necessary to state that different kinds of fire-arms require powder of a different grain. Thus for fowling-pieces a fine-grained quick powder, is required; for rifles, a much coarser powder, and for cannon a very large-grained powder. Every variety of fire-arm, whether the variation be as to length, twist of grooves or calibre, involves a special size in the grains of powder to obtain the best results. Gun cotton possesses no such variable qualities. It also explodes so rapidly that it could not be used in common fire-arms, because of its bursting effects; the best steel barrels of rifles having been shattered by common charges.

There are quite a number of fulminating agents, which it would be convenient to use in place of gunpowder, were it not that they are violently explosive, without producing great projectile results; that is, they will shatter strong steel barrels to pieces with a small charge, but they cannot project missiles to such great distances as gunpowder. This is the case with the fulminates of mercury, silver, and gold. The propulsive force of any material, such as gunpowder or the fulminate of mercury, depends on two qualities, namely, the volume of gas which it liberates when it explodes, and the time involved in the liberation of this gas. These are important distinctions. If the substance liberates its gas at once, or in a space of time infinitely short, like the fulminates of mercury and silver, it is not suitable of application for discharging projectiles, because the bursting or shattering effect of those is prodigious, while their projectile effect is small, as the volume of gas liberated by these fulminates is less in volume than the gas of gunpowder, hence the latter is a superior projectile agent. As water expands into 1,700 volumes of steam, it is evident that it must be a superior expansive motive agent to alcohol, which does not expand in vapor to more than 640 of its original volume. Gunpowder and the fulminates are governed by the same law. Gun-cotton, owing to its complete ignition, and leaving very little residue, was held to be superior to gunpowder in projectile effect; but its want of granular construction, its rapidity of combustion and its affinity for moisture were defects which till now have prevented its adaptation to fire-arms and artillery. All these defects have been overcome (it is stated in the *Austrian Gazette*) by Baron Lenk, and it is now used in the Austrian army. The method employed to prevent it from absorbing moisture is by immersing it, when being manufactured and before it is dried, in dilute soluble glass, which acts the part of a varnish, without injuring the igniting qualities of the gun cotton. The same quality as granulation in gunpowder is obtained by forming the cotton into twisted strands of different sizes, and making it into cords, which are cut to form charges for cartridges. Batteries in which gun cotton is used now form part of the Austrian military equipment. The guns are shorter and lighter than those of the same calibre for which gunpowder is employed. A military commission appointed to examine into this subject has reported that the weight of Baron Lenk's gun cotton, to produce effects either in heavy ordnance or in small guns, is to the weight of gunpowder as 1 to 3. In 1860, trials were made with it in a bronze 4-pounder, and after firing 2,000 rounds the gun was not in the least injured. In 1861, fifty tuns of this substance were made without the occurrence of any accident. It leaves but a very slight residuum in firing, and the smoke which results from it is not so disagreeable as that of gunpowder. Some of this gun cotton was sunk under water for six weeks, then it was lifted and dried, and was found to be as powerful in projectile force as before it was submerged. These advantages stated to have been obtained from the improved Austrian gun cotton deserve general attention, for if this explosive agent can be substituted for gunpowder, of course saltpetre may be dispensed with, as the nitrate of soda is used to manufacture the nitric acid that is employed in making gun cotton. Flax will answer as well as cotton, if the latter cannot be obtained.—*Scientific American.*

DESTRUCTIVE EFFECTS OF IRON RUST.

The last published report of the Smithsonian Institution contains a translation from a German publication on the above subject, which affords considerable information of a useful and interesting character, some of which we shall present in a condensed form. It states that it has been frequently observed that in the timber of old ships the wood in the proximity of iron bolts is entirely altered in its character. Around each bolt for a space exceeding one inch, part of the wood is dissolved away, and the remainder is quite brittle and easily broken. The appearance of such wood is such as if it were produced by driving in red-hot iron bolts. This injurious effect of iron rust is one of the principal causes of the want of durability in iron-fastened ships. Rust not only originates where the iron is alternately exposed to water and the air, but also where the iron is permanently submerged under water. It is generally known that rust is an oxide of iron, but as soon as it comes into contact with wood it gives off part of its oxygen, and becomes the protoxide. The latter takes up a new portion of oxygen and transfers it to the wood, and by the uninterrupted repetition of this process, a slow decay of the wood is effected. The protoxide of iron in this case plays a part similar to nitric oxide in the manufacture of sulphuric acid.

In order to demonstrate the fact that oxide of iron is reduced by mere contact with organic substances (such as wood) not yet in a state of putrefaction, M. Kuhlman, of Lille, has instituted different experiments, the results of which confirm the correctness of this assertion. When hydrated oxide of iron, for example, was mixed with cold solutions of logwood, cochineal, corcuma and mahogany, they were decolorized, and the iron was found in a state of protoxide, the oxide having lost a portion of its oxygen by the action of the coloring matter. In every-day life the destructive effects of the oxide of iron have been noticed. For example, linen or cotton cloth containing ink stains becomes tender in its texture in the stained spots after repeated washings, and the spots ultimately fall out, leaving holes in the fabric. When cloth that is colored with copperas to form a black, is submitted to an alkaline ley, the protoxide of iron is changed into an oxide, and the cloth becomes feeble in the texture; and the usual saying in such cases is, "It is burnt in dyeing. According to Kuhlman, the oxide of iron transfers oxygen directly to the cloth