

Perils of the Under Water Tunnel

Experience With Those Now Being Constructed Beneath New York's Great Tidal Rivers Has Revealed Unforeseen Dangers

The Gigantic Scheme of Subaqueous Excavation Which Has Been Going on For Several Years Has Claimed Its Army of Victims--An Undertaking Practically Without Precedent. Engineer SooySmith's Freezing Process Being Tested.

HUNDREDS of lives are being sacrificed as millions of persons gain fifteen minutes in reaching or leaving Manhattan Island. Not a week passes that there is not at least one accident in the railroad and trolley tunnels that are being built under the Hudson and East rivers. When the workmen escape death or injury in an accident they have little or no time to think of their good fortune. They must hasten to repair the damage and continue to work. The public wants no delay in the completion of these wonderful subaqueous passages. If the workmen do not escape--well, there are others to take their places. It sounds harsh, but it expresses the situation.

Advancing foot by foot, some days inch by inch, the "sand hogs," as the subaqueous tunnel workmen are called, face many hidden dangers. Laboring in an air pressure of thirty-five pounds or more to the square inch, which alone threatens them with the dread catarrh disease known as "the bends," they are also likely at any moment to experience a blowout or a cave-in. They must ever be ready to dodge falling rocks, although there is practically no chance to dodge, and they must beware of treacherous quicksand that would suck them in before help could come.

Slowly, laboriously, painfully, the tunnel workmen, with the aid of every modern device applicable to the task, dig their way through rock, sand and silt, or, worse than all, a combination of the three. And while they bore they are constantly on guard against the many lurking dangers, knowing that they are shut off from prompt aid and that in a trap to meet as best they can the fate that is likely at any time to overtake them.

To make his lot all the harder, the "sand hog's" surroundings are particularly disagreeable. His working quarters are limited. Although there are numerous incandescent lights, it is impossible for the eye to penetrate more than a few feet of the thick haze that gathers in these caverns far down under the river. From the walls and ceiling drip water, which runs down and forms slimy pools at his feet. Dungeons of medieval times presented few if any more horrors and certainly many less dangers than do

the river tunnels of today during their construction. They vividly recall Victor Hugo's description of the huge sewers of Paris, through which Jean Valjean passed to save the life of his enemy and his own. But that hero was working under circumstances such as inspire all unusual and brave deeds. In the case of the tunnel workers their

The strongest man cannot stand more than six hours of the twenty-four under the high air pressure. His wages are about \$1.50 a day. The laborers are of that class that would earn much less at any occupation not so hazardous. Upon going to work, after donning oilskins and rubber boots, they descend the shaft and walk

Normal air pressure is about fifteen pounds to the square inch. In the working chamber of a tunnel it is supposed to be thirty-five pounds, but many of the workmen have declared that at times the contractors are compelled to force it up to from forty to fifty pounds. With every additional pound of air pressure to bear the chances of a workman surviving many days decrease.

The mere working under such high air pressure is not the only danger. In case of accident or an attack of "the bends" it takes twenty minutes to pass to the outer world. If that amount of time is not spent in the air lock while the pressure is gradually reduced the

rapidly. It is almost impossible to blow out a candle in a pressure of fifty pounds. In case of a cross circuit electric wires flare up in a moment.

Because of the frequent deaths from catarrh disease and accident, especially in the Pennsylvania's East river tunnel from Thirty-fourth street, Manhattan, the New York authorities began proceedings on June 4 to inquire into the sanitary conditions of the tunnel works and the causes conspiring to produce such a large and unprecedented death record. It was a matter of record that twenty-one deaths had been reported from Jan. 9 to May 29 in that tunnel alone from "the bends" and from accidents, including burning. In nine

the laborers were compelled to lock themselves in.

"In my estimation," said the physician, "the lock tender is the most important man in the tunnel. The lives of all the others depend on his intelligence and expert knowledge."

He declined to express an estimate on the number of deaths in the eight tunnels on both sides of the river, because so many men die at home. He explained that laborers who get "the bends" are usually green men, foreigners who cannot speak English and are therefore unable to tell their physicians where they have been working. Many men also die from catarrh disease, or "the bends," in the tunnel shafts, and

the courts to be of no force, and it is said they or their families rarely seek to collect damages. When they do, the company goes to the company's lawyer to man who was in bed four months as a result of a tunnel accident.

Frightened by the startling revelations that were being made, the companies interested succeeded in blocking the proceedings soon after they were well under way. They alleged that the coroner was not within his legal rights in conducting such an inquiry in the manner he had pursued. It was asserted that the contractors used every means to protect the lives of their employees, that the latter were given the best medical attention possible under the circumstances and that the sanitary conditions in the tunnels were as satisfactory as could be expected.

Lawyers representing the tunnel concerns advised important witnesses who had reported at the session to leave without testifying and advised others who did take the witness stand not to swear to their testimony or to any depositions. As a result of successful opposition to the inquiry neither side of the controversy was fully brought out.

Although there is little hope of eliminating the dangers of the work in tunnels now being constructed, the risk in future operations of that kind will be reduced to a minimum if the freezing process proves as successful as expected. Charles SooySmith, an American engineer of note, invented the process and holds the patents for it. By means of a refrigerating plant the temperature in that part of a tunnel where the work is going on can be reduced to 25 or 30 degrees below zero, and the surrounding mud and water are frozen so hard that it is necessary to loosen the mass with a jack and sometimes to blast.

It is held by Mr. SooySmith that the use of compressed air, however, would be avoided, "the bends" would be a thing of the past, and if free were not exactly welcomed by the workmen in view of the frigid temperature, it would at least be easy to do from them.

Mr. SooySmith offered not long ago to dig the remainder of the Pennsylvania railroad's tunnels by that process, the latter company financing the venture. As the freezing process had never been used except in an experimental way the railroad declined to take the risk, as there was no telling what new difficulties might accompany the process and whether its use would possibly result in the destruction, either in part or in part, of the work that had already been done.

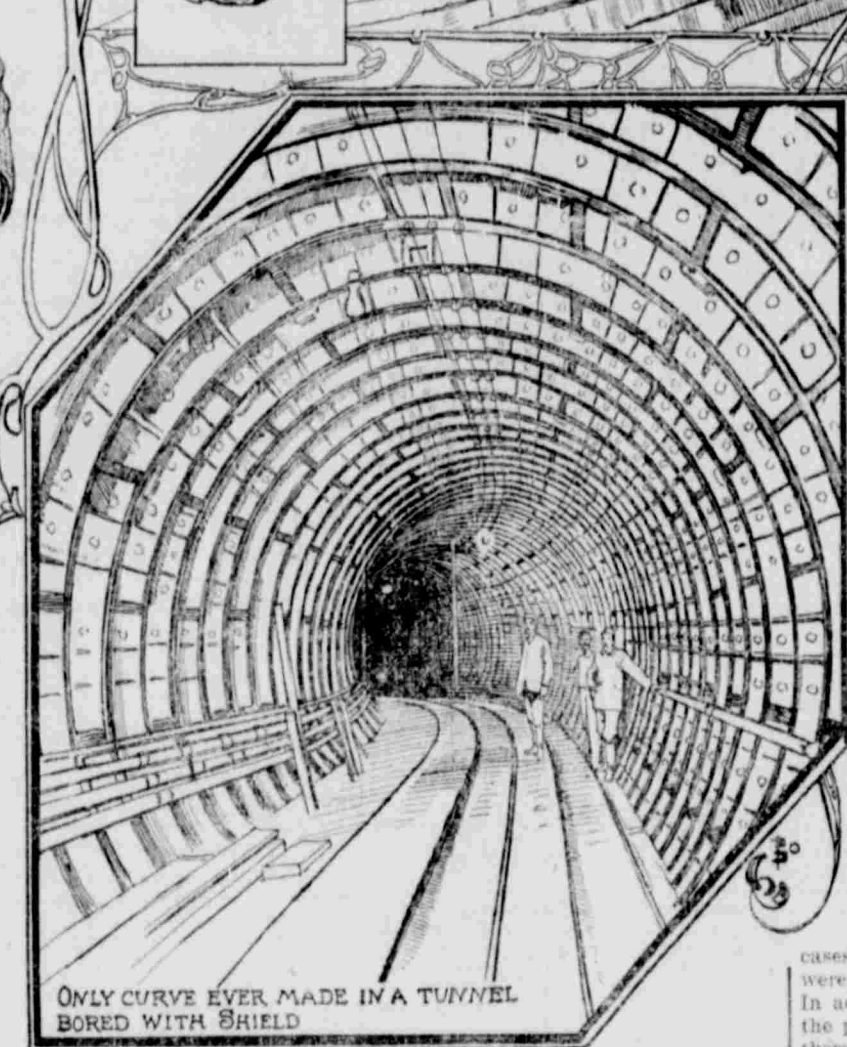
Officials of the road were so impressed with the plan, however, that the company agreed to make experiments with the freezing process, and if the results were satisfactory to use the future tunnel work. The Pennsylvania is now spending \$100,000 in these experiments, which if successful as anticipated will not only save many men in future subaqueous excavations but will prevent great loss of life and innumerable injuries from accidents.

HAROLD B. GREGORY.

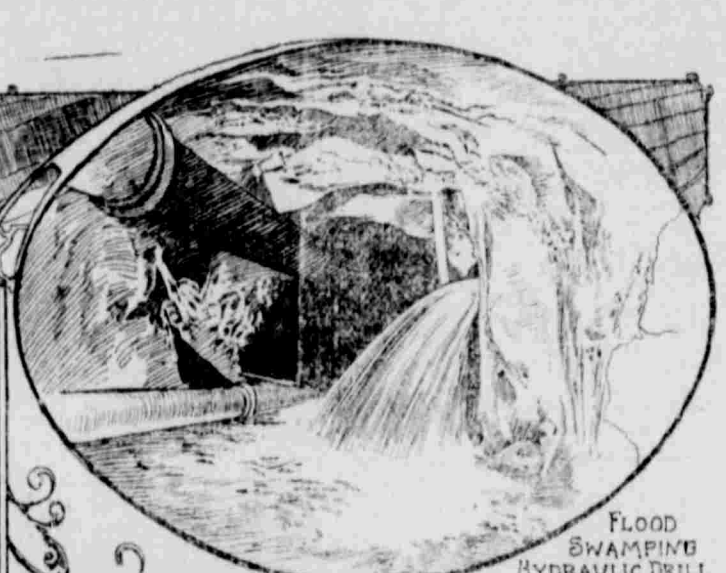


CHARLES SOOYSMITH
ENGINEER

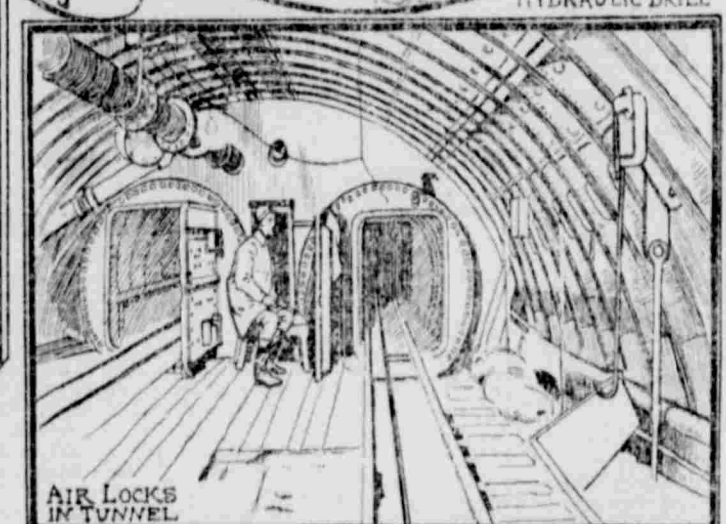
THE SHIELD



ONLY CURVE EVER MADE IN A TUNNEL
BORED WITH SHIELD



FLOOD
SWAMPING
HYDRAULIC DRILL



AIR LOCKS
IN TUNNEL

dangers and sufferings come merely in the daily grind.

Although many lives have been lost and many employees have been injured in a long series of accidents in the Hudson river tunnels, the work under the East river has proved to be far more dangerous. That is because of the treacherous nature of the river bed. Far down where the "sand hogs" are working the material excavated is principally silt, holding large quantities of water. Occasionally the borers strike rock, which must be blasted away.

It is in the work around that complicated mechanical device called a shield, which is forced forward by hydraulic jacks, that the "sand hog" takes his life into his hands. It is there that he must use the shovel or pick or most blast, while an air pressure that is supposed to be not more than thirty-five pounds to the square inch counterbalances the pressure of the surrounding earth and the water above, thereby keeping the tunnel from caving in. A caisson workman remains in the compressed air chamber three hours. Then he comes out for a three hour rest.

through the completed part of the tunnel, lined with water and air tight steel plates, until they come to the compressed air lock. They climb into that, and then compressed air is driven in so that they may gradually become accustomed to it. They then go to the forward compartment and relieve the gang that is on duty. Workmen are supposed to spend twenty minutes in the air lock to become accustomed to the change.

results may be fatal. The companies digging the tunnels have physicians in attendance, but they play on the outside. It takes a victim of "the bends" twenty minutes to reach him. If he rushes out immediately his sufferings are increased many fold.

The pressure is dangerous in other ways. It is a difficult matter to fight fire in the compressed air chamber, because the additional quantity of oxygen makes it burn the more fiercely and

others succumb on their way home. A policeman testified that at different times when on duty near the foot of East Thirty-fourth street he had seen the bodies of men stealthily removed from the tunnels to the morgue.

He also said he had frequently seen men with "the bends" returned in ambulances from the hospitals, presumably to die in the shaft.

Employees of the contractors testified that all laborers must sign a paper releasing the company from all pecuniary liability in case of death or injury by accident. Foreigners who are employed are ignorant of the fact that such a release has been held by

Captain Simon Lake's New and Successful Submarine; Another Notable Triumph For American Ingenuity

THE recent successful exploit of Captain Simon Lake in navigating a submarine built at Newport News, Va., from that point to Bridgeport, Conn., a distance of about 400 miles, is evidence that there is no let up in the development of this species of naval fighting machine. No other submarine in this country had ever attempted a test of this severity. Heretofore all that have ventured out to sea have been accompanied by a tow or at least one escort.

The Lake, as this newest submarine wonder is called, seems to be a great advance in modern naval science. She put to sea with a crew of eight men, and forty hours later made her appearance off Atlantic Highlands, N. J., having sailed over 300 miles of sea travel as unconcerned as a coast liner. Thence she proceeded up the East river to her destination. The fact that she made this considerable distance entirely without assistance from any other craft and under her own power is causing those who have never lost faith in the submarine to experience the deepest satisfaction and those who have been doubtful to exchange their misgivings for enthusiasm.

The Lake is equipped with two kinds of motive power. When moving on the surface she is propelled by powerful gasoline engines. The moment she becomes submerged the motor is changed to electricity. She is eighty-five feet in length and is reputed to be the largest submarine ever built in America. She is provided with three torpedo tubes and has carrying capacity for five large torpedoes.

According to the log of the skipper, the Lake encountered some rather ticklish weather on the voyage up the coast, but the boat met it without flinching. She proved herself to be the sturdiest kind of saller, and her propelling machinery worked like a charm. Most of the difficulties which have made the navigation of the submarine a matter of a good deal of uncertainty seem to have been overcome by the designer of the Lake, and it looks very much as if the day had come when this form of sea fighter is to be in the ascendant.

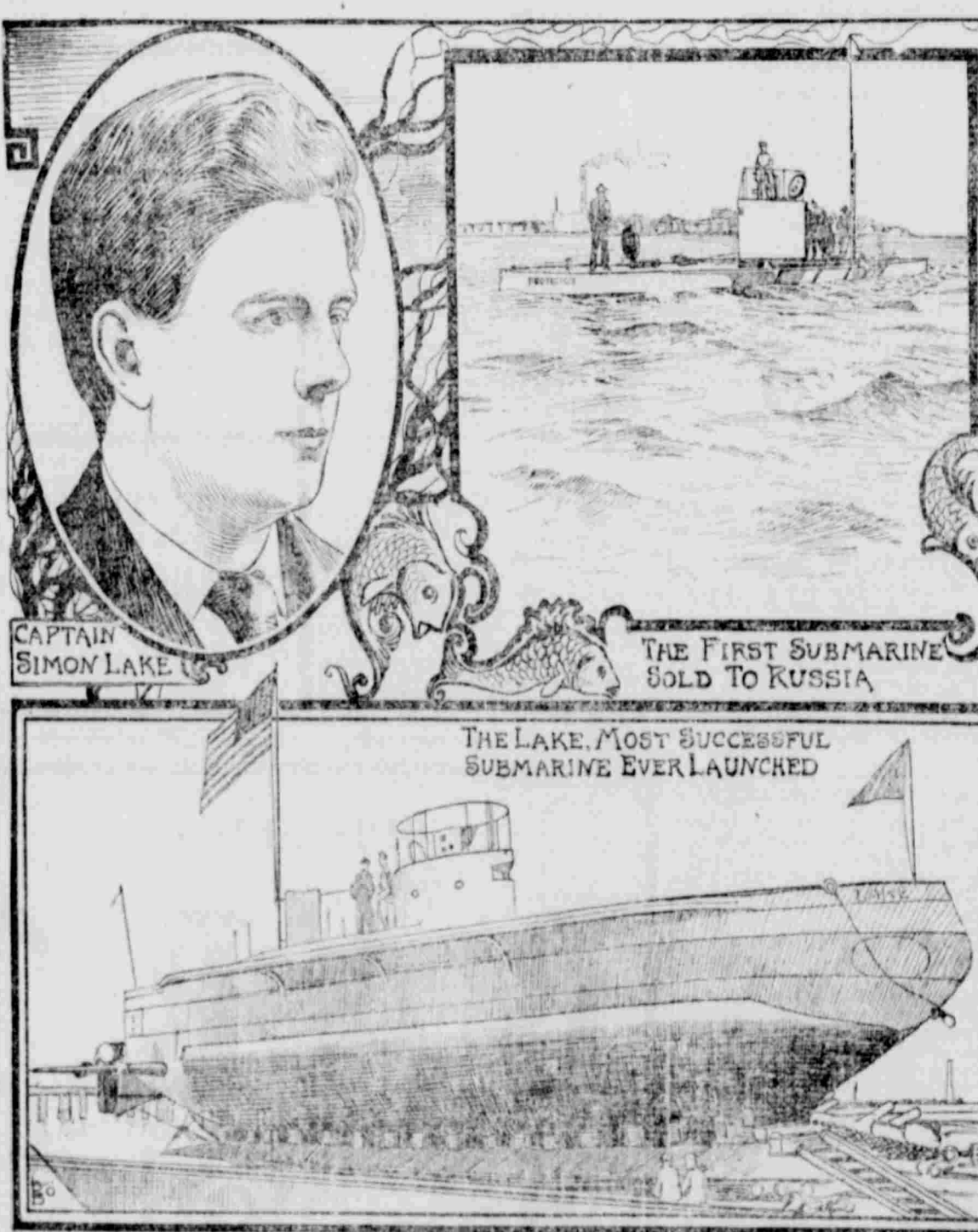
The triumph of the Lake has certainly given a tremendous boost to the reputation of its designer. For years

this clever young Connecticut engineer had plodded at his Bridgeport home, sans friends, sans influence, sans capital. Every effort that he had made to win the recognition of the naval authorities had resulted in failure. Finally, weary of the constant aloofness of his countrymen, he accepted a rather flattering offer to settle in Berlin, and at the German capital his merits have attracted the attention of the naval experts of all Europe.

The account of Simon Lake's struggle to secure a hearing in America reads like a romance. Under the circumstances it is almost incredible that such a series of untoward events could have happened. In 1893 the United States navy department issued an invitation to naval architects and engineers interested in the development of submarine torpedo boats to submit plans for such a vessel. Captain Lake, then in his twenty-second year, accepted the invitation and sent in a design and the specifications for such a craft.

But he was doomed to disappointment. His proposal lacked technical form, and he was not prepared to guarantee that he could "furnish the goods." As a consequence his bid was rejected. Although he did not know it at the time, his design received much verbal commendation from some of the department's experts. Had he known of this, it might have dulled the sting of disappointment, but he only knew that the award had gone to the Holland design, and later he found that a submarine was under construction by that company at the Columbian works in Baltimore. It was the original Plunger, the pioneer of a type of submarines to which the government has remained faithful until the present day. It was in a boat of this kind, the most recent Plunger, that President Roosevelt was submerged for a brief period one day last summer.

Lake did not become hopelessly discouraged at his failure to interest the government in his design. He went immediately to work and built a crude submarine of modest dimensions, and when it was completed gave public demonstrations which proved the fundamental soundness of his idea. This boat was a sort of homemade affair, made of pine planking tarred on the outside. But the performances of the Argonaut, Jr.--for so Lake named her



CAPTAIN
SIMON LAKE

THE FIRST SUBMARINE
SOLD TO RUSSIA

THE LAKE, MOST SUCCESSFUL
SUBMARINE EVER LAUNCHED

INTERESTING BITS.

Professor Koch is said to have decided to apply the Nobel prize recently awarded to him to the publication of a complete edition of his scientific writings.

The Bible Evangelizing company is a Japanese organization now three years old. Pastors, Bible women and other workers engage in its work, which consists of reading and preaching.

beginning to end at fixed times and with explanations to one inquirer. This method of concentration has had good results.

An ingenious Italian method of manufacturing fraudulent antiques is described in a scientific journal. A rough imitation is struck of coins bearing the head of Tiberius, Caligula or some other emperor.

"fed to" turkeys. By the time the imperial couple has gone through the turkey's digestive process it displays a degree of corrosion almost exactly similar to that of a genuine relic.

One of the natural curiosities of South Africa is the "sneeze wood" tree, which is so called because it cannot cut it with a saw without sneezing, as the fine dust has exactly the effect of snuff. No insect or worm

taste, and when placed in water it sinks.

The Order of the Garter has been conferred on only two oriental rulers--namely, the shah of Persia and the emperor of Japan.

The ranch in which the lord mayor of London lived on state occasions has been in use since the year 1757.

In northern China the average annual rainfall is under forty inches; it

increases from the coast toward the interior of the empire, and in individual years it is subject to large fluctuations. In Korea the annual fall is about thirty-six inches on the west coast and is generally more than forty inches on the east and south coasts.

Items in the first great athletic meeting held in China, which took place at Canton, were arithmetic races. Pupils from schools carried slate and pencil,

counted a blackboard containing a sum to be solved. The boys were lined up as they reached the goal, and those whose calculations were wrong were then eliminated. The first three left in the line were counted winners.

The United States Pharmacopoeia is being translated into Spanish by the Society of Pharmacists in Cuba.

If there is a labor grievance in a German porcelain factory the case is presented to a committee of the workers' association, and if the manufacturer is sustained and a strike is declared by the workers every manufacturer in the association is bound by its agreement to shut down his works until the matter is adjusted.

Australia exported 22,204 tons of butter to England from July 1, 1904, to April 29, 1905.

York, though the most buoyant substance, will not rise again if sunk 20