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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

## THE PENNSYLVANIA RAILROAD TUNNEL.

The attitude of the Board of Aldermen of this city in holding up the franchise for the construction of the Pennsylvania Railroad tunnel beneath Manhattan is one of the most shamefaced exhibitions of political tyranny that ever disgraced the city of New York. Here is a great corporation which offers to remove the insular disadvantages under which this city labors, owing to its being cut off by the Hudson River from direct railroad communication with the West, by building, entirely at its own expense and at a cost of something like \$50,000,000, a vast engineering work on which, for many years to come, it cannot hope to realize a penny of interest. The tunnel will be built at such a depth below the street grade that there will be practically no interference with traffic, and but very little surface indication that such a vast excavation is being made. From the point of view of transportation the gain to New York city will be simply enormous; and as to the question of rental, there have not been wanting many prominent citizens, and especially those who understand transportation problems, who have declared that the charging of any rental whatever to a company that is voluntarily providing such a beneficial scheme to the city, is altogether unwarranted. The ultimatum which has been presented by the lawyers of the Pennsylvania Railroad Company, stating that if further opposition develops they will drop the scheme altogether, is perfectly natural. While we should greatly regret to see the threat carried through, its execution would be a logical outcome of the exasperating and disgraceful tactics employed by the Board of Aldermen.

## TEST OF THE MAXIMUM CAPACITY OF THE NIAGARA FALLS TUNNEL.

In order to ascertain beyond any question of doubt the tailrace capacity of its tunnel, a most interesting test was recently made by the Niagara Falls Power Company. This tunnel is 7,436½ feet long, 21 feet high and 18 feet 10 inches wide. When ground was broken for it, the idea prevailed that it would not have to be lined, but later it was found that a portion of the rock through which it was constructed was so soft that it might possibly be worn by the rushing water. For this reason and in order to make it perfectly substantial, the tunnel was lined from end to end with four courses of brick. In the rough, the tunnel was to have had a capacity of 120,000 horse power; but the lining lessened its capacity, so that it has always been rated at 100,000 horse power.

While not doubting the correctness of the calculations of the eminent engineers who had to do with the tunnel construction, the opportunity presented itself on November 19 for testing the tunnel by sending through it an amount of water equal to the quantity that would be used by the perfected installations in the development of 100,000 horse power. By making a test the Power Company would know by actual practice what up to that time had been theory. While the first six units in the new station will probably be in operation within the next three months, the complete installation will not be in service until the latter part of next year, so by its test of the date referred to the Power Company now knows under just what conditions its tunnel will operate when the flow of all the turbines is passing through it.

The quantity of water sent through the tunnel on the occasion of the test was twice as great as many notable rivers carry. Still, it was only a very small fraction of the water that comes down the upper Niagara from Lake Erie. Observations showed that its diversion was not noticeable on the brink of the cataract, the beauty of which was unimpaired. The test began at 10 A. M. and lasted until 5 P. M., giving ample opportunity to observe the effect on the river, the currents and falls, also the conditions existing in the wheelpits and tunnel.

The discharge at the portal of the tunnel was a most interesting spectacle. The stream from the tun-

nel extended clear across the river to the Canadian shore, and it was noted that a portion of the surface current passed upstream and a portion of it downstream. Between the top of the arch and the rushing water at the portal considerable space was shown, the entire semicircular arch remaining above water. The test was announced as a success in every particular.

Those who observed the test were of the conviction that one result from the discharge from the tunnel, when 100,000 horse power is being developed, will be that the flow of water will serve to hold back the ice that comes over the falls from Lake Erie, and aid in forming ice bridges of far greater magnitude than have been witnessed at Niagara at any time in the past. If this proves true, no doubt many interesting ice conditions will be seen in the Niagara gorge.

## THE GUN IN NAVAL WARFARE.

We have heard so much of late years about the wonderful efficiency of the modern breech-loading rifle, that one feels something of a shock of surprise to learn from the lips of a Lieutenant-Commander of the United States Navy that in future wars it will be only pure good luck that one ship will sink another by the power of her gun-fire. The late annual gathering of the Society of Naval Architects and Marine Engineers was marked by one or two rather startling papers, among which one on "The Tactics of the Gun," by Lieutenant Commander A. P. Niblack must be reckoned. The writer defined a battleship as being, when reduced to its simplest terms, a floating gun-platform. Considered as a unit of defense it contained, on a given displacement, the maximum of concentrated destructive power, first for giving battle on the high seas, and secondly, for attack on an enemy's coastline. The author of the paper believes that if ships are to be sunk it will be done by the ram or torpedo, whose special province it is to penetrate the underwater body of a ship, destroying its watertight subdivisions, and by letting the water into the "vitals"—engine or boiler rooms, or magazines—either putting it out of action, or sinking it altogether. On the other hand, the province of the gun is to deal with the above-water portion of the ship, putting out of action the guns, gun mounts, ammunition hoists, etc., and destroying the officers and gun crews. It is argued that as long as the motive power and steering gear of a warship and such personnel as is not engaged at the battery are intact, it is almost impossible for the guns alone to destroy the vessel. When Mr. Niblack says, "It is only by luck or by indirection that a modern battleship can sink another by gun-fire alone," it is evident that he has in mind the results shown by the examination of the Spanish vessels which have been raised since the battle of Manila Bay, and also the results of gun-fire as shown on the ships sunk at Santiago. "We need not," he says, "in the future expect to set ships on fire by gun-fire as at Santiago and Manila, and, indeed, we have a long way to go before we can expect to achieve victories over our next adversary." Of course, it is well understood that the great destruction of the Spanish fleets was due to fire started by bursting shells, and in what he says above, the writer has in mind the fact that modern warships carry practically no combustible material in the way of inflammable decks, bulkheads and fittings. Hence, we cannot expect, should we engage in another naval war, to see the enemy's vessels burning up before our very eyes after the first fifteen minutes of an engagement. The present situation as regards the tactics of gun-fire is stated succinctly as follows: Bow-fire has become a great factor in modifying tactics. The ram is more than ever a dangerous weapon. Armor has almost nullified the great danger from raking fire at close quarters. The torpedo has made it dangerous to fight at closer range than 1,000 yards. Smokeless powder and high speed make the windward position of little importance compared with getting the sunlight on the enemy and in his eyes. Elaborate subdivisions in ships tend to prolong the time and increase the difficulties of the destruction of a ship by any weapon.

Gun-fire, then, being concerned mainly with the destruction of batteries and personnel, the author of the paper goes on to show that the public does not realize the horrible destructiveness of modern gun-fire. What our fleet accomplished at Santiago was done with only four hits out of every one hundred shots fired; yet since that day, "both ordnance and gunnery have been almost revolutionized, and methods good enough for 1898 are an invitation to-day to disastrous and bitter defeat." To illustrate how gunnery has improved in the past three or four years, and how terrific must be the hail of projectiles in a future engagement, Lieutenant Commander Niblack instances the progress made since the war in the British Navy in the matter of target practice, and he quotes official records of the annual prize-firing contest for last year. A target 20 feet long and 16

feet high was anchored at a distance of about one mile from the course followed by the contesting ships, each of which steamed by the target at a speed of 12 knots and fired for two minutes with each 6-inch gun, firing one gun at a time. According to the official reports, the average of forty-eight ships was nearly two hits per gun per minute. The best fifteen ships made from two to four hits per gun per minute. This means that eighty-two 6-inch guns fired eight hundred and sixty-seven projectiles in two minutes and made 518 hits, or nearly sixty per cent. The battleship "Ocean" averaged nearly five hits a minute, while one of her gun captains fired nine shots and made nine hits in one minute. This, Lieutenant Commander Niblack states, is easily the world's record, as it means less than seven seconds between aimed shots. One gun in particular fired seventeen shots in two minutes and made fifteen hits.

"Just now," says the author of the paper, "the navy needs unusual and heavy expenditures for ordnance." This somewhat pessimistic view of the condition of our navy may seem puzzling in view of the abstract of the report of the Bureau of Ordnance given in our last issue, in which it was shown that our new guns are fully the equal of any that have been built abroad. Mr. Niblack, however, is referring to the number of ships of our navy that are carrying the older types of weapons, shells and powder, which, although excellent in their day, have become out-classed by modern material. He says that owing to the pressure of the past five years, some of our ships have been in continuous service for that period, and everyone of these needs a thorough overhauling as to battery and ammunition, and particularly as to ammunition, as they have on board a heterogeneous lot of brown powder, smokeless powder and projectiles collected from various sources, most of it for the war with Spain. These are matters that can easily be remedied if Congress will only grant sufficient appropriations to renew these older batteries and replenish the magazines with modern shells and powder. A good beginning has been made in this work, and it should be carried through with regard to every ship on the active list of the navy.

## THE DEATH OF FRIEDRICH KRUPP.

The death of Friedrich Alfred Krupp, head of the iron and steel industry of Prussia, removes the most conspicuous citizen of the German Empire and one of the greatest manufacturers of the world. The reputation of his works for fine artillery earned for him the name of the "Cannon King" in Germany.

Friedrich Krupp was born on February 17, 1854, the son of Alfred Krupp, who inherited the works at Essen from his father. The first of the steel-making Krupps began work at Essen with two laborers in 1817. When the late Friedrich Krupp became the head of the firm he found at Essen a well-established business which he developed into a world-wide enterprise. The Krupps will always be remembered as great steel makers and as armorers of the world's fighting forces. That was the work of the "Cannon King."

The Krupp works are vast in extent. The real estate belonging to the firm amounts to 900 acres, of which 150 are covered by buildings. The daily output of the works amounts to about 1,877 tons. The late Herr Krupp had the general management of these gigantic works; but the various branches were placed in the hands of a board of twelve directors, who were responsible to him for all the departments, numbering about one hundred.

Friedrich Krupp was the richest man in Germany. Yet he had been accustomed all his life to toil with both hands and brains.

"From my fourteenth year," he once said, "I had to care like a father for my family during the day added to hard work at the factory. At night I had to study how to overcome the difficulties in the way. During this period I lived on potatoes, bread and coffee and scant portions of meat, and toiled until late in the night. For twenty-five years I struggled thus, until conditions grew a little easier. My last remembrance of that period is the growing danger of total ruin and my endurance, suffering and hard labor to avert the calamity; and I say all this for the encouragement of young men who have nothing, are nothing and want to get something and be somebody."

The Krupps have always been known for the interest they have taken in the welfare of their employees. But the "Cannon King" so far excelled his predecessors in this respect that he was more than once accused of harboring socialistic principles. It was Friedrich Krupp's father who started the system of modern dwellings for workmen as an experiment. The late Herr Krupp himself appears to have developed them from conviction and in accordance with his ideals. He owned 5,469 dwellings, each being constructed differently to avoid architectural monotony. All the houses have front yards with beds of ornamental gardening. Besides convalescent hospitals and orphanages, Fried-