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THE MANUFACTURE OF ARTIFICIAL LIMBS.

It would be hard to find a more beneficent example of the progress of mechanical science than that afforded by the peculiar industry we describe and illustrate in this issue. The artificial limb manufacturer ranks, in a sense, with the reparative surgeon in the good he does to humanity. Especially at the present day his operations are of importance. The cases of amputation are getting more and more frequent. Trolley cars, steam railroads, agricultural machinery and factories are all responsible for many accidents, and naturally they are increasing in number. In early days the old peg leg of the Peter Stuyvesant type represented the best substitute for the natural member. The hook of Captain Cuttle recalls the substitute for the other members in vogue some years ago.

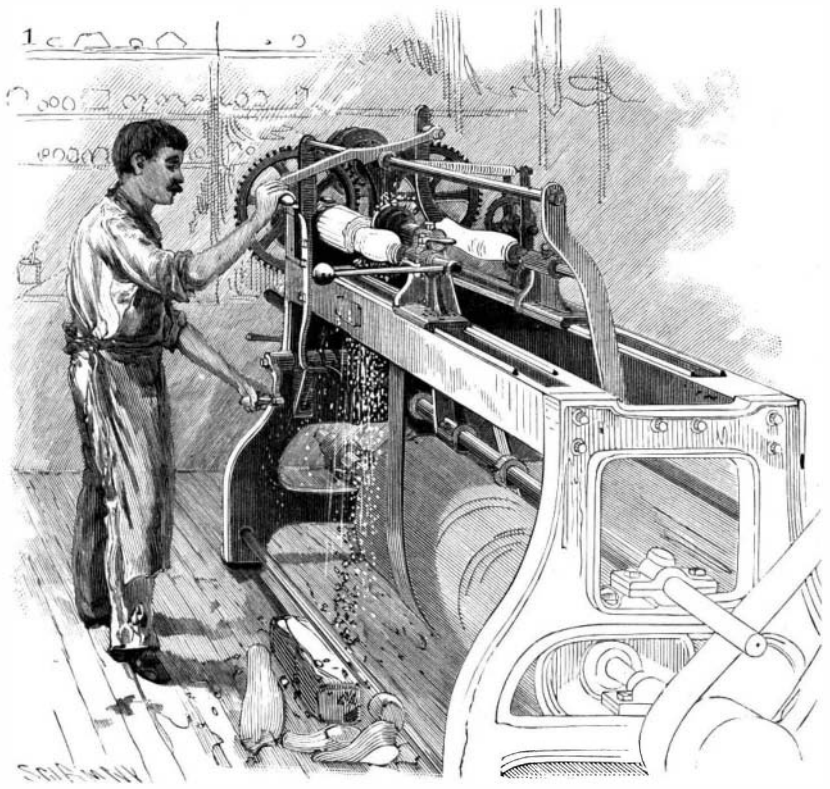
Manufacturers of these primitive affairs attempted to improve their product, and produced arms and legs with joints. The complicated natural leg was the model, and efforts were directed to reproduce its many motions. Much ingenuity was expended in this direction, and in due course of time, through simplification of its parts, the structure, as has been aptly said, "passed through all the possible stages from the leg automaton to the leg practical." The object of this article is to show how the artificial leg of the day is made, and our sketches have been made at the establishment of A. A. Marks, of New York City. A curious collection of envelopes is framed and displayed in the office of the firm—envelopes addressed to them and which inclosed correspondence from every country, and which would in many cases be treasures to the philatelist. They are exhibited to show how the entire world draws upon their factory for artificial limbs.

The leg with restricted back and forward ankle motion was constructed by Mr. A. A. Marks during the interim 1853-1863. The joint included a spring adjustable for tension and provided compensation for wear. The experience of ten years showed that the ingenious and much praised ankle joint was too weak for hard service, and repairs were very frequently required. A patient applied to Mr. Marks for a new foot without ankle joint. The idea, opposed to preconceived notions, was carried out with some difficulty and the problem was practically solved. Now, except in very special cases, the ankle joint is definitely abandoned, and the India rubber foot, the result of a vast number of experiments, patented and controlled by this firm, is employed.

The first step in the process of leg making is the cutting of the timber. Two kinds of wood are used—the willow and the bass. These are felled with saws, are cut into short lengths, and an auger is driven through the axis of each log. The wood is kiln dried in live steam at a pressure of eighty pounds to the square inch. The endeavor in boring out the axis of the log is to provide for internal contraction, thus preventing checking. Several years' seasoning are given.

The seasoned wood, which has been roughed out with a buzz saw, is received in the factory and is ready for the workman. Fig. 6, g, shows a log prepared for the shaping process. The workman has to give the interior a shape representing the contour of the stump on which the shape is based. With peculiar carving tools, illustrated below (Fig. 6, a, c), the interior is rapidly excavated until the approximate shape is reached. As guide or template for the interior, two pasteboard profiles (Fig. 6, d) of the stump are used, together with paper rings (Fig. 6, e), giving the girth of the stump at different places. The exterior is brought to shape by the drawing knife for the first steps, followed by the gouge (Fig. 6, b), spoke shave, rasp and sandpaper successively. The operation of carving the exterior of the leg is shown in one of the cuts (Fig. 5). The interior is brought to its final shape by revolving sand wheels which smooth it out to precise contour. The wheels, made of glue and sand on a core, are carried on the end of spindles rotated at high speed by power, and these are moved about against the interior of the leg until it is finished. Coarse and fine wheels are used. The operation is shown in Fig. 2, in which also is seen a workman facing off the end of the leg to receive the foot.

The foot is made upon a wooden core which extends down below the instep. The lower portion of the foot and the extension to the toes are made of sponge rubber, fortified with several layers of canvas embedded in the mass. The foot is rigidly secured to the ankle end of the lower limb by a sort of mortising. Sometimes the section of a log is turned out on a shaping machine from a template or duplicate, and one of the cuts (Fig. 1) shows this machine in operation.



The leg is covered with rawhide tightly stretched over the outside of the wood; the foot is covered with white calfskin cemented on the upper surface and lapping over the sole. A sole is cemented on and is sewed all around the edge to the upper covering. The foot and leg are now enameled and dried in an oven. This leaves them waterproof for all ordinary purposes. These operations, one of which is shown in Fig. 4, are termed finishing.

But for special cases, where water is to be feared, a log is selected whose natural grain follows the curve of a leg and foot. From such a piece the entire lower leg and wooden core of a foot is made all in one piece, and the rubber portion of the foot is attached

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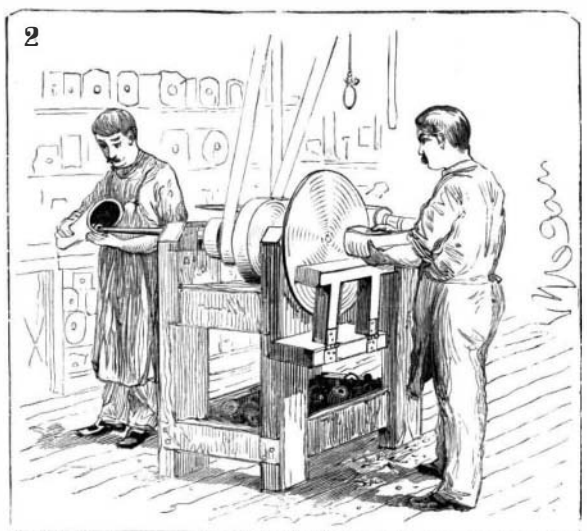

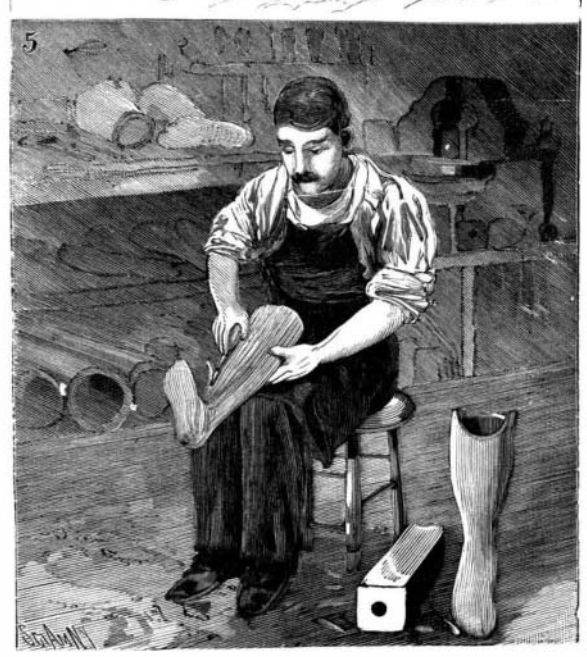

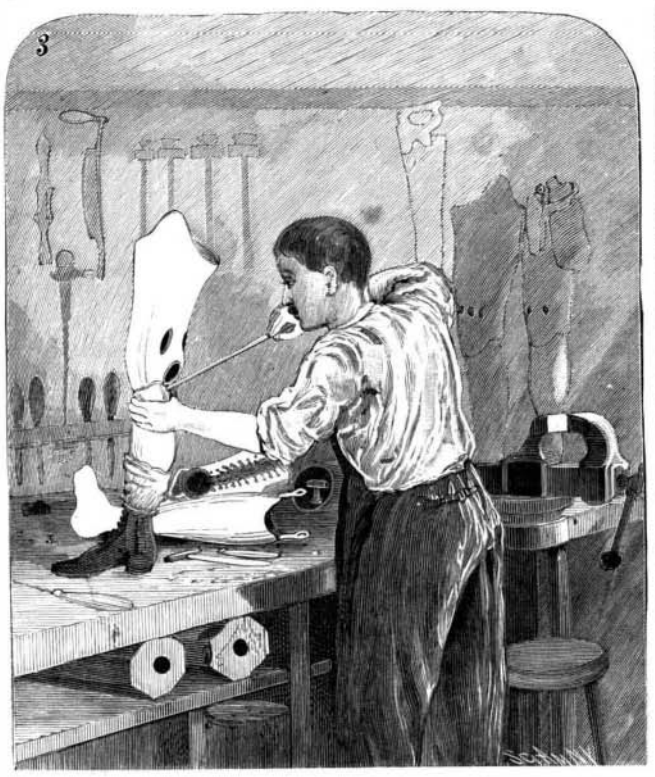

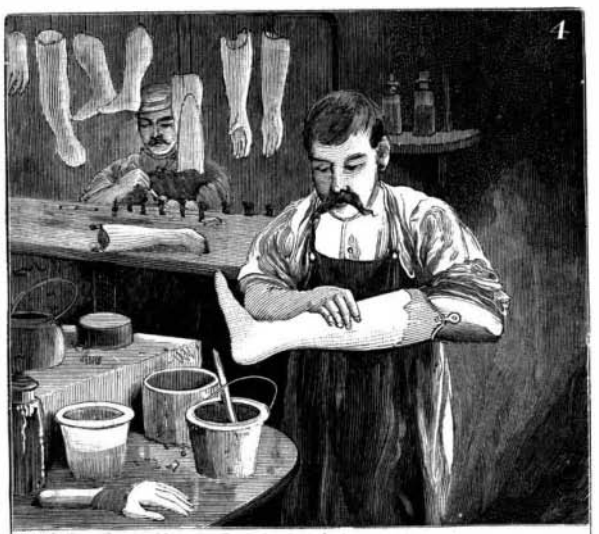

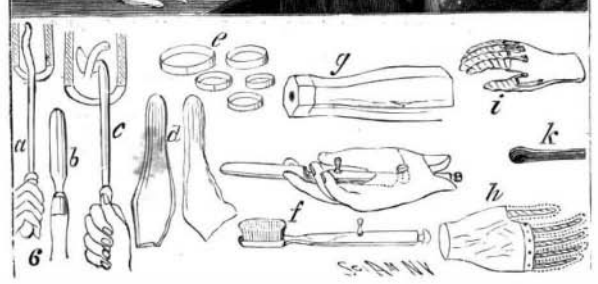

1. Shaping machine turning a leg section. 2. Finishing interior of leg and facing off ankle end. 3. Setting up legs. 4. Finishing legs and arms. 5. Carving leg sections by hand. 6. Details and parts of artificial limb making.

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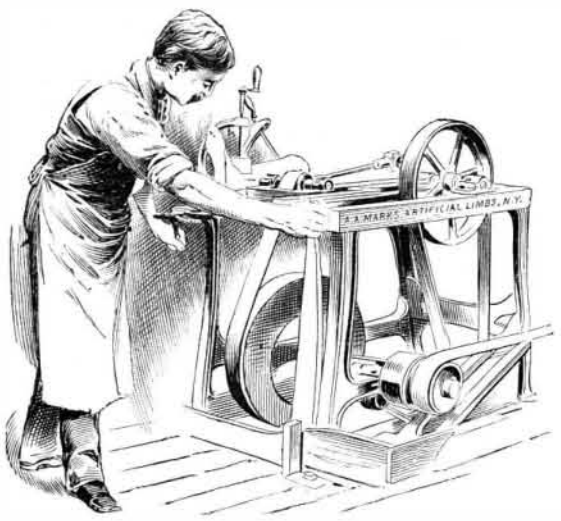
THE MANUFACTURE OF ARTIFICIAL LIMBS.

(Continued from first page.)

directly thereto. This makes an absolutely waterproof leg, which is adapted to those whose occupations expose them to wetting.

The knee joints are made in several ways, whose details cannot well be gone into here. The operation of setting up the leg and connecting the knee joints is shown in Fig. 3. These joints have been, in some



MORTISING.

cases, constructed on principles adapted to the ideas of the wearers, where such seemed good practice. The elasticity of the foot, due to the depth of sponge rubber at the heel and to the long rubber toe, takes the place of the ankle joint.

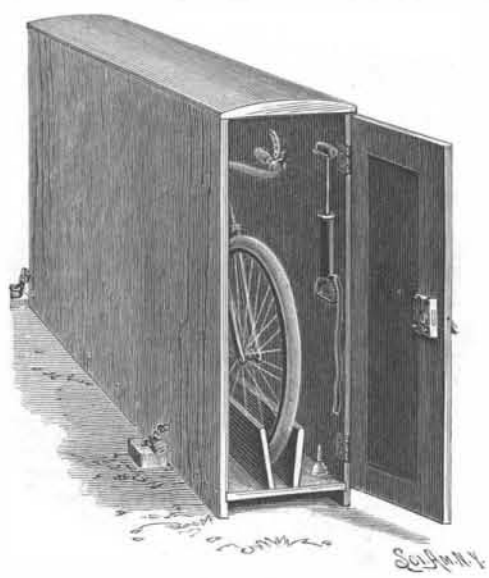
Artificial arms are made in the same way. India rubber hands are used instead of the old wooden ones. Sometimes a hand with malleable wire finger cores is employed. Holes are bored in the wooden core of the hand into which the doubled ends of bundles of wire (Fig. 6, k) are inserted and pinned; h shows the hand thus far advanced. Tape wrapping is then applied until the fingers reach the proper size, as shown in i, when all is ready for the coating of India rubber. This hand can have its fingers bent so that it can hold a pen or other light instrument. In Fig. 6 f are shown a knife and brush adapted to be inserted in a socket in the hand. The small projecting handle is used to insert them with.

The beneficent results of this work have been mentioned. In the Marks factory is a workman with two wooden legs. He does a full day's work standing at his bench, and then will often play billiards all the evening. It is impossible to believe that he depends altogether on artificial limbs. Tight rope walking, hurdle jumping and other apparently impossible feats are performed by wearers of the Marks limbs. As a mechanical process the operation of wooden leg making is most interesting, and the limits of this article preclude a full description.

The noise of machinery, the humming of wheels, the buzzing of saws and the many men stationed at their benches show that the industry is of far greater magnitude than any one would suppose. There are over forty employes in this establishment, and the capacity represents an output larger than the aggregate of any other ten artificial limb factories in the world.

A CASE TO HOLD A BICYCLE.

To obviate the inconvenience of moving a bicycle into or out of the house whenever the machine is used,



MUMFORD'S BICYCLE CASE.

the case for holding the wheel shown in the accompanying illustration has been patented by Mr. Norman W. Mumford, of Santa Barbara, Cal., the case being adapted to be securely locked to a building, post or other fixture. It is a closed box-like structure, with bottom raised to protect it from moisture and has at its ends handles to facilitate moving it about. In its bottom are parallel guides, whose inner ends incline upward, so that when the machine is pushed back into the case, the rear wheel will fit snugly between the higher portions of the guides. Nearly opposite the handle bar, at the top and sides, are straps by which the machine may be held so as not to move in the case.

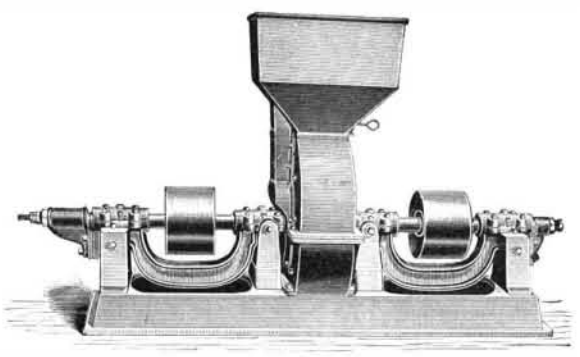
Mishap to the Columbia.

On July 13 the U. S. cruiser Columbia, while being dry-docked at Southampton, England, was strained, owing to the placing of the keel blocks of the dock too far apart, which caused the keel plates of the vessel to be dented in and the cement between them and the inner hull to be cracked. The ship was further damaged by the bending of several frame stanchions. Recent reports from the Navy Department at Washington say that about $5,000 will be the cost of repair, and also that a court of inquiry will probably be instituted for fixing the responsibility in the matter. The Columbia was dry-docked at Secretary Herbert's orders, so that she might be put in condition for a trip against time across the Atlantic, and it is not thought the damage is serious enough to prevent this or participation in the coming squadron maneuvers.

The mishap to the Columbia appears to have been the result of gross carelessness somewhere. It seems almost incredible that the dock people should not have known how to block the ship properly. We presume the arrangement of the blocking was not examined by the officers of the vessel before the docking; they no doubt took it for granted that everything was arranged in the best possible manner.

AN IRON GRINDING MILL OF LARGE CAPACITY.

The illustration represents a mill of approved excellence, especially adapted for grinding corn, oats, spices, oil cake, cocoanut shell, glue, sugar, etc. It is manufactured by Munson Brothers, Utica, N. Y. The grinders comprise two disks mounted on steel shafts, and running at a high speed in opposite directions, there being fastened to the disks hard metal grind-



THE ROBINSON GRINDING MILL.

ing plates which require no sharpening and which will wear from six to twelve months. When worn out they are replaced at small cost. The mill requires no special foundation, and can be driven by belts from above, below or diagonally. The mill is easy to adjust, and the journals are connected by yoke and are self-oiling. It does not require skilled labor to operate the mill, and its capacity is from 60 to 100 bushels per hour. It occupies a floor space of 6 feet 8 inches by 2 feet 4 inches over all, and is run with 20 to 25 horse power.

Typography a Roman Art.

It is stated on the authority of the Foia Diecessana, the official paper of the Greek-Rouman bishopric of Carausebes, in South Hungary, that unmistakable evidence of the art of typography has been discovered among the ruins of Bersovia, in Dacia, an old province established as a colony by the victorious Romans on territory then acquired by them. The discovery is attributed to the architect and archæologist Adrian Diaconu, who, it is said, found evidence of the use even of movable type by the Romans at this colony, and particularly by those of the fourth legion, Flavia Felix. Two members of the Bucharest Scientific Academy confirm Diaconu's opinion, having examined the evidence and declared the discovery to be of the utmost importance.

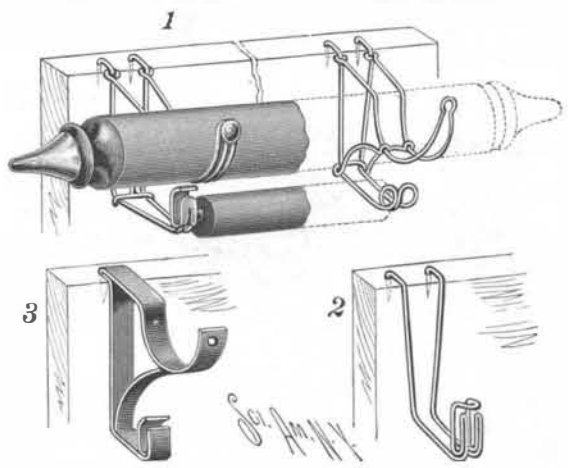
If these facts be really true, the honor of inventing typography will no longer reside with the Germans nor with the Italians, who attributed the discovery to Panfilio Castaldi.

A Northern Scientific Expedition.

The steamer Portia sailed from Brooklyn June 22 carrying an expedition under Emil Diebitsch which will proceed to Lieut. Peary's headquarters in North Greenland and will bring him and his small party of explorers home. The relief party is composed of Prof. Rollin D. Salsbury, of Chicago University, Theodore Le Boutillier, of Philadelphia, John E. Walsh, of Washington, and Prof. L. L. Dyche, of the Kansas State University.

A BRACKET SUPPORT FOR SHADES, CURTAINS, ETC.

A very simple and convenient bracket, readily attachable to a window or door frame, is represented in the accompanying illustration, and has been patented by Mr. Charles Pettit, of No. 3005 South C Street, Tacoma, Washington. Fig. 1 shows the bracket in position for the support of a curtain pole and a shade roller, Figs. 2 and 3 representing modified forms of the improvement. As shown in the first figure, the bracket is formed of bent wire, terminating in pins at its upper end adapted to be driven into the top of the window



PETTIT'S CURTAIN BRACKET.

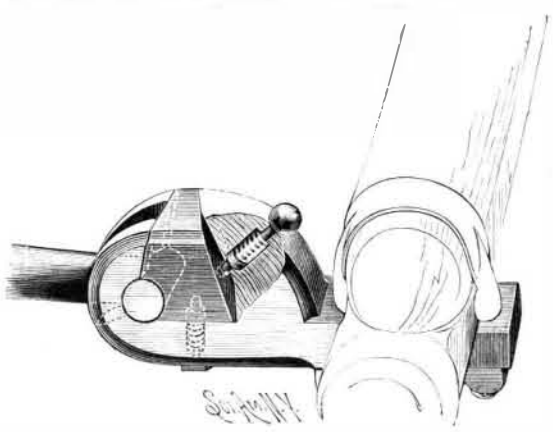
or door frame, an auxiliary bracket for the support of the curtain pole being held on the first bracket, and having at its outer end an eye in which a thumbscrew may be inserted. In Fig. 3 the bracket is shown formed of sheet metal, and the flat arm at its upper end has an angular extension with teeth adapted to be driven into the top edge of the support. Other variations of the form of the bracket are set forth in the patent.

Animal Humbugs.

In military stables horses are known to have pretended to be lame in order to avoid going to a military exercise. A chimpanzee had been fed on cake when sick; after his recovery he often feigned coughing in order to procure dainties. The cuckoo, as is well known, lays its eggs in another bird's nest, and to make the deception surer it takes away one of the other bird's eggs. Animals are conscious of their deceit, as shown by the fact that they try to act secretly and noiselessly; they show a sense of guilt if detected; they take precautions in advance to avoid discovery; in some cases they manifest regret and repentance. Thus, bees which steal hesitate often before and after their exploits, as if they feared punishment. A naturalist describes how his monkey committed theft. While he pretended to sleep the animal regarded him with hesitation, and stopped every time his master moved or seemed on the point of awakening. — Public Opinion.

AN IMPROVED THILL COUPLING.

In this coupling the thill or pole iron is so held that it cannot leave the coupling unless purposely removed, the thill irons being readily placed in coupling position or removed. The improvement has been patented by Mr. William H. Byrne, of Piedmont, Wyoming. The body of the coupling has extending through from side to side a horizontal wedge-shaped recess with undercut side walls, and in the bottom of its forward wall is an auxiliary semicircular recess. A wedge-shaped block adapted to fit into this space has a semicircular recess registering with the auxiliary recess in the body of the coupling, the head of the thill iron being held in the space afforded by the two recesses, and its shank having free movement in a vertical recess in the front of the body of the coupling. The block is held from



BYRNE'S THILL COUPLING.

lateral movement by spring-pressed bolts, at the bottom and back, and to prevent rattling a packing of rubber may be placed on the head of the thill iron, to be held in place by the block or by a thin iron fitting the back end of the shaft, and with each end turned back over the block.

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