Why Cotton Is Contraband of War

By Hudson Maxim

Cotton: It will make a shirt to hide your nakedness or blast a subway to make transportation easier

COTTON happens to be the best combustible element to combine chemically with nitric acid so as to produce a high explosive, and also to serve as the principal ingredient for the manufacture of smokeless powder.

A bale of cotton may, therefore, be considered a bale of guncotton in embryo.

There are many kinds of nitrocellulose, depending upon the so-called degree or character of nitration, that is to say, upon the way in which it is treated with nitric acid and the strength of the nitric acid.

When ordinary cotton is immersed in nitric acid, the cotton absorbs oxygen from the nitric acid, but not as free oxygen, because the oxygen is taken up in combination with nitrogen. But the weight of the oxygen absorbed is much in excess of the weight of nitrogen, the nitrogen acting merely as a carrier of the oxygen. The appearance of the cotton is not changed to any appreciable

extent, but the weight of the cotton is considerably increased.

The oxygen which the cotton absorbs from the nitric acid is sufficient to consume all of the cotton without atmospheric air, so that when guncotton is put in a confined space and set on fire it explodes with great violence, producing what are called carbon dioxide and carbon monoxide, with free nitrogen and steam.

When the cotton is immersed in the nitric acid the acid takes water out of the cotton, which dilutes the acid. But the cotton gets the best of the bargain, because the weight of oxygen and nitrogen which the cotton receives is in excess of the weight given up by the cotton.

In order to keep the nitric acid bath strong enough to act on the cotton, and to minimize the acid, it is necessary to add sulphuric acid to absorb the water, and it takes about three parts sulphuric acid to one part of nitric acid to make a proper mixture for this purpose. The sulphuric acid, however, has no effect whatsoever upon the cotton. It merely acts to absorb the water liberated from the cotton.

There are several ways in which the cotton is treated with the acid mixture. The oldest and simplest was merely to immerse the cotton in the acid, and when it was thoroughly nitrated to place it in a centrifugal machine and wring out the acid and throw it into an excess of water to wash out the remainder.

From the portrait by S. J. Woolf.

If you want to know how to write poetry or blast a subway, lay out a garden or design a battleship, ask Hudson Maxim. It is no off-hand slap dash opinion that he will give, but a well reasoned statement. For Maxim believes that everything could be reduced to a science, whether it is writing sonnets to your lady's eyebrow or defending the country against foreign invasion.

But Maxim is above all an authority on explosives. That is why we asked him to write this article for the Popular Science Monthly. *He invented the process of making the multi-perforated smokeless powder used by the United States. His Maximite, adopted by the United States Government, was the first high explosive which could be sent through armor plate and burst inside of a ship. That achievement in itself was enough to make any man famous. But then he is also the inventor of Stabilite, a powder which we have every reason to regard as important because it can be made quickly in an emergency. A torpedo invention of his, intended to do away with compressed air, has also been bought by the Government. Mr. Maxim is a member of the Naval Consulting Board.*

The way that is employed principally by the United States Navy is to do the nitrating in a centrifugal machine and when the nitrating is complete to set the centrifugal machine in motion, which extracts the acid from the nitrocellulose. Thereupon the nitrocellulose is quickly and thoroughly washed.

After the washing process is completed there is a quantity of acid remaining, and also there are contained in the nitrocellulose certain unstable compounds. These are removed by thoroughly boiling the nitrocellulose in a large excess of water.

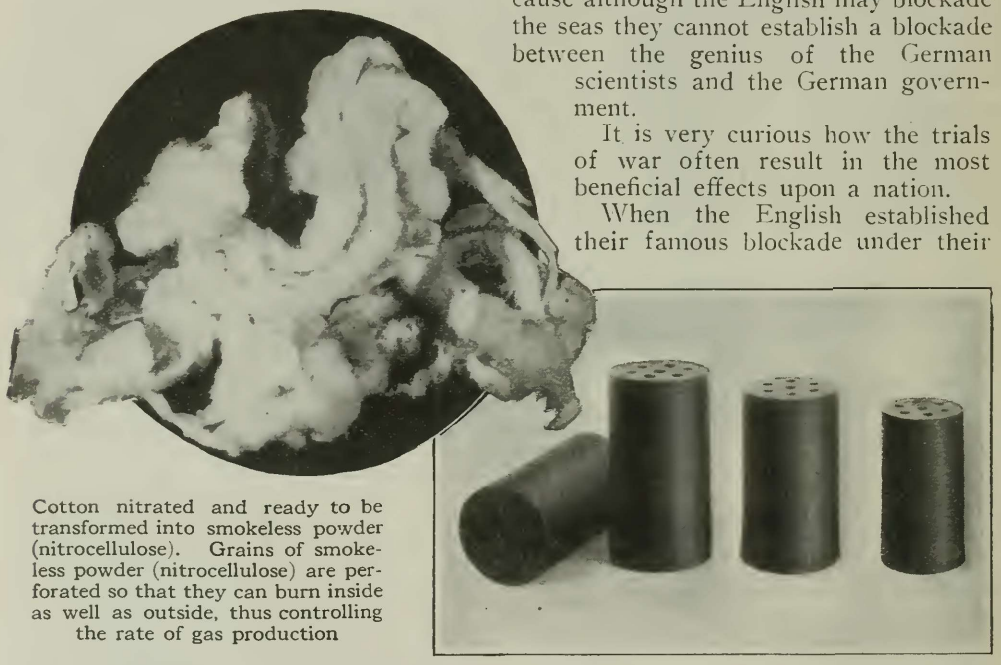
After this is done the nitrocellulose is pulped in an ordinary pulping machine, like that used in making paper pulp. When this is thoroughly done the finely pulped nitrocellulose is gathered and pressed into cylinders. It still contains a considerable percentage of water, which must be removed in order to dissolve or gelatinate it as a step in converting it into smokeless powder.

This is done by forcing alcohol under pressure through the mass of pulped

guncotton cake from the top, the water beig forced down ahead of the alcohol until it is driven entirely out at the bottom, and alcohol takes the place of the water.

This is called the replacement process, and was discovered by Francis G. du Pont. It is very important.

Making cotton contraband of war does not prevent the Germans from making guncotton from other materials. When wood fiber or fiber obtained from grass is treated with nitric acid it also becomes a kind of guncotton. The German chemists are very well able to make their guncotton, and consequently their gunpowder and high explosives, from the trees of the forest.



Cotton nitrated and ready to be transformed into smokeless powder (nitrocellulose). Grains of smokeless powder (nitrocellulose) are perforated so that they can burn inside as well as outside, thus controlling the rate of gas production

But nitric acid also is contraband of war. How then are the Germans to get their nitric acid?

Before the outbreak of the European War the Germans had anticipated the present blockade and prepared for it. The German chemists and scientists had developed a very practical, very efficient and cheap method of producing nitro compounds from the air, nitric acid among them, by means of the electric current.

I understand that today the Germans are not only able to make all the nitro compounds they need for the purposes of explosives, both high explosives and smokeless powder, but also what they require for fertilizers for the farmers.

With a nation of scientists, chemists and inventors like the Germans, it is entirely impossible to stop them from producing explosives in any quantity they may desire, entirely independent of any class of imported materials, because although the English may blockade the seas they cannot establish a blockade between the genius of the German scientists and the German government.

It is very curious how the trials of war often result in the most beneficial effects upon a nation.

When the English established their famous blockade under their Continental system in Napoleon's time, the French were compelled to resort to some other means than importation to get their sugar. Consequently, they developed the sugar beet, and planted it in enormous quantities, with the result that France introduced the sugar beet industry, which has been of vast importance to that nation ever since.

Likewise, the English blockade against Germany today is compelling the Germans to develop their internal industries in a most phenomenal way. They have solved the nitric acid problem, and very likely they will continue, after the war is over, to make their nitric acid and other nitro compounds from air. What is more, they will probably compete successfully with the natural nitrate of Chile.

If you want to know why cotton is contraband of war this picture will tell you. It shows a Russian mine which ran ashore on the Baltic Sea and which the Germans exploded. As in all modern mines the charge was composed of a high explosive made by the proper chemical treatment of cotton. The war is actually being fought with cotton—cotton grown upon the peaceful southern plantations of the United States. So long as cotton is obtainable these high explosives can be manufactured in great quantities. Naturally, the warring countries who can secure unlimited control of the cotton supply make themselves just that much more formidable to their enemies. Great Britain watches with never-closed eyes every shipload of cotton leaving the United States

You read of "craters" in the newspapers—great holes produced either by the explosion of some huge shell or of some subterranean mine. This is a photograph of a type of crater produced by a mine. Surely the men in this war live on the crests of volcanoes—not figuratively, but literally. At any moment the soldiers in the trenches may be blown to atoms by mines charged with high explosives made from guncotton. The tremendous expansive power of guncotton when exploded, will lift many million times its own weight of matter, with a suddenness that prevents any possibility of escape for those who are within its range