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THE IDEAL SMOKELESS POWDER.

Great as are the advantages of the best forms of nitroglycerine and guncotton smokeless powder, there is not one of them that can be called an ideal powder. They all suffer from an inherent and ineradicable defect, due to the presence of the nitroglycerine and the fact that its explosive qualities are affected by changes of temperature. The best of these powders might be considered ideal explosives, provided they were always used at exactly the right temperature; but they never or rarely ever are.

When it is stated that 19·5 pounds of cordite fired behind a 100-pound projectile in a 50-caliber 6-inch gun will produce a muzzle velocity of 2,642 feet a second, the statement is not altogether complete; since one of the elements effecting these results has been omitted—or rather, it is supposed to be understood. Strictly speaking, these results can only be obtained if the powder at the moment of firing is at the normal temperature of the atmosphere. If its temperature is lower, as it would be in the Arctic regions, the velocity will be lower, and if it should be higher, as during an engagement in the tropics, the velocity will be higher. Now between these extremes of cold and heat there will be a difference of velocity which will interfere with the accuracy of the gun; for the sights are adjusted for the velocities due to the powder when fired at normal temperatures.

The pressures, moreover, are even more liable to change than the velocities. It frequently happens that a gun becomes quite hot from firing or from being exposed to the rays of the sun. While in this heated condition a charge may be inserted and, for some reason, allowed to remain for some length of time in the chamber before being fired. The heat of the gun is imparted to the powder, and in this heated condition it is liable to produce abnormally high pressures, and may even detonate and destroy the weapon. It is a fact that in some makes of machine guns serious accidents have resulted from leaving the piece loaded for a few minutes when the gun was overheated.

These troubles are entirely due to the nitroglycerine, and they are inseparable from any powders that include this powerful agent as one of the constituents.

For these reasons several of the European nations have always opposed the use of nitroglycerine in any form, and a vast amount of experimental work has been done in the hope of producing a smokeless powder that should contain none of this explosive. We are reliably informed that a certain Austrian chemist, who is considered to be the greatest European expert on high explosives, has at last produced a smokeless powder which is entirely free from the defects alluded to and is as safe and reliable as the old black powder. It contains no nitroglycerine and it is affected very little by overheating. It is not only very effective, but it can be manufactured much more cheaply than smokeless powder of the ordinary type.

Our informant, who is perhaps the most noted expert in rapid-fire weapons in Europe, states that the discovery has produced a sensation in naval and military circles, and that great expectations are entertained regarding the new explosive, regarding which particulars will be made public early in the year.

FAILURE OF THE GATLING CAST-STEEL GUN.

The idea that a cast-steel gun can be produced which will have the same ratio of energy to weight of gun as the hooped or wire-wound gun, and stand the test of continued firing, dies hard. The latest attempt to work out a proposition which our artillery experts regard as, in the nature of things, impossible was embodied in the 8-inch cast-steel gun of Dr. Gatling, for the construction of which Congress appropriated $40,000. As we noted in a recent issue the gun was duly constructed according to the inventor's specifications and sent to the Sandy Hook proving-ground to be tested. A sum of $18,600 was allotted by the Board of Ordnance and Fortification for this purpose, and it was the intention to subject the weapon to three hundred rounds in all. These tests are commenced at the standard firing pressure used in the army guns of 37,000 pounds to the square inch, but before they are over it frequently happens that the pressures rise far above this figure, in some cases exceeding it by over 100 per cent. When a gun has stood three hundred rounds, during which the pressure may have risen as high as 82,858 pounds, as actually occurred in the case of the Brown wire gun, the ordnance experts do not hesitate to pass it as being perfectly satisfactory, as far as danger of rupture is concerned.

The Gatling gun had already resisted five rounds with ordinary charges in its first trials. During the second series of trials, which took place on January 4, ten rounds were fired with the same charges and pressures of about 37,000 pounds. At the tenth round of the series, or the fifteenth round for the gun, it failed completely, and is described as flying into many fragments.

On being interviewed, Dr. Gatling stated that the failure did not surprise him, because he was aware that there was a mishap at one stage of the manufacture. He avers that tests of the metal of the gun showed that the breech was considerably weaker than the muzzle of the gun, the defect being due to the fact that the breech was subjected to a high temperature for three days longer than it should have been. As a result, the strength of the breech compared with the muzzle was about as six to ten, the metal at the muzzle representing the strength which was designed to be secured for the whole gun.

If these are the facts, though we confess the statement needs elucidation, it is greatly to be regretted that the weapon was not rejected and another cast. Every one, and none more than ordnance officers, is anxious to know the exact possibilities of cast ordnance. The present failure, notwithstanding the alleged mishap in the manufacture, will tend to strengthen the prejudice which undoubtedly exists against the type.

EDUCATION BY CORRESPONDENCE.

Elsewhere in our columns will be found a letter from a Russian correspondent, Mr. N. A. Shishkov, giving the rough outline of a new scheme of education which he desires to bring prominently into public notice, with a view to its general circulation and discussion. The writer will doubtless be remembered by many of our readers as the author of an article ("The Horrors of Hunger") describing the great famine in Russia, which appeared in the Nineteenth Century in 1892, and was largely instrumental in arousing the practical sympathy which was shown both in this country and Europe with the distressed Russian peasantry. Speaking broadly of the proposed scheme, without consideration of the difficulties of organization and detail which would be encountered in carrying it out, we think the spirit and purpose of Mr. Shishkov's ideas are to be commended. Work along somewhat the same lines has been started in this country in the schools and colleges of correspondence, which have proved to be so successful, and though their organization differs in important particulars from the present proposal, they are so nearly allied to it in principle as to afford reason to expect that education by correspondence, if carried out on an international scale, might, by the valuable benefits conferred, commend itself to universal favor.

The first and obvious question that will suggest itself to the average overworked and brain-weary citizen in this utilitarian age is: How could any one be expected without adequate compensation to devote valuable time to answering the many questions which such a scheme might bring? To the commercial mind, the objection is a serious one, and does violence to the trading instincts of an age which has a way of demanding *quid pro quo* in all the ventures or occupations of life.

To which it is sufficient to reply that it requires a broad intelligence, a liberal mind, and a progressive spirit to appreciate the actual benefits—should it prove to be practical—of all such schemes as that outlined by Mr. Shishkov.

Another and perhaps more serious difficulty would be that of diversity of language; for, unless the sources of income of the association were more fruitful than we think those suggested by our correspondent would prove to be, it would be impossible to maintain anything like the corps of translators that would be necessary to cope with an international correspondence of the magnitude which this association would presumably carry on. On the other hand, it is probable that one of the best results of the undertaking would be that it would greatly stimulate the mutual study of the three great languages, English, French, and German, adopted for the uses of the association.

It will, moreover, suggest itself to our readers that the need for such a medium of information is probably more apparent in the great country to which our correspondent belongs than in some others. Speaking for the United States, we can say that, in addition to the schools of correspondence above mentioned, there is a splendid field for the mutual exchange of information afforded by the press of the country. In the half century of its existence the SCIENTIFIC AMERICAN has devoted a column or more of each issue to this form of instruction under the head of "Notes and Queries;" and by this medium and by letter some 5,000 items of information emanate from this office alone each year.

This method of conveying information is practiced in some degree by other journals throughout the country, and it is probable that the items thus secured by correspondence exceed in themselves and far exceed in the numbers of their readers those that would pass to and fro in a system of correspondence between individuals.

At the same time we fully realize that information by correspondence through the press is of a national and therefore somewhat local character; whereas Mr. Shishkov's scheme is formed on the broadest international lines.

NEW SUSPENSION BRIDGE AT NIAGARA.

During the next three months a large force of men will be at work erecting a new suspension bridge across the Niagara River, a short distance above the village of Lewiston, on the New York side, and the village of Queenston, Ont., on the Canadian side. This bridge is to be built by the New Jersey Steel and Iron Company for the Lewiston Connecting Bridge Company and the Queenston Heights Bridge Company. The consulting engineer is L. L. Buck and the engineer R. S. Buck. James Stewart & Company had the contract for the substructure, which is about completed.

The location of the bridge will be on the site of a suspension bridge erected in 1850–51, and will adhere pretty closely to the lines of the old bridge, which was wrecked by a hurricane on February 1, 1864, and never since rebuilt, because of the fact that it was an unprofitable investment. As the great suspension bridges which stood further up the gorge have given place to new steel arches, this suspension bridge will be the only structure of the kind spanning the Niagara. The cable span of the new bridge will be 1,040 feet and the span of the stiffening truss 800 feet. From center to center of trusses the width will be 28 feet clear and the roadway will have a clear width of 25 feet. The versed sine of the cables will be 87 feet and the height of the susperstructure above high water mark will be 65 feet. The height of the bridge above the tracks of the Niagara Falls & Lewiston Electric Road will be about 15 feet. The stiffening truss will extend about 4 feet above the floor and the only railing will be light strips of iron flats reinforced by oak half rounds. The floor will be of 2 inch oak plank laid crosswise. A single track for trolley cars will be laid through the center, the width of the bridge affording ample room for vehicles to pass on either side of the track. There will be no walk for pedestrians, as the point of the bridge's location is such that there is not likely to be much travel on foot.

The towers for the bridge have been completed, and are four in number, two on each side of the river. The towers on the New York side have a height of 26 feet, bases of 13 feet square, and they are located 28 feet back from the edge of the bluff. The towers on the Canadian side have a height of 18 feet, with bases 12 feet square, and are located 15 feet back from the edge of the bluff, the ledge on the Canadian side being more firm than on the New York side. In the construction of these towers it was found possible to use a great part of the old towers in the new bases, and the old inscription stones of the towers on both sides of the river were preserved and have place in the new towers. The new stone used in the towers on the New York side came from the Buffalo quarries, and that in the Canadian towers from the Queenston, Ont., quarries.

Four cables will form the main support of the bridge. Each of these cables will be composed of fourteen 2¼ inch galvanized cast steel wire ropes. These cables once formed a part of the old suspension bridge that stood close to the falls, and which was taken down in the early part of last year. The span of the upper suspension bridge was so great and the anchorages so far back from the towers that it has been found possible to cut the old cables in half, and thus use them on the shorter span of this new bridge at Lewiston. However, when so cut they are hardly long enough to fill out the entire span and reach back to the anchorages, and for this reason about 75 feet at each end of the cable span will be made up of eye-bars. The cables will be anchored in solid rock about 150 feet back from the towers, the shafts to be filled with concrete. The suspended span will be connected to the river banks by two approach spans, the one on the New York side to be 34 feet 6 inches long and the one on the Canadian side to have a length of 19 feet 6 inches.

On each side of the river the bridge will have long approaches on which double tracks will be laid for electric cars passing on and off the bridge. These approaches are about 25 feet wide, and the one on the Canadian side is about 1,000 feet long and the one on the New York side about 800 feet long. Both approaches have face walls to prevent the native shale disintegrating under the weather. The approach wall on the New York side runs close beside the tracks of the Niagara Falls & Lewiston Electric Road. Its highest part is about 19 feet, and for 660 feet it drops