NEW KINDS OF GUNPOWDER

TO MEET THE REQUIREMENTS OF MODERN WARFARE.

VALUE OF THE INVENTION OF BROWN OR SLOW-BURNING POWDER—NOISELESS AND SMOKELESS POWDERS.

Brown gunpowder was introduced in 1882. It has been generally supposed that the invention was German, but a few months ago Col. Brackenbury stated in London that England was the first country to make slow powders, and that the German powder came in long after the experiments at Waltham Abbey. The chief characteristic of brown powder is its slow rate of burning. This is due to the fact that it contains very little sulphur and a peculiar kind of charcoal. Sulphur is a powerful kindling agent, and any powder may be slowed or quickened by varying the proportions of this ingredient. The composition of brown or "cocoa" powder was kept a secret for a long time, but it is now known that the German powder is composed of 79 per cent. of potassium nitrate, 3 per cent. of sulphur, and 18 per cent. of lightly baked brown charcoal made from slightly carbonized straw. Previous to 1882 the powder formula the world over was about 75 per cent. of potassium nitrate, 10 per cent. of sulphur, and 15 per cent. of charcoal. The Du Ponts in the Brandywine, who supply the Government with powder, have succeeded in making brown powder that has given as good results as the foreign article.

Brown powder is made in hexagonal prisms one inch long, pierced longitudinally with a central hole. In making up cartridges the prisms are built up regularly like a honeycomb, with the holes over each other, so as to form continuous tubes through the cartridge. The object of this is to permit the gases to permeate through the entire mass. When the charge is ignited the flame and gases rush through to the other end of the cartridge, inflaming each prism in its central hole, thus causing them to burn from in out and consequently producing a progressively increasing surface of ignition and evolving increasing volumes of gas. Hence brown powder is sometimes called "progressive," but the term applies really to all powder, fine grain as well as prismatic, because in the true sense of the word powder is not an explosive such as gun cotton or nitro-glycerine.

The velocity of combustion is greatest in fine-grain black powder, which seems to explode when ignited, so rapidly is it consumed, and slowest in brown powder. A prism of black powder of the old composition when ignited in open air burns in less than a second, while a similar grain of cocoa powder is nearly sixty times as long in burning, giving off dense volumes of white smoke.

As the velocity of combustion of black powder is almost instantaneous, the pressure arising from it resembles the force of a sharp, quick blow, and would impose upon the gun in which it is fired severe strains if the projectile did not move at once and relieve it. For this reason black powder cannot be used in high-power guns which employ a long heavy shell having upon its rear end a band of soft metal the diameter of which is greater than that of the bore of the gun, so the shell cannot pass through the bore until this metal is forced out into the grooves of the rifling. Now, if the gun were loaded with black powder the pressure would rise to its maximum almost at the instant of ignition before the shell would have time to move, and the result would probably be the destruction of the gun. The case is very different with brown powder. When the charge is ignited the pressure is low at first, gradually rising until it is sufficient to start the shell; the copper band is forced into the grooves, and the projectile starts on its flight, slowly at first, but with a velocity of 2,000 feet per second when it leaves the muzzle. As the space between the shell and the charge increases the pressure of the gases would rapidly fall were it not for the fact that the powder is giving off constantly-increasing volumes of gas. In this way the pressure is maintained on the projectile all the way to the muzzle, thus greatly increasing its muzzle velocity. It is clear, then, that brown powder gives a much higher mean pressure in the gun than black powder, and that the maximum pressure is not reached until after the projectile is started. In a six-inch steel breech-loading rifle the maximum pressure is fifteen tons, and the pressure at the muzzle from three to four tons.

The development of powder has lagged behind that of guns. Before the "steel age" of guns, the tendency was toward an increase of calibre only and consequently larger charges; but as the charge of quick-burning powder increased, so did the pressures, and the gunmakers had to provide some means of protecting their guns from the violent strains set up by the pressure of the powder gases. Then it was that the principle of building up guns by shrinking tubes over tubes was introduced, and this system has been almost perfected in the high-power built-up guns of to-day which form the armament of every military power. Slow powder followed the wrought-iron built-up gun, and forced another change in the manufacture of ordnance—the gun had to be lengthened and in consequence breech loading became a necessity and not a matter of choice. By increasing the length of the bore and chambering the piece the charge of slow powder was greatly increased, and in the navy guns the rule for the charge is one-half the weight of the projectile for a gun thirty calibres long.

The products of combustion of powder are liquids and gases, and the actual temperature about 3,800° Fahrenheit. At this temperature the volume of the gases is about six thousand times that of the powder, but when cooled down to the ordinary temperature it is about two hundred and eighty times greater. Brown powder when fired in a gun leaves a reddish deposit in the chamber and on the face of the breech plug. This deposit when cool is readily flaked off. It is composed of 64 per cent. of potassium carbonate, 14 per cent. of potassium bicarbonate, and 22 per cent. of potassium sulphate.

The knowledge of what actually occurs in the charge during combustion must, of course, be altogether theoretical, but it is probable that Mr. Eugene Du Pont's theory is not far wrong. He says:

"The action of such powders seems to be as follows: Upon firing the charge the gases confined in the powder are released and act to expel by their expansion the projectile toward the muzzle of the gun. This I term the 'first explosion.' At this time the oxygen and hydrogen are released as gases, but under too great heat to unite in the form of steam. As the pressure is decreased by the motion of the projectile in the gun this heat also decreases, and the gases—oxygen and hydrogen—unite in the form of water. The heat generated by this union at once changes the water into steam, and this expansion, which takes place before the projectile leaves the muzzle of the gun, I term the 'second explosion.' There is thus formed a powder of great explosive force, which acts twice upon the projectile. I have also found that such powders are very effective in dissipating the smoke arising from the discharge, owing, as I suppose, to the fact that the steam, generated as above stated, condenses, and in so doing absorbs large quantities of the carbonate of potash, the solid portion of the result of decomposition of a charge of powder, and that portion which forms the smoke."

All the brown powder for the navy is manufactured by the Du Ponts, and before acceptance it is sent to the Naval Ordnance Proving Ground to be tested. Its physical qualities are determined at the powder yard, and at the proving ground it is fired for velocity and pressure. The Government specifications require a pressure of 15 tons per square inch in the chamber and a muzzle velocity of 2,000 feet per second. The velocities are measured by the Boulongé chronograph and the pressure by the crusher gauge. The specific gravity of brown powder ranges from 1.821 in the 5-inch B. S. R. to 1.855 in the 10-inch B. S. R.

The attention of the general public has lately been called to so-called "smokeless" and even noiseless powders. There are several patents on the former class of powders, and Schultze's powder is an early example of it. They are all of nitro-cotton or other kind of nitro-cellulose, specially treated with the view of producing a slower-burning substance, or of nitro-glycerine or nitro-cotton. The French have adopted a smokeless powder (Poudre B) for the Lebel rifle. This is said to possess high ballistic qualities, and to produce very little smoke, but it is also reported to be very deliquescent. Prof. Deering, Chief Assistant Chemist in the War Department, in a recent lecture, summarized the views of a French writer on smokeless powders as follows:

"As regards the influence which the use of a smokeless powder would have on tactics, the writer remarks that the subject is at present conjectural, but some obvious consequences can be foreseen. In the case of artillery, the use of smokeless powder against an enemy similarly provided would render precision of aim possible, and would allow the effect of fire to be seen. A small drawback would be that it would be more difficult to execute the movement recommended for avoiding the effects of well-directed fire from the enemy, viz., advancing the guns by hand about fifty-five yards, a movement favored by the cover of smoke.

"As regards infantry, he thinks that the question is more complex. The smoke cloud with the old powder is less dense than in the case of artillery, and interferes less with the maintenance of effective fire. The smoke shuts out the sight of death and suffering and gives a sense of protection: a false sense, however, as the smoke really betrays the infantry's position. By these remarks the writer does not mean to find fault with 'Poudre B': on the contrary, he regards it as a necessary accompaniment of a reduction of calibre of the rifle, the old powder causing too much fouling. If the enemy were also provided with a smokeless powder, the balance of advantage would be equalized; both sides would have to modify existing tactical arrangements. Surprise would be a factor of the greatest importance in the use of artillery and still more of infantry: the latter can find footing anywhere and remain unnoticed for a long time while keeping up fire, the smoke alone betraying their whereabouts. Hearing, it is stated, will not be able to take the place of sight in judging of the direction from which firing with smokeless powder proceeds, Col. Séibert having recently shown that the apparent direction differs much from the true one on account of the disturbing influence of the projectile on the sound waves produced in firing."

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