for large guns by which the rate of burning might be modified:—1. A quick burning powder, with a high density and no appreciable porosity. 2 A moderate burning powder, with a moderate density, leaving moderate porosity. 3. A very slow burning powder, with very large porosity. Another method was that by which powder has hitherto been made at Waltham Abbey. It was the cheapest, but it depended to a great extent on the most uncertain of all qualities, namely, porosity. That uncertainty could, however, be neutralized. In all cases the size of grain was a most important element, which never could be dispensed with, owing to the facility which it gave for the complete ignition of the charge; and with large grains, such as 2-inch cubes, no wave action was to be discovered. It was therefore a safe and sound principle to keep the grains as large as possible, provided other qualities were not unnecessarily sacrificed. He should prefer, however, to see heavy guns breech-loading and the cartridge ignited along the whole centre from the rear, when smaller powder could be safely used and greater efficiency thus obtained. The Chairman, in thanking Major Morgan for his instructive paper, said that for some years past the whole of the military institutions of the country, and with them the arms and powders, had been more or-less in review. Next to keeping their powder dry, the most important thing was to have the best possible powder. He, however, did not believe in finality in anything, and it was quite possible that an explosive superior to gunpowder would be discovered. Pending that time he thought they had arrived at almost a perfect solution of the powder question. For small arms it appeared that the best powder was produced by long milling and slack-burnt charcoal, while in powder for big guns almost the opposite was found to be best."

At Page 575, Volume IX of the VOLUNTEER REVIEW, our readers will find an article on "Artillery Experiments" which had taken place at Okehampton, England, in August and September, 1875.

The London *Times*, in a recent number, has published a long abstract of the Report of the Committee under whose superintendence the experiments were carried out. The following portion thereof will be found most interesting to our artillerists.

For Field Artillery, we should say, the results are most valuable, and it is to be hoped that a series of experiments with the heavier guns will follow as a matter of prudence.

"The batteries ordered to take part in the experiments represented one of 9 pdr. guns, one of 16 pdr. guns, and a half battery of the 10th Brigade. The projectiles used by the committee were common shell, with percussion fuse; Abel's water shell, with percussion fuse, and Boxer Shrapnel shell, with time fuse. The common shell is a cast iron, hollow projectile, filled with gunpowder, and fitted in the apex with a brass fuse, which explodes on impact, and thus bursts the shell into about thirty or forty pieces. The common shell is converted into a water shell by filling it with water instead of gunpowder, and inserting a small gun metal cylinder, containing fulminating mercury and gun cotton, into the fuse-hole in the apex, in addition to the ordinary fuse. On striking the ground, or any object, the percussion fuse acts and fires the fulminating mixture, which detonates the gun cotton. The force of the explosion, acting through the incompressible substance water, is then instantaneously and completely transmitted in all directions, and the shell is thus broken up into a far greater number of pieces than that obtained by employing the full charge of gunpowder which it would contain. Boxer Shrapnel shell is of the same general exterior dimensions as common shell, but is filled with bullets cemented in resin, and contains a small bursting charge in the base. This charge is calculated only just to open the shell and free the bullets.

"As regards the value of the several projectiles tried at Okehampton, the committee consider the common shell ill adapted for use against troops, and recommend that the proportion carried of this projectile should be reduced from one third, as at present, to one fifth. They are of opinion that the water shell is capable of producing a greater effect against troops as a percussion shell than any projectile which they are acquainted. Owing, however, to the absence of a puff of smoke on bursting, it is difficult to mark the spot where the shell grazes, and one of the advantages of a percussion shell is thus lost. Further, it has yet to be proved whether the detonator and dry gun-cotton primer will successfully withstand the effects of travelling and climate. The committee recommend that further trials be made to ascertain these points, and that meantime Shrapnel shells should be used both as time and percussion shells. They consider the Boxer Shrapnel thoroughly efficient as a time shell, but point out that the effect of this projectile depends greatly on the accuracy with which, when firing at objects in motion, the varying distances are estimated, and the judgment exercised in boring the fuses to correspond with these conditions. On the other hand, they look upon the extreme simplicity of the service of percussion shells and the valuable aid they offer in readily picking up the range as advantages that cannot be overestimated in the excitement and heat of action. Boxer Shrapnel, being designed specially for bursting in the air, is not calculated to afford the best results as a percussion shell—indeed, its use as such is opposed to the principles upon which it is constructed. Still, the committee are of opinion that the results of the Okehampton experiments show that these projectiles when burst under proper conditions are very destructive, and may safely be relied on until some other percussion shell, less expensive and equally efficient, has been produced. They are therefore unanimous in thinking that both time and percussion shells have their role and are indispensable to the efficiency of field artillery. With respect to the effective zone of artillery fire, the committee state that having proved the accuracy of shooting of the guns at ranges exceeding the effective range laid down in the rules approved for the Umpire Staff at the Aldershott manœuvres of 1875—namely, 2000 yards for 9-pounder and 2,500 yards for 16-pounders—they carried out successful practice at troops with the 9-pounder up to 3,500 yards, and with the 16-pounder up to 4,000 yards. At a range of about 4,000 yards, as measured by the range-finder, the 16-pounder battery, with one salvo (six shells) of percussion Shrapnel, made 140 hits, and disabled 25 troopers in a target representing four squadrons of cavalry (288 men) in quarter distance columns. On another occasion the 9-pounder battery, firing at the same target at 3,500 yards, by a lucky salvo of time Shrapnel, made no less than 233 hits, disabling sixty troopers. It was further shown that a column of infantry, consisting of 400 men in very open order, may experience in a very few minutes a loss of over one-fourth by the fire of one battery of six guns, at 3000 yards, or nearly two miles. In these circumstances the committee are justified in coming to the conclusion that bodies of troops cannot with impunity remain stationary, or even move deliberately, in front of guns at any distance under 4,000 yards, if the ground is at all open, the artillery posted so that they can see the distance, and the atmosphere clear.

"In favorable circumstances of weather and of open ground, such as it may fairly be assumed an attacking force would have to pass over, it would be impossible, without great loss, to maintain column formation under the fire of rifled artillery at any distance under four thousand yards, moreover, in favorable circumstances of weather and ground, permitting objects to be readily seen, a well-sustained and concentrated fire of rifled field artillery will prove more formidable than is generally believed to the advance of troops in any formation, and well served time Shrapnel could be used with considerable effect, even against skirmishers, at ranges under two thousand yards.

"During the experiments at Okehampton, the committee used two experimental sets of Nolan's small pattern "range finders," and during a month's very constant and, occasionally, very rough work, the readings of the instruments remained constant Judging from their knowledge of the requisites and their experience at Okehampton, they are of opinion that there is great room for improvement in systematic and accurate shooting and in judging distance."

COMMANDER NOEL, Mr. BARNBY and other authorities, have assigned a place in Naval tactics and future warfare to the *Torpedo*—only inferior to artillery. We have always held a very poor opinion of it as a naval weapon, in the proper sense—admitting that it is applicable to harbor defence, and that only under certain favorable conditions.

The following articles copied from the *Correspondence of the New York World* of 25th April, only tends to confirm our conclusions on the subject. In this case, as in all others, the experiments were made in still water against an object at rest.

"Yesterday a large number of invitations were given members of Congress and others to witness an exhibition and practical trial of the Lay moveable torpedo-boat at the Washington Navy-yard. About 10.30 o'clock a long dark coloured object, resembling, as it lay in the water, a gigantic cigar, was towad alongside the Alarm. Two sets of wires were attached to the top of this object, the moveable torpedo boat. The ends of these wires were carried to the top of an ancient hulk which lay near the Alarm. Suddenly a splash of water, which revealed to the observers a propeller on the rear of the torpedo boat, was heard, and it darted forward through the water at the rate of about twelve miles an hour. It was intended to run the machine about a mile down the river, and stakes had been planted in the water to mark the course, but low tide and a dangerous bar precluded that arrangement, and it was found necessary to send the boat down the river channel. Opera glasses and telescopes were directed toward the rapidly receding boat. Two flags served to mark its course. In an incredibly short space of time it was almost beyond sight of the naked eye, and then persons who were looking through