SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION. ART. SCIENCE. MECHANICS, CHEMISTRY AND MANUFACTURES.

Vol. XLIX.—No. 5. [NEW SERIES.] NEW YORK, AUGUST 4, 1883. $3.20 per Annum. [POSTAGE PREPAID.]

THE MANUFACTURE OF ELECTRICAL CONDUCTORS.

Covering.—From an electrical point of view, a conductor and its covering must in general present diametrically opposite qualities. The former cannot be too good a conductor, and the latter can never be too good an insulator, since its purpose is to prevent a passage of the current when two conductors or two parts of the same conductor come accidentally in contact. Such covering will vary in thickness, and will be more or less resistant, according as it will or will not have to undergo the inclemencies of the weather or mechanical shocks, or according as it is to be wound once for all upon the bobbins of an apparatus under cover.

We may distinguish the wires as follows:

1. Overlaid wires, or those simply covered with a layer of silk or cotton wound around them like a bandage.

2. Braid-covered wires, in which the covering, forming a true tube of braided silk or cotton, constitutes a much firmer envelope than does the preceding, and one which is capable of resisting repeated friction. The conductors of the telephone and medical apparatus are types of this kind of conductor.

3. Cables, whose covering is always multiple and more or less complex, but which always comprises at least a primary, electrically insulating covering, and a second one whose purpose is to serve as a protection to the other.

4. In submarine cables, which form the last of the series, the protecting layer is itself covered with a third envelope, formed of iron wire, called an armor, and designed to support all the tractive stresses to which the cable is submitted. We shall omit reference to the manufacture of submarine cables, and confine ourselves to that of wound and braid-covered wires, and of simple cables that are also known as electric light cables.

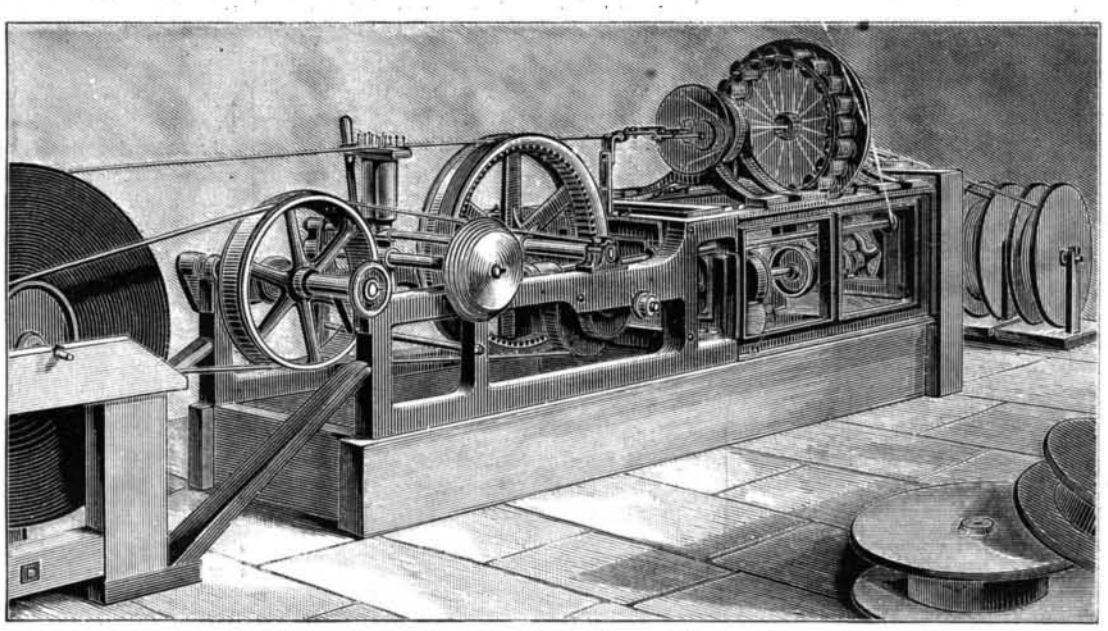
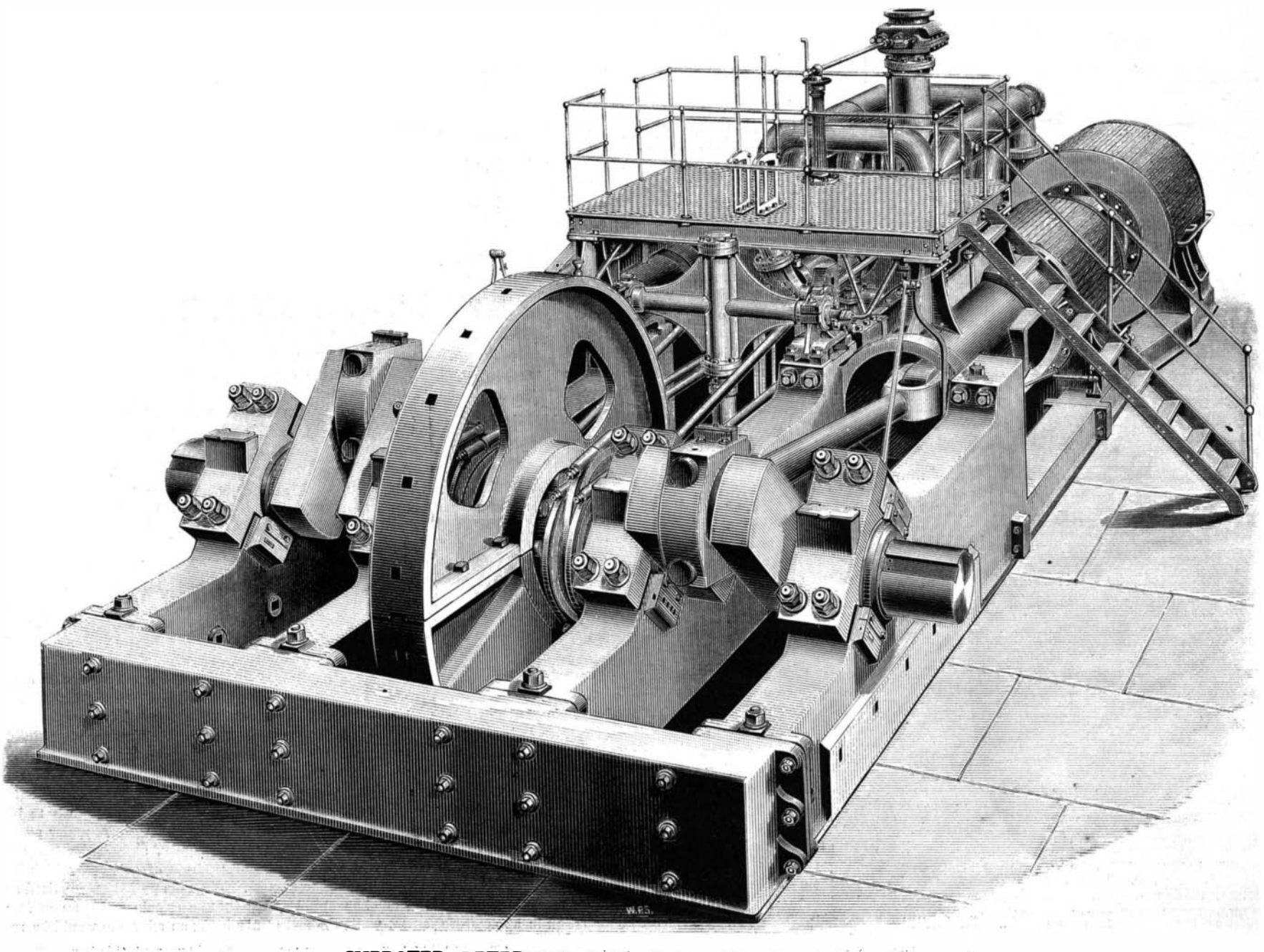


Fig. 1.—ELECTRIC CABLE MACHINE.

Overlaid Wires.—The winding of naked conductors is effected by means of machines called whipping wheels. The number of bobbins in each machine varies with the size of the wire to be covered. Thanks to the kindness of Mme. Bonis, who has kindly shown us in detail the interesting process of manufacturing electrical conductors, we are enabled to place before our readers a representation of one of the twenty-four bobbin whipping machines of the most recent style, and furnished with all the latest improvements that long practice alone could suggest. This machine (Fig. 3) consists in reality of twenty-four distinct apparatus, which are mounted upon a single frame and actuated by one and the same gearing. One person, a woman, suffices in general to start and attend to these twenty-four bobbins. Each of the latter is capable of covering about 400 meters per day, and the product of the entire frame is therefore nearly 10,000 meters per day. The wire to be covered is placed upon the bobbins at the upper part, descends vertically, bends at right angles to run over pulleys placed behind the frame, and

(*Continued on page* 66.)



IMPROVED REVERSING RAIL MILL ENGINES.—[See page 70.]

THE MANUFACTURE OF ELECTRICAL CONDUCTORS.

(*Continued from first page.*)

then passes into the axis of other bobbins that are filled with silk and have a rapid rotary motion. The silk which these bobbins carry then winds around the wire, which is moving forward with a regular motion under the action of the pulleys around which it runs. These pulleys are shown toward the center of the frame. After leaving them the wire winds around bobbins in the upper part of the frame. By properly proportioning the speed at which the wire is carried along, and that of the bobbins' rotation, one can vary at will the thickness of the insulating layer, which is formed here of a continuous band of silk or cotton making a certain number of turns to each centimeter of wire covered. All transmissions of motion are made by the aid of small cords; and a series of conical pulleys that correspond to each bobbin permits of regulating the speed with which the wire moves forward, this varying between 30 and 60 meters per hour.

The bobbins upon which the wire is wound likewise present special arrangements that are very interesting. As may be conceived, the length of wire that they are capable of taking up at one revolution depends upon the quantity that they already carry, since the diameter increases as the bobbin fills. If the latter possessed a regular motion, it would wind badly at the beginning and would infallibly break the wire at the end. All this is prevented by carrying it along *by friction*. To this end the diameter of the pulleys is calculated so that the speed shall be a little greater than that that corresponds to the empty bobbin, that is to say, to the least advance per revolution. The transmitting cords, after passing over the pulley of the bobbin, support a small roller furnished with a hook from which are suspended weights for regulating their tension. These weights are shown at the bottom of Fig. 3. When the tension of the covered wire exceeds a certain amount, the cord *slips* on the pulley of the bobbin and fails to carry it along. There results from this a motion which is partly a sliding one, and an excessively regular winding of the wire, since the tension is constant and is regulated by the weight suspended from the friction roller.

It now becomes a question of distributing the wire throughout the length of the bobbin. To this end, the bobbins are mounted upon a frame which is movable horizontally. A series of gearings and a cam (represented to the right in Fig. 3) give this frame a slow and regular backward and forward motion. The travel of the frame is equal to the internal length of the bobbin between its two flanges, and the winding of the wire is thus effected very uniformly. The travel is changed, according to the diameter of the wire, by modifying the train of gearings. It may be seen, in fact, that the relative speeds of the different parts of the machine depend upon the diameter of the wire and the nature of its covering, although the principle is the same for all. The 24-bobbin machine is designed especially for wires of small diameter that are always covered with silk. For wires of medium and large diameter the machine is provided with a less number of bobbins of larger size. In Fig. 3 may be seen what appear to be cylinders of different sizes, divided off by black lines. These are composed of bobbins, each carrying a like quantity of silk. Before beginning operations, there is thus stored up in a tube which is traversed by the wire the number of bobbins full of silk that are necessary for the entire work. When one of these bobbins is empty, it is taken off and replaced by a full one from the stock in reserve. When the wire is to be covered twice, it is, with its single covering, passed into a second machine, and the winding is effected in a different direction, and so as to obtain a crossing of the threads in order to give greater firmness. For medium wires we have seen in Madame Bonis's establishment machines that performed the two opposite windings at a single operation.

Braid-covered Wires. — The machine for covering the wire with braid is termed, in the language of the workshop, a "waltzer." Fig. 2 represents one of these apparatus in the act of covering an electric light conductor. The motion of the wire is here the opposite of that which it has in the overlaying machine. The uncovered wire enters through the lower part, while the covered is stored up in the upper part. The braiding constitutes a true fabric of more or less compactness. The number of threads that compose it varies between 12 and 48. The "waltzer" shown in the cut is arranged for 48 bobbins. These latter, which are arranged vertically, are grouped in twos, and are carried along by 24 disks that revolve alternately in one direction and the other through gearings, and that are arranged upon a circumference whose center is occupied by the wire.

The wire to be covered passes through the center of this circumference, and all the threads, in rejoining the point where the braiding is performed, form a sort of conical surface which is well shown in the figure. The bobbins containing the thread of each braid are mounted upon vertical spindles. Owing to a mechanical combination which is as simple as it is ingenious, these spindles change disks at every half revolution and traverse the entire surface of the 24

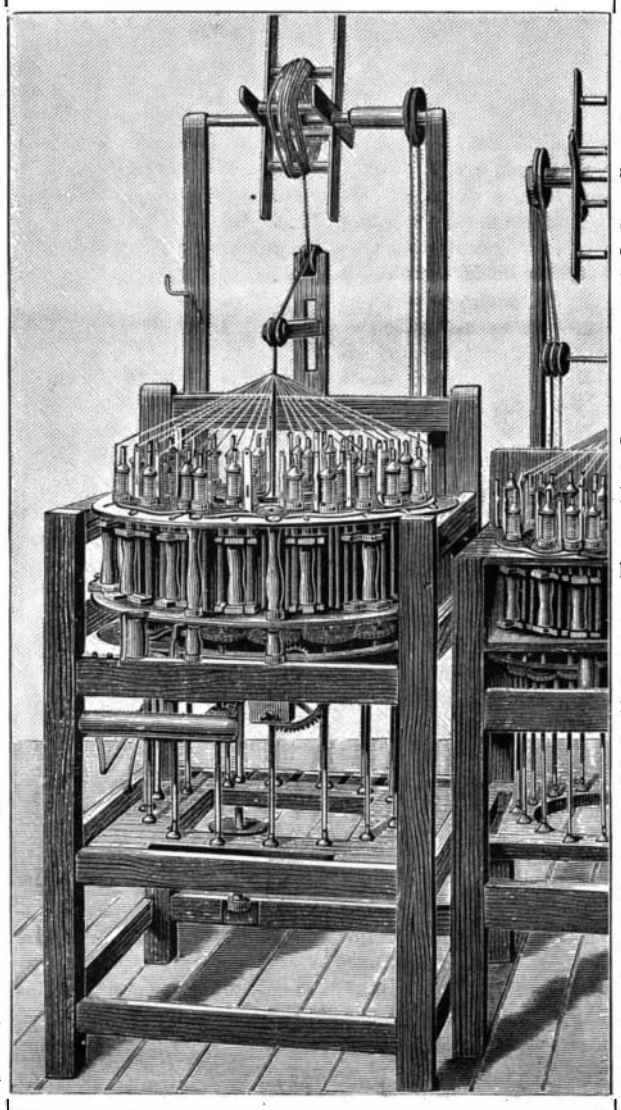


Fig. 2.—THE WALTZER, A MACHINE FOR COVERING ELECTRICAL CONDUCTORS.

disks, describing in doing so a regular curve formed of small semicircles that are alternately external and internal to the large circumference formed by the 24 disks. Half these bobbins effect this movement from right to left and the other half in an opposite direction. The result of these combined motions generally is that each of the threads taken isolatedly, during one entire revolution, successively crosses all those that are running in an opposite direction

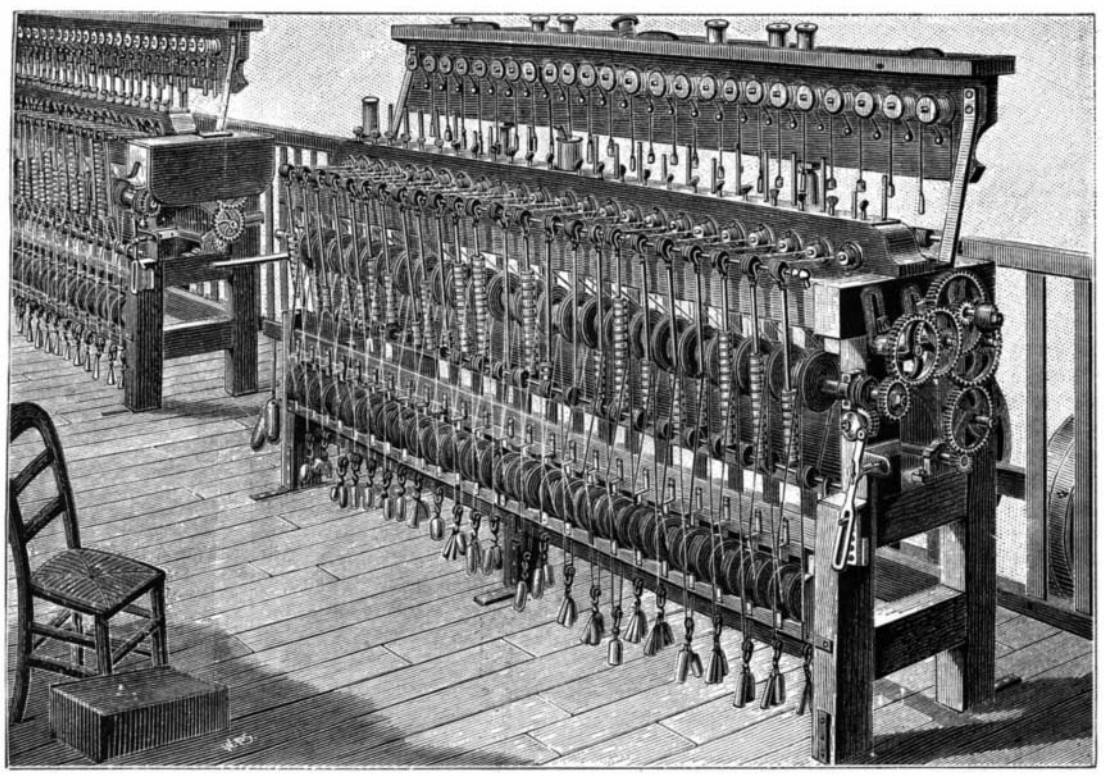


Fig. 3.—MACHINE FOR WHIPPING SILK OR COTTON AROUND CONDUCTORS.

while at the same time remaining parallel with all those that are running in the same direction with it, and passing alternately above and below two successively crossed threads.

The "waltzer," then, realizes automatically what is done by hand in ordinary braiding, and is identical in principle with the apparatus made use of by trimming makers in the manufacture of watch cords, etc. The mean production of one of these apparatus is 100 meters per day.

Electric Light Cables.—The English cable machine (Fig. 1) is capable, according to requirements and to the arrangement of its parts, of producing several successive or simultaneous effects, and, consequently, of furnishing a number of types of cables. There are three phases in the operation that it performs: (1) the uniting of several wires into a single strand which is afterward to be covered with India rubber or gutta percha, according to the application to be made of it; (2) the covering of the conductor with a fabric to protect the insulating material; and (3) the covering of the whole with a band of protecting material, by an operation analogous to that performed by the overlaying machine.

These two latter operations are always identical in principle, the conductor being carried along with a uniform motion, while the covering is given a rapid rotary motion around it.

When the cable is not provided with the intermediate covering, the bobbins are removed from the disk, and the conductor then receives only the external bandage. Sometimes the machine is used merely for twisting wires into a single strand, the wrappings being dispensed with.—*La Nature.*

A Cotton Seed Oil Manufactory.

Cotton seed, which only a few years ago was considered valueless by the planter, has become a very important product, its oil being now used for a great variety of purposes, and immense establishments have been erected in different parts of the country for its manufacture.

The Columbus (Ga.) *Sun* closes a long description of a new oil mill in its city with the following description of how oil is made: The seed are first put into a hopper, where they are fed to the cup elevator by a screw conveyer. They pass through a sand screen which takes out the sand, and are then passed over a shaker and fan to take out all heavy substances which may be found in the seed. From here it is taken to the linters, where it passes through three 16-saw gins and is freed from all lint. From thence they are all carried by a belt conveyer to another elevator, and emptied into the huller, where they are chopped, hull and all. After passing through the huller they are again elevated to the third story, where they pass through another screen. Here the hull and meat separate, the meat going back to the second story, where it passes between large rollers, and they are well compressed. They are now ready for cooking, and are conveyed to the second floor into six heaters. After a certain length of time the plugs are drawn from the heaters and the contents are emptied into a bin. They are then taken out and put into small sacks, and placed between mats and again pressed. The oil is then emptied by means of a large pipe into the ground tank. By means of a pump it is forced into two large settling tanks in a separate apartment, and after two or three days it is drawn off into barrels and is now ready for shipment. After being cooked, put into sacks and pressed, the oil cake remains and can be used to advantage after being ground into meal. From it a splendid fertilizer can be made; besides, it is fine for stock feed.

Bathing and Cramps.

A sad instance of fatal cramp from bathing lately occurred at Durham, says the London *Lancet*. A fine young fellow, a trooper in the 3d Dragoon Guards, then on the march from Edinburgh to Manchester, took advantage of the night's halt to have a dip in the Wear near that city. Being strong and a good swimmer, he took an oar, at which he worked for some time in the sultry evening till he came to deep water, and in a suitable place took his plunge. That he was immediately seized with cramp is evident from the statements of his companions, who, alarmed at his cries, hastened to render assistance, but he had sunk before they reached him, and he never rose again. When the body was recovered a considerable time afterward, it bore every evidence of the cause of the disaster. It was described as being "twisted"—that is, contorted; while the vessels of the head, especially in their gorged condition, pointed to congestion, in fact, to stagnation of the circulation! That this young soldier lost his life by bathing when in an overheated condition is quite clear. It would be well if soldiers and civilians would remember the lesson conveyed in the classical case of Alexander, quoted by Dr. Jones from Quintus Curtius, viz.: "It was in the middle of one of the hottest days of a burning summer that Alexander arrived on the banks of the Cydnus. The freshness and clearness of the water invited the king, covered with sweat and dust, to take a bath. He stripped himself of his clothes, and, his body all in a sweat, he descended into the river. Hardly had he entered when his limbs became suddenly stiff, the body pale, and vital heat seemed by degrees to abandon him. His officers received him almost expiring in their arms, and carried him senseless to his tent.