ARTIFICIAL LIMBS OR PROTHESES.

THE orthopedic care of the war disabled presents an immense number of new problems in the construction of artificial limbs, in the solution of which work is continually being done. The discoveries of Hoeftmann, Fleming and others attest the possibility of restoring to those who have suffered the loss of both hands and feet an ability to work and to earn an independent livelihood. The large number of amputations make demands for artificial limbs which must be simple in structure, durable, easily reparable and beneficial to the disabled. In general it can be stated that in the consideration of the principles of artificial leg construction, aside from the question of the stump being able to tolerate weight, there are unimportant differences. It is now possible to provide the disabled with artificial legs that render them good service and that enable them for instance to stand all day at such work as that of a machinist.

As already indicated it has been found very advantageous to have recourse to provisional artificial limbs, so as to get the disabled in condition to begin work as soon as possible. The patient must walk successfully with the provisional limb before he receives his second, final limb. The former serves also on later occasions as a substitute when repairs of the permanent apparatus become necessary.

The provisional artificial limb for the thigh is a simple apparatus with a padded ring-seat capable of adjustment, a knee-joint that can be made stationary, a fixed ankle and

a flexible foot. Those with amputations must be taught to walk correctly with the toes always to the front from the

FIG. 84.—Adjustable walking stilts for beginners after amputation. Crutches are never used.

very beginning. Experience proves that a wooden leg or an artificial leg without a flexible knee-joint makes a bad beginning. Flexible knee-joints must be used by the patients

from the very first and only on rare occasions when long standing or walking may be tiring should the joint be made rigid, or locked.

FIG. 85.—Hospital or provisional prothesis with the use of the Vienna plaster socket. (Heubach.) Personal communication.

At first the artificial limb for the thigh resembled Hoeftman's apparatus, which avoided the disagreeable strong spring of the leg caused by a sitting posture. The disabled

FIG. 86.—Correction of a hip contraction. (Heubach.) Personal communication.

were dissatisfied with the inflexible foot, consequently a flexible one was substituted. A spring pad in place of the

PIG. 87.—Application of a hospital prothesis while preserving the balance with supports. (Heubach.) Personal communication.

FIG. 88.—Hospital workshop for tailoring. *X*, patient sitting on a scoliosis seat. (Heubach.) Personal communication.

FIG. 89.—Orthopedic hospital workshop, Graudenz. (Heubach.) Basket making. Personal communication.

rubber pad, which can be replaced later, was necessary on account of the shortage of rubber. The same foot is common to the provisional limbs for both legs and thighs. Lateral splints for indirect pressure are fastened to a metal shackle confining the tuberosities of the tibia. A heavy pad in the front and back of the shackle supports the bones of the leg.

FIG. 90.—Leg and thigh amputations with provisional protheses incorporated in plaster-of-Paris sockets. (Heubach.) Graudenz.

The padded stump carries little or no pressure and broad rubber bands assist in the elevation of the leg.

The construction of the artificial arm offers a greater problem, the solution of which is yet unsolved. It is evident that until now an artificial arm served principally to conceal the disagreeable impression produced by the loss of a limb.

It is questionable if a so-called universal arm is available for all kinds of work. At least special arms for the various vocations of industry, agriculture and metal work can be manufactured. Recent inventions have contributed consid-

FIG. 91.—High amputation of femur; use of the provisional hospital prothesis and plaster-of-Paris socket. (Heubach.) Personal communication.

erably to progress in the manufacture of artificial arms, and they prove that the question of construction of a useful artificial limb can only be solved from a technical point of view. The attempts to imitate the anatomical structure of the arm and hand have been unsuccessful. Just as the suc-

ess of flying machines has been contributed to by a disre-gard of the bird's movements so we can expect results only by forgetting to try to imitate the anatomy of the arm. After many and various experiments for an arm the simplest form of artificial limb was found best for ordinary purposes.

FIG. 92.—Group of arm and forearm amputations with protheses. (Heubach.)

For the forearm amputations a good work-limb which n be attached directly to the stump is advisable. This me principle holds good for the arm amputations. The oulder-joint through the elbow-joint and the stump must bstitute the functions of the forearm, and the less mechan-n between the shoulder and the end of the prothesis the tter. To be sure these protheses must be provided with nts, which, however, must be placed as close as possible

to the end of the stumps. It is not impossible that, by car ful computation of energy, it can be ascertained what rel tion ought to exist between the length of a working limb an the length of the stump, in order to use the stump to th best advantage.

FIG. 93.—Arm and forearm amputation with protheses according t Rothe. (Heubach.) Personal communication.

The attachment of a prothesis to the shoulder is very dif cult; it is often so loose that the stump easily slips out, givi the impression of a useless attachment. An attempt h been made to correct this fault in cases of exarticulation stumps too short to allow the raising of the arm, by encasi the stump, the acromium inclusive, in a carefully fashion leather cap, which is secured to the upper part of the p thesis. The entire contrivance is then securely fastened

FIG. 94.—Arm prothesis for eating. (Radicke.) Brandenburg.

FIG. 95.—Forearm prothesis for eating. (Radicke.) Brandenburg.

FIG. 96.—Temporary prothesis for hospital use for arm cases: sockets of plaster of Paris. (Radicke.) Brandenburg

FIG. 97.—Definitive and provisional protheses for leg and thigh. (Radicke.) Brandenburg.

the shoulder by means of a bodice. This permits the transmission of a free muscular movement of the shoulder to the prothesis.

Another difficulty in fastening an artificial arm to the shoulder may be shoulder-joint rigidity that does not allow elevation above the horizontal. This condition calls for

FIG. 98.—Definitive and provisional protheses for leg and thigh. (Radicke.) Brandenburg.

careful attention, as whatever mobility there may be must be preserved. An attachment which hinders the shoulder movement increases the loss of function. An arm must be so constructed as not to interfere with the shoulder-joint and thereby complicate the possibility of attaching a serviceable elbow-joint. A steel or leather casement serves to combine both usefulness and good appearance in the artificial arm.

In the reserve hospitals the sufferers from injured nerves often showed spontaneous improvement, and operation is not always necessary. In addition to motor disturbances, sensory disturbances, trophoneurosis and pains in the wounded limb are very common. Protheses are very useful in nerve paralysis. In order to improve cases of radial

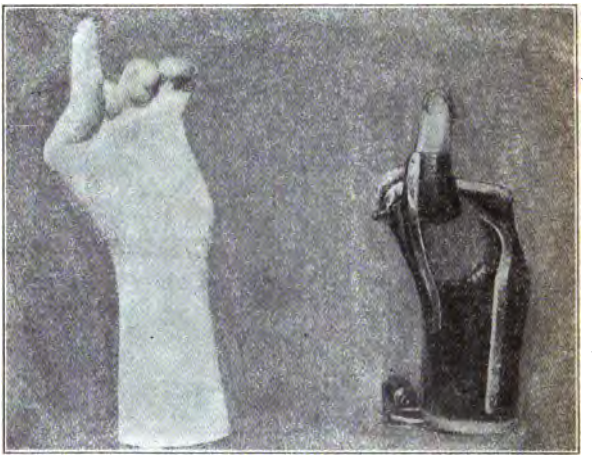

FIG. 99.—Apparatus for loss of thumb and deformities of fingers. (Radicke.) Brandenburg.

paralysis an easy extension position must be substituted for the flexed position. In less serious cases a support for the wrist suffices to restore marked ability for many kinds of work. A painful hand is such a hindrance to work that attempts have been abandoned to provide such cases with artificial appliances. Instead the fists are clenched and encased in a socket.

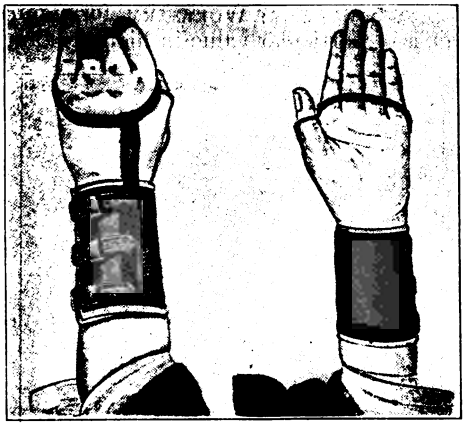

FIG. 100.—Support for musculospiral paralysis. (After Heymann.)

FIG. 101.—Support for musculospiral paralysis; made from wire splint material.

THE SIEMENS-SCHUCKERT WORK-ARM, for manual workers and laborers, is of particular value in high arm amputations.

FIG. 102.—Gunshot wound of spinal cord. With prothesis learning to walk with one-handed support. (Heubach.) Personal communication.

There are many attachable parts adapted to the various requirements of the many trades, but the arm mechanism

itself is always the same. The firm making this apparatus has developed it not as a commercial proposition but as a contribution to the war injured, and sells it at cost. The use of the work-arm must be learned under the direction of teachers or failure will result. It does not take the place of the ordinary artificial arm or prothesis as it is purely a

FIG. 103.—Brandenburg work-arm in wood carving. (Radicke.)

working tool whose use must be mastered the same as that of any other tool. The illustrations of workmen using it are from cases which have learned their trade and are made from photographs taken while at their work. As fast as improvements are made they are published and sent to all owners of the arm. Through its use a workman can accom-

plish from one-half to two-thirds the work of a normal man, and under especially favorable circumstances more than this.

The arm should be used solely as a working tool and not as an ordinary or a cosmetic prothesis; it should be worn over the clothing, in the simplest manner and should be put on and adjusted without assistance; the exertion of force

FIG. 104.—Brandenburg work-arm in wood carving. (Radicke.)

should, so far as possible, be transmitted by the sound part of the shoulder; the stump part does not serve to support the harness or other attachments of the apparatus and needs no bandaging, etc. The range of motion of the stump should be unimpeded to its fullest extent; the same work-arm serves either as a left or a right with slight alterations; it is

readily mastered and easily cleaned; it is very strong, durable and reliable; all parts are made of steel and iron, except the shoulder ring, which is of pressed aluminum, and the leather and soft parts for its attachment to the body; for those of great muscular development a special sized shoulder ring is made; all other parts are standard. The amputation

FIG. 105.—Brandenburg work-arm. (Radicke.)

stump retains its full mobility. The shoulder-joint of this work-arm cannot be exerted in every direction when in a certain position, as it does not functionate at times in the horizontal plane forward or backward, but a slight inclination of the body suffices to overcome this. The Siemens-Schuckert firm, of Nürnberg, publishes a complete description of its apparatus. Figs. 106 to 145 illustrate this apparatus.

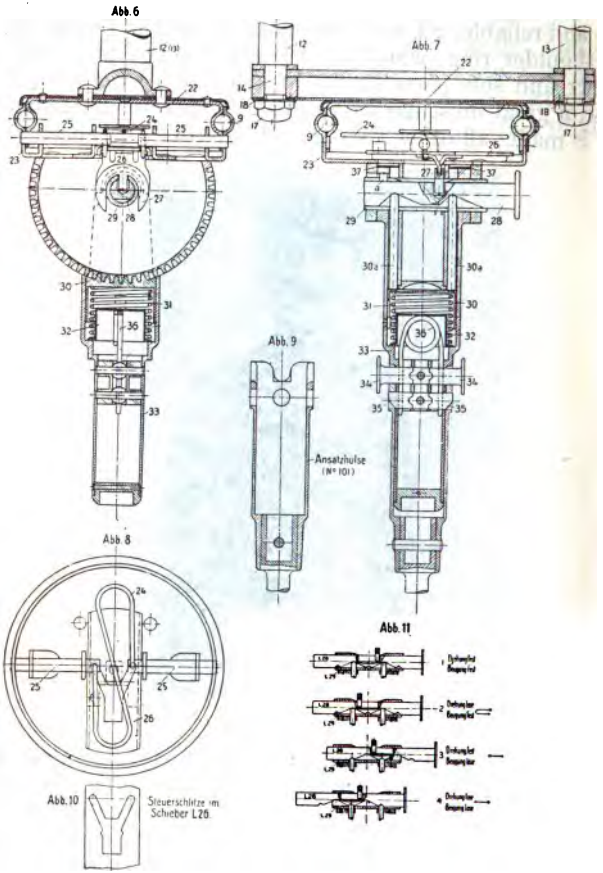

FIG. 106.—Joint of the Siemens-Schuckert work-arm for arm stump.

FIG. 107.—Tool holder.

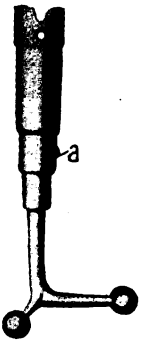

FIG. 108.—Double ball connection.

FIG. 109.—Single ball connection.

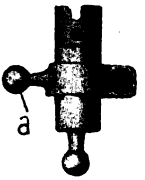

FIG. 110.—Shortened ball connection.

FIG. 111.—Carrying hook.

FIG. 112.—Holder for auger.

FIG. 113.—Hand brush.

FIG. 114.—Wooden hammer.

FIG. 115.—Pressure bowl with flange.

FIG. 116.—Toothed presser.

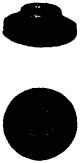

FIG. 117.—Rubber presser.

FIG. 118.—Roughened presser.

FIG. 119.—Nail holder.

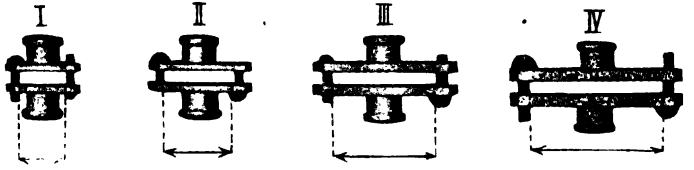

FIG. 120.—Rigid file holders.

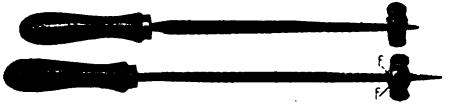

FIG. 121.—Profile files attached.

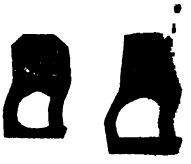

FIG. 122.—Loose file holders.

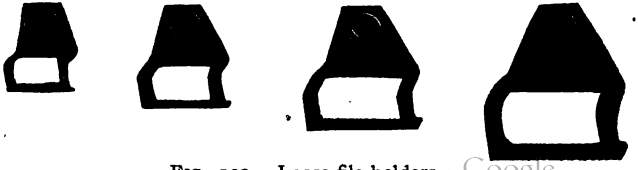

FIG. 123.—Loose file holders.

FIG. 124.—Carrying hook.

FIG. 125.—Adjustable attachment, with pressure connection.

FIG. 126.—Adjustable attachment, with pressure connection.

FIG. 127.—Auger holder.

IG. 128.—Attachment with biting pressure.

FIG. 129.—Attachment with rubber pressure-grip.

IG. 130.—Nail (holder) clamp.

FIG. 131.—Wooden hammer (mallet).

FIG. 132.—Adjustable attachment for scraper.

FIG. 133.—Adjustable attachment for plane.

FIG. 134.—Hand brush.

FIG. 135.—Adjustable attachment, with rubber pressure-grip.

FIG. 136.—Showing adjustment of working arm.

FIG. 137.—Disconnecting lower from upper arm.

FIG. 138.—Shortened ball connection, with rigid file holder.

FIG. 139.—Shortened ball connection, with rubber presser.

'IG. 140.—Shortened ball connection, with loose file holder.

FIG. 141.—Shortened ball connection, with rubber presser.

FIG. 142.—Rivet hammer.

FIG. 143.—Shortened ball connection, with holder for hack saw.

FIG. 144.—Double ball connection, with pressure bowl.

FIG. 145.—Double ball connection, with pressure bowl.