ADMIRABLE WORK OF THE ORDNANCE BOARD AT SANDY HOOK.

In a recent number of the SCIENTIFIC AMERICAN, we gave an account of the final tests of maximite, the new high explosive invented by Hudson Maxim, which completes the series which resulted in the final adoption of this compound by the United States government.

General A. R. Buffington, the Chief of the Bureau of Ordnance, undertook the thorough investigation of the subject of high explosives nearly three years ago, and accordingly the Ordnance Board, with headquarters at Sandy Hook Proving Ground, New Jersey, were assigned this duty. The board is composed of some of the ablest engineers and scientific men among the officers of the United States army, and men admirably adapted to this work. The members of the Board are Major Rogers Birnie, president; Capt. William Crozier, well known as one of the inventors of the Buffington-Crozier disappearing gun mount; Capt. O. B. Mitcham, inspector of explosives; Capt. B. W. Dunn, government expert on fuses and high explosives at Frankford Arsenal, and inventor of a new shrapnel which outclasses anything before done in this line, also inventor of the new government detonating fuse used with such successful results in the recent high explosive tests at Sandy Hook; and Capt. E. B. Babbitt, commanding officer at Sandy Hook.

It was determined to thoroughly investigate the subject of high explosives, including well-known explosive compounds, as well as any new explosive compounds which might be submitted by different inventors and manufacturers, provided the latter appeared to offer sufficient merit to warrant investigation.

It was determined to prosecute this work unceasingly, until the best compound that science could produce should be obtained for the service. At the beginning of these tests, had the board outlined what it would have considered an ideal explosive as a bursting charge for projectiles, the requirements would, we imagine, have been about as follows: Perfect chemical stability or keeping qualities; very great explosive power, high specific gravity, giving it as much force as possible per unit of volume; great insensitiveness, so great as to make it incapable of detonation from shock, rendering it not only safe for projection from guns at high velocities, but capable of withstanding the far greater shock of penetration of armor plate as thick as the strongest armor-piercing projectiles themselves can pass through. It should be comparatively inexpensive to manufacture. It should be capable of being melted at a comparatively low temperature, and it should be incapable of explosion from ignition, enabling it to be melted over an open fire, as occasion might require, and without any danger, for filling projectiles. It should be incapable of detonation from overheating, but should boil away like water on the rise of temperature beyond a certain point. It should solidify in the projectiles, forming a dense and solid mass, incapable of shifting even on striking armor-plate. Such we imagine to be about as high a standard of excellence for a high explosive as the most sanguine could have hoped for. From what we have learned of maximite, in light of the recent tests, it appears to possess all these qualities in a high degree, and the United States government is to be congratulated upon the efficient manner in which these tests have been conducted, resulting in the obtainment for the service of such a valuable high explosive.

The experiments were conducted with the utmost impartiality from first to last, and a very large number of different explosive compounds have been submitted for these trials. The first of note was what is known as thorite, a compound of nitrate of ammonia and a hydrocarbon combustible element, such as coal tar or asphalt. This explosive was submitted by Dr. Tuttle, of Seattle, Wash., and is a modification of the class of nitrate of ammonia compounds. Nitrate of ammonia, being an oxidizing salt relatively poor in oxygen, requires an admixture of only about 12 per cent of a hydrocarbon combustible to produce the best results. As nitrate of ammonia is a salt without a metallic base, it is resolvable completely into gaseous products. Consequently, such a mixture forms a powerful explosive and one, furthermore, which is very insensitive to shock. Nitrate of ammonia being exceedingly hygroscopic, the hydrocarbon combustible is generally melted and the nitrate of ammonia stirred into it, whereupon the nitrate of ammonia, in taking up the liquid, becomes coated or varnished with the hydrocarbon, protecting it to some extent from the moisture of the air. When a very hard hydrocarbon, such as asphalt, is used, it is first dissolved, as, for example, by heating with a small percentage of kerosene oil, coal tar, or vaseline, just enough to render the asphalt soluble in an excess of a lighter hydrocarbon, which, afterward being evaporated from the compound, leaves the particles of nitrate of ammonia coated with the somewhat hard hydrocarbon. The hydrocarbon, however, does not efficiently protect the explosive from the absorption of moisture, and it has to be kept in hermetically sealed vessels. Otherwise the atmospheric moisture will cause the liquefaction of the nitrate of ammonia, and render the explosive inert. Thorite is one such explosive compound, and during the early tests of this material at Sandy Hook the results were considered quite satisfactory. It gave fairly good fragmentation of the shell, and could be fired from guns with perfect safety with full pressures and velocities. Thorite would not, however, stand the shock of penetration of thick armor plate, because, being in granular form, it packed forward in the projectile with such violence that it would go off when fired through a comparatively thick plate; and when fired through a plate of moderate thickness, it packed

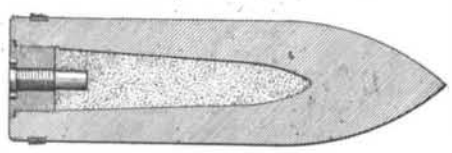

Fig. 1.—12-INCH ARMOR-PIERCING SHELL; 23 POUNDS HIGH EXPLOSIVE.

forward so much as to carry it beyond the reach of the fuse, and it could not be detonated.

Tests were then made by filling the shells with thorite under hydraulic pressure, but it was found that when the explosive was made dense enough to prevent packing forward in the shell on striking the plate, it became so hard and insensitive that it could not be detonated by any means whatever.

Further tests developed the fact that its hygroscopic character alone was so serious a drawback as to render its use as a service high explosive out of the question. Furthermore, it was found to be very erosive in its effect upon the projectile and fuse stock, after it had stood any considerable length of time, and vessels containing it were found to be eaten through by this erosive action. The use of thorite was, therefore, abandoned by the Ordnance Department.

Rendrock is another explosive which has given very good results and has proved altogether far superior to thorite. A high explosive developed by the War Department has given still higher results, and ranks

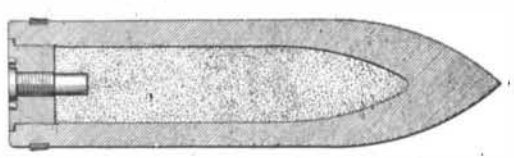

Fig. 2.—12-INCH ARMOR-PIERCING SHELL; 70 POUNDS OF HIGH EXPLOSIVE.

very high, being far superior to anything else which has been tried during these tests, except maximite, by which it is alone excelled. Had not maximite been invented, the government would have an explosive of its own production far superior to anything which has been developed abroad.

We give three illustrations, showing longitudinal central sections of the three principal forged steel 12-inch armor-piercing projectiles now used in the service.

Fig. 1 is the 12-inch armor-piercing shot, showing the construction and the strength of tempered forged steel necessary to penetrate Harveyized nickel-steel armor 12 inches in thickness. This projectile carries 23 pounds of maximite.

Fig. 2 is a 12-inch forged-steel armor-piercing projectile, showing the strength of metal necessary to the penetration of Harveyized nickel plate 7 inches in thickness. This shell carries 70 pounds of maximite.

Fig. 3 is the 12-inch torpedo shell, chiefly designed

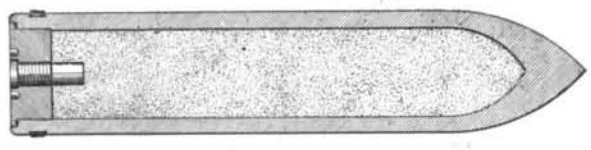

Fig. 3.—12-INCH TORPEDO SHELL; 144 POUNDS OF HIGH EXPLOSIVE.

for use in mortars, and shows the thickness of the metal necessary to penetrate 4 inches of deck armor. This projectile carries 144 pounds of maximite, the column of maximite being 4 feet in length, but so insensitive as not to require transverse partitions.

Portable storage batteries have been provided by the Brooklyn Rapid Transit Company, some of their old cars being utilized. Seven of the old Brighton Beach steam road cars were converted into a moving storage battery sub-station of 248 cells. In the summer, says the Street Railway Journal, they are located at Sheepshead Bay to supply the Brighton Beach cars with current. In the winter they are removed to East New York to double the capacity of the storage battery plant at that place.

Electrical Notes.

The electric tramways in London are proving a great success. So far only about 7½ miles of roads are in operation, and the conversion of the remainder of the old horse tramroad and the construction of the extensions are being rapidly pushed forward. On the section already in operation the cars carried 5,480,208 passengers in ten weeks. The average per day, estimating 70 days, with 60 cars, was 1,200 per car. The company estimates carrying 52,000,000 passengers per annum, and when the whole of the system is completed they expect the number to be increased to 120,000,000 per year. Of the total number of passengers carried within the ten weeks, over 100,000 represented working men who had been carried at the rate of half-a-cent per mile. The tramway extends to historic Hampton Court, and the favorite riverside resorts of Kingston, Kew, Teddington, and Molesey, all of which places are thronged during the season, especially on Sundays.

The town of Davos, in Switzerland, the center of the great tobogganning contests, proposes to dispense with fuel of all description and to resort to electricity for all industrial and domestic purposes. The project is to erect an extensive electrical generating plant at the confluence of two large mountain torrents. A prominent firm of Swiss electrical engineers has been studying closely the possibility of the scheme for several months, and now state that they are in a position to undertake the work. The firm has obtained the necessary permission to utilize the torrents for this purpose. The cost of the first installation, it is estimated, will be $1,700,000. Already electricity is extensively employed for cooking, heating and lighting in several villas, while one of the largest bakeries in the district is electrically equipped in every respect. The company which proposes to carry out the plans has already designed special electric heating and cooking appliances.

The success that has attended the laying of the subterranean telegraph cable between London and Birmingham, a distance of 113 miles, has prompted the postal authorities to utilize the cable for telephoning. This is considered to mark the limit of underground telephoning with the existing apparatus. Several of the other leading provincial towns, such as Liverpool, have petitioned the postal authorities to connect their cities with London by a direct subterranean cable, such as that running to Birmingham, but their requests have been refused until a method of transmitting underground telephonic messages over long distances is found. The British Post Office is gradually providing a reliable telephone system throughout the whole of the United Kingdom by the aid of the telegraph wires. For this purpose $10,000,000 has been authorized by Parliament, a large portion of which sum, however, is being expended upon the London telephone system, which it is expected will be partly in operation in the autumn of this year. The competition between the government and municipal telephone systems on the one side, and the National Telephone Company, which has hitherto enjoyed a monopoly, on the other side, is very keen. One town in the south of England, the first to possess a municipal telephone, has been the means of reducing the charge of the private company from $50 to $20 per annum.

The British Parliament is at present busily engaged in investigating the various underground electric railway schemes that have been projected in all directions of the metropolis since the Central London Electric Railway was opened. It is doubtful, however, whether any of the schemes for new railroads will be sanctioned this session, owing to the trouble that has been experienced in connection with the vibration caused by the Central London Railway. A committee of engineering experts, under the chairmanship of Lord Rayleigh, is at present investigating these complaints, and if they are found substantial the committee will recommend means by which the vibration might be overcome. The only scheme that will possibly receive official sanction is the conversion of the underground railway to electricity. The majority of the objections to the project have been surmounted, and, directly the consent is given, the work of conversion will be carried out with all possible speed. Sir Alexander Binnie, the eminent engineer to the London County Council, gave valuable evidence upon the subject of subterranean rapid transit before the committee and advanced several facts concerning the construction and working of the systems. He advocated the running of frequent trains at a high velocity, and at the same time contended that to insure such a satisfactory system each line would have to be worked independently upon the shuttle system, without any interferences from junctions, but that transfers of passengers should be made at different points where the railroads would cross, or run in close proximity to each other. He warmly approved those lines which promised to open up the suburbs, especially the Hampstead and Charing Cross Railway which Mr. Yerkes is going to construct. Altogether the value of the projected lines before Parliament this session aggregates $243,210,000, and the cost per mile will vary from $2,000,000 to $3,000,000.