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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 OFFER TO BUILD THE PANAMA CANAL BY CONTRACT.

Among the subjects that will form the subject of discussion by the board of engineers that are now engaged in deciding what type of canal shall be built at Panama, one of the most important is the proposal that was made by Mr. Lindon W. Bates, of this city, to build the whole Panama Canal by contract. We have already referred in previous issues to Mr. Bates's plans for excavating the canal; and it is upon these plans that this engineer is prepared to put in a bid, and give an adequate bond to the government, for the completion of this stupendous work within contract time. The proposal is made in a three-fold form, and it includes plans for three different methods of constructing the canal: one with a 96½-foot level, another with a 62½-foot level, and a third with a 26½-foot level. Mr. Bates's proposal differs radically from any that have yet been proposed, either by the French company or by any of the subsequent commissions and boards that have investigated the problem. Briefly stated, it involves the substitution of large, artificially-formed lakes, rendered navigable by dredging, in place of considerable sections of the canal as originally planned. The two most important of these lakes would be located at the terminals of the canal, and would open directly into the ocean by means of locks. Mr. Bates claims that the formation of these two lakes would greatly improve the sanitary condition of the canal zone, by substituting large bodies of fresh water in place of the existing swamps. A further advantage is claimed from the fact that the character of the dams to be built and their location is conducive to more rapid work than can be done under most of the existing plans, while the speed of transit of vessels through the canal would be greatly increased by the more direct course that can be sailed through the lakes, and the general reduction of curvature. Mr. Bates estimates that the comparative cost and time for completion of the three types of canal would be as follows: For a canal with a 26½-foot level, $135,000,000 and nine years' time; for a canal with a 62½-foot level, $125,000,000 and eight years' time; while for a 96½-foot level canal, seven years would be required and a total expenditure of $111,500,000. These estimates are for the engineering and construction work, pure and simple, and do not include the cost of government administration, sanitation, or policing.

Judging from the great success which has attended the construction of our railroads, and the more costly of our engineering works, there can be little doubt that the canal could be built more expeditiously and more cheaply under the contract system than by any other; and we cannot but think that if any responsible contractor, having a wide range of experience in work of this general character, can be found, who can command the financial backing and give to the government adequate bonds for the completion of the work, it would be best for the interests of the country to let the work by contract, and if possible, in a single contract. We have recently had proof in the city of New York of the excellent results that follow from placing these great engineering works in the hand of one single qualified man. We refer to the successful completion by Mr. McDonald of the $35,000,000 contract for the New York Subway, within the contract date set for completion. We give this opinion without any reference to the particular plan offered by Mr. Bates or any other engineer. The present board will decide once and for all what type of canal shall be built; but when their opinion has been delivered, the next important question will be as to by whom and by what system of management this enormous work shall be put through. We believe that the interests of the country and of the canal would be best served by letting the whole work by contract, in a single contract, if possible, subject to the oversight and final arbitrament of the engineering staff, and leaving the general administration, the sanitation, and the policing of the canal zone in the hands of the government, and preferably of the War Department.

THE SUEZ CANAL EXPLOSION.

Details have come to hand of the methods adopted when the steamship "Chatham," which recently sank in the Suez Canal with a load of dynamite on board, was removed by blowing up the vessel. Some curiosity has been expressed as to the way in which the detonation of this large amount of high explosive was made at once certain and safe, and we are indebted to an Egyptian paper published on the day after the removal of the wreck, for an accurate description of the greatest explosion of dynamite on record. The steamship "Chatham," when it took fire and was scuttled in the Suez Canal, had on board about 100 tons of dynamite, as well as a supply of detonators. The blowing up of the ship was accomplished by means of large mines, each containing 300 pounds of explosive and fitted with the proper electric fuses. One of the mines was placed by divers in the hold in which the cases of dynamite had been loaded, and the other mine was lowered into the hold containing the detonators. Cables were led from the mines to the shore, where they were connected to two of the telephone wires on the banks of the canal. The firing station was located three miles from the sunken wreck, and after the circuits had been tested by sending a small current through electric resistance fuses, the mines were fired. An enormous column of water and debris immediately arose, and ascended continuously for five seconds, the estimated height of the column being over 1,500 feet. The report of the explosion reached the firing point in sixteen seconds after the firing key had been depressed, and it was noted that the report was not particularly loud. The earth tremor, however, was felt almost instantaneously, in fact, while the firing key was still depressed. Although half a minute after the explosion the greater part of the debris had fallen, the air continued for over two minutes to be obscured with what looked like a mist. Although telephone wires were torn from the posts opposite the explosion, the blast was not sufficient to throw down the posts themselves. The water of the canal overflowed the surrounding country for a thousand yards in every direction, and fragments of the ship were distributed over a circle 1,200 yards in diameter. The enormous downward thrust of the explosion was shown when soundings came to be taken over the spot where the ship had lain. Here was found a huge hole, 73 feet in depth. This is the greatest explosion of dynamite ever recorded, the nearest approach to it being the blowing up of Hell Gate in 1876, when 50 tons of high explosive was detonated, and the accidental explosion some years ago of 30 tons of dynamite at the port of Lisbon.

HIGH VELOCITIES AND GUN EROSION.

The biggest problem in the development of war material at the present time, is to overcome the terrific erosion which burns out the inner tube of our modern high-velocity guns. The success of Admiral Togo in defeating the enemy by long-range rifle fire has directed attention more than ever before to the advantage of high velocity and big guns. There are two ways in which the punishing range of the gun can be extended; one is by increasing the velocity of the projectile, and the other is by increasing its weight. The disadvantages of increasing the weight are that less ammunition can be carried per gun, and that the loading of the gun is somewhat slower and its rapidity of fire is reduced. On the other hand, if the muzzle velocity be increased, the same striking energy can be developed at the same range without any increase in the weight of the projectile, and if a powder containing a high percentage of nitroglycerine be employed, there need be no serious increase in the weight of the charge. The United States government prefers to use a powder with less nitroglycerine than is present in the English cordite; but although it has succeeded in obtaining as high, and a little higher velocities at the proving grounds, this result is gained at the cost of using a powder charge that is over twice as heavy, the cordite charge for a 12-inch gun weighing 141 pounds, and our nitrocellulose charge weighing for the same gun, 350 pounds.

Nature, however, demands a heavy toll from those artillerists who seek to secure greater range by higher velocity; for in order to secure high velocity, the powder pressures within the gun must be raised to such a degree that the corresponding temperature plays the Old Harry with the inner tube, the white-hot gases melting it away, just as a block of ice is melted by a stream of boiling water. Up to a certain limit, pressures and temperatures may be raised and velocities increased without serious injury to the lining of the gun; but above that point the inner tube begins to deteriorate, the rifling is burnt out, the projectile fails to rotate on its axis, and begins to tumble end over end in its flight.

We do not hesitate to say that to-day the greatest problem in the development of artillery is the prevention of gun erosion.

There are no great mechanical difficulties to be encountered in getting high velocities. There are to-day at Sandy Hook under test by the Board of Ordnance of the army, two 6-inch wire-wound guns, each of which has shown muzzle velocities far in excess of anything that is used either ashore or afloat to-day. One of these is a design by Gen. Crozier, the present head of the Bureau of Ordnance, and the other is the well-known Brown wire-wound gun, the distinguishing feature of which is its inner core of laminated steel plates. We have before us some of the results that have been obtained during the tests of the latter gun at Sandy Hook. These include sixty-five rounds fired with powder charges of from 32 to 72 pounds, with corresponding muzzle velocities of from 1,913 feet per second to 3,380 feet per second, and with powder pressures ranging from 12,274 pounds per square inch to 43,370 pounds to the square inch. The high velocity of 3,123 feet per second was reached in the fourth round, and in the rounds from that up to the sixty-fifth round the velocities have ranged from 3,200 feet per second up to 3,380 feet per second, and most of them have been over 3,300 feet per second. We understand that structurally the gun has shown no signs of weakness whatever; and the indications are that, were it not for the erosion troubles, the pressures could be carried up to 3,500 feet per second, and the gun would prove to be perfectly well able to carry these velocities in service. Unfortunately, in both this gun and the Crozier gun, which has been tested simultaneously with it, that universal enemy of the artillerist, erosion, is getting in its destructive work. Thus we are once more reminded that the question of the ultimate practicable velocities of our guns is a question for the chemist, the metallurgist, and the powder expert to determine. We are squarely up against the fact that our steel makers cannot provide an inner tube that will endure the terrific heat engendered by modern smokeless powders. Furthermore, our artillerists admit that they do not know what is the exact explanation of erosion, whether the action is mechanical or chemical, or both. This is a field that will well repay investigation. The remedy may be found in the projectile, or in the tube or liner, or in the powder; but probably a careful study of the question of proper obturation will give the quickest solution of the difficulty.

THE ELECTRICAL VALUE OF WIND POWER.

The electrical utilization of wind power has obtained considerable popularity in Europe, and for several years now the Danish government has been conducting a series of experiments with windmills, to ascertain the relative amount of electrical power that can be generated thereby. In this country similar experimental tests have been tried, and although the instances are not numerous and are somewhat isolated, the data furnished indicate a useful future for this form of prime mover. This is particularly true of the agricultural regions of the West, where innumerable windmills have been constructed in the past ten years for irrigating purposes. The question of harnessing these windmills to motors for the generation of electric light, and even power, is likely to receive the attention of the farmers within the next few years.

Probably one of the first experimental efforts made to utilize wind power for generating electricity was that of Dr. Charles F. Brush, the inventor and pioneer in electrical experiments, who installed a windmill plant at his home in Cleveland in 1889, to light his house and laboratory. This windmill generating station is in use to-day, and during its sixteen years of operation, has furnished an excellent example of what may be expected of windmill motors in that section of the country. The fact that the wind power and variation differ considerably in the several States should be taken into consideration, and the value of this form of prime mover may prove more profitable in one section than another. The constant or average wind velocity for the year must be considered, rather than for a month or season.

The simplicity of the windmill generating plant is one of its chief features. In Dr. Brush's plant the dynamo is connected by pulleys, so that fifty revolutions are made to every one of the windmill, and the normal speed of the former is 500 revolutions a minute. In an ordinary wind with a velocity of 8 miles an hour this windmill works the dynamo to its normal speed, developing a load of 12,000 watts. Unfortunately, however, a wind velocity of 8 miles an hour cannot be depended upon steadily in the vicinity of Cleveland, and a storage battery is necessary for equitable operation. The average wind velocity for the United States is given at 8 miles an hour, but in many parts of the country a velocity of only 4 and 5 miles is maintained throughout the summer. The dynamo of the Cleveland plant is arranged to be automatically put into operation at 330 revolutions per minute. The working circuit opens automatically at 70 volts and closes at 75 volts.