Palm Springs National Assembly.

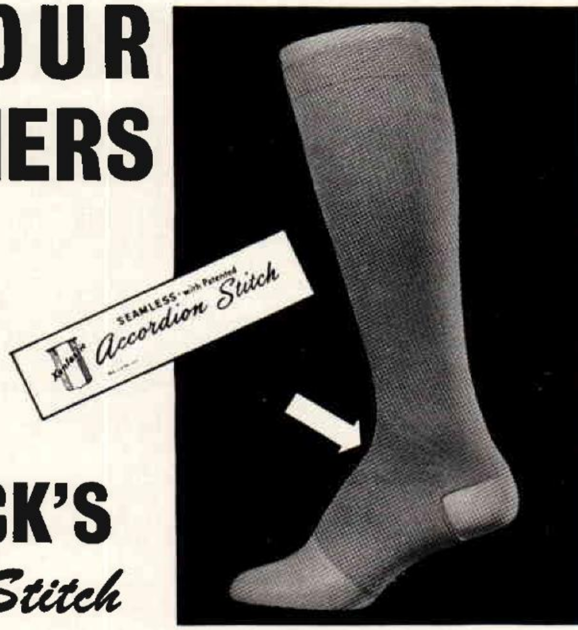
Most of the amendments were of a minor nature to clarify language and meaning and to more effectively implement the objectives of the profession. The name, "The American Orthotics and Prosthetics Association," was changed to "The American Orthotic and Prosthetic Association," as one example. Another was to define the functions of the profession as being "The measuring, designing, fabricating, and fitting of orthotic and/or prosthetic devices."

The principal action formally put into effect the various recommendations of the Long Range Planning Commission for the unified administrative operation of the National Office. These recommendations had been accepted by the memberships of AOPA and ABC at the 1965 National Assembly in Colorado Springs. Their inclusion in the By-Laws required the addition of a new section establishing the Joint Executive Council, and number of amendments to existing sections to conform to that addition.

The National Office prepared Guides to the by-law changes, explaining what each one meant, and distributed them to the members of the two organizations before the Assembly. The Association's revised By-Laws will be published in a future issue of the *Almanac,* and the Board's will be issued with its revised requirements for Certification, which are now being prepared.

Herbert B. Warburton,
Executive Director

DEMAND THE FINEST FOR YOUR CUSTOMERS



KENDRICK'S
Accordion Stitch
seamless hosiery

The Kendrick #300 M Seamless Accordion Stitch Elastic Stocking — medium weight, ideal for the average varicose condition.

PRESCRIBED BY PHYSICIANS . . . SOLD WITH CONFIDENCE

For your customers there should be no substitute for the finest. Kendrick's Accordion Stitch Seamless Elastic Hosiery is unmatched for comfort, perfect fit and customer satisfaction.

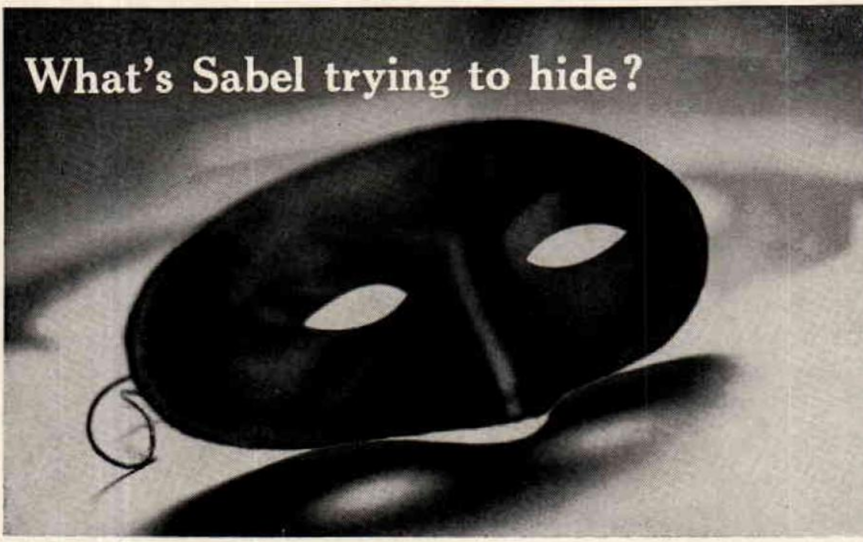
The Kendrick #300 M Elastic Hosiery exerts the correct amount of pressure for varicose conditions. It provides firm, reliable support, yet is not bulky or uncomfortable for the wearer. Due to the special Kendrick Patented Accordion Stitch Process, the #300 M will not pinch, wrinkle or chafe no matter how often the foot or knee is flexed. Custom finished toe provides smooth, thin edge for comfort under foot.

Specify surgically correct Kendrick products for your customers. Their confidence in you will result in more frequent repeat sales and higher profits.

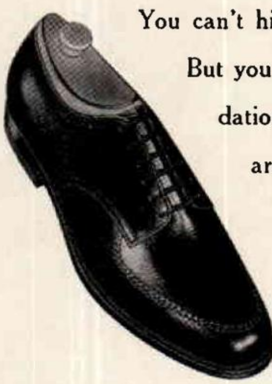
You can recommend Kendrick with Confidence

JAMES R. KENDRICK COMPANY, INC.
Philadelphia 44, Pa. New York 16, N. Y.

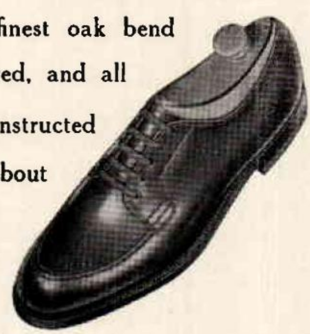
Kendrick
SINCE 1853



They're normal looking-They're normally priced



You can't hide the fact that some feet require special attention. But you can mask many foot defects with special accommodation in Sabel shoes that consider the displacement of area within the shoe and fit the foot without restriction. Shoes that are ruggedly built to stand the strains and stresses of corrective work. That feature heavy ribbed, flanged right and left steel shanks, Thomas heels, finest oak bend oil-treated soles to accept bracework, if required, and all prescribed corrections. So, what's a specially constructed shoe like this going to cost the customer? Just about what you'd expect him to pay for any pair of fine shoes. Sabel made it possible.



SINGLE SHOES OR SPLIT SIZES ALWAYS AVAILABLE

SABEL'S

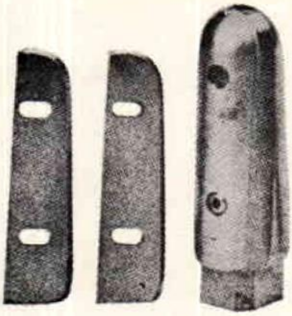
BASIC SHOES

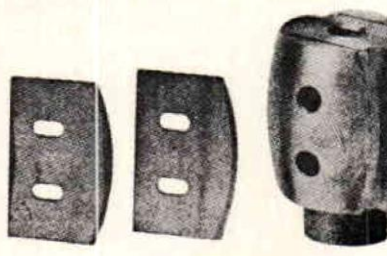
TRADE MARK REG. U. S. PAT. OFF.

SABEL DIVISION, C.H. ALDEN SHOE COMPANY, BROCKTON, MASS.

TRAUTMAN CARVER ATTACHMENTS

CUTTERS

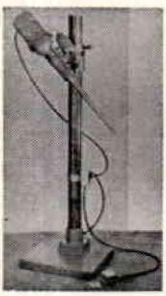




Small Cutter No. 2100A.
No. 2100AB Blades

Large Cutter No. 2100B.
No. 2100BB Blades

Sharpened for one-half cost of a new set of blades, plus postage.



Carver #2100 Foot Switch #2100K

Midget Cutter #2100H (including an extra blade)

ATTACHMENTS

Medium Sand Core No. 2100C. Medium size abrasive cones Coarse Cone No. S41D, Fine Cone No. S41E.

Small Sand Core No. 2100D. Small size abrasive cones only. Coarse Cone No. S41H, Fine Cone No. S41G.

Rasp No. 2100E. We resharpen the Rasp for one-half cost of new, plus postage.

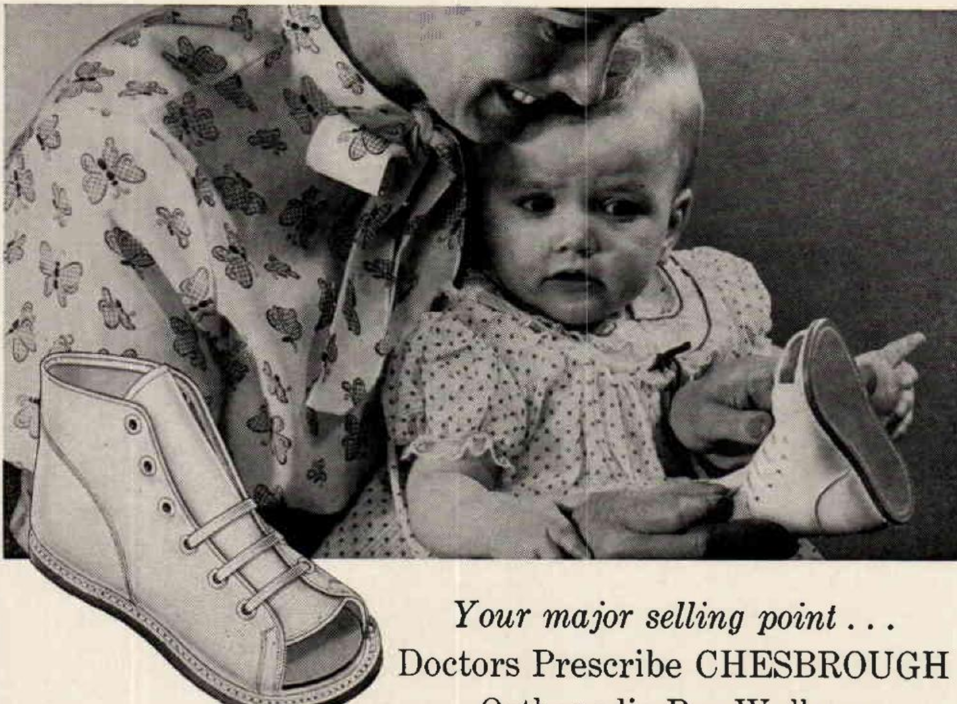
Small Sand Drum No. 2100F. Small size abrasive sheets. Coarse No. S41T, Fine No. S41U.
No. 2100FF — Flat Sides.

Large Sand Drum No. 2100G. Large size abrasive sheets. Coarse S41V, Fine S41W.

Write for price and delivery date

TRAUTMAN SPECIALTIES, INC.

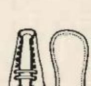
410 Portland Avenue, Minneapolis, Minn. 55415



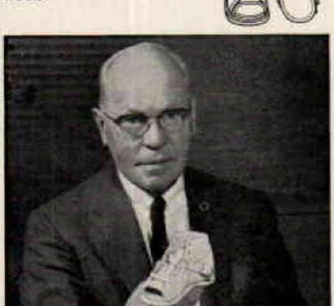
Your major selling point . . .
Doctors Prescribe CHESBROUGH Orthopedic Pre-Walkers

No. 1400 OPEN TOE
Straight-line symmetrical last, firm heel, no back seam. Adaptable to Denis Browne Splints.

No. 1300 CLOSED TOE
Lace-to-toe design permits snug, gentle fit. Perfectly smooth inside.



No. 1700 CLUBFOOT, OPEN TOE
Special outflare last, sturdy instep strap to stabilize heel.



Louis C. Weld, Founder of G. W. Chesbrough Co. . . . "My own personal experience led to the development of the new Chesbrough Shoe."

This is the reason Chesbrough Orthopedic Shoes have had such spectacular success. Orthopedic surgeons in 50 states and many foreign countries are now prescribing them. This large referral business continues to grow and we invite you to share in it.

Any parent whose child requires orthopedic correction will tell you the expense is great, as frequent purchase of new shoes is required.

This problem was brought home to Chesbrough's founder, Louis C. Weld, several years ago, when a child in his own family needed such a shoe. Recognizing the need for orthopedic shoes at an economical price, Chesbrough put their 68 years of shoemaking experience to work and Chesbrough Corrective Pre-Walker Shoes were born.

Here is a shoe of highest-quality workmanship and fine leathers, made to sell at a moderate price.

All shoes in unlined white elk, sizes 000 to 4, narrow and wide. Available in full pairs, split pairs or single shoes (no extra charge for half pairs).

MAIL COUPON FOR SAMPLES

G. W. CHESBROUGH CO.
797 Smith Street, Rochester, N. Y. 14606

NAME ....

ADDRESS ....

CITY .... STATE .... ZIP ....

READY TO FIT HAND, WRIST AND FINGER BRACES, CERVICAL BRACES, TRAINING AIDS AND SPECIAL APPLIANCES – PLUS A COMPLETE LINE OF SPINAL AND LEG BRACES CUSTOM MANUFACTURED TO YOUR MEASUREMENTS.

COMPLETE CATALOG AVAILABLE ON REQUEST

C. D. DENISON ORTHOPEDIC APPLIANCE CORP.

220 W. 28th Street – Baltimore, Md. 21211

The Orthopedic and Prosthetic Appliance Journal

Volume 20

1966

Published by The American Orthotic and Prosthetic Association

Washington, D. C.

JOURNAL INDEX FOR 1966

Part I—Subjects

Part II—Authors & Titles