THE IMPERIAL RESIDENCE AT LIVADIA.

ON the palace at Livadia, in the Crimea, the thoughts of the whole civilized world were fixed when the news was flashed around the world that Alexander III., Czar of Russia, had expired there at three o'clock on the afternoon of November 1. Since the time of Peter the Great no male ruler of Russia has died a natural death until the recent decease of Alexander III. The late Czar of all the Russias became ruler of Russia after the death of his father, Alexander II., who was killed by a Nihilist bomb on the Nevski Prospekt, in St. Petersburg, March 13, 1881. Alexander III. was thirty-six years old when he succeeded to the throne, consequently he was forty-nine when he died. His mother was Princess Maria, of Hesse-Darmstadt. His wife was the Princess Maria Dagmar, of Denmark, fourth child of King Christian, and sister to the Prince of Wales. The late Czar was 6 feet 4 inches in his stockings and weighed 250 pounds. He had enormous strength. For thirteen years the man who held the peace of Europe in his hand was menaced by Nihilists, so that even his car was protected by plates of steel hidden under the costly woodwork. Alexander had five children, the Czarevitch Grand Duke Nicholas, who succeeds him as Czar of all the Russias, under the title of Nicholas II., and was born May 18, 1868; Grand Duke George, born May 9, 1871; Grand Duchess Xenia, born April 6, 1875; Grand Duke Michel, born November, 1878; and the Grand Duchess Olga, born June 13, 1882.

The new Czar is short in stature and very unlike his father in appearance. He made a solemn vow to carry on the government on the peaceful lines laid down by his father, and he has the comforting assurance that the Nihilists have already threatened his life. His bride-elect is Princess Alix, of Hesse.

Livadia, near Yalta, in the Crimea, is a simple villa in an immense park, and through the forest can be seen the waters of the Black Sea, which are in reality of deep blue. Climbing plants attach themselves to the walls of the small palace. A winter garden almost entirely surrounds it, and it is only a Greek chapel with its bulbous bell tower that indicates that we are still in Russia. It seems rather that we are at the country house of a rich merchant in the neighborhood of Stuttgart or Heidelberg.

The ground floor of the chateau of Livadia contains the reception rooms; the first floor was devoted to the apartments of the Emperor and Empress. A small chalet, three-quarters of a mile from Livadia, is where the Empress has passed much of her time the last few weeks plunged in the deepest grief. The Empress has decorated and ornamented this charming solitude with her own hands. In the park are found various buildings for the lodging of officers, barracks, schools, hunting lodges, concert halls, concert pavilions, for military bands, etc. In a word, Livadia is one of the most agreeable residences which the imperial family possess in the South. For our illustrations we are indebted to *Le Monde Illustré*.

SKELETON CONSTRUCTION AND THE FIRE DEPARTMENT.*

SEVEN hundred and fifty years ago, a little knot of architects were busy with the solution of a new problem. All of them had been educated under the same conditions, had been taught the same rules, had copied the same models, and studied the same methods of construction. Now, to all of them, almost simultaneously, had been presented a new set of conditions, which must be fulfilled, but in the fulfillment of which the models upon which their instruction had been based gave them little assistance. Those models expressed, by their thick walls, heavy piers, horizontal lines, and small, round arched openings, solidity, calm, dignified seclusion and aristocratic sanctity; and now had suddenly arisen in the community a fever of revolt against aristocratic and sacerdotal exclusiveness, a passion of democratic feeling, to which the narrowness and heaviness of Benedictine architecture were intolerable. Everywhere was heard the demand for air, space and light, for vast, bright, open halls, in place of the gloomy monastic churches in which the laity, for five centuries, had been permitted only to listen, from behind a screen, to the prayers of those holy persons whom alone the Saviour of mankind permitted to approach His altar. In one word, the modern spirit had been born, and upon a few men had fallen the task of expressing it in architecture. You all know how they acquitted themselves of this duty; how, starting with the necessity before them of providing vast and lofty buildings, with slenderer supports and larger windows than had ever been seen before, they not only completely satisfied these requirements, but, almost within one man's lifetime, developed a style of architecture absolutely new, even to its smallest detail, and in this style produced buildings which, speaking to architects trained to appreciate many sorts of architectural beauty, I will not call the most beautiful in the world, but which may be justly described as the most interesting in the world, through the richness of artistic feeling which shows itself everywhere in them.

A comparison of the last decade of the nineteenth century with the era of the emancipation of the communes may seem historically unwarranted, but, architecturally, there are some striking points of similarity. With us, as with the people of Paris and Amiens and Rouen toward the end of the twelfth century, buildings of the sort that our grandfathers erected no longer serve our purposes. It is true that we can use their dwelling houses comfortably enough, but, for the occupations and amusements which we carry on in common with other people, we need, and must have, stronger, lighter, more wholesome and more enduring structures than any known to our forefathers. As economy of time must be practiced to the utmost in our modern system, each sort of business must be as far as possible localized; and this involves collecting near a given spot as many persons, whose interests are connected with that locality, as can safely be accommodated; this requirement alone bringing us inevitably to the modern high building, with its many stories,

and its swift running elevators, standing upon a lot whose situation alone gives it fabulous value.

Notwithstanding all that has been said in ridicule of the "sky scrapers," there is no doubt that these high buildings meet a need that has been urgently felt, and will continue to be felt more and more in our large cities; and, however conservative we may be in our notions of the virtues of six stories of solid wall, we all know that the buildings that the age requires, standing on land worth two hundred dollars a square foot, must be made with protected metallic skeletons, and we have probably prepared ourselves, by earnest study of the subject, to make the best of the new construction, whether it appeals to our artistic sympathies or not. That it should at once appeal to our artistic sympathies is not particularly to be desired. The people who cast off the old love with most alacrity are not those who gain the firmest hold on the affections of the new one; and a regard, based on an appreciation of the many excellent qualities of the new architecture, will be the best foundation for an esteem which, we may hope, will hereafter find artistic expression.

Among these excellent qualities, the greatest ought to be, and will be, if architects choose to have it so, the security of the modern high building against fire. As a rule, fire engineers are disposed to condemn those already erected, for the reason that they are so lofty that streams of water cannot be thrown into them, and so incautiously built, in many cases, as to present an immense mass of fuel, in a condition for burning comparable with that of a pile of kindlings built up in a chimney; and they are certainly justified in their criticism; but there is no necessity for filling these blast furnaces with woodwork, and where the architect is allowed to apply his knowledge, it is easy to make the protected skeleton, of fifteen or twenty stories, not only safe against injury by fire within, but extremely valuable as a bulwark against the course of conflagrations outside it. In the presence of so many of my brethren, much better qualified than myself to treat of the details of the new construction, I will not presume to point out the methods which architects should follow in carrying out designs of the sort here considered, but it will do no harm to suggest certain possibilities, in the way of application of materials, which may contribute in new ways to the diminution of the fire hazard. It is well understood by architects that no building, however constructed, is safe against fire, unless the amount of combustible material contained in it is either very small or is divided into small portions by incombustible partitions; and it is also well known that a building, very safe against internal hazards, may be destroyed by the attack of a fierce conflagration from the outside. Great as has been the progress in the art of incombustible construction within the last ten years, there is still much that can be done, with materials already at hand, in fortifying our lofty buildings against both internal and external risks. Where the fireproof building of ten years ago had its partitions set with wooden studs, filled in with blocks of hollow plaster or porous terra cotta, and its wooden doors and windows trimmed with wooden architraves, the modern structure is divided by partitions of cement on metallic lath, held by uprights of channel or angle iron, or of wrought iron pipe, and, in many cases, provides iron frames and casings for its doors and windows; and the fireproof building of the future will undoubtedly add to these, either doors entirely of metal and glass, such as are made in Germany, and occasionally here, or of wood, covered with sheet metal, in the manner recently introduced, which gives a light, handsome and perfectly incombustible door, at a very small expense.

With marble floors, on concrete or terra cotta arches, between iron beams, plenty of partitions of iron and cement, metal covered doors and windows hung in iron frames, and bases and wainscoting either of marble or of metal cased wood, the internal hazard of the high fireproof building can be reduced to almost nothing, as a fire in one room could not spread to the next. There is, however, the external hazard still to provide for, and here, also, there is still some progress to be made. Obviously, the most vulnerable point in such buildings is to be found in the windows, which, as at present made, offer no resistance whatever to a fire outside. For skylights we have found, in the new wire glass, a material at once transparent and fire resisting, and there seems to be no reason why a similar material should not be used in the windows in the vertical, as well as the horizontal walls. Of course, it is not to be expected that the tenants of a great office building would be satisfied with the ordinary wire glass for their windows; but there is nothing to prevent us from designing the most beautiful lace work of which we can conceive, and having it executed in gilded or silvered wire, and embedded in the polished plate glass of the windows of our "sky scraper" buildings. Such treatment, whether the tenants liked it or not, would add greatly to the external appearance of such buildings, and would render them practically secure, no matter how numerous or ample the openings, against fire from the outside, as the glass, held by the wire network, would keep its place until it was melted away.

Again, we are told by the fire engineers that the brick and terra cotta with which we clothe the steel skeleton of our new buildings are liable to destruction by the combined effect of heat and water, and that, when exposed to a serious conflagration, either from the inside or the outside, they are likely to fall off, and expose the steel structure. Experience has shown that there is truth in this, but it does not follow that high building must be condemned in consequence. Our medieval brethren, in attempting to adapt their old round arched models to their new conditions, found that their buildings generally fell down. Did they for this reason desist from their attempts to solve the problem imposed on them? No. They knew, as we know, that the problem must be solved; and to solve it they at last invented a form of arch which had never been seen before since the beginning of the world. So strange and outlandish did this arch appear to them that for years, although they were compelled by constructive necessity to use it, and did use it with great skill, they disguised it, so that no one should notice that their buildings contained anything but the round arch of their forefathers. In the same way, if brick, stone and terra cotta cannot be made to protect ef-

ficiently the metal framework of the buildings which we are trying to make fireproof, something else, that will accomplish this object, will assuredly be employed, no matter how much our traditions, may have to be upset for the purpose. For example, there is no practical reason why a steel skeleton should not be clothed first with cement mortar, on iron lath, and then cased entirely over with copper, or brass, or aluminum, riveted at the joints. With a little grouting between the steel work and the casing, to give a substantial backing to the sheet metal, a building of this sort would be almost indestructible. Fire and water would expend their force upon it in vain, centuries of exposure to the weather would only increase the beauty of its patina, and, if well anchored to the ground, and cross braced with moderate skill, no earthquake could bring it down. It would be a queer looking affair, no doubt, and the critics would have plenty of sport at its expense; but we may remember, in our efforts to accomplish, by the light of our own intelligence, the results that are required of us, that it was the ugliest of the ducklings that grew up to be a swan, and that in the solution of the most important, most difficult, and yet most imperious problem that confronts us certainly lies, to a great extent, the future of the art of architecture in America.

THE PROPOSED DEEP WATERWAY FROM THE GREAT LAKES TO THE OCEAN.*

By First Lieut. WENDELL L. SIMPSON, 9th U. S. Infantry.

A PROJECT for a deep waterway to connect the Great Lakes with tide water has of late been somewhat prominently before the public. Men of capital and influence are interested, conventions have been called, a general congress with representatives from many commercial interests and several States has been in session, and that the project may at no distant day materialize seems probable.

Many years ago the Erie Canal was projected, and though purely a State undertaking, it was carried through to completion. Its importance outside the State of New York was scarcely recognized in the days of its inception, and its most enthusiastic advocates underestimated the importance of the part it was to play in commercial affairs.

As the great Western interior was settled and developed, the center of agricultural production moved westward. The productions of this vast territory have rapidly increased even in proportion to local consumption, and the question of cheaper transportation to Eastern markets has become one of grave importance. Notwithstanding the almost endless network of railroads reaching out and gathering in the immense product to the great commercial centers for distribution, the conditions are far from satisfactory to those interested in the production. The actual expense of long-distance shipments by rail, the expense incident to the necessity of breaking bulk and making transfer in shipment to distant points, and the obstacles in the way to free competition resulting from railroad combinations, deals and monopolies, one and all, serve to counteract the advantages of cheap land and cheap production.

During the summer of 1892, when wheat was quoted in New York from eighty to eighty-five cents per bushel, a Nebraska paper quoted prime wheat at forty cents. This is a startling difference in this day and age to be due to cost of transportation only, and the financial meaning of such a difference becomes apparent with a brief comparison of shipping statistics. The immensity of the shipping of the Great Lakes is scarcely comprehended by those who have not made a careful study of the subject.

One eighth of the entire commerce of the United States passes through the St. Mary's Falls Canal. The tonnage that passed through this canal in 1891 exceeded by over 2,000,000 tons the entire freight of all nations that passed through the Suez Canal during that year.

More tonnage passes the city of Detroit than any other point in the world. In 1889 there were nearly 10,000,000 tons more than the total entrances and clearances of all United States seaports, and nearly 3,000,000 tons more than the aggregate shipping of London and Liverpool; and this latter excess was increased to 10,000,000 tons the following year.

A great portion of this freight is destined for Eastern markets and gains an outlet through New York or Montreal. For the former point it must be reshipped by rail or by the Erie Canal, and for the latter it passes through the St. Lawrence and Welland Canals. The disadvantages of the New York route are apparent. The disadvantages of the Montreal route become apparent when one learns that boats representing one-half the tonnage of the lake traffic are of too great draught to pass through the Welland Canal, and that there are many of the boats that can pass the Welland that cannot pass the St. Lawrence canals.

With these facts before us, no good reason is apparent why a deep waterway is not already in process of construction. Our people are not slow to recognize commercial advantages, nor are they slow to act in securing them, especially when immediate financial benefits are sure to follow. With the need so urgent, the interests involved so extensive, yet at the same time no action, an opposing interest is naturally looked for; but no opposing interest is apparent unless it is that of the railroads. The project, from a commercial basis, is not merely of local importance. It is not a matter of securing deep water transportation between two given points and along the connecting line only, but also and primarily of securing the conditions to render it practicable to load several hundred miles nearer the place of production for distant points, and to load on such transport vehicles as shall reduce the actual cost of transportation, do away with the necessity of breaking bulk or transferring in transit, and establish a wholesome competition to railroad traffic. Under present conditions the railroad companies own and control many of the lines of carriers on the lakes, and with their connecting railroad lines control to a great extent the lake shipping rates. With a through waterway from the West, open to all craft, and independent of connecting railroads, the natural laws of competi-

* From the Journal of the Military Service Institution.

* A paper by T. M. Clark, F.A.I.A., read before the American Institute of Architects at their twenty-eighth annual convention.—American Architect.

tion would quickly regulate the rates to a standard of "Live and let live."

The enterprise is one of immense financial magnitude; but considering the changed conditions, the wealth of the country as compared with earlier times, and the capital to be affected directly, it is no more of an undertaking than was in its day the construction of the Erie Canal.

In the accomplishment of this project its friends and advocates see a way to realize the objects set forth. With a deep waterway connecting Lake Ontario with the Hudson River, and another connecting Lake Ontario and Lake Erie, both entirely within United States territory, they see ocean ships loading at Chicago or Milwaukee or at any other lake port, not only for our Eastern and Southern seaports, but for any foreign port to which commercial conditions render it desirable to transport our products. Then with a widening and deepening of the Illinois Canal, they see the system and its benefits extended to the Mississippi River.

In this country commercial necessity alone can carry through such a project. When it becomes evident that business interests will warrant such an undertaking, then, and then only, will the project materialize. Will it pay in dollars and cents? is the test question to be applied to such an enterprise; and when it will, the powers act. The hills are leveled and the hollows are filled up; in fact, anything seems possible with this condition at the outset.

The United States seldom makes extensive and expensive preparations for military reasons only, until the absolute and immediate necessity exists; and then the element of time steps in as a dictator to say that this or that cannot be done. It would be useless, therefore, to urge the value of a deep waterway from a military point of view as a reason sufficient for its construction. It could in no way be a ninety days measure. When, however, the time is ripe for the enterprise, as determined by commercial interests, the United States should foster and promote the work with an interest beyond that of financial gain to the citizens and the State. If, as it may appear, the time is already at hand, and the measure is being held in check by railroad interests, the government should give due weight to the great military advantage secured, take the matter in hand, silence opposition and push the construction to completion as speedily as possible.

MILITARY IMPORTANCE.

However much civilized nations may be opposed to war in general, the nation best prepared to enforce her demands and maintain her rights will meet with the greatest courtesy and consideration from other nations, and commend the greatest respect. How many war ships and gunboats are ready to speak in this respect? is a question that all take into consideration. There is no native courtesy among nations. It is all artificial, a matter of policy; but expected, required, enforced. A nation that neglects to provide and maintain the means to enforce must cease to require, and may no longer expect. No nation can afford this neglect. It is shortsighted economy.

In our country there has always been some effort to keep up a naval force and provide coast defenses. Following the sudden changes of naval construction and coast defenses incident to modern improvements in armament and increased speed in navigation, we fell fearfully behind the times in such matters; but during the last decade there has been a sufficient effort in building war ships and improving coast defenses to show that there is still an inclination to provide the whereupon to rest a proper national dignity. With a continuation of this policy for a few years, our sea coast will be fairly protected. Though the coast is of great extent, the important harbors are few—twenty-seven in all—and the naval force will be large enough to act with and support such coast defenses as may be built to protect these harbors. While this policy is being carried out, however, not a step is being taken to provide for the defense of our Northern frontier. Here for three thousand miles we are practically in contact with foreign territory pertaining to a country strong in military and naval resources. Along 1,800 miles of this frontier lie the Great Lakes and their connecting waterways, which, forming an apparent natural barrier, really makes the problem of effective defense much more complicated than it could be were it all inland frontier. The conformation of the lakes extends this 1,800 miles of frontier line into 2,000 miles of coast; an extent equal to our entire Atlantic coast. Along the lake front are distributed towns and cities of great wealth, which are distributing and shipping centers of an immense territory, thickly settled, productive, and wealthy. These towns and the producing tracts that they represent furnish, as has been shown, over one half the commerce of the United States. With these facts in view, nothing further would be necessary to show the importance of this coast, or the great advantage, in the event of war with England, that the possession and control of the lakes would be to the one power or the other. In our possession it would mean a complete protection of all this wealth and shipping, a warrant for the continuation of the great production of the Northwest, a control of Canadian lake ports, and the advantages that this would give for invasion. In the possession of England it would mean either a total destruction or control of these important towns and the entire lake shipping, a safe rendezvous where forces could be collected with undisputed lines for concentration and supply, practically in the very interior of our territory.

There could be no division of this control and possession as has been in the past. The first power to place a naval force on the lakes could hold possession to the end. The avenues of approach are contracted and easily guarded by the power in possession. They might be destroyed or made impracticable, but that would be of minor moment to the possessor. No ship building could be carried on in opposition to the controlling power, while any amount could be effected under its protection. No coast defenses of importance could be built to oppose a destroying fleet, while similar work could be undertaken by the enemy with impunity. Finally, no ready constructed land defense, without the support of war vessels, would be of avail to protect the harbors and coast towns. The coast is flat and ill adapted to land defenses at best. If the defense be

placed on the water front of a town, the destruction of the town would not thereby be prevented. The very fire drawn by the defenses would, to a great extent, take effect on the town itself. If the defenses be established on the flanks, they would still be ineffective to save the town. An attacking fleet could, in this case, after coming within range of the defenses, move to a point much nearer the town without materially lessening the distance from the defenses. Moreover, when once in possession of the lakes, the action could be so prompt as to destroy or lay under contribution every important town on the coast before anything further than the preliminary steps of providing defense could be taken. The wealth thus placed at the mercy of the opposing power would be immense.

The commercial interests and wealth on the lake coast in the United States is far greater than on the Canadian side. Leaving this fact out of consideration, the possession of the lakes in case of war is of about equal strategic importance to the two countries. One would be led to suppose that the importance of these interests combined would lead the United States to be sure to provide means of securing possession of the lakes in event of war at least equal to those available to England. This has not been done. By the way of the St. Lawrence River and St. Lawrence canals and the Welland Canal, England can place a naval force upon the lakes in short order. These canals are entirely within Canadian territory. The part of the St. Lawrence to be traversed not within Canadian territory is to a great extent too wide or too thickly dotted with rocky wooded islands to permit any effective resistance being offered by land forces to the passage of a fleet. The narrowest part of the river is of sufficient width to make effective resistance impracticable on short notice or with a small force. In regard to the canal locks, the real key to this line of advance and communication, England has facilities for protection for a short period superior to our facilities for destruction. Add to this the presence of a fleet passing to the lakes, and the possibility of our accomplishing an injury to the locks in time to prevent the passage of the fleet becomes very small.

The defense would act with full knowledge of the importance of the end to be attained and of the short space of time that the defense would be necessary. The short time needed would be greatly to their advantage, as no considerable force could be collected to oppose them within this limit. The day once passed, the purpose would be accomplished, and the destruction or control of the locks would then be without advantageous effect other than to prevent the immediate re-enforcement of the force already on the lakes. This would be of comparatively little injury, as the power that gains possession of the lakes has everything at hand that is necessary to provide re-enforcements. Control is at once gained over an immense carrying power to transport material and supplies, and the work of converting lake vessels into engines of war and building new vessels, if desired, may be pursued undisturbed. For forty-four miles only on the St. Lawrence is canal navigation necessary. Allowing four miles per hour on the canals and ten miles per hour for the intervening portions of the river, which aggregate sixty-eight miles, less than eighteen hours would be required to pass from Montreal to the open river above the upper rapids. Allowing liberally for delays in getting a somewhat extensive fleet under way and for the working of the locks, it would not take two days to pass a fleet of one hundred vessels over this part of the route to the lakes.

By the provisions of a treaty made in 1817, both the United States and England are prohibited from placing war vessels on the Great Lakes, except to the slight extent provided for in the treaty, the exceptions being the same for each country. Through the St. Lawrence and the canals, however, England has provided an approach to the lakes, and nothing in the treaty prevents her from assembling a fleet at Montreal or even in Alexandria Bay, within a few miles of Kingston. In this manner England may practically hold possession of the lakes before war is declared. This is the possibility most favorable to England. On the other extreme, suppose the start be made from the British coast. Even in that case fourteen days is sufficient time for England to place a fleet in possession. If the canals can be held for that time, their main mission will have been fulfilled.

The smallest locks on the St. Lawrence canals are 200 ft. long, 45 ft. wide, and 9 ft. deep, and all have been built with a view of enlarging to 280 ft. long, 45 ft. wide, and 14 ft. deep.

From the U. S. Naval Bureau of Information the statement is obtained that England has 57 war vessels drawing over 9 ft. and less than 12 ft.; 10 drawing over 7 ft. and less than 9 ft.; and 44 drawing less than 7 ft.; 54 vessels could, therefore, pass the canals rapidly and without delay, and 57 more could be passed by removing ballast and armament. One hundred and eleven vessels are to be considered as at once available for service on the lakes, all with modern armament, and several of them well armed. Add to this the auxiliaries that could be rapidly transported to meet the fleet on the lakes, torpedo boats, armament, supplies, crews, marines, and it will be seen that a formidable force could be ready for action in a remarkably short time.

The work of enlarging the canals and locks is provided for. Two of the canals already have locks 270 ft. long, 45 ft. wide, and 14 ft. deep. With the completion of this work, a much larger fleet and more powerful vessels could be sent to the lakes, if desired.

The Welland Canal is entirely beyond the reach of our country, except by invasion by the lakes, or by crossing the Niagara River. The smallest locks of this canal are 280 ft. long, 45 ft. wide, and 14 ft. deep. An English fleet on Lake Ontario could, therefore, take possession of Lake Erie at once, while a United States fleet coming by the way of Lake Ontario would be promptly cut off from Lake Erie by the destruction of the locks on the Welland before the fleet could reach that canal.

To be sure, the passage from Lake Erie to Lake Huron could be quickly rendered temporarily impracticable by obstructing the canal through the St. Clair Flats, and by sinking obstructions along the narrower parts of the channel of the Detroit River, where it might be practicable to bring heavy batteries to bear on the location, provided this could be accomplished

in time to prevent the fleet from gaining possession. The chances are perhaps about equal as to which could be accomplished first. To provide for a possible contingency at this point, a canal has been projected leading from Lake St. Clair directly across to Lake Erie, through Canadian territory.

An enemy's fleet on Lake Huron could pass to Lake Superior without serious hindrance, unless the canal of St. Mary's River should have been destroyed. Even here a canal is being constructed giving an independent passage through Canadian territory.

No serious opposition would be met with in passing a fleet from Lake Huron to Lake Michigan, in absence of an opposing fleet.

Having briefly traced the advantages available to England for occupying the Great Lakes, and the probable opposition that could be offered thereto, the other side of the question demands attention.

One can rest assured that in the event of war, or even of threatened war, England would take the necessary precautions to thwart the United States in any effort to make use of the St. Lawrence and canals to place a naval force on the lakes. The many ways available for prevention and delay leave no doubt that this could be most efficiently accomplished. They need only be mentioned, as their efficacy is apparent. This could be effected by previous possession, if time or forethought has permitted; by the delays and damage that might be inflicted at Quebec, Montreal, and other points; and by the destruction of the canal locks as a final resource.

Turning our attention to other entry ways, we find but one—the Erie Canal. Leaving the Hudson River at Troy, this canal connects with Lake Erie at Buffalo. Here communication with Lake Ontario would be blocked, owing to the Welland Canal being in Canadian territory, and being under the control of opposing forces. The only route open to Lake Ontario is by a small canal that branches from the line of the Erie at Syracuse and connects with Lake Ontario at Oswego. By either of these routes considerable time would be consumed on account of the long distance to be covered by means of slow canal navigation. This, in fact, would never have to be considered, as the dimensions of the canal preclude, at the very start, the possibility of its being available as a means of placing effective war vessels on the lakes. The locks on the Erie are 110 ft. long, 18 ft. wide, and 7 ft. deep. Any boats that could be placed on the lakes over a waterway of these dimensions would cut no figure in opposition to a fleet such as has been shown could be brought in by the St. Lawrence. Our one entry way to the lakes sinks into insignificance.

Let the United States construct the deep waterway proposed, with a depth of not less than 21 feet, and locks of length and breadth to correspond; we shall then have much the advantage of England in a race for the possession of the lakes, and can send in war ships of much greater size and power than can be sent in by the St. Lawrence route. At the outside limit, forty-eight hours' steaming from New York will then be sufficient to place a naval force on Lake Ontario. Five hours more, and it may lie off Kingston, and a few hours thereafter the first lock on the St. Lawrence canals may be in our power. If, upon reaching this point, our fleet should have twenty-four hours the advantage of an opposing fleet, we should have a fair chance to gain at once full control of the St. Lawrence, besides being able to accomplish the first and principal move toward the capture of Montreal and Quebec.

The deep waterway is but one of the measures to be considered in connection with plans for the defense of our northern frontier, but it would seem to be of the first and greatest importance. With any treaty in operation that prevents the United States from building and maintaining a fleet on the lakes, no other means of defense would be effective without such a waterway. Even in case the treaty were annulled, it would be poor policy for the United States to go to the expense of building up and maintaining a lake naval force, without providing a way by which this force could be transferred for service elsewhere. The money expended for a deep waterway would render our entire naval establishment available for service on the lakes, and at the same time would provide a great commercial thoroughfare, the benefits of which would be widespread and important.

THE MANCHESTER-THIRLMERE WATERWORKS.

OPENED OCTOBER 13.

THE inauguration of the supply of water from Thirlmere Lake to Manchester marks the completion of a daring enterprise and a memorable engineering work. The problem of supplying towns of rapid growth with an adequate amount of water has always been a pressing one; and Manchester, except very recently, has been a town of phenomenally rapid growth.

At all events, her imperative demand for a more plentiful water supply has been for many years incessant. The old supply from the river Etherow might be increased, and the Longdendale reservoirs might be multiplied, but the fact remained that with a rainfall of about forty-four inches per annum the total available quantity of water which a gathering ground of nineteen thousand acres could supply was no more than thirty-eight million gallons per day, of which thirteen millions and a half were required for what is known as "compensation water," that is, water which is supplied to various persons who had been accustomed to rely upon the ordinary provision of nature, which has probably been disturbed by the machinations of engineers and contractors.

It is not necessary to enter in detail into the circumstances which made the abandonment of the old waterworks as a staple source of supply an absolute necessity. Suffice it to say that the summer of 1873, before the present works were begun, and that of 1887, when they were in full progress, were enough in themselves to give warning to the local authority that there was great danger in leaving the supply in the state in which it then was. It was determined, after processes which may be rapidly passed over, to secure a site in the midst of the Cumberland lakes, where an unfailing supply of water could at all times be obtained and passed on for the use of a great and busy city.

There were but three of the group of lakes that were available for the purpose. These were Ulles-