CAPTAIN JOHN ERICSSON.

This distinguished inventor and engineer died at his home, No. 36 Beach Street, New York City, at 12:39 A.M., March 8, of an affection of the kidneys, of which he had been ailing for about two weeks, although his indisposition had not been considered serious until a day or two before his death. He would have been 86 years old on July 31 next.

Capt. Ericsson was born in 1803, in the Province of Wermland, among the iron mountains of Sweden. His father was a mining proprietor, so that in his youth he had ample opportunities to watch the operations of machinery. He early became an expert draughtsman, and exhibited a strong predilection for scientific and mechanical pursuits, making several philosophical instruments and miniature machines before he was eleven years of age. Count Platen, a distinguished civil engineer, and friend of Bernadotte, King of Sweden, heard of Ericsson's precocious mechanical talents, and went to see him. The Count examined his plans and drawings, and expressed high approval of them, saying: "Continue as you have commenced, and you will one day produce something extraordinary"—words of encouragement which sank deeply into the mind of the young mechanic.

Young Ericsson was soon afterward entered as a cadet in the corps of Swedish engineers, and at 12 years of age was appointed to service under Count Platen, in the construction of the series of canals which, in connection with river and lake navigation, gives Sweden internal communication between the North Sea and the Baltic. The work was carried on by the labor of soldiers, and young Ericsson had to provide employment for about 600 men. Work was conducted only in the summer, but his time in winter was devoted to the plans and drawings, and many important works on the canal were constructed after the drawings made by him at this early age.

He afterward entered the Swedish army as a lieutenant, at the age of 17, rose to be captain, and was appointed military surveyor of the north highlands of Sweden, the archives of the government at Stockholm now containing maps executed by his own hand of fifty square miles of territory.

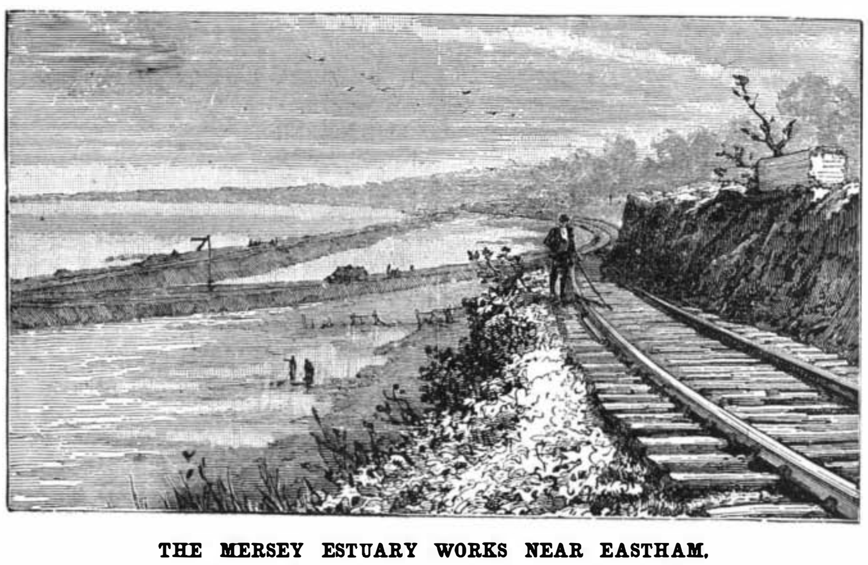
He was also at this time actively occupied with mechanical inventions, and made a small engine to be operated by the heat products of Swedish pinewood as a substitute for steam—this engine probably being in fact the real predecessor of the hot air engine, which he afterward successfully developed. In order to better prosecute his plans in connection with his new motor, he visited England in May, 1826, and took up his abode in London. Here he soon brought out a number of other new inventions, especially an improved boiler with artificial draught, associating himself for its manufacture with Mr. John Braithwaite. While thus engaged, in 1829, the Liverpool and Manchester Railway Company offered a prize for the best locomotive engine. Ericsson immediately set to work and planned an engine, made the working drawings, had the patterns made, and the whole machine completed within seven weeks. Three engines were entered for the prize—the Rocket, built by George Stephenson, the Novelty, by Ericsson, and the Sanspareil, by Timothy Hackworth. The details of this competition have afforded one of the most interesting chapters in the whole history of steam engineering. The Novelty had a bellows draught and winding flue boiler, and with its tank weighed 3 tons 17 cwt., while the Rocket weighed with tank 7 tons 9 cwt. The Rocket was the only engine which fulfilled the conditions required, and therefore was the accepted competitor, but the Novelty commanded high praise, and is said to have made a speed as high as fifty miles per hour.

CAPTAIN JOHN ERICSSON.*

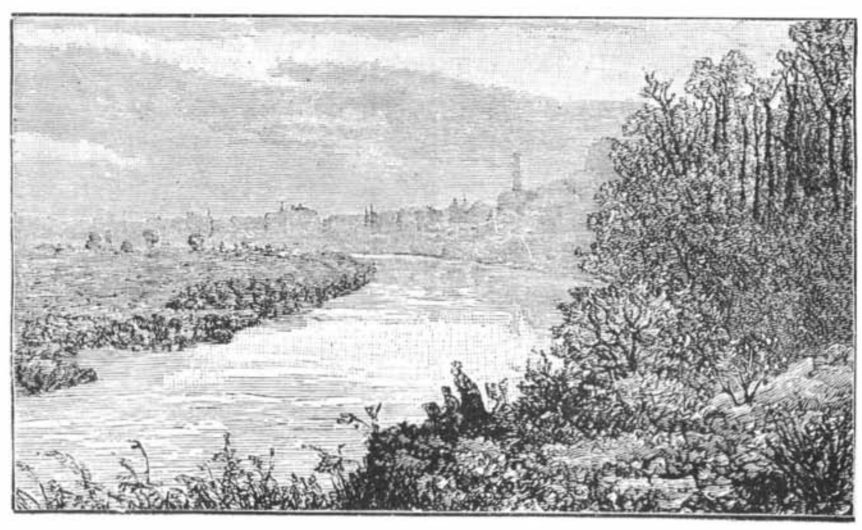
Captain Ericsson about this time brought forward the idea of a screw propeller for vessels (which had been before proposed) and urged its adoption, especially for war vessels, in conjunction with the arrangement of screw and all the machinery under the water line. He proved the utility of his plan on a small boat on the Thames, which the watermen styled the Flying Devil. The British Admiralty authorities took a trip on this boat, but decided against the plan from the supposed difficulty of steering a war vessel with a screw at the stern. Two Americans had, however, examined Captain Ericsson's drawings, taken a trip on his little vessel, and highly appreciated its merits. They were Francis B. Ogden, American consul at Liverpool, and Commodore Robert F. Stockton, U. S. N. Through the influence of the latter, Captain Ericsson came to the United States in 1839, and in 1841 became engaged with Commodore Stockton in building the U. S. steam frigate Princeton, said to be the first successful propeller war vessel with all its machinery under the water line. In France Captain Ericsson is called the father of screw propulsion applied to war vessels, as he designed the Pomone, the first screw vessel in the French navy. In 1837 he built a vessel having twin screw propellers.

About 1833, Captain Ericsson brought out his first practical hot air engine, which has undergone many improvements since that time, but of which many thousands have been in use for years, although, when considerable power is required, the high anticipations at first entertained in regard to them have not been realized. He was also among the earliest constructors of steam fire engines, an engine of this kind made by him having been used in London in 1829. During the thirteen years that Captain Ericsson lived in England he is said to have brought out forty new inventions. Among them were a file-cutting device; an instrument, still in use, for taking soundings at sea; a

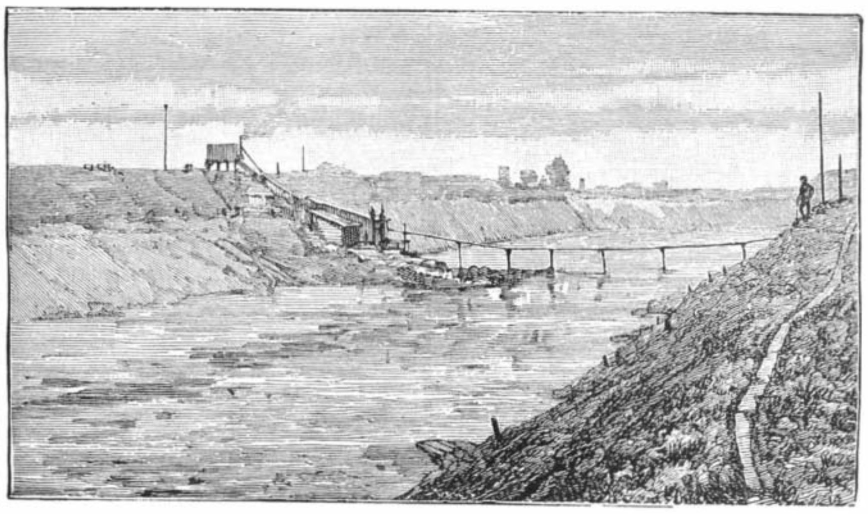
* A more extended illustrated article upon Capt. Ericsson and his work will be published in the next issue.



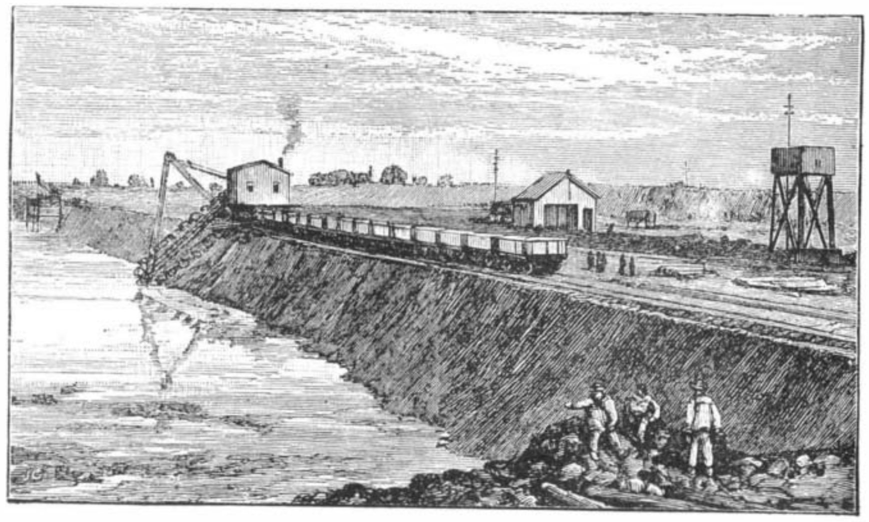
THE MERSEY ESTUARY WORKS NEAR EASTHAM.



SITE OF THE WARRINGTON DOCKS.



DIVERSION OF THE MERSEY AT THELWALL.



THE GERMAN STEAM DIGGER AT LYMM, CHESHIRE.

PROGRESS OF THE MANCHESTER SHIP CANAL.—[For description see page 164.]

hydrostatic weighing machine, an apparatus for making salt from brine, a pumping engine, a rotary steam engine, and a system of artificial draught for steam boilers, dispensing with huge smokestacks and economizing fuel. In 1828 he applied on the Victory the principle of condensing steam and returning the water to the boiler, and in 1832 he gave to the Corsair the centrifugal fan blowers now generally used in American steam vessels. In 1830 he introduced the link motion for reversing steam engines on the locomotives King William and Adelaide, and in 1834 he superheated steam in an engine on the Regent's Canal Basin.

Undoubtedly the greatest of all Capt. Ericsson's achievements, however, and the one by which his name has become most widely known, was the building of the Monitor, in 1861. This little iron gunboat, almost submerged, and with revolving turrets for the guns, was so successful in the now historic naval engagement at Hampton Roads, early in 1862, that the combat marked an epoch in modern warfare on the sea, and changed the course of naval construction throughout the world. This vessel was built by Capt. Ericsson in one hundred days from the time the contract therefor was signed, and at a cost of $275,000. Little faith was anywhere felt in her success, and it was only with great difficulty that the government was induced to enter into the contract; but immediately following the day on which the Monitor drove the Merrimac, disabled, back to Norfolk, all maritime nations began the policy of building armored ships, which, with many changes, has since been pursued.

Capt. Ericsson has since made many improvements in this class of vessels, and in 1878 had constructed, at the Delamater Iron Works, a torpedo boat, which he styled the Destroyer, that had many novel and ingenious features. During the attack the vessel is to be submerged, the torpedoes themselves to be discharged under water by the aid of a novel construction specially designed therefor.

During late years Capt. Ericsson has devoted a good deal of time to the construction of a sun motor, and has built a series of experimental machines for utilizing the sun's radiant heat. The leading feature of these machines is that of concentrating the heat by means of a rectangular trough, having a curved bottom, lined on the inside with polished plates, so arranged that they reflect the sun's rays toward a cylindrical heater placed longitudinally above the trough, this heater to contain steam or air, to transfer the solar energy to the motor.

Captain Ericsson has resided for more than a generation at the house where he died, but for many years it has been rare that any one has been allowed to see him. He had a high appreciation of the value of time, economizing every moment in the working out of some one or another of many proposed improvements. The speed with which he mastered details and threw off designs is said to have been almost unparalleled, and he was a very close critic of all plans or drawings made for him. His manners were simple and dignified, but without assumption, and he impressed every one with whom he came in contact by his broad views and rich stores of learning.

The deceased leaves no family. He married an Englishwoman many years ago, but his wife died childless more than a quarter of a century ago.

THE MANCHESTER SHIP CANAL.

Although little more than a year has elapsed since the cutting of the first sod in this vast undertaking, the work is now, thanks to the energy of the contractor, Mr. T. A. Walker, in a remarkably forward state. Indeed, more than one-third of the actual excavation has already been accomplished. The transformation wrought along the line of the canal in so short a time is truly marvelous. The meadows along the banks of the Mersey and Irwell, on the borders of Lancashire and Cheshire, now resound with the shrieks of dozens of busy little locomotives and the rattle of innumerable pumps and steam excavators. The landscape has suffered rather badly; not only has every tree along the canal been felled, but entire woods, such as those at Moore and Eastham, have been wiped off the face of the earth; while the green meadows have been cumbered by enormous and hideous spoil-banks, which meet the eye in every direction. The end, however, in this case, at least, certainly justifies the means. A few years more, and the locomotives and other machines will, doubtless, be at work on one or other of the many ship canals now being projected; while the earth will hide its scars, and the unsightly tips will be clothed with a green mantle of herbage.

The greater part of the excavation is performed by various kinds of machines, of which the German digger is, perhaps, the simplest in its action, and, in suitable soil, the most effective. It is in reality a land dredger, and will excavate loose sand or soft earth at the rate of about two thousand tons per day, but in hard or stony ground it is helpless. The American digger, on the contrary, will cut through the hardest soil, and even soft sandstone, with the greatest ease; nay, it will even tackle the hard sandstone rock, after this has been "shaken up" with dynamite or blasting powder. There is something apparently diabolical in its method of working. With every movement of its huge spade it rips up a ton and a half of earth; and no one who has watched its work will deny that its nickname, "Yankee Devil," if not euphonious, is at least appropriate. Though of American parentage, this digger is made at Lincoln. Its daily task amounts to some one thousand two hundred tons. Besides these two machines, there are two other forms of powerful excavators, and many of other patterns working on the canal. The total number of machines employed is over eighty, while more than a hundred locomotives are required to dispose of the spoil. Some idea of the undertaking may be formed from the fact that Mr. Walker has found it necessary to lay upward of two hundred miles of temporary railway.

After leaving the Manchester, or No. 3, dock, the canal immediately passes the great No. 1, or Salford dock, where already the concrete quay walls are being built. From this point to Thelwall the canal follows pretty closely the course of the twin rivers Mersey and Irwell, touching little of importance save the Bridgewater Viaduct at Barton, to which we have already referred, and two railways—namely, the Cheshire Lines Railway at Irlam and the Midland line at Partington. These two railways, as also the other three which are cut by the canal, will be diverted and considerably elevated, crossing the canal by high level bridges, so as to leave a clear headway of seventy-five feet. At Thelwall the canal leaves the course of the Mersey and cuts straight across country to Runcorn, demolishing many private houses and the Latchford railway station on its way. It just touches the river below Warrington, at the site of the Warrington docks, which will be formed along the old river course. At Runcorn the canal again joins the Mersey. For the greater part of this distance the ship canal runs along the line of the old Mersey and Irwell Canal, which has already been blocked for traffic in a very summary manner. From Runcorn the canal skirts round the Cheshire side of the estuary of the Mersey as far as Eastham, where it finally enters the river. It thus crosses the mouth of the Weaver, and taps the salt traffic from Norwich and the Cheshire salt field.

Our illustration shows how the canal crosses one of the bays of the estuary, the canal being separated from the river by a training wall, which is being tipped across the bay from shore to shore.

The "Track-bridge," at Lymm, carries the contractors' main line across the Mersey. There are five such bridges within two miles, to such an extent does the river wind about. This railway now extends, without a break, the whole of the distance between Manchester and Eastham, and is the line shown in our view of the estuary works.

The canal, when finished, will be one hundred and twenty feet wide at the bottom, and the sides will be faced with stone. The whole of this stone is being cut out of the canal at Eastham, Ellesmere, Moore, Barton, and other places; while all the bricks required for the locks, railway works, and different structures are being made at Lymm. An excellent clay is dug out of the cutting there, and is converted into bricks by machinery on the spot. There are two mills at work, and the total output is about a quarter of a million bricks every week.

The river diversion at Thelwall is being cut to straighten the course of the Mersey a little; otherwise the canal would cut it twice within about three hundred yards. The deviation is now being faced with stone.

We are indebted for our present illustrations to some photographs taken by Mr. H. C. Bayley, of Lymm, near Warrington.—*Illustrated London News.*

The Robert Process for Iron and Steel.

About a year ago, a Frenchman, Gustave L. Robert, of Stenay, France, made some experiments which were the starting point of the new process, and the news of his experiments came to the ears of J. W. Bookwalter, the manufacturer at Springfield, Ohio. When he heard of this discovery, Mr. Bookwalter immediately went to see Robert's experiments, and he secured the right to the process in the United States. Returning to his factory in Springfield, he built an experimental plant and improved and expanded upon the idea of the inventor. After twelve months of experimenting he has perfected the invention, and within a month or two his first patent has been issued.

The process is so simple that every iron worker will wonder that he did not discover it long ago. It can be best explained by comparing it with the Bessemer process. The peculiarity and the defect of the Bessemer process is that the air is blown perpendicularly through the mass of iron, keeping it in constant agitation, and therefore mixing all the impurities with the iron. If the current of air be blown long enough to burn out all the silicon and carbon, the oxygen will also attack the iron, and the resulting product will be a weak and oxidized iron. To remedy this, the Bessemer system introduces some ore of iron, such as ferro-manganese, containing a large amount of carbon, and a certain amount of this peculiar ore is necessary to be used with the common ore to produce the Bessemer product. The Bessemer converter blows the air from below the mass of iron.

In the new converter, on the other hand, the blast is over the edge of the iron, horizontally, and produces a rotary motion in the metal, causing a most violent agitation, which presents every portion of the metal to the blast and at the same time blows the slag and other impurities which are floating on the surface to the farther side of the converter.

It will be seen that this converter is simply a mechanical means of doing exactly what the puddler does by hand, turning the iron over and over, and presenting all parts of the molten mass to the air, and exposing only a small portion of it at a time to the action of the blast. So long as there is any silicon in that part of the metal exposed to the blast, the oxygen will attack neither the iron nor the carbon; and so long as there is carbon, the oxygen will not attack the iron. By the new process all the silicon, and practically all the carbon, can be burned out of the iron, or only the silicon may be burned out and the carbon left, and the impurities removed by gathering them on the surface of the molten metal, leaving steel when the blast is stopped.

Thus, by the new process, every grade of iron can be made, from the purest wrought iron to the highly carbonated steel. It covers the whole catalogue of products of iron ore. The new process is like the Bessemer process in this—no fuel is necessary in converting the melted cast iron into the finished product, which by the Bessemer process is Bessemer steel, and by the new process is any grade of iron or steel that may be desired, whether metal for machine bolts or metal to be made into surgeons' tools. The development of the Bessemer process has prepared the way for this new process. The perfection of the converter, and of the blast machinery, and all those appliances which distinguish the Bessemer works of to-day from the early ones, are necessary in the new process. The marvelous feat of mechanical engineering which was hardly a less noteworthy achievement of Sir Henry Bessemer than the discovery of his process itself is as useful to the new process as to his. A Bessemer converter weighs, with its contents, from twenty to thirty tons, and it is moved by a gentle effort, and it receives a blast so powerful that the whole mass of molten metal is heated to the highest temperature that has hitherto been used in the practical mechanical arts. In the materials of its manufacture, and in the appliances for its manipulation, the new converter has the same essential necessities as the old.

Since the metal which comes from the Robert converter can be a pure iron, a low or mild steel, or a steel high in carbon, from this converter can be poured every grade of metal that is used by the smith or a rolling mill. And this range of metal includes iron that is now made by the puddling process, which is the iron used by the smith and manufactured by the rolling mill into all forms of bar and sheet iron; the steel now made by the Bessemer converter, which is used for railroad iron, for iron beams and girders for buildings, for ship building, and all forms of massive iron; the mild steel which is used for boilers and those processes requiring a soft and tough steel; and a crucible steel, from which are made the tools and all the finer products of the mechanic. This means that every grade of iron or steel that has hitherto been used for railroad bars and ship plates can now be produced by the same method; and that all products of the ore may be produced by a mechanical process, and so cheaply as to give a greater stimulus to the use of iron and steel than any previous invention. Since the blast of air in the Robert process does not support the enormous mass of iron as in the Bessemer process, the blast is vastly less, and the entire plant, including engines and all the necessary machinery for the production of 100 tons a day of any grade of iron or steel, can be built for less than $10,000, or one-third the cost of the Bessemer plant of the same capacity. The tuyeres of a Bessemer converter must be renewed after fifteen blasts. The tuyeres of the new last for 250 blasts. The Bessemer converter must be relined after a very few blasts; the Robert after 1,000 blasts. By the new process the metal is heated much hotter than by the Bessemer process, and is therefore much more fluid; but this quality, added to the freedom from impurities, enables the new converter to pour the metal directly into the billet which is to be rolled into the desired form, whereas the Bessemer product is so impure that it is cast first into a 14 inch ingot, and then "broken down," as it is called, being rolled through a succession of rolls which reduce the ingot to four inches square. The new system makes possible the saving of about four dollars a ton in the making of the billet.

The cost of making all grades of iron or steel is the same by the Robert system, and that cost is less than the cost of making Bessemer steel. The significance of this will be appreciated when it is realized that the poorest grade of iron costs from four to six dollars a ton more than Bessemer steel, and the highest grade of tool steel costs several hundred dollars a ton more. Not only are all these products, which are already made