

A MECHANICAL SCARIFIER.

Probably no road paving is worse than a macadam road when it gets uneven and is in want of renovation. But the repair of a macadam road is both slow and expensive, necessitating the blocking of the thoroughfare for several days. Then, again, pedestrians incur considerable risk by flying pieces of stone, which cannot possibly be avoided by the hand-picking process. Messrs. Marshall & Sons, Limited, of Gainsborough, England, have placed on the market a scarifier which may be attached to a traction engine or steam roller. The scarifier is attached to the back end of the tender of the roller in such a manner that the weight and strain in connection with the same are equally distributed over the full width of the tender. The latter is constructed of extra thickness and strength, so that there is no possibility of the roller itself being pulled to pieces through the vibrations of the scarifier.

The scarifier itself works on a traversing motion. By this means it can be set to scarify any part of the road, from the gutter on either side to the crown, without having to turn the engine round. Then, again, it can be arranged to operate either backward or forward, and the depth of the cut into the road can be easily regulated by means of a hand wheel and worm gear. Under ordinary circumstances it will score the road to a depth of about two or three inches, but, of course, this depends upon the nature of the road upon which the scarifier is at work.

The scarifier consists of a dozen chisels mounted in a swinging frame, pivoted at its upper extremity and carrying two segments of worm wheels gearing into two worms. The tools are rigidly held in position in the frame by means of wedges, so that there is no possibility of their working loose while at work. They can easily and readily be withdrawn when required for sharpening or replacement. One set of chisels is intended for forward work and the other set for working backward. A lever actuates in a slotted sector, for the purpose of changing the scarifier from the forward to the backward motion, and vice versa.

When the roller has completed its work, the scarifier may be lifted from the ground to any desired height by means of the hand wheel and worm gear. This arrangement of gear is self-locking in any position.

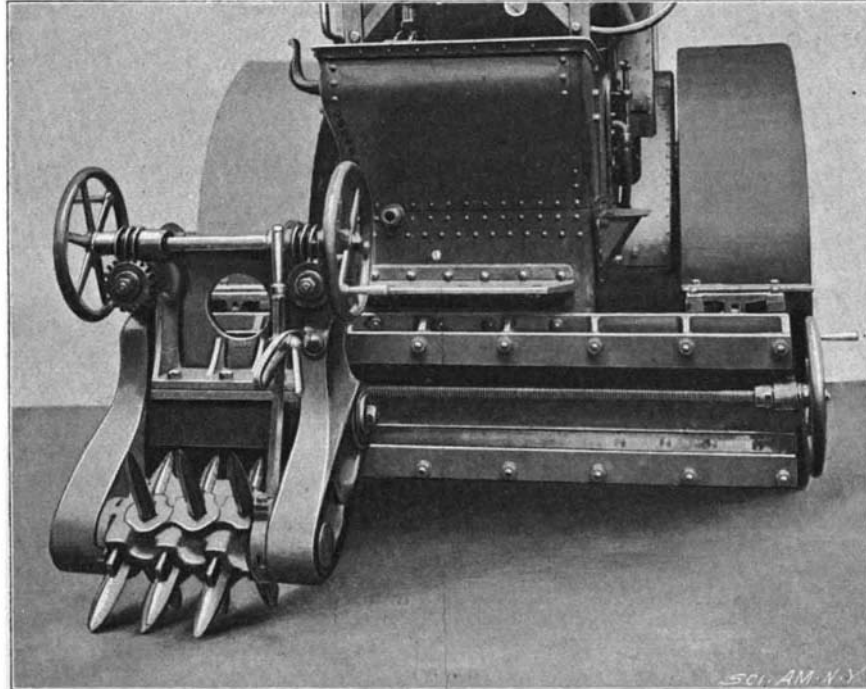
By working with one of these scarifiers a macadam road may be scored in a very short time, and it performs the work much more thoroughly than the handpick, while there is also a considerable saving of material. The picking of a road is very destructive to the metal, but by means of this scarifier it is simply turned up regularly, and often only requires leveling and rolling in again. Then, again, the surface of the road is disturbed to a uniform depth throughout the whole section, which desideratum it is impossible to obtain by means of the handpick.

THE 16-INCH RIFLE AND 20-INCH SMOOTH-BORE COMPARED.

In our recent article on the new army 16-inch gun, we described the construction of this powerful weapon and gave some particulars of its remarkable ballistic powers. It was shown that if the gun were set up at the Battery, New York, with an angle of elevation of forty degrees, and fired with a full charge of smokeless powder, the shell would reach a maximum height of $5\frac{1}{4}$ miles, and range to a distance of just under 21 miles. With a view to showing what a vast area would be dominated by such a gun, we present the accom-

panying map of New York city and vicinity, from which our cosmopolitan readers may readily determine whether their nightly ride of one hour, more or less, into the suburbs would be sufficient to place them beyond its zone of fire.

By the courtesy of the War Department, we are enabled to present the accompanying photograph

**A SCARIFIER FOR MACADAM ROADS.**

showing a full-sized model of the new 16-inch army gun, suspended above two of the largest coast-defense guns of the civil war period. The one to the left is a 20-inch smooth-bore Rodman, the largest smooth-bore in the world. The gun to the right of it, below the chase of the 16-inch gun, is a 300-pounder Parrott rifle, which also is the only one of its size ever constructed, all the other Parrotts being of 8-inch, 6-inch and smaller bores. The 20-inch Rodman closely resembles in outline and relative proportions the celebrated 15-inch smooth-bores, of which so many were used in the civil war. The iron used in casting the gun was

**MAP OF NEW YORK AND VICINITY SHOWING AREA DOMINATED BY FIRE OF 16-INCH GUN.**

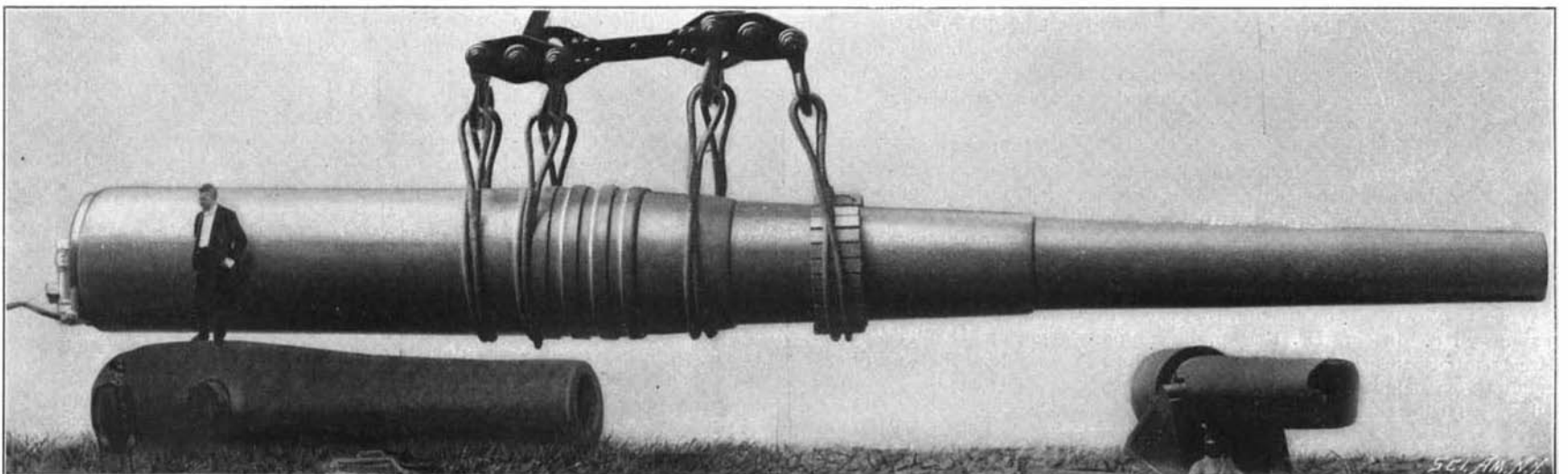
what was known as a No. 2 warm blast hematite. The smelted pigs were remelted and cast into pigs, which were again melted in three air furnaces. The weight of the iron melted was 172,000 pounds, time of melting $7\frac{1}{4}$ hours, time of casting 23 minutes. After the gun was cast, water was run through the core for the first 26 hours, after which air was forced into the bore at the rate of 20 cubic feet per minute from the 11th of February, 1864, the day of casting, to the 24th of the same month. The tenacity of the metal was found by actual test to be 28,737 pounds to the square inch. The length of this gun is 20 feet $3\frac{1}{2}$ inches, the maximum diameter 5 feet 4 inches, the diameter of the muzzle is 2 feet 10 inches, and the total weight 115,200 pounds. For the sake of comparison we recapitulate some figures of the new 16-inch army rifle as follows: The length of the gun is 49 feet 2.9 inches, the maximum diameter at breech 5 feet and at muzzle 2 feet 4 inches, and the weight of the finished gun 300,000 pounds. The weight of the shot for the 20 inch smooth-bore was about 1,000 pounds, whereas the shell for the 16-inch gun will weigh 2,370 pounds.

Phosphorescent Bacteria.

M. Raphael Dubois, in a paper read before the Académie des Sciences, describes a series of experiments in which he obtains a luminous source of considerable intensity by the use of certain microbes or photobacteria, which have the power of emitting light. These are allowed to propagate in a liquid bouillon of special composition. When the experiment is made with good microbe cultures to start with, and at the proper temperature, the development is rapid, and the liquid soon contains the microbes in sufficient quantity to give the luminous effect. A glass vessel is used to contain the liquid, preferably with plain sides, and it is possible in this way to light a room strongly enough to distinguish the features of a person placed at several yards distance, and newspaper type may be read. The light has scarcely any calorific effect, and the properties of its chemical rays seem to be also feeble, as it requires several hours' exposure with an instantaneous plate to obtain a good image; on the other hand, the rays seem to possess considerable penetrating power, as impressions may be made upon the plate even though screens of wood or cardboard are interposed. A sheet of aluminium is, however, not traversed by the rays.

In these experiments it is important that the bouillon in which the microbes are propagated should be well prepared. It should contain water, salt, an aliment analogous to glycerine or manite, another represented by the peptones or asparagine, and an aliment containing phosphorus, such as nucleine or phosphates, as well as traces of the mineral compounds which enter into the composition of such organisms. The use of peptone is attended with some difficulty, as putrefaction is likely to set in and destroy the action; if it is used, it should be aerated by a current of sterilized air and slightly agitated.

With asparagine the best results have been obtained, and the solution keeps well, giving the phosphorescent effect in free air; its cost, however, is a disadvantage. If well prepared, the phosphorescent solution will keep for a long time without deteriorating; the experimenter has kept some samples in a basement at a low temperature for more than six months. He expects to be able to increase the luminous effect, and thinks that a practical outcome may result from these experiments.

**THE NEW ARMY 16-INCH BREECH-LOADING RIFLE COMPARED WITH A 20-INCH RODMAN SMOOTH-BORE AND A PARROTT 300-POUNDER RIFLE.**