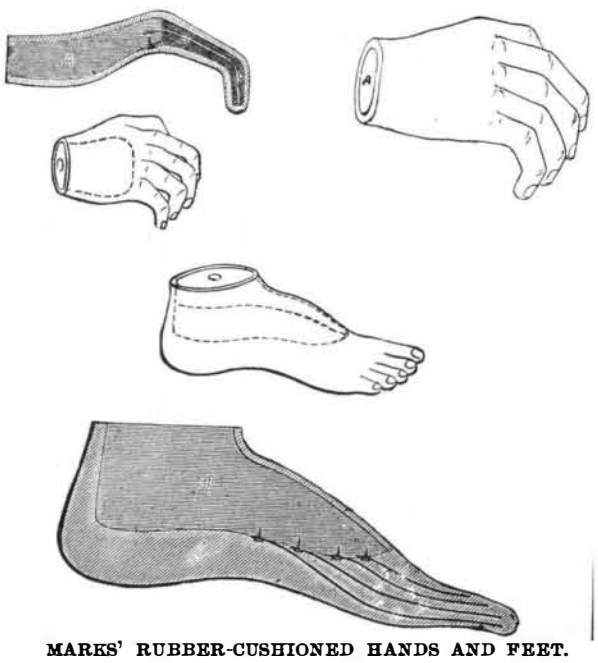
ARTIFICIAL LIMBS.

The Franklin Institute, of Philadelphia, has been given the privilege of awarding a money premium of $20 and a medal, at certain periods, for the encouragement of "ingenious men and women who make useful inventions," this award being from the interest on a sum of money left in trust to the city of Philadelphia by John Scott, of Edinburgh, Scotland. The Committee on Science and the Arts, of the Franklin Institute, which considers all claims for an award of the John Scott Legacy Medal and Premium, has recently recommended the granting of nine different awards under the legacy, one of these awards of the medal and premium being to A. A. & Geo. E. Marks, of 701 Broadway, New York City, for their "improvements in artificial limbs." In an abstract of the report of the committee, published in the *Journal* of the Institute, it is said that the first improvement consisted in the substitution of an elastic artificial foot, made of India rubber, without any joints whatever, for the artificial foot, previously made of wood, with joints to permit motion of the ankle and toes, and also an artificial hand made of India rubber, simulating the missing member. As a matter of course, such an artificial hand, which is here illustrated, could do little else than restore appearances. It had, besides this, the merit of not wearing out gloves and other apparel as rapidly as its wooden and metallic articulated predecessors, and it was much less costly and not so unpleasant when it came into personal contact. The rubber foot, which is also here illustrated, consisted of a wooden block rigidly secured or formed with the leg and extending downwardly to within about two-fifths of the distance from the ankle to the sole, and forward to nearly the first articulation of the metatarsus and toes. This block was covered with India rubber, and all the rest of the



MARKS' RUBBER-CUSHIONED HANDS AND FEET.

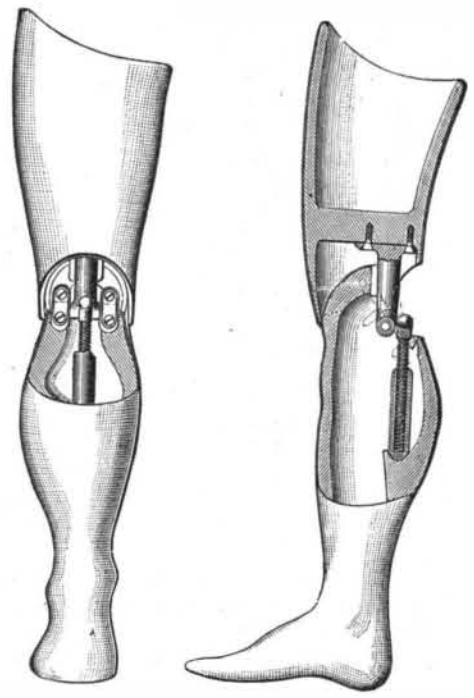
foot, from heel to toes, was formed of elastic vulcanized rubber.

The action of such an artificial foot was that of an elastic segment of a wheel. The shock of placing the weight upon the heel at each step was avoided by the elastic cushion of rubber forming the heel, and as the weight was progressively transmitted to the forward part of the foot, by the combined effect of muscular exertion in the remaining part of the natural limb to which it was applied and the momentum previously acquired, an easy flexure of the toes took place, which, reacting elastically as the weight was transferred to the other limb, assisted in the flexure of the knee joint, giving an easy and naturally appearing movement. Such artificial feet were, upon trial by those who were maimed and had used other artificial substitutes, found to be easier to use, lighter, and more comfortable. They were rapidly introduced into use, and have proved from their greater simplicity more durable and far less destructive to clothing.

The next improvement (the picture of which is here shown) is an improved and simplified construction of the knee joint of artificial limbs, made with a view to strength, facility of accurate manufacture, and easy application. This joint consists of a flanged plate, secured by screws to the under surface of the thigh socket, and has formed, integrally with it, of steel, by drop forging, a cylindrical pillar, terminating in two lateral journals having the same axis, resembling an inverted capital letter T.

These journals perform the function of the condyles of the femur in the natural limb, and are fitted accurately in bearings formed with oblique caps, secured by screws in the rear of the knee portion of the leg.

On the rear of the pillar, in about the same horizontal plane as the axis of the journal when the limb is extended and erect, is formed a short lever, having a spherical end, against which a cup, formed upon the upper end of a sliding plunger, is pressed upwardly by a spring in a guiding cylindrical case, having a hemispherical lower end resting in a correspondingly shaped cup or cavity in a shoulder in the interior of the calf portion of the leg. When the limb is extended, the spring operates with full effect, in holding the limb extended; as it is flexed the lever gradually assumes a greater angle to the line of reaction of the spring and



IMPROVED KNEE JOINT.

cup, so that, when it is flexed with the thigh at right angles with the leg, the spring has no motion or effect, and if flexed still further, the spring then operates to assist in further flexure. The pillar and journals are made hollow, so as to reduce their weight.

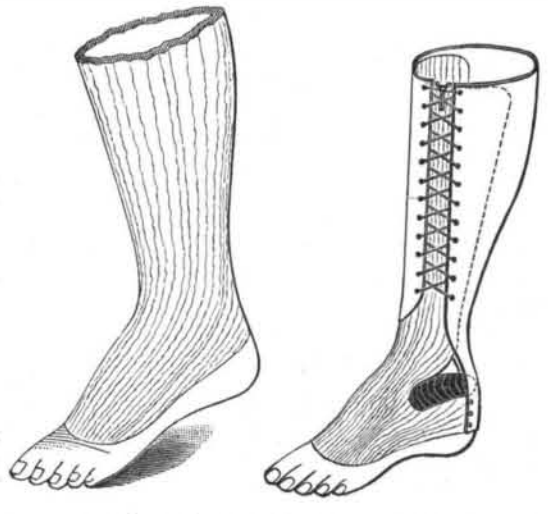
It is obvious to every mechanic, from the form of these parts, that they can readily and accurately be finished by drilling and turning, that from their shape they must possess great strength, and that they can easily be fitted accurately into their working positions in the limbs.

Another useful feature of this form of joint is that the upper part of the pillar forms an effective stop, to arrest the forward motion of the thigh upon the leg during extension, by coming in contact with a cushioned cavity in the rear of the knee; this point of support, being at a considerable distance from the axis of the knee joint, avoids any severe strain and shock from the sudden extension of the limb, which in other constructions, having the stops made in plates at the sides of the joint, are necessarily close to the axis of motion, and consequently are subjected to a greatly increased strain.

This concussion of the stop is found to be a frequent cause of breaking both of the stops and joints of other forms of limbs, and has had a great deal of ingenuity expended upon it to avoid it, by providing check straps or cords reaching from the thigh to the leg, and designed to stretch tight before contact of the stops occurs. These cords required greater care to keep adjusted to the proper tension than could readily be given to them. The simple contrivance here shown obviates the entire difficulty.

The axis of the knee joint is placed near the back of the limb, so that the weight of the wearer insures a firm support on the limb when extended, and at the same time slight exertion suffices to move the limb in stepping forward.

The shell or parts, which in form imitate the natural limb, are made of light willow or basswood, as thin as



TEXTILE FABRICS INCORPORATED WITH RUBBER CUSHIONS.

is consistent with strength in the lower part, and in the upper part excavated to fit the remaining portion of the natural limb; these are covered tightly with parchment and painted and varnished to resemble the complexion of the natural skin.

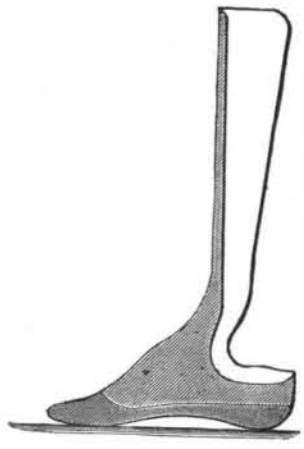
The continued use of the limbs thus constructed demonstrated that the front portion of the foot was too easily flexible, or rather that greater elastic force was desirable, and this requirement was met by the inventor by a device in which a textile fabric was introduced between the lamina of India rubber forming the ball and toe portion of the foot, as here shown in the drawing.

The desire to adapt the India rubber hands to changes of flexure, for purposes of better and more natural appearance and to grasp light objects, led Mr. Marks to improve them by making a light wooden core in the palm or metacarpal portion of the hand, and inserting ductile or flexible metallic wires in such core, which extended centrally through the fingers. By bending the fingers they retain the form in which they are set. The test of several years' use of these last named improvements has proved their utility.

The latest improvement in artificial limbs consists in forming the leg and foot part of a single piece of wood, having the grain curved naturally in its growth, such pieces being procured from the parts of the trunk contiguous to the roots and branches of trees; limbs made in this way are stronger with the same amount of wood remaining in them than when made of parts and glued together, and are made waterproof, which is a specially valuable feature when the occupation of the wearer exposes it to constant dampness, or to water itself, as in fishing, mining, dredging, etc.

By making limbs in this manner from natural curves in the growth of the wood, it has become practicable to make light and substantial artificial feet, adapted to partial amputations of the foot. Such appliances are shown herewith, and have been used with unprecedented satisfaction where articulated feet were clearly impossibilities.

The advantages derived from lightness of such artificial substitutes will readily be apparent when the resistance to motion from inertia is considered. The ankle and foot and lower part of the limb being light



LEG AND FOOT OF NATURALLY CURVED WOOD.

and hollow, move easily and promptly with but little exertion from the remaining part of the natural limb, and the comfort and ease of the wearer are thereby greatly promoted.

With the specimens of limbs are submitted well-perfected adjuncts in the way of suspender straps and girdles, and great ingenuity and skill have been displayed by these inventors in adapting limbs to specific cases which, while useful and light and highly commendable, cannot be particularized in this report.

The Franklin Institute has not made any examination in this department of the arts since January 11, 1849. Since this time about sixty or more patents have been granted for alleged improvements in artificial limbs, nearly all of which, except these, which are the subject of this report, added complications or additional parts to the limbs. In none of these inventions does there appear such desirable simplicity of construction and reduction of cost of production as in those under consideration. The makers are enabled to make most durable and substantial workmanship of all parts, and have demonstrated all of these points by making something over 9,000, which are in constant and satisfactory use.

The extreme simplicity of construction has proved the means of bringing their cost within the reach of many persons requiring such appliances, who could not otherwise afford to use and maintain them, and there are now many persons using them and actively competing with others in many lines of industry: among them machinists, blacksmiths, farmers, fishermen, carpenters, moulders, instrument makers, railway conductors, engineers, and, in fact, representatives of nearly every handicraft.

IN 1816 it took just one bushel of corn to buy one pound of nails, now one bushel of corn will buy ten pounds of nails. Then it required sixty-four bushels of barley to buy one yard of broadcloth, now the same amount of barley will pay for twenty yards of broadcloth. It then required the price of one bushel of wheat to pay for one yard of calico, now one bushel of wheat will buy twenty yards of calico.