THE BRITISH INSTITUTION OF CIVIL ENGINEERS.

This most useful society celebrated its fiftieth anniversary on the 2d of January last, when the new president, Mr. C. H. Gregory, made an able address, full of much useful and valuable information. We subjoin some extracts from this address, in which, among other things, the history, influence, and introduction of American inventions and engineering practice in England are noticed:—

Fifty years ago, on the 2d of January, 1818, this Institution was founded, its members then being only six in number. On the 21st of March, 1820, Thomas Telford, our first president, in his inaugural address, referred to the nature of the Institution and its probable future usefulness, and pointed out the significant fact, that while in foreign countries, such institutions depended on governments for their support, in this country their existence and their prosperity were dependent on the united action of the individual members. In this, our jubilee year, we may, with pardonable pride, congratulate ourselves that Telford's views have been justified, and even surpassed, in succeeding years of increasing prosperity, in our satisfactory financial condition, in our numbers, now comprising 1,472 members of all classes, in the formation of our student class, and our benevolent fund, and in the firm establishment of the Institution of Civil Engineers as the recognized representative body of the profession, comprising within its ranks, past and present, the names of so many illustrious in abstract or practical science, whose labors have enlarged the resources of our country and materially promoted the civilization of the world.

INTRODUCTION OF AMERICAN FIRE-ARMS.

On the 25th of November, 1851, a paper was read in this Institution "On the Application of Machinery to the Manufacture of Rotating Fire-arms," by Col. Samuel Colt, of the United States Assoc. Inst. C. E. The paper claimed for the machinery used the advantage of cheap production of the weapons in large quantities, and such uniformity in the various parts that "when a new piece is required a duplicate can be supplied with greater accuracy," while "in active service a number of complete arms may be readily made up from portions of broken ones." In 1852 the first manufactory in England for the construction of arms on this principle was erected at Thames Bank, under the direction of our honorary secretary, Mr. Charles Manby, M. Inst. C. E., and subsequently a manufactory was erected by Messrs. Dean & Adams, which in later years passed into the hands of other companies; but prior to this time the construction of fire-arms was really carried on by small manufacturers, who each made only one separate part—one for locks, one for barrels, one for bayonets, etc,; the gunmaker being, in fact, little more than a setter up; and the government, after obtaining by contract the separate parts of their muskets, excepting barrels and some small parts, from separate manufacturers, put them together at their own works at Enfield.

In 1853, Mr. John Anderson, M. Inst. C. E., engineer to the Board of Ordnance, proposed the construction and equipment of a government manufactory, in which, by the use of complete machinery, all the processes for the production of small arms should be carried on successively to completion. In 1854 the subject was considered by a select committee of the House of Commons, and the adoption of machinery, as recommended by Mr. Anderson, was advocated by Mr. Jos. Whitworth, M. Inst. C. E., Mr. James Nasmyth, Gen. Tulloch, R. A., and other officers and engineers; and, in spite of the views of those whose habits or prejudices led them to oppose a new system, the committee recommended a partial trial, which issued in the establishment of the present small-arm factory at Enfield.

This new factory, stocked with improved machinery, founded on that already in use in the United States arsenals at Springfield and Harper's Ferry, and made partly in America and partly in England, was set to work in January, 1857, under the direction of Col. Manley Dixon, R. A., the present superintendent of small-arm factories, in the construction of small arms generally but particularly of the Enfield rifle of the pattern of 1853, which, with trifling modifications, is the long rifle now used in our army, where not superseded by the Snider breech-loader [an American invention]. The machines used at Enfield are to a great extent varieties of copying machines, in which a standard model is reproduced by a revolving cutter, in wood or metal, as the case may require. The different parts, as produced, are checked with templates and gages, and finally the finished parts, stock, lock, barrel, bands, bayonet, plates, screws, etc., find their way in numbers to an "assembler," who, furnished with a screwdriver and a chisel, takes the parts up indiscriminately and puts them together; and so entirely interchangeable are the parts found to be that a payment of 3.29d. for each rifle put together gives the workman wages of about 50s. per week.

The long Enfield rifle consists of 53 parts, and passes through about 740 processes of manufacture. These processes are multiplied so as to simplify each operation, to divide the labor, and to require mostly only a cheap class of workmen. All parts, including the stock, are issued for repair in a finished state, any damaged part in a rifle in use can at once be replaced by a corresponding part without any fitting.

Up to the present time the government has had no contract for interchangeable arms, excepting one for 30,000 with the London Armory Company. The Birmingham Small Arms Company has, however, lately made interchangeable short rifles for the Turkish government. The cost of non-interchangeable long Enfield rifles with bayonets, under a contract made in 1859, was £2 18s. 6d. each, to which must be added the cost of the stock, 2s. 6d., and viewing expenses, 3s., bringing the total cost to £3 4s. each. It is stated that the average cost of the long Enfield rifles made at the government factory, including an allowance of five per cent on the cost of buildings and machinery, for depreciation, has averaged about £2 each. In 1859 a contract was entered into for short Enfield rifles, which, complete, and including stocks and viewing expenses, cost £4 14s. each. The cost of subsequently producing the same weapon at Enfield is stated to be £2 14s. each. Neither interest on capital nor profit are included in the government estimates here quoted.

It has been estimated that the improvement arising from the accurate work produced by good machinery, coupled with that arising from better ammunition, has resulted in reducing by 50 per cent the mean deviation in rifle shooting. The old smooth-bore musket was considered to make good practice if at 100 yards 75 shots in 100 hit a target 6 feet square. With the present service rifle and ammunition 100 shots can, at the same range, be placed in a space of 6 inches.

From January, 1857, to December 26, 1867, the total number of new arms made at Enfield was 616,828. The number of arms converted to breech-loaders on Snider's plan up to the same date was 175,550. On April 1st, 1866, an order was sent to Enfield to prepare for the conversion to breech-loaders of 40,000 arms; on July 1st this order was enlarged to 100,000; between July and September 10,000 converted breech-loaders had been sent to Canada, and by April 1st, 1867, the whole 100,000 had been supplied. The cost of the alteration of old machines and the supply of new ones for the purpose of the conversion has nearly reached £10,000, which, divided over 200,000 arms, would come to 1s. each. The cost of converting to the Snider breech-loader, including the above sum and depreciation on buildings and plant, is said to be about 16s. 3d. per arm. With the present machinery Enfield is capable of turning out about 130,000 new arms annually.

THE FIRST IRON-CLADS.

While suggestions had been made and partial experiments tried with a view to the use of iron for defensive purposes prior to the Crimean war, the credit of the first great trial of a practical nature is due to the Emperor of the French, who built three floating batteries cased with thick iron plates, which were engaged in the attack of the allies on Kinburn on October 17th, 1855. These batteries were exposed, unsupported, to a heavy fire at a range of 700 yards for about three hours, and although some casualties occurred from shot and shell entering the large old-fashioned port holes, the vessels received very little injury. From this date the public attention was drawn more closely to the protection of ships of war by armor plating, and various experiments were made in this country.

FIFTEEN-INCH WROUGHT-IRON PLATES.

During the last few years the size and thickness of iron plates have greatly increased. The plates of the *Warrior*, constructed in 1861, were 4½ in. thick; those of the *Bellerophon* are 6 in. thick, while the *Hercules* has plates of 8 in. and 9 in. thick at the water line. In France, the plates used for the navy have been increased to a thickness of 15 centimeters, or 6 in., and the *Marengo* and the *Ocean* will have at the water line plates of a thickness of 20 centimeters, or nearly 8 in. A wrought-iron plate, 14 ft. long and 6 ft. 6 in. wide and 15 in. thick, has been prepared for trial at Shoeburyness. Some of the principal English manufacturers (Messrs. J. Brown and Co., C. Cammell and Co., and the Millwall Iron Company), now offer to roll plates about 20 ft. long, 6 ft. wide, and 15 in. thick; but it may be doubted whether plates of such thickness and size can at present be so perfectly manufactured as to give their full proportionate resistance; the production of sound and uniform plates of large size, 10 in. thick, may, however, I believe, be regarded as an accomplished fact.

GREAT GUNS AND MORTARS.

For many years before the Crimean war, brass and iron guns had been made with very little change of form; but when public opinion was drawn to the application of mechanical improvements to the production of guns of great size and strength, clever designs were brought forward by so many that I will not attempt here to give even a list, much less to assign to each its due proportion of merit; but the large wrought-iron Horsfall gun of the Mersey Company, and the monster mortar of Mr. Mallet, may be cited as two remarkable examples. The Horsfall's was a smooth-bore gun, in one piece, weighing 21½ tuns, and having a caliber of 13 in.; and it is now mounted at Tilbury Fort. Mr. Mallet's mortars were compound, weighing forty-one tuns, with a caliber of 36 in., from one of which, with a charge of 70 lb. of powder, a shell weighing 2,395 lb. was thrown 2,759 yards, burying itself eight yards in the ground on its fall. The limited practice with this mortar was interrupted by the fracture of a tie-bolt; but it is greatly to be regretted that no further experiments have been made with it, or with the second piece, which has never been fired.

BREECH-LOADING CANNONS.

You will all remember that in 1860 breech-loading rifled guns were the order of the day, and that neither brass nor cast iron, as materials, were considered to fulfill the necessary conditions. The designs which had earned the greatest consideration, both from the government and the public, had been produced by those two distinguished members of our body, Sir William Armstrong and Mr. Whitworth; and as far as the construction of the guns was then concerned, the leading points of difference were, that while the Armstrong gun was built up of several rings or tubes of coiled wrought iron shrunk over one another and over a steel lining, with small grooves to take a soft-coated projectile, the Whitworth gun was built up of tubes of mild steel, forced with a taper over one another and over a steel lining, the bore being polygonal, with a hard, mechanically-fitting projectile.

ENGLISH CANNON AS NOW MADE.

Irrespective of breech-loading, which has been abandoned in this country for heavy guns, and of rifling, in which the original mode has been to a great extent superseded by larger grooves to guide soft metal studs fixed on a hard metal projectile, the gun now generally manufactured for the service has undergone considerable structural changes, the most material one being the diminution of the number of parts, and the substitution of outer coils of fibrous Staffordshire iron for coils of the best Yorkshire iron, tough steel being still maintained for the lining, as best resisting surface wear. In the former type of gun there was a forged breech-piece over the breech end of the steel lining tube, and, according to the size of the gun, a greater or less number of coiled tubes, carefully and successively fitted on. The pattern at present in use for all guns consists of only four pieces, viz: 1st, the steel barrel, or lining; 2d, a coiled tube over the barrel, extending from the muzzle nearly to the trunnions; 3d, the breech coil, consisting of three coils in alternate directions, welded together, with a trunnion welded on, the whole piece shrunk on over the breech of the barrel, and lapping over the front coil; 4th, the cascable. It is considered by the present authorities that the diminution in number of parts leaves the gun less liable to injury by accident, and less dependent upon perfection in manufacture, and that practically an equal amount of strength is obtained; while it is held that a fibrous iron is to be preferred, as more workable for coils, and as giving out its greatest strain over a greater distance than the best Yorkshire iron, which, while strong statically, is considered not to yield so far before fracture. It is stated that this change has diminished the cost of production by 35 or 40 per cent.

The heaviest projectile thrown by any gun in the service prior to 1854, was the 200 lb. shell of the 13 in. mortar.

The largest Armstrong gun hitherto constructed is an experimental one, which has a caliber of 13·1 inch, weighs twenty-three tuns, and throws a shell of 600 lb.

It is intended that future 12 in. guns shall have a weight of twenty-five tuns.

The 11 in. gun lately constructed weighs twenty-three tuns, and the weight of the several parts are as follows: The steel barrel, 5 tuns 5 cwt. in the rough, 2 tuns 16 cwt. finished; the muzzle coil, 2 tuns 15 cwt. in the rough, 1 tun 16 cwt. finished; the trunnion and breech coil, 22 tuns 6 cwt in. the rough, 17 tuns 17 cwt. finished; the cascable 14 cwt. in the rough, 11 cwt. finished.

Two guns of Mr. Whitworth's, of 9 in. caliber, and weighing fifteen tuns, are about to be delivered for trial.

RANGES OF PROJECTILES.

Prior to the mechanical improvements which have led up to the present rifled guns, the greatest distance to which a projectile was ever thrown from a smooth-bore gun was not much over 6,000 yards, and the limit of bombarding range at high elevations, with the 13 in. mortar was 4,500 yards. With the modern ordnance, projectiles have been thrown with greater precision to a range exceeding 10,000 yards; the guns of the service make good practice at 6,500 yards—in fact, much better practice than was formerly attainable at 3,000 yards.

At 1,000 yards the mean error of range of round shot from smooth bores may be taken as forty-three yards, and that of rifled shot nineteen yards; the mean error of direction (referred to the mean direction of all the shot) with round shot may be taken as 4.1 yards, and with rifled shot as 0·8 yard. At 2,000 yards the mean error of range of round shot may be taken as sixty yards, and that of rifled shot twenty-one yards; the mean error of direction with round shot ten yards, and with rifled shot twenty-one yards. In other words—the accuracy being inversely as the products of the errors—the rifled gun is in one case more than eleven times, and in the other more than thirteen times, as accurate as the smooth bore.

I may be allowed to express my belief that great as have been the advances made in the manufacture of heavy ordnance in France, in Prussia, and in the United States, neither have attained the certainty, the economy, or the perfection, of the productions of British factories. But all our improvements will be of little avail in time of need until smooth bores are much more largely replaced by rifled guns. Meanwhile, for all practical purposes, we are almost unarmed in many of our so called defenses at home and abroad.

RAILROADS IN WAR.

Any notice of the principal application of engineering to the purposes of national defense would be incomplete without some reference to railways, which have always been expected to have an important bearing on modern warfare. They were admitted to be of great use in the movement and concentration of troops in the war in Lombardy in 1859; and in the German war of 1866 the Prussian government organized a special corps consisting of workmen and railway servants, under the direction of engineers and traffic officers, of which a division was attached to each *"corps d'armée,"* to act, assisted by a military escort, in advance of the army, to repair any damages effected by a retreating enemy, to work lines occupied by the army, and in case of retreat, to destroy lines in their rear.

Lieutenant Hozier, in his admirable account of the Seven Weeks' War, admits the value of improved roads and railways in shortening the duration of campaigns, and especially in facilitating the transport of provisions, stores, and a siege train, and in relieving soldiers of heavy loads; but he considers that the power of railways for the support of troops has been over-estimated, and that in an enemy's country railways have been proved to be of no use for the transport of the troops of the invader during his advance, as the defending army breaks them up, and they cannot be repaired quickly enough.

AMERICAN RAILROADS OPERATING DURING THE WAR.

I cannot but think that Mr. Hozier's views of the carrying

capacity of railways might have been modified by the knowledge of what is done on the volunteer field days in this country, while his opinions on the uselessness of railways in an enemy's country are apparently inconsistent with the experience of the last American war.

In that war railways and steamboats were found of inestimable advantage. The reports of General Parsons, chief of rail and river transportation for the United States, show that he considered the application of steam to transport had modified the art of war as much as the pursuits of peace; and he stated in 1865, as the result of his experience, that "it is now practicable, on twenty-four hours' notice, to embark by railway, at Boston or Baltimore, a larger army than that with which Napoleon won some of his most decisive victories, and landing it within three days at Cairo, 1,200 miles distant, there embark it on transports, and within four days' more time disembark it at New Orleans, 1,000 miles further." In January, 1865, in the depth of a severe winter, the 23d army corps was wanted for General Grant's operations before Richmond. After four or five days' notice this force, consisting of 20,000 men, with all its artillery, and over 1,000 animals, was started from the Tennessee river, and moved nearly 1,400 miles in an average time not exceeding eleven days. The distance was about equally divided between water and railway transport, along rivers obstructed by fog and ice, and over mountains during violent snow storms, with various interruptions, including thirty hours' detention from fog in the river, and at one point the unexpected delay of transferring the troops to boats of a smaller class, the railroad, meanwhile, being in the bad condition unavoidable in the severe winters of North America. Within seventeen days from the embarkation of the first troops on the Tennessee, General Parsons had the satisfaction of seeing the army quietly encamped on the banks of the Potomac, as fresh as when they started from Tennessee.

During the war, 611 miles of railway in Virginia, Maryland and Pennsylvania, 293 miles in North Carolina, and 1,201 miles in the military division in the Mississippi, giving a total of 2,105 miles, were more or less occupied by the United States authorities as military railways, under the direction of General M'Callum, the government staff carrying on all the working of these lines, and repairs of works and rolling stock, and to some extent the rolling of rails and the construction of new lines. At an early period a number of workmen, under competent engineers and foremen, were formed into a "construction corps," and stationed in detachments along any railway exposed to hostile attack, and stores were established at intervals to furnish the necessary supplies of rails, fittings, sleepers, and bridge timber.

HOW THE YANKEES BUILT BRIDGES.

This corps became at last very experienced in the work of repairing damage. General M'Callum's reports state that the Rappahannock river bridge, 625 ft. long and 35 ft. high, was rebuilt in nineteen working hours; that Potomac creek bridge, 414 ft. long and 82 ft. high, was built in forty working hours; that Chattahoochee bridge, 780 ft. long and 92 ft. high, was completed in four and a half days; that between Tunnel Hill and Resaca twenty-five miles of permanent way and 230 ft. of bridges were constructed in seven and a half days; and near Big Shanty thirty-five and a half miles of permanent way and 455 ft. of bridges in thirteen days. The last of these remarkable operations took place on the line by which General Sherman was connected with his base, in his advance from Chattanooga to Atlanta; and that the Military Railway Department, almost entirely through a hostile country, should have kept pace with the march of General Sherman, constructing and reconstructing the road in his rear, and ultimately have maintained the supplies of an army of 100,000 men and 60,000 animals from a base 360 miles distant, along a single line, exposed at all times to the attacks of an active and resolute enemy, is indeed a wonderful example of forethought, energy, patience, and watchfulness.

EDITORIAL CORRESPONDENCE.

NAPLES, Jan. 28, 1868.

Vesuvius—A Novel Spectacle of Neapolitan Life—Herculaneum and Pompeii.

Naples, apart from the extraordinary beauty of its situation, its rich museum and splendid churches, does not possess many objects to long detain a tourist; but in the number and variety of its excursions east and west, it offers more attractive features than any other city in Europe. From my youth up I have cherished a desire to visit Vesuvius, Pompeii, and Herculaneun, and to have had that wish gratified fully repays me for all the toils of a journey of four thousand miles. I have seen Vesuvius by dull star light, with its cone all on fire, vomiting streams of red-hot lava, which flowed down its sides like rivers of fire, and casting its dense clouds of smoke and its lurid light upward to the sky; again, on the second night, the appearance still more brilliant and the volume of lava considerably increased, but grander still was the effect of a visit to the mountain by night. Numerous parties go down every afternoon in carriages, as far as the village of Resina, which stands above the spot where Herculaneun lies buried eighty feet below the surface. Here we engaged horses and a guide, and some torch bearers, and thus provided made our way up the mountain near to the crater of the terrible eruption of 1858, which continued nearly three years. The afternoon being clear and still, we were favored with a fine view of the city and bay of Naples, the Castle of St. Elmo high above it, the isles of Capri and Ischia in the bay, and a range of the snow covered Appennines far to the north, while just above our heads rose the awful volcano, with its overflowing streams of liquid fire, and as often as every thirty seconds would a shower of stones be thrown upward hundreds of feet into the air, the shower succeeded by a heavy, rumbling sound, like the distant fire of artillery—certainly a grand and terrifying spectacle. We proceeded on horseback as far as the guide would permit, with sticks in hand, "to try the lava," as the people say when they urge you to buy them. We made our way up one of the principal streams by passing for some distance over the blackening crust of fresh lava, which but three days before was moving down the mountain like molten iron running from a furnace, and was still red hot underneath. At this point, and under cover of the night, we could take at one view not only the eruptions from the crater, but also the several channels through which the lava was working its way down the sides of the mountain, already covered with the blackened masses of former eruptions. We happened to see Vesuvius in one of its most angry moods, and I do not think any of our party will ever forget the sight, and yet no one seems to fear this burning mount. The inhabitants of Naples, and the towns along the base of the volcano, live, eat, and sleep, regardless of the fate of cities that lie buried under its ashes.

The road to Pompeii runs along the eastern bay of Naples, and through a continuous line of villages, whose inhabitants appear to live upon macaroni, if one may judge from the immense quantities of this article hung out to dry. Almost every house has its string of macaroni poles hung out in front, and the people who make it are often so dirty that it is almost impossible to distinguish their features. Pigs are sometimes seen walking around under the pendant links, to say nothing of the dirty urchins who are permitted to handle it. I have heard it said that a lazaroni would keep fat on a daily diet of two cents' worth of grapes and macaroni, but it appears now that the latter article is a luxury which the lazaroni don't enjoy in such abundance.

The roadway from Naples to Pompeii was lined with the strangest assortment of men, beasts, and vehicles, that human eyes ever looked upon. Here is a vehicle or go-cart, resembling a long furniture truck, suspended on a pair of tall wheels, upon the platform of which is fastened what very much resembles an old-fashioned doctor's gig, with covered top thrown back, hung upon double C-springs The seat is occupied by a priest and a fat woman; while behind and underneath the top, sitting on the platform, are two old vegetable women just returning from market. Four men, with red caps, dressed in brown duck trowsers, and short sacks or tunics, are standing up behind, holding on to the gig-top. One is a lazaroni, exposing a pair of legs that might serve for an Apollo. In front, beside the driver, are seven men, who are either sitting or standing upon the platform; the whole load being drawn by one little horse, with a fancy top-knot, and carrying upon his back a huge saddle, provided with three long horns most fantastically ornamented in brass—the center horn carrying a turret of bells and a wind vane. The shafts of the vehicle pass obliquely along the sides of the little animal, and fasten to the saddle a little above his back by a heavily stitched leather band, which slides through openings or grooves cut in the top of the two outer horns. Here is another heavy cart, loaded with cabbages; the skeleton form of a large white ox is yoked between the heavy shafts. On one side of the ox is a little horse, a cow, or a mule; on the other, a small donkey, fastened to the cart by ropes and whiffletrees, to assist in hauling the load. Here is another immense load of carrots, macaroni, or salt cod-fish, drawn by a horse, mule, and donkey, working abreast. Here, again, is a small, open, two-wheeled gig, drawn by a donkey, or a very small horse; the rider is a full-grown man, who jogs along apparently indifferent of the cares and opinions of the world. There is a woman trying to drive a black pig, having a rope tied around his body, and is very nearly being run down by an elegant carriage with fine horses and liveried servants, while all along the sidewalks, fronting the houses, and covering church steps, are to be seen lazaroni sunning themselves; women washing, cooking, spinning from the distaff, examining their childrens' heads, or having their own attended too; half-naked boys running after carriage, pounding their chins to attract our notice; and beggars, plenty, old and young, sick and sore—the whole constituting an actual scene of every day life along the shores of the bay of Naples, and no mere fancy sketch of a letter-writer. Beggary is reduced to a science in Naples, and we witnessed many singular and disgusting forms of it which suggested a most wretched form of society.

Herculaneum is still a buried city, and but little is known of its extent, except what can be conjectured by the discovery and partial excavation of a theater of very solid construction, and capable of seating 8,000 people. This structure was accidentally discovered during the process of digging a well eighty feet below the surface, and some fine marble statues were found which are now at the museum at Naples. All hopes of knowing anything more of this buried city of the dead are forever lost, as a modern city stands above it, and this may some day share the same fate.

Pompeii, of which the world already knows so much, lies buried upon an open plain, and it is estimated that about one fifth of the city has already been uncovered. It is a strange and melancholy sight to walk through its well paved streets, still bearing the marks of vehicles, worn more than two thousand years ago; and amidst ruined heathen temples, amphitheaters, forums, theaters, palaces, houses, mills, tombs, and other structures, which speak of a people who cultivated many of the refined arts and customs of our Christian civilization.

The museum of Naples contains a very extensive collection of objects of art and utility, dug out of this overwhelmed city; and the work is still going on, though slowly, under direction of the government. As I wandered about through the ruins of Pompeii, I could not resist the conviction that all the objects which have been dug up ought to have been kept where they were found, thus forming the grandest and most interesting museum in the world. S. H. W.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

Canal Navigation---Steam Power and Enlargement of Locks.

MESSRS. EDITORS:—Having had some experience in building canals in this country and in Canada, and seeing considerable discussion going on in your State Convention respecting the New York canals, with your leave I will venture to make a few suggestions respecting them, not that I am silly enough to suppose I can effect any particular change in their management; but if I should happen to let fall even *one* idea that will benefit the people of your Empire State, I shall feel amply rewarded.

One great obstacle to the expeditious navigation of the Erie Canal is the numerous locks and the great length of time required to pass the boats through them. To obviate this difficulty, I would suggest the lengthening of the locks to eight hundred or one thousand feet by removing the gate at the upper end of the lock, and then extend the lower level by excavating the 800 or 1000 feet, at which point let the upper part of the lock and gate be put in as it was before. It will readily be seen that instead of locking one boat at a time, six, eight, ten, or more, could pass at the same time. Of course the sluices could be correspondingly increased, to give the water the same free passage it now has in the short locks. Wherever the fall is too precipitous, in order to carry out the foregoing, it will only be necessary to extend the length of the canal by a more circuitous route, thus lengthening the grade also.

Another obstacle to expeditious navigation by the canal, is the present method of towing the boats, which is not only slow but expensive. To obviate this, I would suggest the laying of a railway track on the present "tow path," and tow with locomotive engines. If a double track should be thought too expensive, double switch "turnouts" could be put in at each mile, or as often as necessary, which would be short, as only the engine and tender would require to occupy them. It is estimated that a forty-tun engine, with small drivers, will tow thirty boats at the rate of two and a half miles the hour. Suppose one-sixth of the time should be occupied in locking, the engine would take the thirty boats from Buffalo to Albany in about seven days—no small saving of time, to say nothing about expense. At this slow rate of speed, the wear on the track and engine would be scarcely perceptible.

At the present high prices for labor and running such an engine would not be over thirty-two dollars per day. For the seven days it would be $224, or a little less than eight dollars to tow each boat from Buffalo to Albany, and *vice versa*. The expense of towing, in such a case, would be added to the canal tolls; and the freighter would only have to furnish and man his boat.

By running the engines at a uniform rate of speed, it will be difficult to estimate the number of "trains of boats" that could be taken through at the same time.

The "tow path" of the canal being ready for the superstructure, or nearly so, the expense of this method of traction would only be the ties, iron, engines, water tanks, and engine houses.

The plan of lengthening the locks here suggested is a very different thing from "enlarging" them; as, after the excavation is made, the same gates, stone, etc., can be used that would be taken from the upper end or half of the short locks.

I am clearly of the opinion that there is no economy in moving freights on a canal, where horse-power is used, by enlarging the boats, and consequent increase in width of the size of the boat; consequently the horse-power must be increased if the boats are enlarged. As for towing by steamboats or tugs, I believe it is an admitted fact, that in our shallow canals it is impracticable.

According to the foregoing estimate one engine would make two round trips from Buffalo to Albany per month, taking thirty boats, each way, each trip. This would be 120 boats taken through the canal per month. For the seven months of navigation it would give 840 boats as the work of one engine. At this rate 100 engines would move eighty-four thousand boats through the canal once during each season of navigation. Supposing each boat were to carry two hundred tuns of freight, it would amount to sixteen million eight hundred thousand tuns per season.

I am entirely convinced, if this plan of working the Erie Canal were adopted, there would be no necessity for building a ship canal around the Falls of Niagara, on the American side, or the adoption of any other expedient to move the heavy freights from the West to your city as rapidly as they may accumulate. ENGINEER.

The Mysteries of Boiler Explosions and Railroad Accidents.

MESSRS. EDITORS:—"Cause unknown." This is a favorite verdict for a coroner's jury on accidents of all kinds. It has in some sort, taken the place of the old-time mortuary verdict, "died by the visitation of God," and is an easy escape from responsibility and a soothing salve to conscious incapacity or willful negligence. "Nobody to blame" is another comfortable and accommodating verdict in case of accident. These set terms are well enough for whitewashing purposes,