SEPTEMBER 1967

ORTHOTICS AND PROSTHETICS

THE ORTHOPEDIC AND PROSTHETIC APPLIANCE JOURNAL

the GOLDEN JUBILEE Assembly

Hotel Fontainebleau, Miami Beach

(For program details, see Pages 191 to 193)

PUBLISHER: AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION

The 1967 NATIONAL ASSEMBLY of the

AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION

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at the

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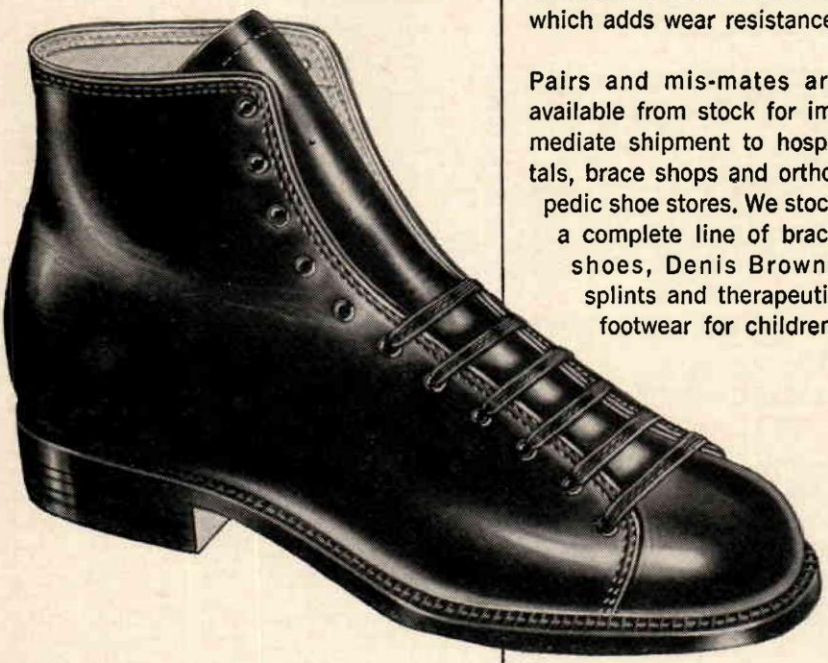

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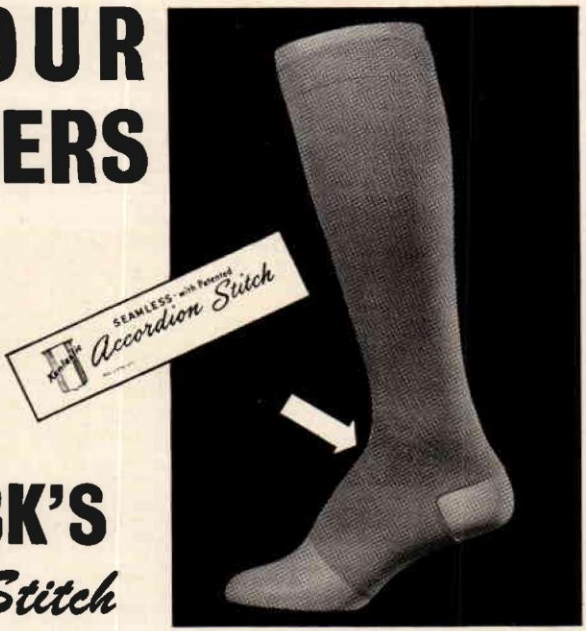

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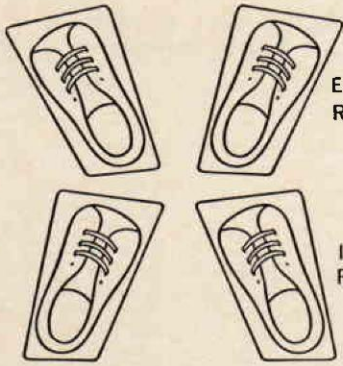

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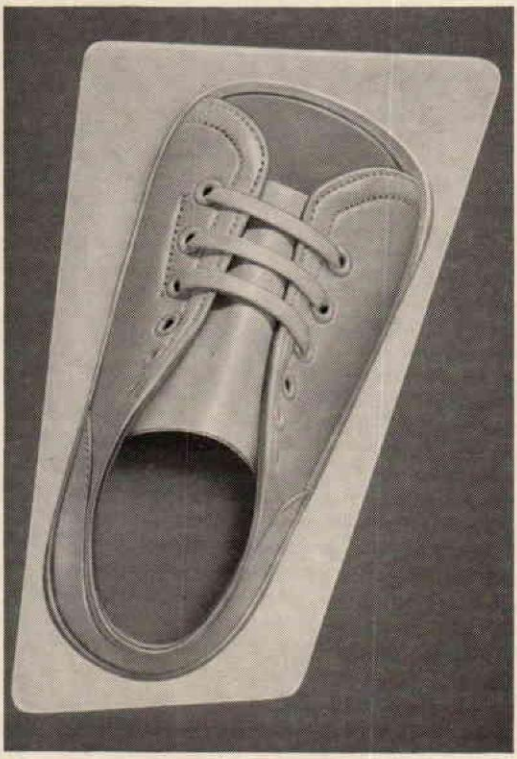

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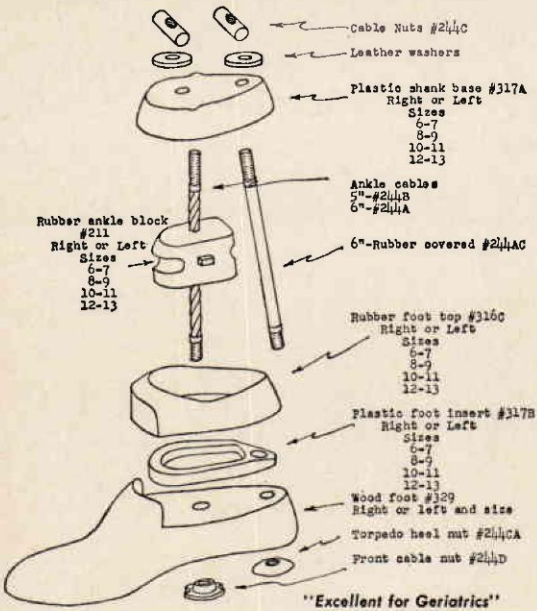

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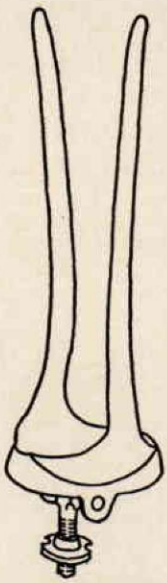
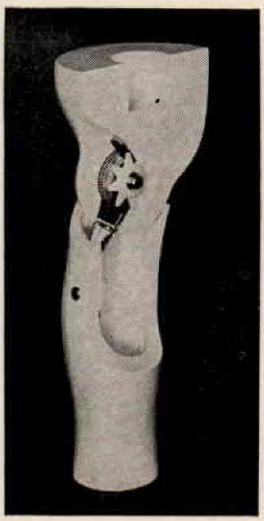


Symes Frame #270A with ankle joint, shaped to cast and measurements.



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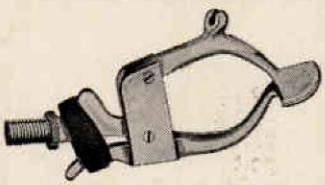

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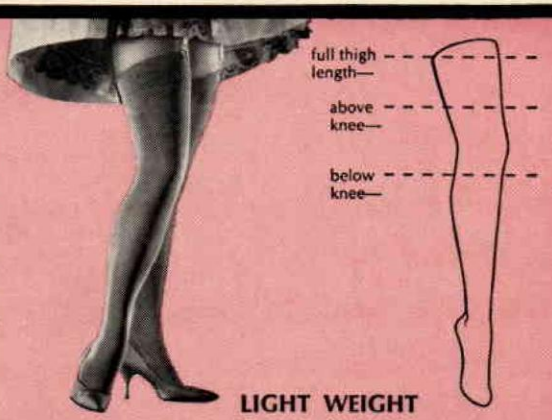

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THE GOLDEN JUBILEE PROGRAM

TUESDAY, OCTOBER 3

12:00 Noon—ASSEMBLY OFFICE OPENS
(Grande Gallerie)

WEDNESDAY, OCTOBER 4

9:00 A.M.—TRIPS AND TOUR DESK OPENS
(Grande Gallerie)

OFFSHORE FISHING TRIP
(Fontainebleau Departure)

THURSDAY, OCTOBER 5

GOLF TOURNAMENT
(Westview Country Club)

9:00 A.M.—AOPA BOARD OF DIRECTORS
(Everglades "A")

2:00 P.M.—ABC BOARD OF DIRECTORS
(Everglades "A")

4:00 P.M.—LONG RANGE PLANNING COMMISSION
(Everglades "B")

FRIDAY, OCTOBER 6

8:00 A.M.—EXHIBITORS SET UP
(Jade Promenade)

8:00 A.M.—North American Subcommittee Int. Comm. on Prosthetics & Orthotics
(Everglades "A")

9:00 A.M.—ASSEMBLY REGISTRATION
VOTER REGISTRATION
(Grande Gallerie)

9:30 A.M.—JOINT EXECUTIVE COUNCIL
(Conference Room "G")

1:30 P.M.—V.A. Supplier Meeting
(Everglades "B")
Presiding—Mr. Anthony Staros

6:30 P.M.—COCKTAIL RECEPTION
(Fontaine Room)

SATURDAY, OCTOBER 7

8:00 A.M.—THE PRESIDENT'S BREAKFAST
(Fontaine Room)
Presiding—Mr. George H. Lambert, Sr.
Speaker—Mr. Glenn E. Jackson

9:00 A.M.—FORMAL OPENING OF ASSEMBLY
(Fontaine Room)
Presiding—Mr. George H. Lambert, Sr.
Report of Nominating Committee by Mr. Fred J. Eschen, Immediate Past President

10:15 A.M.—OPENING OF EXHIBIT AREA
(The Jade Promenade)
Presiding—Mr. James D. Snell

11:00 A.M.—TECHNICAL SESSION NO. 1
(The Meeting Area)
"The Immediate Post-surgical Procedure"
Presiding—Mr. Richard G. Bidwell
Participating—Dr. A. L. Critter
Marquette University
Dr. Frank Clippinger
Duke University Medical Center
Capt. Frank Golbrantson, USN-Ret.
Mr. Richard G. Bidwell
Mr. Bert R. Titus
Mr. Charles Asbelle

11:00 A.M.—LADIES AUXILIARY MEETING
(Louis Philippe Room)
Presiding—Mrs. James D. Truesdell

3:00 P.M.—COMMITTEE AND REGIONAL MEETINGS
(As requested)

3:30 P.M.—VETERANS ADMINISTRATION
(The Meeting Area)
Presiding—Mr. Earle Lewis

SUNDAY, OCTOBER 8

9:00 A.M.—UCOPE MEETING
(Louis Philippe Room)

9:00 A.M.—CONFERENCE OF ORTHOTISTS
(Everglades "A")
Presiding—Mr. Carlton E. Fillauer

10:00 A.M.—CONFERENCE OF PROSTHETISTS
(Everglades "B")
Presiding—Mr. Ralph A. Storrs

11:00 A.M.—TECHNICAL SESSION NO. 2
(The Meeting Area)
"Insensitive Limbs"
Presiding—Mr. George H. Lambert, Sr.
Presentation—Dr. Paul W. Brand
Public Health Service Hospital
Carville, La.

11:00 A.M.—LADIES AUXILIARY TRIP WITH LUNCHEON

1:00 P.M.—TECHNICAL SESSION NO. 3
(Voltaire Room)
"Dynamic Foot Corrections
(With U.C.B. Shoe Inserts)"
Presiding—Mr. William L. Bartels
Participating—Dr. Donald S. Pierce
Massachusetts General Hospital
Mr. Gordon G. Plorin

1:00 P.M.—TECHNICAL SESSION NO. 4
(The Meeting Area)
"Below-knee Prosthetic Indications"
Presiding—Mr. Samuel E. Hamontree
Participating—Mr. Samuel E. Hamontree
Mr. Howard Tye
"Technical Demonstration of the P.T.S."
Mr. Kurt Marschall
Mr. Robert O. Nitschke

3:15 P.M.—TECHNICAL SESSION NO. 5
(The Meeting Area)
AUDIO-VISUAL PRESENTATIONS
Mr. Erich Hanicke—"Problems of Duplication"
Mr. Fred Quisenberry—"Fabrication of Temporary BK Appliances"
Mr. Alan R. Finnieston—"Immediate Post-Surgical Jig"
Mr. Richard Lehneis—"IRM Electric Arm Orthosis"
Mr. Bernard C. Simons—"The Hemicorporectomy"

6:00 P.M.—HAWAIIAN LUAU
(Garden Patio)

MONDAY, OCTOBER 9

8:00 A.M.—TECHNICAL SESSION NO. 6
(The Meeting Area)
"Powered Orthotics and Prosthetics—The Stage of Current Development"
Presiding—Mr. Thorkild Engen
Participating—Dr. David W. Lewis
University of Virginia
Dr. Roy Wirta
Einstein Foundation
Mr. Lloyd L. Saulisbury, Jr.
Mr. Albert B. Coleman
U.S.A. Biomechanical Laboratory

10:00 A.M.—TECHNICAL SESSION NO. 7
(The Meeting Area)
"Medicare and Medicaid"
Presiding—Mr. Daniel A. McKeever
Participating—Mr. Thomas Kennedy
Bureau of Health Insurance
Department of Health, Education and Welfare
Mr. Everett F. Haines, Iowa
Mr. John A. Metzger, California
Mr. John Gallo, New York

1:00 P.M.—ABC CERTIFICATION LUNCHEON
(Fontaine Room)
Presiding—Mr. Bert R. Titus
Speaker—Dr. A. L. Critter

2:30 P.M.—ABC BUSINESS SESSION
(Fontaine Room)
Presiding—Mr. Bert R. Titus

4:00 P.M.—ABC BOARD OF DIRECTORS
(Everglades "A")

TUESDAY, OCTOBER 10

8:00 A.M.—TECHNICAL SESSION NO. 8
(The Meeting Area)
"The Bunnell Hand Splints"
Presiding—Mr. Roy Snelson
Presentation—Dr. L. D. Howard, Jr.

9:00 A.M.—LADIES AUXILIARY BREAKFAST
(Club Gigi)

9:30 A.M.—TECHNICAL SESSION NO. 9
(The Meeting Area)
"Plastics and the Profession"
Presiding—Mr. Jerry Leavey
Presentation—Mr. Ralph R. Snell

1:30 P.M.—AOPA ANNUAL MEETING
(The Meeting Area)

6:00 P.M.—RECEPTION
(West Ballroom)

7:00 P.M.—CONCLUDING BANQUET
(East Ballroom)
Presiding—Mr. George H. Lambert, Sr.

WEDNESDAY, OCTOBER 11

8:00 A.M.—AOPA DIRECTORS' BREAKFAST
(Champagne Room)

10:45 A.M.—JOINT EXECUTIVE COUNCIL
(Everglades "A")
Presiding—Mr. George H. Lambert, Sr.

11:45 A.M.—LONG RANGE PLANNING COMMISSION
(Everglades "B")
Presiding—Mr. Theodore W. Smith

A Message from the President

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

THE YEAR'S END

Almost a year ago—in December, 1966, to be exact—I had the privilege of speaking to you through an article in this publication. It was then called *The Orthotic and Prosthetic Appliance Journal.*

The name of this publication is now *Orthotics and Prosthetics.* The change is one of many more that it will undergo in the next few months. Among them are the use of a more attractive format, the development of a broader range of meaningful articles and so on. The goal of these changes is to make this publication a more effective communication medium for the members of our profession and all of those who have an interest in it.

I think, as I leave office as President of AOPA, that the old *Journal* is an example of what has been going on for the year I have been privileged to hold that office. It has been a period of change and transition. It is hard for me to realize that so much has happened in such a short time—and that so much still remains to be done.

The AOPA-ABC National Office has been undergoing a complete reorganization—yet there is more to do to put it into its final form.

The Delgado College program for training orthotic and prosthetic laboratory technicians has been worked on constantly and energetically—but it still must be brought to completion so that it will actually operate and thus serve as a pilot for other similar institutions around the country.

Every region has been visited by one or more of our officers—yet each region must be linked more firmly to the overall effort of our Association.

A proposal for a five-year plan has been submitted to the Directors for discussion at the National Assembly—yet changing times have already demanded revisions.

Such change is, to me, the key to our future. We are evolving as a universally recognized health-related profession, a status that other allied sectors have attained before us. A major part of the responsibility that goes with achievement of that recognition is that none of us in our profession can be static. We must accept that change will be our lot: we can no longer merely adjust to this condition but must look forward to it as fundamental to our progress. It is the obligation of each one of us to seek out the ways in which we must change so that we will be worthy of the responsibility that is being entrusted to us as practitioners.

The practice of orthotics and prosthetics is an honorable occupation. From time immemorial, it has been the foundation for rehabilitation of the disabled. As we move toward professional status, the demands placed upon us will increase and not decrease. The greatest change we must make is preparing ourselves for the test of worthiness: as practitioners, and as members of our profession, we must be able to demonstrate that we are dedicated to the service of the patient above all other considerations.

If we fail to do that, we will have failed ourselves and those of our fellows who depend upon our unique capabilities to help them back to independence and a full life. We will not and cannot fail if we dedicate ourselves to total support of educational research. This is our road into the future day which we must set as our course.

In leaving, I express my appreciation for the privilege you inferred on me in electing me President of our Association, and for the support and encouragement you have given during this year of transition.

Levels of Amputation and Limiting Factors*

By GEORGE MURDOCH

Whatever the indication for amputation, the result is a limb stump. In the case of a hindquarter amputation for chrondrosarcoma of the pelvis the stump as such is non-existent but the level of limb section is mandatory. In other situations and particularly where the pathology is more distal in the limb the precise level of limb section is selected ideally within relatively narrow limits and hopefully after due consideration of all the relevant factors.

As to the surgery itself the surgeon will have a choice of hundreds of procedures. Some of these operations have well founded reputations with a long history of usage and acceptance. Others are somewhat fanciful and a few, in the light of hindsight, frankly comical. At the present time some 70-80 per cent amputees lose their legs because of vascular disease, in particular, atherosclerosis. It is possible to make broad classifications of the patterns of vessel pathology, but consideration of the individual patient still deserves a decision individually tailored to his needs. Usually the question to be answered is whether the amputation should be above-knee, through-knee or below-knee. If the surgeon's interest is solely that of primary wound healing then the level of limb section will be above-knee in nearly all cases. Indeed there are still some surgical units where the problem of amputation level in atherosclerosis has been rendered down to an axiom which states that if the gangrenous process is proximal to the toes then above-knee amputation is obligatory. There is little doubt that evidence could be produced to support such an axiom if, and only if, we look at the problem against a background of crude and inaccurate methods of assessing tissue viability, "conventional" amputation surgery performed by relatively junior surgeons, primary wound healing as the sole criterion of the success of the operation and finally a total disregard for the patient's needs.

Close consideration of the subject of leg amputation leads one directly to the conclusion that this is a medical situation with unique implications. Prosthetic replacement of other parts of the body, at least at this time, poses quite different and usually simpler problems. For example, the removal of an eye, an ear or breast requires a prosthesis which depends solely on the cosmetic art (spectacles are not prostheses but rather sophisticated technical aids). The excision of the head and neck of femur and its replacement with a prosthesis also presents a quite different philosophical situation. In this instance, the design of the implant, the materials employed and its method of fixation may all have been devised on a basis of the knowledge of the forces involved in human location, the functional properties of joints, tissue reaction to different substances and the behaviour of bone in response to varying loads. Even if this were so, the surgeon himself fits the prosthesis and performs his surgery precisely with prosthetic replacement in mind. Other examples of this kind can be quoted.

Perhaps the clinical situation closest to leg amputation is found in the field of dentistry. The days when wholesale removal of teeth was followed by the patient's purchase of a set of "store" teeth are long since past. The dental surgeon today is now strongly conservative and when dental extraction is inevitable or desirable the prosthetic replacement (which is both cosmetic and functional) is very much in his mind. More than that, he

* Reprinted by permission from the Annals of the Royal College of Surgeons of England, 1967, 40, 204-216.

devotes a large part of his training to learning about the cosmetic and functional requirements of the prosthesis, how to take casts of the "stump", what materials are available and even constructs a prosthesis. He supervises and works closely with his "fitter", the dental technician, and is able to do this because of the broad area of common knowledge and experience.

Leg amputation, on the other hand, is performed by a man who is unlikely to possess any fundamental knowledge of human locomotion. He knows little about socket design or the limited functional characteristics afforded by prosthetic devices. He might well never have met a limb-fitter in his life. It can be argued that he is not equipped to determine exactly the level of amputation, however deep his knowledge of pathology and no matter how surgically expert he may be.

Hopefully, reorganization of undergraduate training and of the limb-fitting service itself will go some way towards effecting a remedy for these deficiencies. Meantime the amputating surgeon would be well advised to establish close contact with the regional limb-fitting surgeon and his team of limb-fitters and become an integral member of the Clinic Team.

This is indeed our main trouble. The surgeon, the patient, the limb-fitter, the limb-fitting surgeon, all look at this problem from a different viewpoint. The prosthetist sees as his problem the patient with his stump; the patient may be astounded and frightened by the mutilation that has occurred, and the surgeon, depending on his views, may regard it as nothing more than a surgical exercise or refer the matter to the Registrar or house surgeon.

Not so long ago surgeons were urged to perform amputations at so-called sites of election; levels determined largely by the prosthetic considerations of the day, and a knowledge of the survival of amputation stumps at different levels. This advice, which was fostered by some powerful protagonists, had a considerable influence on surgical practice in this country and had in my view two important effects. The first was the depreciation of certain very valuable procedures such as the knee disarticulation and the Syme's amputation, and this was due largely to semantic laxity in the assessment of large numbers of amputations performed during the 1914-18 War. The second effect, the removal of a very large part of the surgeon's responsibility for his patient and the effects of his surgery is a regrettable although perhaps inevitable result of a service which has failed to modify with changing needs.

I believe the amputee has over these years suffered from this disassociation of responsibility. The projected removal of part of a patient's body is not to be treated lightly, or undertaken in ignorance, even though supported by considerable expertise in one's own field. Our purpose, therefore, is to do several things: to decide whether amputation is the correct form of treatment, to define the correct level of amputation and, most important, to define the objects of the operation. The event, amputation, marks not the end of a story but rather the beginning. If the surgeon's sole objective is the certainty of primary wound healing, then the patient's aspirations in terms of locomotion may be frustrated. The pathology, therefore, is not the only factor to be considered in determining the appropriate level of amputation. One might express the relevant factors as being:

Pathological
Anatomical
Surgical
Prosthetic, and
Personal, e.g. sex, age and occupation.

Each of these will play some part in the decision to ablate the limb at a given level, with varying emphasis according to the clinical situation. The simpler decisions will tend to be those involving new growth at a high level and the complicated deliberations those concerned with elective ablative surgery which is not obligatory. As each of the amputation levels in different pathological situations is discussed the cogency of the different factors should emerge. At any rate a close consideration of these factors will permit us to select one of the following levels of limb section:

Hindquarter
Hip disarticulation
Thigh amputation
Knee disarticulation
Below-knee amputation
Syme's procedure
Distal amputations.

A listing of this sort needs some comment because to some there may appear to be important omissions. For this reason each level is considered in a little more detail.

Both the *hindquarter amputation* and the *hip disarticulation* require little comment because those levels are determined almost entirely by the pathology. It should be pointed out that there is no longer any need to attempt to leave an inch or two of femur at hip level because of advances in the prosethetic art.

The above-knee amputation should be as long as possible subject to the pathology. Two prosthetic factors require consideration, viz. hip flexion deformity and the need to provide space for prosthetic devices. If the hip flexion deformity is considerable, e.g. 30-40°, it may not be possible to fit the patient with an artificial limb at all; and if less marked it may well affect the level of amputation. The strain on the lumbar spine brought about by the presence of a hip flexion deformity and responsible for limited capacity and disabling back pain in a whole person can prove intolerable in the amputee. Furthermore there is a limit to the hip flexion than can be accommodated in the prosthesis: these thresholds can be seen from the cosmetic point of view and from the biomechanical aspect at the socket brim, where location of the bearing areas and containment of the anatomy may prove impossible. In general, if there is a hip flexion deformity, limb section will require to be more proximal than the pathology itself would suggest.

The other factor requiring consideration is the need to accommodate prosthetic devices above the artificial knee axis. In all but the frail we will wish to have the patient walking with a mobile knee and to introduce one of these devices to help or control function during the stance or swing phase of gait. This requires that the stump should terminate at a level which will leave a gap of 4½ to 5 inches between stump end and the knee axis.

Finally, reference has to be made to the surgical technique employed. I have already referred to the "sites of election". These levels have been arrived at on a very large experience of stump survival and point to the main problem of terminal ischaemia. In the thigh the "ideal" level, 10 to 12 inches from the trochanter, has long been accepted as the site of election in the United Kingdom and was confirmed by the countries of the Brussels Treaty organization in 1953 (*Brit. med. J.* 1953). At a conference under the auspices of the World Health Organization, held in the following year, it was stated that "The Conference considered these recommendations too

rigid and drew attention to more functional methods of stump-length determination". The report of this conference (W.H.O., 1955) goes on to urge that all relevant factors should be considered in arriving at the "site of election" for the individual patient. The surgical technique itself has emerged in recent years as an important factor stimulated by the work of Dederich (1963), Ertl (1949) and Mondry (1952). Their contributions suggest among other things that the distal circulation in the myoplasty procedure is superior to that found in stumps following "conventional" surgery. What is unquestionable is that they are prosthetically more satisfactory; the stumps are more powerful, they provide better adherence to the socket, and problems produced by a prominent bone end are eliminated.

Amputations performed at or about *supracondylar* level, e.g. Slocum, Gritti-Stokes, are not recommended. This view is based on the fact that they are not truly end-bearing on one hand and, on the other, they fail to leave sufficient space for the insertion of knee control devices in the prosthesis. Perhaps a special comment is required on the Gritti-Stokes amputation as it has a measure of residual popularity. Undeniably it has merits in terms of wound healing and in ease of performance, but in this procedure a "fracture" is created, time must elapse for the "fracture" to heal and, as happens in a significant number of cases, the patella fails to be firmly located at the end of the stump and can prove troublesome in socket construction (Vitali, 1966).

The *knee disarticulation or through-knee amputation* has proved an excellent procedure and increases in popularity because it is an easy, relatively bloodless operation where the great majority of the thigh muscles retain their normal insertions. It provides a long strong lever and a large (up to 20 square inches) bearing surface with excellent proprioception. It is particularly applicable during the growth period as the distal femoral epiphysis is retained, and in the elderly where its end bearing properties with better ability to balance is greatly appreciated. Because of the stump length the arguments regarding the influence of a hip flexion deformity are even more cogent, and significant flexion deformities preclude amputation through the knee. The prostheses available for the stump following knee disarticulation are not entirely satisfactory from a cosmetic viewpoint. In the case of a young adult female the writer would perform a low thigh amputation using a myoplasty technique because of the cosmetic advantages even if all other factors permitted a knee disarticulation.

Amputation at below-knee level has usually meant ablation at a point 5½ inches from the tibial plateau. Certainly the division should not be made lower than the musculo-tendinous junction of the calf muscle and, although shorter stumps have proved functional, can rarely be effective shorter than 3½ inches, again measured from the tibial plateau. If the insertions of the hamstrings do not encroach too much on the stump and bone division leaves a broad expansive bone end capable of end bearing, then short below-knee stumps can be remarkably successful. Surgical technique again plays a part in survival of the longer below-knee stumps and any of the procedures which ensure a secure attachment at the bone end for the muscle groups under some tension will also ensure a better terminal circulation. The osteo-myoplasty of Ertl (1949), described by Loon (1962), or the technique used by Burgess (1966) of Seattle are good examples of these procedures. Again joint flexion deformity may influence the level of ablation. I question whether a knee flexion deformity of more than 15° can be accommodated satisfactorily by the prosthesis and this is especially true in the case of the very long stump.

The next recommended level of limb ablation—*the Syme's amputation*—provides an excellent stump with good end bearing properties and in certain circumstances allows locomotion in the absence of a prosthesis. Since the first description (Syme, 1843) of the procedure Syme's amputation has enjoyed a variable popularity. Its loss of popularity in this country following the 1914-18 war was due largely to a poor survival rate in stumps described as Syme's amputations. Many of these operations were performed under adverse conditions, the tissues of the heel flap were often deeply scarred and a proportion were in fact the result of Elmslie's modified Syme's amputation (Elmslie, 1924). When properly performed with the knife dissecting against bone throughout, removing only a thin slice of tibia and ensuring proper location of the heel flap, there is no better amputation (Harris, 1956). As in the knee disarticulation it is particularly applicable in the growth period and in the elderly, but cosmetically is not entirely satisfactory and may not be acceptable to an otherwise attractive young woman. I would condemn the Pirogoff and Boyd procedures: the stumps are too long, the heel anatomy is distorted and in both the weightbearing is delayed. All the procedures in the hind foot and the mid-tarsal region, notably the Chopart, are subject to a problem of muscle imbalance. Even in those cases where tendon transference has been carried out, e.g. of the tibialis anterior, muscle imbalance persists and the stump becomes deformed, with resultant equino-varus and painful sores.

In my view there is no place for any procedures which fall between the Syme's amputation proximally and the amputations through the metatarsals distally. This opinion can be properly modified when we consider communities where no prosthetics services exist and stumps resulting from procedures such as the Pirogoff operation may assume real validity.

It is appropriate at this point to consider the several indications for amputation. They may be listed thus:

1. Vascular disease
2. Tumours
3. Trauma
4. Chronic infection
5. Paralysis
Deformity
Limb discrepancy
6. Congenital limb deficiency.

Of these indications far and away the commonest reason for amputation in North America and Northern Europe is vascular disease. This provides the largest and unfortunately the most difficult problem and remains for consideration later.

So far as *tumours* are concerned, elective sites of amputations remain controversial; clearly the management of the patient will be determined by a number of factors including the place of limb ablation itself, the nature of the tumour, and the presence or absence of metastases. The practice generally accepted, if we take the typical example of an osteosarcoma, is to have a joint intervening between the tumour and the amputation site. One might regard amputation in tumours as a wide excision: the amputation then being contingent on the involvement or proximity of the tumour to the nerves, vessels or supporting bone.

In the case of *trauma* the rule is to save all possible tissue: elected procedures, such as myoplasty, should be performed later.

Chronic infection remains an indication for surgery, where all systemic and local antibiotics have failed, the systemic effects of infection are feared or evident, and reconstructive surgery is not possible. A review of the 1,400 amputees who attend Dundee Limb Fitting Centre suggests that a small but significant number of amputations have been performed since the beginning of the antibiotic era in the presence of chronic infection for the best of reasons but at too high a level. Caution should be tempered by a cool appraisal of the needs of locomotion in the light of the extensive therapeutic armamentarium. My experience suggests that it is possible to do the amputation through the affected bone but proximal to the infection. It is preferable to close the wound. If any doubt exists then one may fashion one-piece flaps with minimal dissection and suture them loosely over a pack; secondary suture can be performed two or three weeks later.

The next indication comprising and possibly combining the disabilities of *deformity, paralysis and limb discrepancy* is perhaps the most difficult to define. Amputation in these circumstances is never a life-saving procedure or indeed necessary to permit locomotion; many factors have to be considered and some of these involve matters which the surgeon rarely is required to consider. These matters might well include the influence of fashion (known to be fleeting), the individual sexualtiy of the patient, the occupation of the patient and family relationships. In the male the decision may well rest solely on functional considerations although not necessarily so. In the female, cosmesis is of great importance especially during the second and third decades of her life. At the same time one must not replace static disfiguration with dynamic ugliness. The decision in the long run will depend on an intimate knowledge of the patient, her parents, her desires and aspirations and, most important, a fundamental appreciation of the biomechanical and prosthetic possibilities. The operating surgeon is strongly recommended to consult his local limb-fitting surgeon.

Very rarely one has to consider amputation on cosmetic grounds alone. Figure 1 illustrates such a case: a teenage girl, who some years before had been run over by an omnibus with gross degloving. She survived with a leg of very unpleasant appearance. Nevertheless, despite the appearance, absolute limb shortening and overgrowth of the femur she walked well without discomfort and had excellent foot and ankle function. Because of her ugly leg the girl, on leaving school, refused to venture outside her home and always wore slacks. After many discussions with both patient and parents an above-knee myoplasty was performed. Despite marginally reduced function, this young girl is now much happier with limbs of equal length and appearance and is well on her way to being a fully integrated member of the community.

Congenital limb deficiencies present similar surgical, functional and philosophical problems. Unless working specifically in this field the amputating surgeon is unlikely to build up a sufficiently large experience of these cases on which to base a competent opinion. He would be well advised to seek advice from doctors working in the speciality of prosthetic replacement before undertaking any irrevocable step. Perusal of the literature (Aitken, 1959; Hall *et al.*, 1962; Kruger and Talbott, 1961) might suggest that, for example, in a case of congenital absence of the fibula, ablation of the foot is the standard procedure. This may not always be so as McKenzie's (1957) experience demonstrates.

These then are the main pathological situations, excepting that group which is responsible for most of the amputation today, viz. *peripheral vascular disease.*

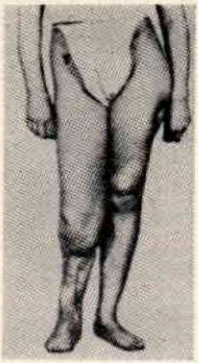


FIG. 1—Very ugly leg with good function. Amputation for cosmetic reasons.

As an orthopaedic surgeon I do not have full clinical control of all patients who require an amputation because of disease of the blood vessels in the limbs. Nevertheless as the surgeon responsible for prosthetic replacement I am familiar with the case histories of those patients presented for prosthetic prescription and with a significant number prior to surgery. The vascular catastrophes, such as embolism and acute vessel thrombosis, and special cases, such as frostbite and chemical gangrene, are not considered in this contribution.

The disease responsible is atherosclerosis, affecting mainly the older age groups and males significantly more than females. Atherosclerosis may affect the whole vascular tree, and conditions such as coronary thrombosis, cerebral vascular lesions or amputation of the other leg may complicate the clinical picture or loom ominously in the future. The great majority of these patients are over 60 years of age and other diseases such as blindness, arthritis and diabetes are all too common.

Except in cases of ischaemic nemopathy with extreme pain (Smith, 1964), evidence of frank tissue death is usually present before amputation is considered as the first line of treatment. The patient is faced with amputation and the surgeon in his wisdom with a critical decision as to the level of limb ablation.

Over the years several ancillary methods of assessment of blood flow have been evolved. These include:

Plethysmography
Oscillometry
Skin temperature tests
Arteriography.

There is little unanimity regarding the value of these techniques and in my experience arteriography allied to the clinical examination is likely to give the most realistic assessment of tissue viability. Even so, the techniques available are crude and it is hoped that more sophisticated and refined methods will become available with advances in the field of bioengineering. There is little question that certain gifted radiologists can with sufficient experience produce arteriograms which may offer valid information regarding collateral and distal vessels to a degree not normally produced in standard arteriographic procedures. One thing is certain: any arteriographic representation demonstrates the real vascular picture at a disadvantage; it cannot do otherwise.

The picture most commonly seen after all investigations have been made is one of distal gangrene, a proximal main arterial block and a variable pattern in the more distal vessels. The discerning surgeon will be interested in determining the degree to which the distal vessels and collateral vessels have been invested by the basic disease.

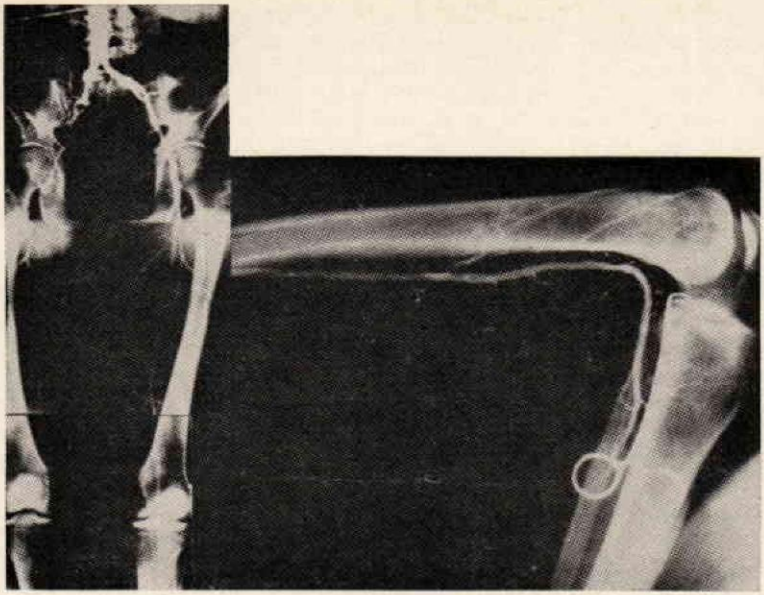
In this disease there is an unfortunate paradox. The earlier the onset of the disease the more slowly its progress and the more chance there is for the development of a useful collateral circulation. Furthermore this is more usually the picture in the younger patient and more distal amputations are feasible. The later the appearance of atherosclerosis the more rapid the progress and the less chance there is for the development of a collateral circulation. Unfortunately this is the clinical picture commonly seen in the elderly patient and the more proximal is the amputation performed. Yet the younger patient is more able to overcome the considerable locomotion disability that derives from a high amputation whereas in the elderly there is correspondingly less chance to achieve a satisfactory rehabilitation.

It behoves us, therefore, to perform limb ablation at the lowest possible level consistent with tissue viability and useful function in the retained joints. There is a clear and observed advantage to the patient to retain the knee joint or to have preserved the broad end-bearing surface of the femur as in the knee disarticulation. Whatever help we may obtain from arteriography, and in certain cases it may be invaluable, in the end the decision as to level of section will depend upon a clinical assessment. The features of this assessment will include the peripheral pulses, the extent of local sepsis and oedema, and the effects of ischaemic nemopathy in terms of the sensory deficit and absence of hair. In the majority of cases the dilemma will reside around the knee: should the amputation be above or below the knee or at knee level itself?

In selected cases vascular surgery will allow of a lower level of limb section and in such a case (Fig. 2) a below-knee operation was possible with sound wound healing and a functioning stump.

Diabetes is a major complication, affecting from 21 to 42 per cent of those patients subjected to amputation for vascular disease (Wilson, 1964). It plays a variable role: it may accompany an otherwise typical atherosclerosis, it may modify the disease pattern in atherosclerotic vessels, be itself responsible for disease of the vessels or by reason of neuropathy necessitate distal amputation. Whatever its role it should be carefully defined. Obviously the patient with forefoot gangrene, a palpable posterior tibial pulse and diabetes should not be subjected to above-knee amputation. In these circumstances if the sensory loss is proximal and there is an absence of pain then the tissue death is probably due to a neuropathy, the blood flow is liberal, demarcation is more rapid and precise and non-destructive distal amputations can be done. Conversely the presence of diabetes does not necessarily suggest a distal amputation. Each case deserves consideration on its own. The presence or absence of peripheral pulses, infection and the state of the skin at the line of demarcation of tissue death all provide clues to the circulation gradient and the level of limb section.

A lower level of operation may be possible if a number of general measures have been undertaken. Any diabetes should be properly stabilized, the general nutrition of the patient improved and physiotherapeutic measures instituted. A sound philosophy is that of pre-prosthetic training, where the patient is taught to walk in a special pylon with the knee flexed (Vitali, 1966). The most important of these pre-operative measures is the correction



(*a*) (*b*)

FIG. 2—Before and after ilio-femoral by-pass procedure.

of any anaemia because if it remains untreated then it will adversely affect wound healing and even the ultimate level of limb survival.

Despite a careful evaluation and pre-operative preparation there may still remain doubt regarding the level of amputation. In these circumstances I believe the patient should be told of the problems and possibilities existing and a mandate for the operation obtained. If, for example, at operation below-knee amputation proves to be impossible then the surgeon should have permission to proceed to knee disarticulation or above-knee amputation.

The technique of operation itself will influence the ultimate level of limb ablation. It cannot be emphasized too often the need to ensure haemostasis at the end of the operation. Some other general principles in amputation technique are worth mentioning because they are directly applicable. The main arteries and veins should be ligated separately and low to ensure the survival of the maximum number of collaterals. Conversely the nerves should be divided high and cleanly to reduce the chance of leaving ischaemic, dissociated nerve fibers (Smith, 1964), thus preventing unnecessary stump and phantom pain. Similarly proper muscle suture and the treatment of the bone end play an important part in the final survival of the stump. The question of drainage is often debated. From my own operative experience and from some 12 years' experience in amputee clinics it is possible to say that well over 50 per cent of amputations performed without drainage present for prosthetic prescription with a frank bloody haematoma or a mass of scar tissue indicating an organizing haematoma. In my view drainage should always be used.

The management of the stump after operation will determine the extent of the development of oedema. For the past six years I have employed a rigid plaster of Paris "dressing" and noted a decrease in oedema formation. The recent development of immediate post-operative fitting techniques have

reinforced this observation. It seems clear that if stable pressure relationships are established between the stump and the "dressing" (plaster) then venous drainage is aided and oedema reduced if not eliminated (Burgess, 1966). The technique requires care, some knowledge of prosthetic principles and a complete avoidance of any proximal constriction. Considerations of this kind are important as failure to heal necessitates a re-amputation rate of the order of 20 per cent.

Once again I must emphasize strongly the importance of flexion deformities. One cannot avoid the conclusion that too often the flexion deformity is associated with prolonged ill-supervised bed rest prior to amputation. It is heart-breaking to see a patient with a below-knee amputation, obtained as a result of several months in hospital and an elaborate vascular operation, with a soundly healed stump but presenting with a crudely shaped tibial end blanching the skin and firmly established flexion deformities of hip and knee precluding any prosthetic management. I almost hesitate to mention the value of fracture boards under the mattress, but do so because their absence is all too often a major factor in the production of flexion deformities. The injudicious use of pillows under the knee is also to be condemned. If arterial surgery is considered then these matters require further emphasis solely because of the increased time spent in bed. It is imperative that the atherosclerotic patient when admitted to hospital is submitted to a programme of aggressive evaluation and treatment.

If the patient has already suffered from an amputation of one limb then this will bear directly on the selected level of amputation for the other. It is a complicated problem which has been well covered by Vitali and Harris (1964). It is sufficient here to say that if the patient has been fully rehabilitated following the first amputation, e.g. above-knee, then, all other factors considered, an amputation at a lower level, e.g. below-knee, may be a viable proposition. If, however, the above-knee amputee has never walked you will do him a disservice by performing a below-knee amputation. A through-knee or above-knee amputation will serve him sufficiently well to allow him to walk with rocker pylons when a long-leg management may well be impossible. A careful assessment of the patient's fitness and morale is required prior to operation.

In all these considerations reference has been made to skills which are not necessarily surgical. The author recommends strongly that the amputating surgeon realizes that the stump has no valid existence on its own and that to become functional a prosthesis is necessary, thereby implicating other disciplines. It is earnestly hoped that the surgeon will consider himself as a member of a team including, at least, the patient, the limb-fitter, the physiotherapist, the nurse and the doctor specializing in the prosthetic field. As such I hope that he will involve all the members of the team as soon as possible to ensure a dynamic approach to a problem which for the patient is compounded of bewilderment, mutilation, often hellish pain and the frustration of ignorance.

Our object is clear—the patient should be returned to his own home without pain and able to walk and enjoy life in some degree with a measure of independence.

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Management Guide for the Child With Cerebral Palsy *

Foreword

This is the third in a series of Guides developed by the Committee for the Care of the Handicapped Child of the American Academy of Orthopaedic Surgeons, the first having been a Guide for the Management of the Child Amputee and the second, Management of Patients With Myelomeningocele and Congenital Spinal Defects Guidelines for Care.

The purpose of this Guide, which is endorsed in principle by the American Academy of Cerebral Palsy, is to express minimal essential professional requirements for program improvement and new program development for the child with cerebral palsy. It must be realized that no absolute or arbitrary standards are possible. There are many differences in local and state methods of caring for the handicapped child, availability of facilities and personnel, individual philosophies of approach, and personal differences in the medical and social requirements of children with the same diagnosis. With this Guide as a foundation, leadership by interested orthopaedic surgeons and other medical and paramedical personnel, coordinated with planning and cooperation by state and local community, education, social and therapy services, can lead to fulfillment of the needs of children with cerebral palsy.

Committee for the Care of the Handicapped Child, 1966-1967

Robert S. Stiffert, Chairman

Robert W. Bailey
Burr H. Curtis
George R. Miller
Edwin L. Mollin
Charles H. Franz
Lawrence Noall
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I INTRODUCTION

During the past 20 years considerable emphasis has been placed on the care for the child with cerebral palsy. The American Academy for Cerebral Palsy, an organization composed of professional people with a common interest in the problems of children with cerebral palsy, was founded in 1947. During this period cerebral palsy clinics were established throughout the country and were supported by volunteer agencies and by state and federal sources. The agencies included the National Society for Crippled Children and Adults, United Cerebral Palsy, State Crippled Children's Programs, and the Children's Bureau.

Many articles and books have been written on the management of the child with cerebral palsy. The American Public Health Association pub-

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lished its first guide entitled Services for Children with Cerebral Palsy in 1955 and at about the same time, the New York City Department of Health published recommendations for Comprehensive Care of Children with Orthopaedic Handicaps which also emphasized cerebral palsy. These guides and standards are being reviewed and revised in view of the more recent experiences in classification, prognosis, therapy techniques, and programs of medical, paramedical, and community care.

Children with cerebral palsy have multiple handicaps. The common denominator is brain damage. The damage may be focal or diffuse, depending on the etiology, but it is present in all. The complex nature of cerebral palsy requires understanding of the immediate problem and anticipation of those obstacles that will develop as the child approaches school age, adolescence and maturity. Physicians who assume responsibility for management of these children should have special knowledge concerning all of the physical, social, educational and vocational aspects of the child's development that must be dealt with during his maturation.

In cerebral palsy the "team approach" is the foundation of treatment. Awareness of medical advances as well as of the social, vocational, educational and psychological aspects, and knowledge of planning agencies are essential. Satisfactory management of the child's physical problems alone is not sufficient. It is but one of the many aspects that must be considered in the habilitation which will enable him to care for himself and to take his place as a functioning member of his family and community.

It is the purpose of this guide to outline those recommendations of the American Academy of Orthopaedic Surgeons which represent an expression of basic requirements of medical, paramedical and community personnel, and their functioning together as a team in the development of a coordinated care concept for the child with cerebral palsy. It is hoped that these guidelines can serve as a basis for the further development of realistic programs, the structure of which depends upon local facilities, resources, and philosophy of medical care.

Although "Cerebral Palsy" has become the accepted designation for this group of children, "A Guide for the Managament of Neuromuscular Disease" might be a more appropriate title. Such a guide would include other conditions of the neuro-motor-skeletal system with similar problems, such as muscular dystrophy, myelomeningocele, myesthenia gravis, etc.

II CLASSIFICATION

Cerebral palsy is a manifestation of non-progressive brain damage. We may choose any one of a number of classifications; for example, etiology, pathology or the clinical manifestation. It is essential that both the medical and paramedical members of the team make the kind of evaluation which will lead to good overall planning and which will allow them to give sound advice to the parents.

An accurate initial evaluation permits a realistic therapy program for bracing, physical therapy, and surgery. For example, auditory impairment and dental problems are commonly associated with athetosis whereas convulsions and sensory deficits are more frequently associated with spasticity. Surgical procedures are much more successful in the child with spasticity than in the child with athetosis, and thus particular care must be taken in clinical assessment and classification. An example of classification follows:

FIGURE 1

Diagnosis	*Area*	*Etiology*	*Motor*
A. Spastic	Cerebral cortex (pyramidal)	Vascular or traumatic (prematurity)	Development of flexion contractures
B. Athetoid	Basal ganglion (extrapyramidal)	Anoxia (Rh and ABO incompatibility)	Involuntary activity without flexion contractures
C. Ataxia	Cerebellum	Anoxia	Most apparent during walking
D. Rigidity	Diffuse	Encephalitis	"Pipestem rigidity"
E. Mixed	Mixed pyramidal and extrapyramidal	Vascular, e.g. Caesarian section	Ordinarily a combination of an athetosis and spasticity

III RECOMMENDED STANDARDS

These are guidelines for minimum standards for care of children with cerebral palsy. Each clinic or medical program should include these basic essentials and expand on them, depending on the type of individual program. It is not enough to accumulate a group of certified medical and paramedical specialists if they continue to function as individuals. The child and the family will need the combined support of the entire group which means they must *function* together as a *team.*

A. Location of Facility

The facility should include adequate space for examination and a place for the children to play while they wait. A separate recreational room may be provided where volunteers may work with the children. In large facilities recreational therapists are valuable.

The clinics should be held adjacent to or in the physical therapy department so that training devices such as parallel bars, steps, walkers, and the like are available for use during physical examination.

B. Medical and Paramedical Personnel

Although defined separately, all individuals concerned with the care of these children should function as a "Team" with close coordination in order to insure that the care is comprehensive and continuous.

1. The *Director* should be a Diplomate of his specialty. He should be *specially trained and have special experience* in the care of children with neuromuscular disease, in particular cerebral palsy. He should maintain a sympathetic relationship with the child and the family and he should be knowledgeable regarding the use of community resources.

2. *Medical Staff:* The team should include a pediatrician, orthopaedic surgeon, neurologist and, whenever possible, a physician trained in physical medicine. Consultants in ophthalmology, otology, audiology, dentistry, and speech pathology should be available to work closely with the therapy team. Examination by the neurologist, orthopaedist, pediatrician, psychiatrist, or other specialist, may be performed as a group. Generally a more thorough evaluation can be performed when these examinations are done separately. Since the major needs of the child may vary from time to time, various specialists may have to take a greater degree of responsibility during the therapy regimen. For example, it may be that the child should be seen every

three months by the neurologist because of seizures, and only every six months by the orthopaedic surgeon. Likewise it may be that the child should be seen much more frequently by the pediatrician than by other members of the team. Regardless of the special examinations being performed and the therapy responsibilities at any particular phase of treatment, regularly scheduled periodic *team conferences* are essential.

The ideal arrangement might be to have the clinics scheduled so that the child attends all clinics on the same day. Those children who present a particular problem might be detained for a late afternoon discussion or simply rescheduled.

3. *Physical and Occupational Therapists* are essential members of the group. They should be graduates of an accredited school of physical or occupational therapy and be registered by the state. It is preferred that the therapist have had at least six months of special training in neuromuscular disease.

4. *Psychologist:* A qualified psychologist should work closely with the therapy team, rather than solely in consultation. He should be specially trained and have had experience with brain damaged children. The psychologist will frequently be in a position to direct the family counseling, or to assist the Director or the designated counselor. This is another one of the particular values of the team conference approach, since in many instances the specific medical problem is small compared to the overall problem.

5. *Social Service:* The size of the clinic will determine the number of medical social workers required. If the clinic is large, several medical workers are needed. A director of the section should coordinate the efforts of the various case workers. A well qualified social worker can alert the physician to the home situation, so that a more sound decision regarding therapy regimen, school placement, clinic visits, etc., can be made than one based solely on the physical and medical needs of the child. This close relationship between the family and the therapy team and the paramedical liaison with the medical social worker, nurse, and psychologist, may determine the success or failure of the treatment program in all of its aspects.

6. *Nursing:* The nurse provides effective liaison between the members of the team since she works with both medical and paramedical personnel. Sufficient clerical assistance should be provided to relieve the nurse of routine administrative duties; e.g., taking the children to the examination rooms, removing shoes, running for records and x-rays. The role of the nurse is more effective when she is utilized in counseling and working with community nursing agencies. These services may be added to regular nursing duties if clerical tasks are eliminated from her responsibilities.

7. *Bracing:* This facility should be available and the orthotist should be certified by the American Board of Prosthetics and Orthotics. An orthotist should be present at all clinics. Close cooperation among the orthotist, the orthopaedic surgeon and the clinic director is essential. The parents should be present at the time the brace is being prescribed and delivered so that they understand its use and the reasons for prescription.

C. Referring Physician

Close liaison should be maintained with the child's family physician, not only in the early stages of diagnosis and recommendations, but also as the treatment progresses. The physician should be invited to attend and participate in the total discussion and when he cannot attend, a report of the discussion should be sent to him.

D. In adition to the initial comprehensive examination and evaluation with the appropriate recommendations, the following practices should be observed:

1. Periodic team *reevaluation* of the child's gains, including all medical and paramedical members of the team.
2. *Resetting of realistic goals* that will be reevaluated at a specific time interval, the scheduling of such meetings to depend upon the stage of treatment of the child and his accomplishments to date.
3. *Inclusion of the family* in all or part of the conferences so that they are aware of what is going on.

E. Records

Typed records should be maintained and properly coded so that at any time during the treatment of the child his status can be determined. Some clinics prefer to have each specialist's note written in a different color, i.e. orthopaedic examination in red, the pediatric in green, and the neurologic in blue, etc. Others prefer to have the specialist's note written on a separate different colored page. Whatever the method of record keeping, it is essential that there be a unit system of records so that all notes, therapy schedules, x-rays, laboratory results, photographs, and other information relating to the patient be accessible for immediate review by all members of the team. There should also be facilities for movies, tape recordings, and other diagnostic and evaluative procedures.

F. Efficient follow-up

Appointments should be arranged at times which are feasible for the patient and family so as to reduce the number of broken appointments. An administrative assistant should review the records before the child appears, so that if x-rays, laboratory work or brace work will be required, the appropriate individuals can be present at the clinic at the time of the child's visit. In addition, the administrative assistant should bring to the attention of the physicians the records of children who have failed to keep their appointments so that a determination can be made as to the best means of follow-up. If hospital admission is anticipated, as much preliminary work-up as possible should be performed on an out-patient basis to shorten the in-patient stay.

G. Statistical Records:

The annual statement should include the number of patients who have been seen, the number of visits, the number of treatments by type, the number of new patients, the number of staff meetings, etc. Review of these statistics will reveal problems that need further investigation and will result in improved educational research training and better patient care.

H. Parent Guidance

Perhaps the most important part of all the services is the inclusion of the family in a discussion of the therapy programs. A number of effective methods have been devised, among which are the individual as well as the group techniques of parent guidance. The plan of therapy, the rationale of the treatment program, realistic goals and methods of family participation should be openly discussed, since the understanding and the cooperation of the parents may determine the success or failure of the prescribed treatment. Free discussion by the parents, particularly in a group setting, often brings to light deep-seated anxieties and concern that must be understood by the clinic director and the therapy team.

IV SUMMARY

This guide presents the minimal standards which the American Academy of Orthopaedic Surgeons believes are essential in the management of the child with cerebral palsy. These children have multiple problems which will require many skilled individuals who in turn must function as a team. This is only made possible by the active group participation of all of the members of the team.

The cerebral palsy clinic itself presents a challenge in management. The children are often difficult to control and the parents are generally anxious about the examination and conference. Whatever can be done to relieve the family tension and to insure that the family, the team, and the patient are striving for a common goal will be beneficial to the child.

—American Academy of Orthopaedic Surgeons, Committee for the Care of the Handicapped Child, Subcommittee on Cerebral Palsy

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William Cooper, M.D.
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Prosthetic Prescription for the Geriatric Amputee *

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Patients who are in a state of physiologic decline and who require major amputation or disarticulation as a result of disease affecting the circulation of or sensation in the limbs need special evaluation for prostheses. Geriatric amputees have usually had a major illness, are physically and mentally tired, and are usually suffering from cardiovascular disease or diabetes, as well as a variety of other diseases.

Each patient requires individual evaluation for most suitable rehabilitation. This is sometimes best accomplished by teaching the patient activities of daily living in a wheel chair. A prosthesis should not be prescribed merely because the patient thinks he wants one, especially if careful consideration indicates that he will not use it. Definite contraindications for fitting include angina decutibus, lack of sitting balance, dyspnea at rest, uncontrollable dependent edema, and the presence of other diseases, such as carcinosis or uremia with probable short life expectancy. Local considerations that preclude vary, but certain patients with severe flexion contractures are suitable neither for fitting nor for correction of the contractures. Patients with bilateral amputations above the knees are seldom good prosthetic candidates.

Vultee[1] has classified the functions of prostheses as follows:

1. Cosmesis alone.
2. Limited use in the home, where wheel chair is not practical.
3. More generalized use in and out of the home.
4. Use for return to vocation, as needed.

I do not prescribe purely cosmetic prostheses, although occasionally a patient may use his prosthesis for this purpose alone. For most geriatric patients, the prosthesis prescribed for limited use would differ little from that for return to work, since the work would not be arduous and would therefore not require unusual prosthetic consideration.

Prosthesis

Syme's amputation. — For the occasional amputation at the ankle in geriatric patients, I prefer the leather socket prosthesis with metal reinforcements and the usual ankle-and-foot unit, rather than the plastic laminate Syme's prosthesis. The plastic laminate socket is sometimes difficult to use because of variation in size of stump as a result of edema of cardiac or renal origin, whereas the leather socket allows some adjustment for this by the amputee. The articulated foot is preferable to the Sach foot for these patients, since a slight jar associated with action of the ankle unit gives the amputee a clue regarding the position of his foot. This is particularly important if the patient becomes a bilateral amputee.

Amputation below the knee. — Amputation below the knee is, of course, preferable to one at a higher level. The usual length of the stump is from

* Reprinted by permission from Prosthetics International, 1965, 2, 12-14.

4½ to 5½ inches below the medial tibial joint line, and the fibula is seldom resected. In most patients, postoperative splinting and exercises prevent knee flexion contractures, and the stumps present no particular prosthetic problems. Although some patients have been successfully fitted with patellar tendon-bearing or total-contact, below-knee prostheses without knee joints and thigh lacers, they usually get along better with a conventional type of below-knee prosthesis with a wooden socket and thigh lacer. Lack of lateral stability, from absence of the knee joint, is sometimes disconcerting.

Although I formerly prescribed high thigh lacers routinely in an attempt to obtain partial ischial or gluteal weight-bearing, I have abandoned this practice, since some patients complained a great deal of the discomfort of the high thigh lacers when they sat down. The duration of their prosthetic use and the level of their activity does not seem to produce complications because of adductor rolls of fat developing at the top of the thigh lacers. I therefore now usually prescribe a thigh lacer of standard length. I have had little experience with padded, soft, or slip sockets but routinely ask the prosthetist to fit the patient initially with a thick wool sock, even though the fitting takes place as early as six to eight weeks after amputation. The additional protection of the thick wool sock has reduced the time lost from the prosthetic training program as a result of minor pressure sores and abrasions around the stump, although liners must be used much earlier.

Stump choking or tension on scars from excessive pistonaction can usually be corrected by applying a partial end-bearing hammock, additional suspension around the trunk, or a supra-patellar strap. Occasionally, a patient with a short stump and knee flexion contracture can benefit from the use of a bent knee prosthesis, and some of these do better with a drop lock.

Although the Sach foot has been successfully used, my preference for a foot-and-ankle unit is the conventional articulated two-way ankle because it allows easier adjustment of motion of the ankle and provides the geriatric amputee with auditory or kinetic clues from its action.

Knee-joint disarticulation. — Knee-joint disarticulation, like Syme's amputation, is uncommon in geriatric patients. I prefer a conventional end-bearing knee disarticulation prosthesis with a leather socket laced in front and suspended by means of either a silesian bandage or a hip control belt, with the usual two-way foot and ankle.

Supracondylar amputation. — Supracondylar amputations can be fitted successfully in several ways. My preference is for the leather thigh-lacer, above-knee prosthesis with side-joint kneehinges and provisions for as much end-bearing as can be tolerated. These stumps can be fitted with wooden ischial-bearing sockets of either quadrilateral, triangular, or plug shape, or can be fitted with total-contact sockets. Because of changes in weight and in size of the stump in the debilitated patient, I prefer the leather socket, which can be adjusted, affords greater sitting comfort, and requires less training. An articulated two-way ankle and conventional foot is usually prescribed.

Amputation above the knee. — Most amputations through the shaft of the femur, which is too proximal to provide a good end-bearing stump, are at or below midthigh and can be fitted with a quadrilateral socket, with suitable allowance for any uncorrectable hip flexion contracture. The anterior brim in these patients should be slightly lower than usual for sitting comfort, and the ischial seat should be somewhat thinner. Total contact can be used in these patients, but weight changes may cause problems.

For patients who have had vascular operations and have tender scars in Scarpa's triangle, a triangular or oval socket is most suitable. In certain

patients with short stumps and hip flexion contractures, a plug fit has been found satisfactory when other sockets have been unsuccessful.

Suction suspension is generally inadvisable in geriatric amputees, since the difficulty of learning to apply the prosthesis and the accompanying fatigue is often insurmountable. Most patients can use a hip control belt, whereas others find a corset suspension with medial and lateral rollers satisfactory[2]. Patients who cannot tolerate any pressure around the abdomen should use shoulder harness suspension.

Geriatric patients derive little advantage from a variable friction type of knee joint or from hydraulic units which do not incorporate stance phase control. Since these patients are rarely vigorous walkers, terminal impact is not a problem. In some patients, use of a Hydracadence unit, with its stance phase stability, toe pickup and ability of the patient to put the foot in plantar flexion during sitting seems worthwhile.

When the Hydracadence unit is contra-indicated, the conventional two-way foot and ankle has been the most satisfactory prescription. Except with the Hydracadence unit, considerable alignment or geometric stability should be achieved by initial socket flexion, posterior positioning of the knee joint, and relative firmness of the instep bumper in the foot. The abnormalities of gait that may result are, of course, preferable to no gait at all.

The friction-locking knee unit is seldom used in our subtropical climate, since change in humidity and temperature causes problems. I prescribe a manually operated knee lock when the patient is unusually feeble or poorly coordinated.

Hip disarticulation. — For the occasional geriatric patient with disarticulation at the hip, the Canadian hip disarticulation prosthesis seems best. Unless contraindicated a Hydracadence unit is prescribed.

Extraprosthetic aids

During prosthetic training of the patient, the original objective of the fitting should be remembered, and efforts should not be made to achieve the impossible. The best function possible should be sought but results obtained in juvenile or young adult amputees should not be anticipated. Extraprosthetic aids, such as one or two canes or crutches, may be useful in some patients. Although the clinical team should be optimistic, some failures which can neither be predicted nor prevented are inevitable in this group of physiologically deteriorating patients. These should not prevent intelligent attempts at maximum rehabilitation in the geriatric amputee.

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2. E. T. Haslam and E. G. Scott, Jr.: Experience with a Corset Suspension for Above Knee Amputees. Orthopedic and Prosthetic Appliance J., Dec. 1964, 18, 288-291.

Plastic Short Leg Brace Fabrication

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ROBERT H. JEBSEN, M.D.*

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Conventional short leg braces, made of metal and attached to the shoe either by a solid or a split stirrup, are necessarily heavy and quite conspicuous. The weight of a metal brace has the tendency to fatigue weak muscles and to cause rotational gait problems.

In an effort to improve cosmesis and to decrease weight, a plastic short leg brace has been devised that is completely hidden when worn by a male patient and is less conspicuous than the standard brace when worn under nylon hose by female patients (Fig. 1). The plastic brace weighs approximately 250 grams as compared to the 500-1000 grams of a standard double-upright short leg brace.

The brace is a molded plastic shell that is secured to the patient by his shoe and by a velcro closure at the proximal end. The rigid ankle construction provides plantar and dorsiflexion control as well as medial-lateral stability. A lightweight calf-length stocking is worn under the brace (elastic hose may be used). The usual stocking is worn over the brace. To lessen

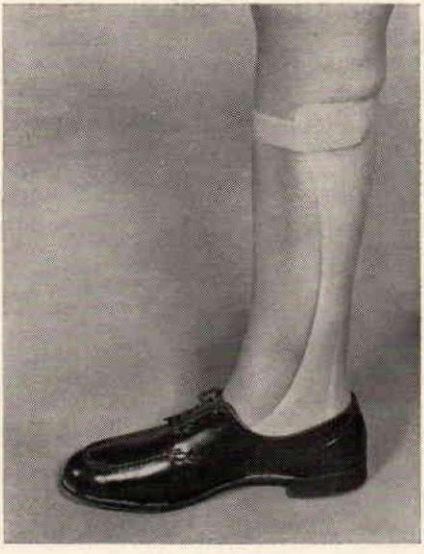

FIGURE 1

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the shock at heel strike, a soft rubber posterior wedge is used in the shoe heel (Fig. 2). A Blucher-type shoe should be used; in some cases it may be necessary to use a shoe one size wider than usual over the brace.

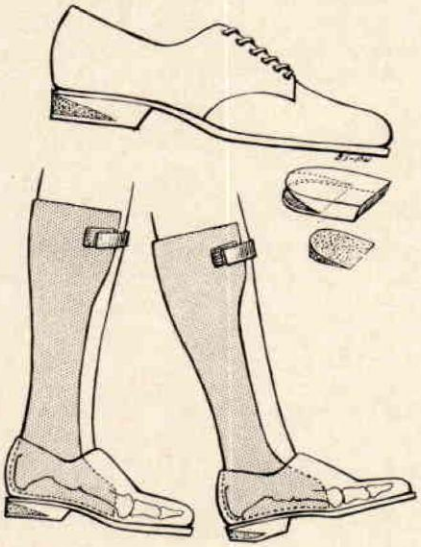

FIGURE 2

FABRICATION TECHNIQUE

To take the plaster impression of the patient's lower leg and foot, place a 1-inch strip of felt or webbing material along the anterior aspect of the tibia and over the dorsum of the foot. Cut a piece of TUBEGAUZ[1] twice the length of the patient's lower leg. Pull the tubegauz up to the knee, twist the distal portion to close the tube at the toes, and pull up the second layer. Secure both layers to an elastic belt around the hips, using YATES CLAMPS.[2]

Place the patient in a sitting position, wrap the foot and shin with 4-inch plaster of Paris bandage. Wrap from distal to proximal, starting at the heads of the metatarsal bones and ending at the head of the fibula. Wrap the foot rather loosely so as not to impinge on the metatarsals during weight bearing. Place a thin plastic bag[3] over the foot and ankle; place the foot into the shoe; lace the shoe; help the patient to a standing position and direct him to bear equal weight on each foot. The heels should be 2 inches apart or normal base width. Hold the knee in slight flexion (5-10°) and correct any ankle varus or valgus by hand pressure on the appropriate malleolus until the plaster wrap has set.

Assist the patient again to a sitting position, being careful not to deform the plaster wrap. Remove the shoe and plastic bag. Draw a line along the anterior portion of the cast over the felt or webbing strip. Cut the cast on this line with a scalpel or cast cutter. Remove the cast from the leg, and prepare it for filling with plaster of Paris and placing of a mandrel.

The plaster positive mold is sanded smooth and a ⅛-inch buildup is made over each malleolus, being particularly careful to include the anterior portion of the lateral malleolus. Slightly flatten the positive mold along

the lateral side to a depth of 1/8 to 1/4 inch from 3 inches below the head of the fibula to 2 inches above the lateral malleolus. Coat the positive cast with HI-GLO parting lacquer.[4] This is necessary to prevent softening of the inner PVA[5] by moisture in the positive.

Pull a cast sock[6] tightly over entire plaster positive and tie the mandrel. Sprinkle talc over entire model. Fashion a PVA bag, moisten and pull tightly onto positive. Tie proximal end with PVA strip to mandrel. Pull PVA bag distally and tie off the PVA strip at end of cast. Drive a finishing nail into the distal end of positive through center of tied off PVA, leaving about 3/8 inch of the nail projecting. This will be used to hook and hold the fiberglas roving[7] (see Fig. 3).

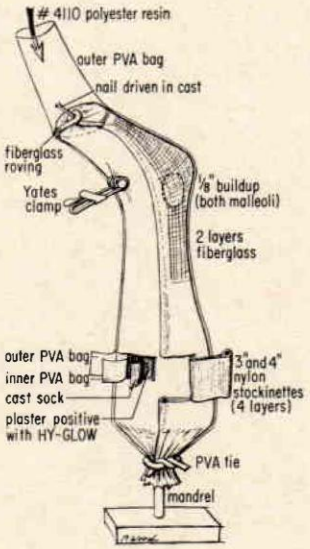

FIGURE 3

Cut 2 lengths of nylon stockinette, one 3-inch width, the other 4-inch width (narrower widths may be necessary for children). Place the 3-inch stockinette inside the 4-inch and a loop of fiberglas roving inside these. Attach fiberglas roving over nail and position stockinette as shown in Figure 1. Place two layers of fiberglas cloth inside the 3-inch stockinette (see Fig. 3). Pull down on roving and stockinette and adjust as shown and tie off at mandrel. The lateral malleolus is completely covered and the medial malleolus is covered to midline only.

Before applying outer PVA bag, drive nail further into cast so as not to snag or tear PVA. Laminate with 4110 polyester resin and color pigment. The PVA may tend to gap at the malleoli. To correct this, pull bag forward and secure with a Yates Clamp.

After resin is cured remove plastic brace from positive and grind the anterior edges back to the stockinette. Do not grind into fibers of the cloth as this will weaken the appliance. The distal trim line should be posterior to the heads of the metatarsals to prevent undue stress on the brace. This is a compromise and tends to slightly decrease the knee stability gained from a long toe lever arm.

The closure on the brace is velcro material. A SACH heel is created in the patient's shoe to absorb shock at heel strike. See details in Figure 2.

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ACKNOWLEDGEMENT: The authors wish to acknowledge the cooperation and assistance of Mrs. Phyllis J. Wood, Medical Illustrator, School of Medicine, University of Washington.

FOOTNOTES

1. TUBEGAUZ S-223, white; not sterilized; size No. 78
   The Scholl Mfg. Co., Inc., Chicago 10, Illinois
2. YATES CLAMPS—W2
   A. J. Hosmer Corp., Campbell, California
3. Plastic bags: "Baggies"; food wrap size
   Colgate-Palmolive Co., New York, New York
4. HI-GLO parting lacquer
   A. J. Hosmer Corp., Campbell, California
5. PVA (Polyvinyl Alcohol Film)
   A. J. Hosmer Corp., Campbell, California
6. Cast sock: No. 7923, thin, not processed
   Knit-Rite Co., Kansas City, Missouri
7. Fiberglas roving—863
   Knit-Rite Co., Kansas City, Missouri

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Customized Hand Crutches

by DANIEL L. CURTIS

Space Sciences Laboratories
Litton Industries
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Continued use of Canadian hand crutches (Fig. 1) may, over a period of time, develop painful lesions on those parts of the hands subjected to constant irritation by the hand grips. The conventional grip resembles the standard handlebar grip of a bicycle. It performs an adequate interface function between the hand and the appliance for temporary usage but leaves much to be desired if use is continued for long periods of time. The user in this case normally resigns himself to the discomfort or pain generated by constant use of the appliance. He tells himself, "I shouldn't complain because I am better off than if I were confined to a wheel chair." The need

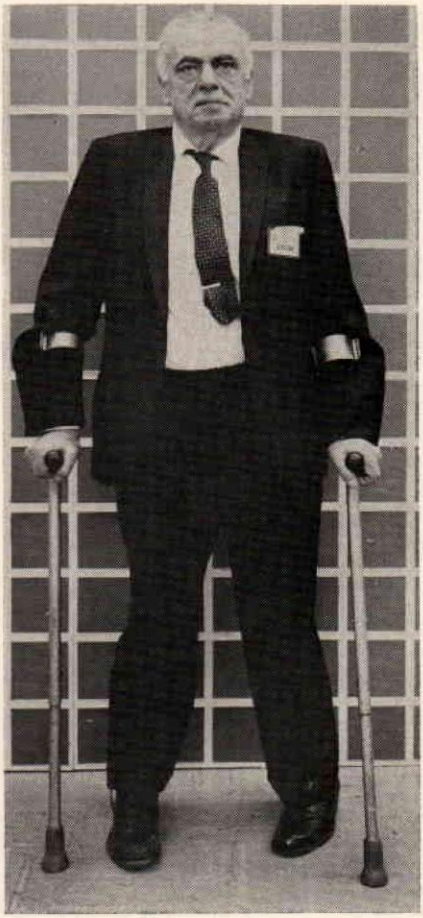


FIGURE 1

for improvement is primarily recognized by the user and has not been conveyed strongly enough to the manufacturers of the appliance to result in a modified design.

The need for improvement recently came to the attention of Litton Industries' Space Sciences Laboratories when a 72-year-old user of the hand crutches was confronted with the necessity of having a tumor removed from his left hand. A polio attack in childhood had left him a cripple requiring constant use of crutches for support during walking. Through the years a painful, callous type of growth developed on his left hand between the thumb and index finger (outlined area, Fig. 2). The growth finally developed to a point that surgery was required for its removal. The problem, as presented to us, was how to allow continued use of the crutches following the operation. A six-month healing period is normally required following such an operation before any pressure is allowed to be applied to the sensitive area. To be deprived of the crutches for this period of time would present an undue and unnecessary hardship to the patient; consideration of alternative approaches was indicated.

The approach that was finally adopted resulted in replacing the standard rubber grips with custom shaped, plastic hand grips (Fig. 3.). Machine epoxy (epoxy loaded with aluminum) was employed to make the final grips from plaster of Paris masters of the patient's hand prints.

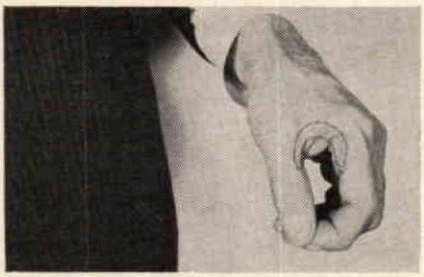


FIGURE 2

It was decided at the outset to make a plastic grip for both hands. This was suggested by Anderson [1] to assure ambulatory balance in the patient even though only one hand required the essential modifications. (The suggestion, in fact, was quite a propitious one for the patient was much more satisfied with the plastic grips than he had ever been with the standard units).

As shown in Fig. 3, the plastic grip for the left hand is relieved in the area of the thumb and index finger. For this hand the grip forces the major load on the hand to impinge on the palmar area with the third, fourth, and fifth digits used for lifting the crutch at the completion of each step.

The right hand grip is molded to contour the entire palm and digit area allowing maximum distribution of load to the hand and thus maximum comfort. In addition, the larger, more contoured design allows the body weight to be applied in a direct line from the forearm through the wrist and palm to crutch support. This is in contrast to the original design that forces the hand to be at an angle to the forearm with body load transmitted to the crutch through the first metacarpal joint. This grip is considered sufficiently superior to the original design that it is anticipated the left hand grip will be remade following post-operative convalescence to copy the design of the right hand support.

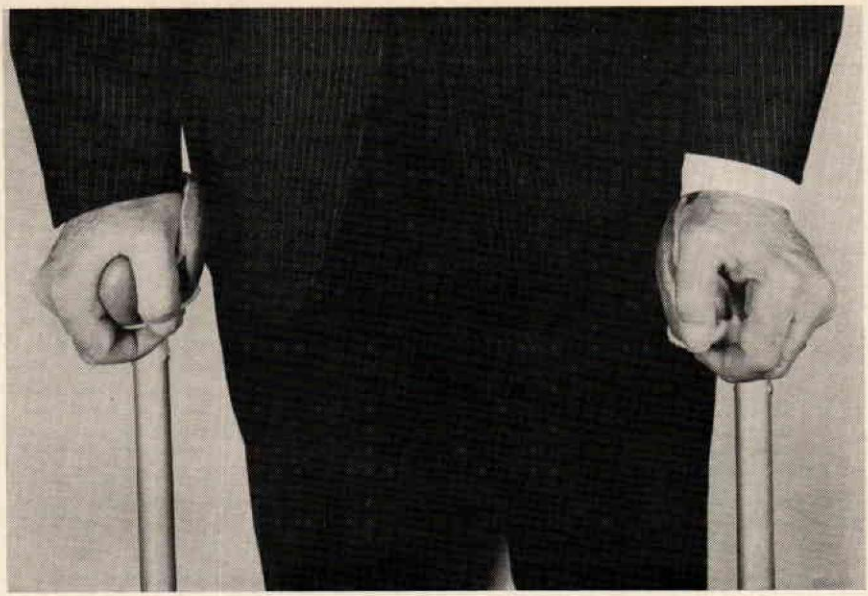


FIGURE 3

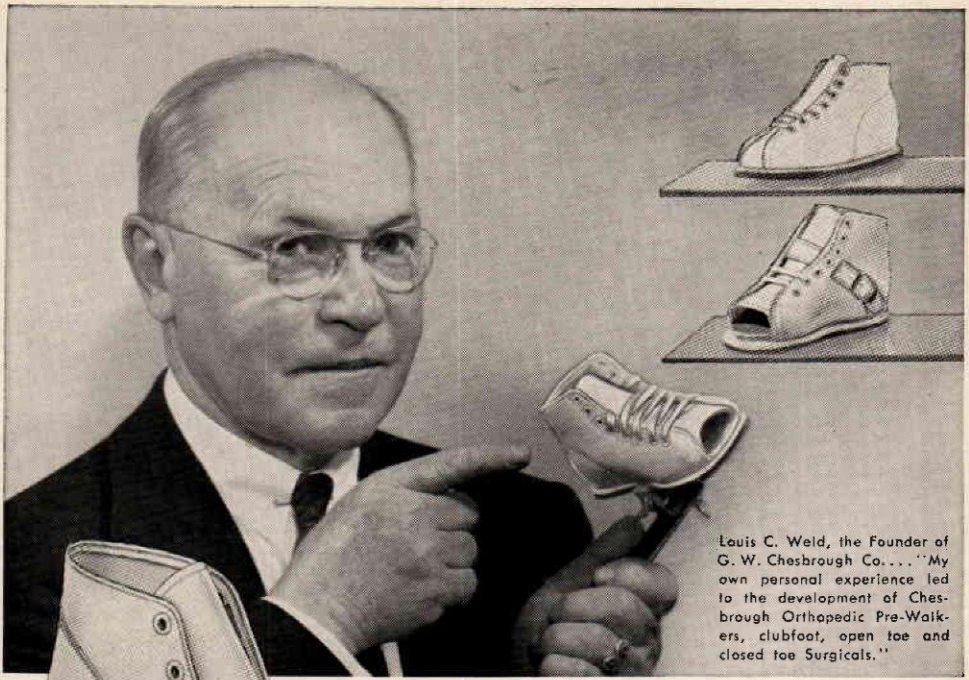
Two problems were encountered in the testing of the grips. The first of these was a tendency of the left had to slip, especially if the hand became sweaty. A coating of polyurethane on the grip was tried but this did not adhere well to the epoxy; moreover, the surface was still too slippery for comfort. The technique finally adopted was to bond (using rubber cement) a thin sheet of polyurethane foam on an initial surface of Caran adhesive. This approach appears to offer an acceptable solution to the slipperiness and as well provides a comfort liner between the hand and the grip that can be replaced every month or so as required by considerations of cleanliness. The second difficulty was a result of the added weight of the structure. As initially cast the grips weighed approximately 1½ lb. each with the added weight becoming tiring to the arm muscles. This problem was remedied by removing excess material resulting in a final grip weight of about ¾ lb. which was found to be satisfactory to the patient.

In summary, it is our finding that substantial improvement can be made to the hand crutch by providing a grip that more closely conforms to the shape of the palm. Distribution of the body load over a larger area results in increased patient comfort as well as increased control in the use of the appliance. Of particular importance is that the contoured grips allow the weight of the body to be applied in a direct line through the wrist rather than at an angle to it. Also, from our experience, it would appear that three or four standard sizes of grips could be manufactured that would fit almost all patient populations. This factor should significantly reduce the cost of the grips and still provide a customized support structure.

ACKNOWLEDGEMENTS

We wish to acknowledge the contributions of Messrs. William Staiger and Floyd Palecki who assisted in the design and construction of the grips.

[1] M. H. Anderson, M.D., Director, Prosthetics Orthotics Rehabilitation Center, University of California at Los Angeles.



Louis C. Weld, the Founder of G. W. Chesbrough Co.... "My own personal experience led to the development of Chesbrough Orthopedic Pre-Walkers, clubfoot, open toe and closed toe Surgicals."

"Chesbrough Pre-Walkers mean NEW business for you"

"Here are orthopedic shoes parents can afford. Orthopedic surgeons in 50 states and many foreign countries are now prescribing them. Spectacular sales figures prove it. This important referral business can be yours.

"When a child in my own family needed a corrective shoe, I discovered what a strain it can mean to a family budget, because 1) corrective footwear is expensive and 2) frequent purchase of new corrective shoes is required. Then and there I decided there was a real need for a moderately priced corrective shoe—a shoe parents could afford. That's why and when Chesbrough Orthopedic Pre-Walkers were born.

"Our 68 years of shoe-making experience resulted in corrective Pre-Walkers of scientific design, expert workmanship, fine leathers combined with orthopedically correct lasts to provide necessary correction at an economical 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).

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

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

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

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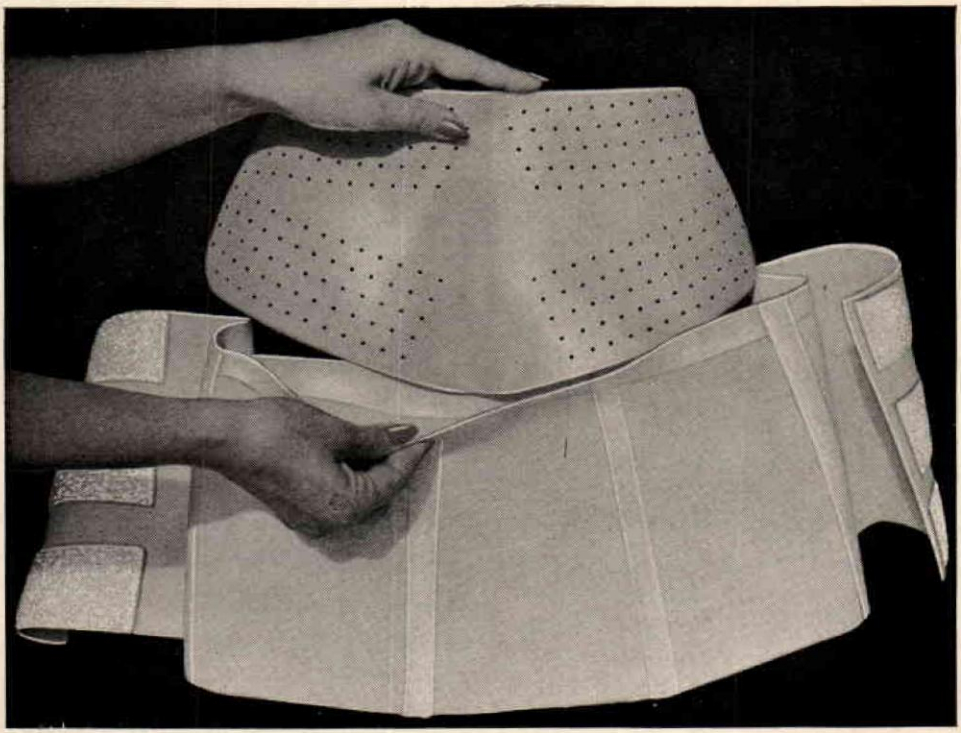
It is a semi-rigid contour molded plastic insert which fits into an elastic belt. "Velcro" closures assure perfect fit.

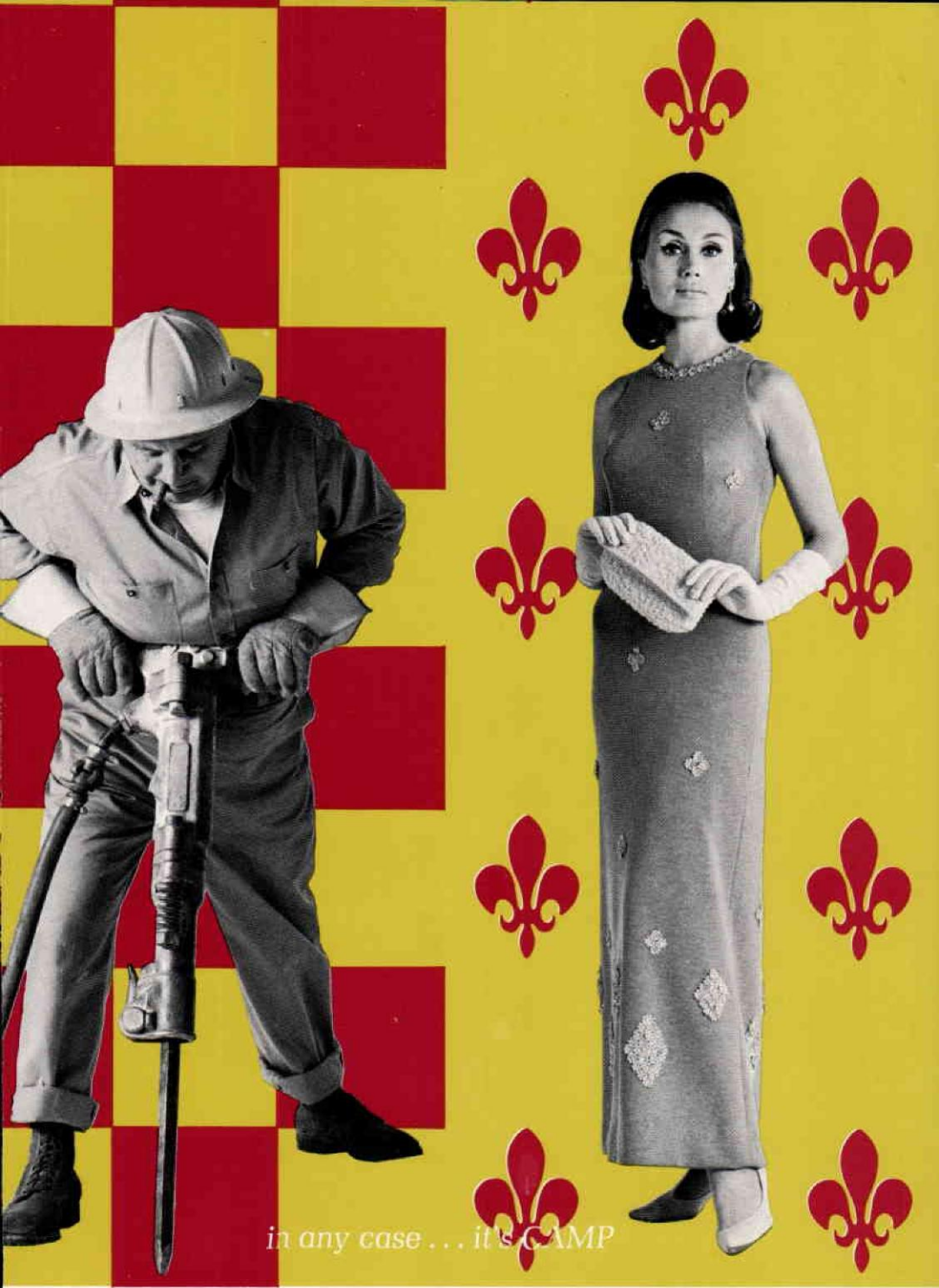
Clinical evaluations confirm prominent medical opinions that the YARDNEY COMO™ Contour Molded Support* gives effective, if not more effective relief than 80% of the supports it replaced in treatment of low back conditions.

For more information please write to:

YARDNEY CHEMICAL, INC.
Professional Products Division
40-52 Leonard St., New York, N.Y. 10013

*Patent Pending





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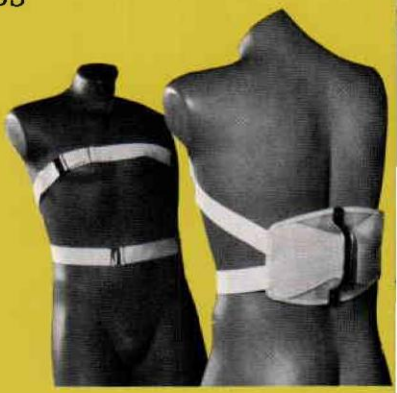

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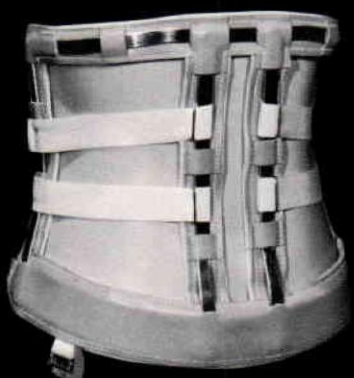

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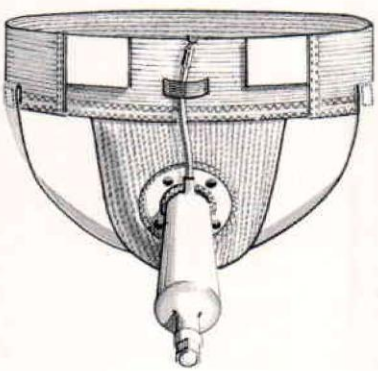
Prefabricated spring aluminum. Uprights partially exposed for precise shaping to individual needs. Provides lateral stability and effective lumbosacral bracing. Corset or apron fronts. Washable slip-on covers available.



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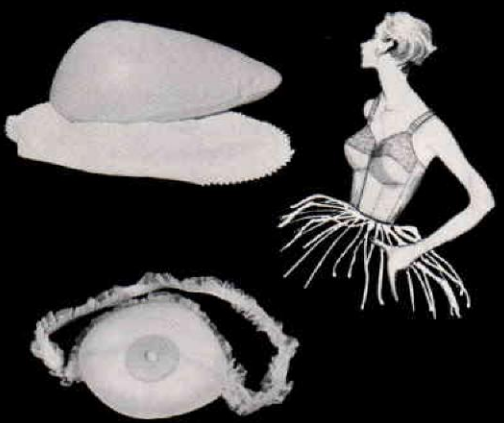

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Night wear prosthesis. Gives feminine appearance while wearing lounge attire and nighties.

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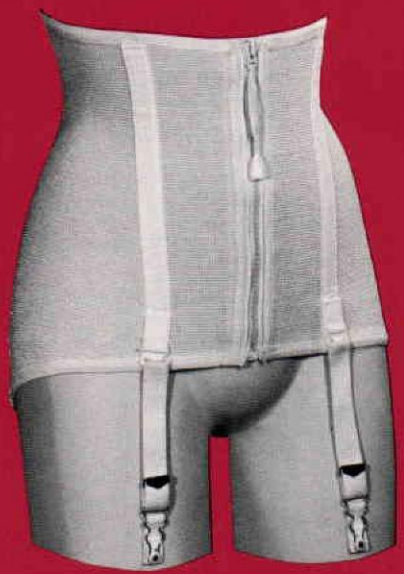
Provide support without compression on breast or under arms. Models for pendulous breasts, maternity, nursing and general wear.



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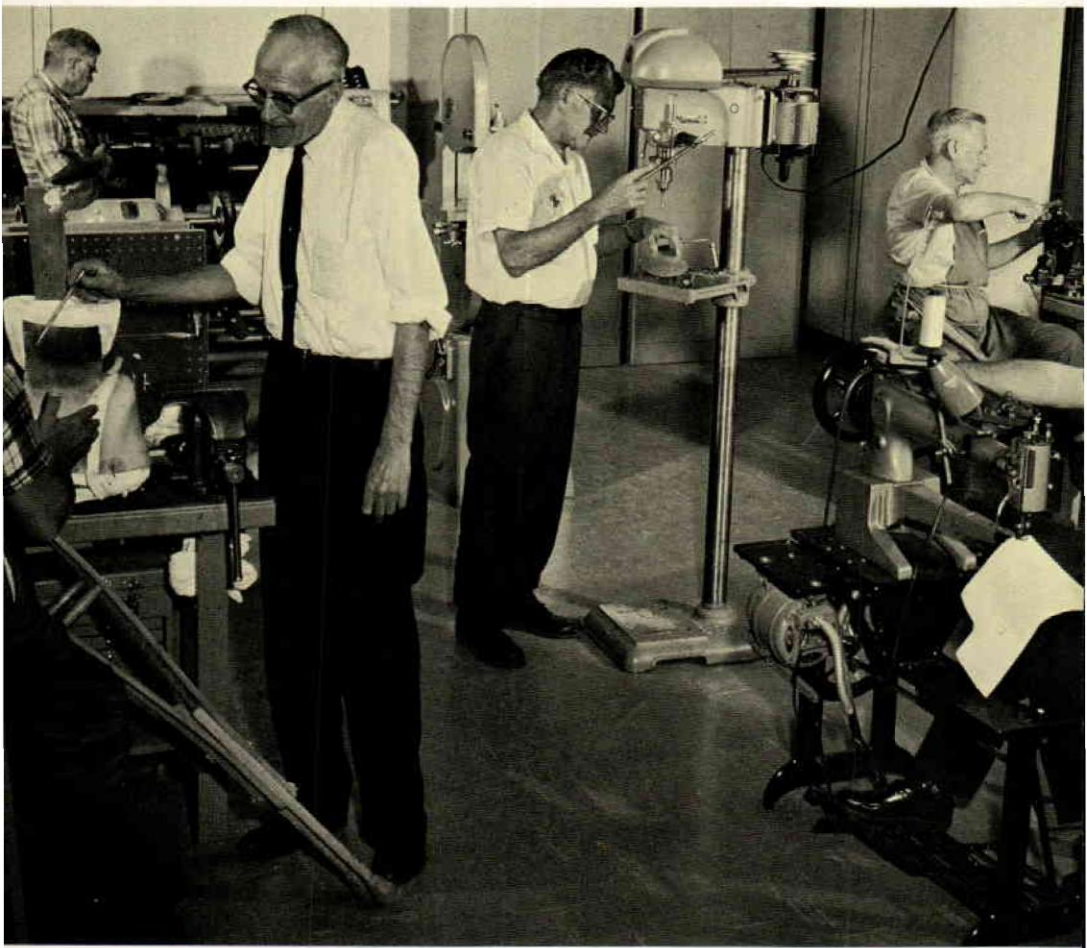

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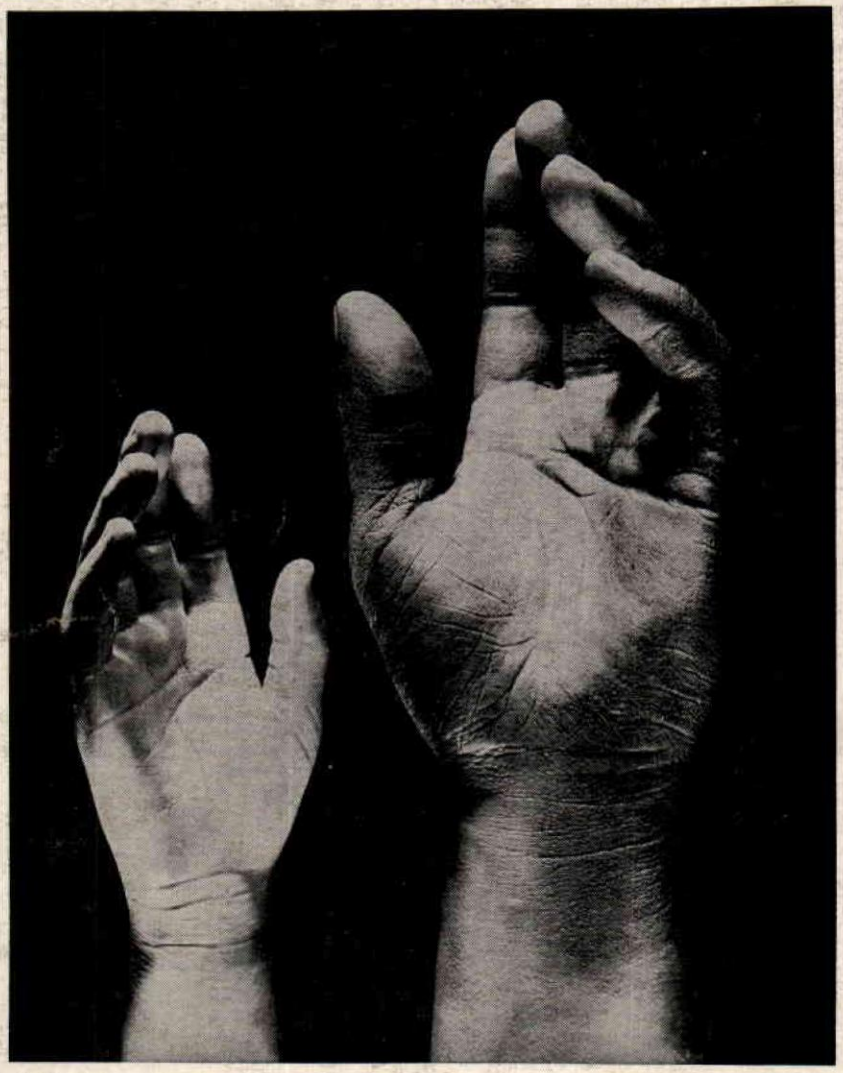

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