

factors that will but slightly influence the probable result of the general problem.

The essential thing to state is that the system of locks adopted has not been combined or devised for the needs of the cause—it exists. Mr. Eiffel can answer for its operation and base his expectations upon striking examples borrowed from the history of previous great public works. Any other project for traversing the passage between the two Americas, moreover, would have necessitated locks of this or some other kind, from the moment

crossing from one ocean to the other, say a daily consumption of 22,290,000 cubic feet of water, furnished by the Chagres at the rate of 324 cubic feet per second. This figure may be carried to 350 cubic feet on including the losses by evaporation and infiltration.

The supplies of water disposable are the following: the waters of the Chagres basin, which has an area of about 360,000 acres; the basin of the Obispo, of an area of 36,000 acres; and the basin of the upper Rio Grande, of an area of 4,000 acres.



FIG. 7.—WORK ON CULEBRA SECTION.

that the necessity of opening the canal at a fixed date intervened. The fantastic ship railway proposed by the late Captain Eads would alone have escaped this practical necessity. The dead canal is the only desirable and final one—the lock canal is an immediate and practical solution.

Traversing the Lock Canal.—What will be the system of traversing the lock canal by ships? It is agreed that a vessel moving at a fitting, but moderate, speed will make six miles per hour in the large reaches and 1,050 ft. in the short ones. It is admitted, besides, that it will take about an hour to pass through a lock. Hence, taking account of the time necessary for the entrance of ships in the lock chambers, their exit, the filling and emptying of the chambers, the maneuvering of the gates, etc., an isolated ship ought to pass from one ocean to the other in 17h. 28m., and a ship with convoy in 28h. 25m. The maritime power of the provisional canal thus established can therefore be estimated at 10 ships per 24 hours, say at the rate of 2,000 effective tons per ship, 25,000 tons daily, or 9,125,000 tons per annum.

At the level 38 the reach might be fed by utilizing the large dam in the Chagres at Gamboa, and by carrying the level of the river up to the altitude 40. But with the reach at the altitude 49, natural feed would be no longer assured. It would be necessary, at least during a few months of the year, to elevate water from level 40 to level 50 by means of steam engines, whose total power, however, would not exceed that of 3,600 horses, a very small affair in comparison with the enormous power that we daily see developed by great transatlantic ships.—*Le Genie Civil*.

THE FIRST ATLANTIC STEAMSHIP.

By HOWARD FULLER, Great-Grandson of Moses Rogers.

THE honor of first navigating the sea with a steamer belongs to Colonel Stephens, of New York, and the credit is not diminished by the fact that he was forced to it by circumstances beyond his control. Having

Transatlantic steam navigation was long discussed before any one combining sufficient skill and nerve and a spirit of adventure made the bold attempt.

The *Times* of London, England, in the issue of May 11, 1819, thus announces the expected event:

"*Great Excitement.*—A new steam vessel of 300 tons has been built in New York for the express purpose of carrying passengers across the Atlantic. She is to come to Liverpool direct."

On the very day that this brief notice appeared, the vessel referred to was visited by the President of the United States, James Monroe being President at that time.

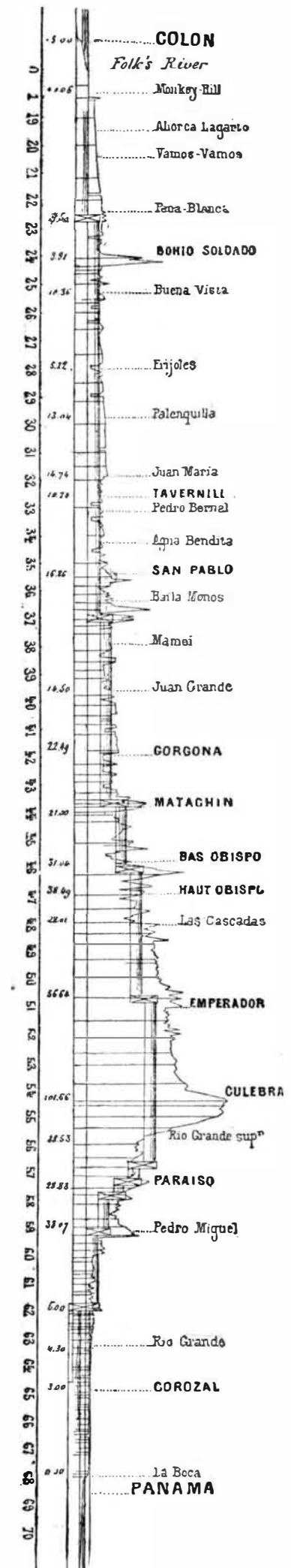


FIG. 9.—LONGITUDINAL PROFILE OF THE LOCK CANAL.

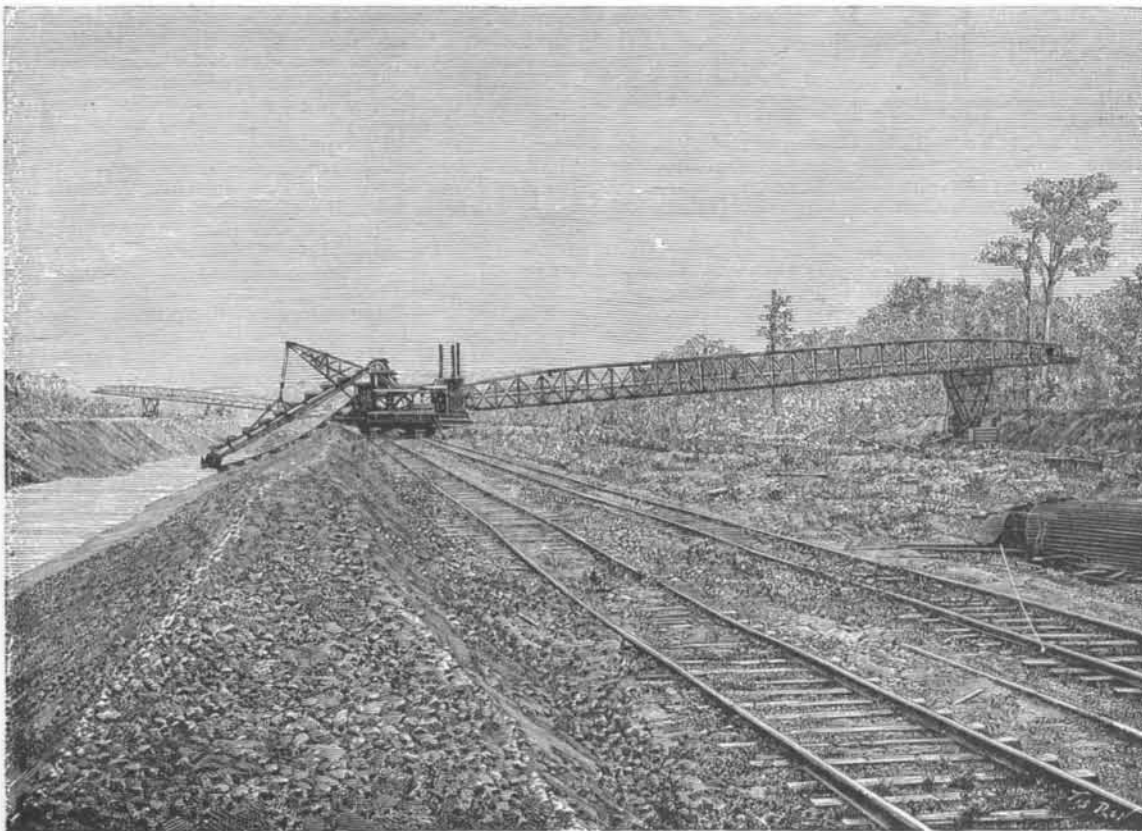


FIG. 8.—WORK ON THE TABERNILLA SECTION.

The first traffic estimated by the congress is 7,500,000 tons.

We shall not enter here into an economic discussion of these figures, but they are evidently moderate as to estimate, and, moreover, certain from a technical standpoint.

Feeding the Canal.—The quantity of water necessary for the maritime transit just mentioned is about 1,450,000 cubic feet per lock chamber, and 2,290,000 per ship,

built the steamboat Phoenix, he was prevented from navigating the Hudson, because at that time (1808) Fulton and Livingston had a monopoly of the river, and accordingly the Phoenix was sent around by sea to the Delaware River. England in those days was very active and ambitious in the new enterprise, yet it was nine years later before she ventured on sea voyages. In 1817 the steamer Caledonia first crossed the Channel on her way to Holland.

The steamer, named the Savannah, the first that crossed any of the oceans, was built at the city of New York by Francis Tiekett for Daniel Dodd. Her engines were made by Stephen Vail, of Morristown, N. J. She was launched on 22d of August, 1818. She could carry only seventy-five tons of coal and twenty-five cords of wood. Commanded by Captain Moses Rogers and navigated by Stephen Rogers, both natives of New London, Conn., the Savannah sailed from Savannah, Georgia, on the 25th day of May, 1819, bound for St. Petersburg, via Liverpool. She reached the latter port on January 25, having used steam eighteen days

out of twenty-six, and thus demonstrated the feasibility of transatlantic steam navigation. The question naturally arises, Who was Moses Rogers and what were his qualifications for the venturesome undertaking?

Moses Rogers was born in New London, Conn., in the year 1779, and from early youth was engaged in seafaring enterprises. He was actively interested in the earliest experiments which were made on the North River in the application of steam to the purposes of navigation.

He commanded the first steamboat on the Hudson River; the Fulton, the first steamboat on the Delaware; the Phoenix, the first steamboat between Charleston and Savannah; and the first steamship that crossed the Atlantic, the Savannah.

On his return from Europe he was employed on the Great Pelee, in South Carolina, and contracting malarial fever, died at the early age of 42 years. The original log book of the Savannah, containing the daily record of her memorable voyage, was presented to the Smithsonian Institution at Washington, D. C., about four months ago. This valuable relic is made up of ninety-six pages of coarse paper of unusual size, twelve inches wide and about nineteen long. Only fifty-two pages are written on. It is not bound, but the large sheets are sewn into an enveloping piece of strong canvas, which is rudely hemmed at the upper and lower edges. This cover bears the simple inscription, "Steamship Savannah's Log Book." The handwriting is that of Stephen Rogers, the sailing master. Every word on the closely written pages is legible, the ink being still black. But a small portion of the entries, however, is of any special interest. They are mostly remarks on the weather and the results of observations of latitude and longitude. The caption of the first page is as follows:

"A Journal of a Voyage from New York toward Savannah, on board Steamship Savannah. Moses Rogers, Master."

This is continued on three pages, the caption of the fifth being:

"A Harbour Journal on board S.S. Savannah. Moses Rogers, Master."

And after a few pages this in turn gives place to:

"A Journal of a Voyage from Savannah toward Liverpool, on board Steamship Savannah. Moses Rogers, Master."

The caption changes several times, but preserves the same formula. The first entry in the log book is the following:

"Sunday, March 28th, 1819. These 24 hours begin with fresh breezes from N. W. At 10 A. M. got under way with the crew on board. At 1 P. M. the pilot left the ship off Sandy Hook light."

The second entry is:

"Remarks on board Monday, March 29th, 1819: These 24 hours begin with fresh breezes and clear. At 4 P. M. the Highlands of Neversine bore N. by W., 6 leagues distant from which I take my departure. At 10 P. M. took in topgallant sails; at 6 A. M. set topgallant sails; at 8 A. M. tacked ship to the westward; saw a brig and schooner steering to the westward; at 11 A. M. took in the fore and mizzen topgallant sails; at 11 A. M. got the steam up and it came on to blow fresh. We took the wheels in on deck in 30 minutes; at meridian, fresh breezes and cloudy. Lat., by observation, 39 degrees 19 minutes."

These are fair samples of the daily records, extending, without much to relieve the monotony, over a period of nine months. The statement, "We took the wheels in on deck in 30 minutes," refers to the fact that this steamer was so constructed that in case of bad weather the paddle wheels could be brought on deck. During the next two days the vessel encountered heavy gales and strong breezes. On the Saturday following the departure we find this entry:

"These 24 hours begin calm and pleasant. Used the wheels in the middle of the day."

The steamer reached Savannah on Tuesday, April 6, having used steam four days. It remained there eight days and then "got steam up and started for Charleston," which they reached next day.

The vessel lay at Charleston, "all hands employed in ship duty," until April 30, when they returned with steam to Savannah.

A few days later, while the vessel was lying at the wharf in Savannah, we find this interesting entry:

"May 3, Joseph, the cook, left the ship"—a circumstance of no small importance to those depending upon his culinary labors; probably any of the crew could make hash or "lob skouse," but not duff, and a sailor who receives no duff is not worth much.

The Savannah remained at the city of that name twenty-three days. The entry of May 12 is quite curious. It is as follows:

"Daniel Claypit cut his left thumb off. The doctor done it up and then bled James Monroe."

The recurrence of this name in this connection is very singular; probably one of the crew was thus named.

On the 22d of May Captain Rogers "got steam up, and at 9 A. M. started" on the transatlantic voyage. Nothing of much interest is detailed in the daily records of the log book, which are, on the whole, rather monotonous.

On the 2d of June they stopped the wheels to clean the clinkers out of the furnace; at 6 P. M. started the wheels again; at 2 A. M. took in the wheels. In this connection I will say that Captain Moses Rogers superintended the construction of the boilers and engines, and was chief engineer as well as master of the vessel.

Land was sighted on June 16, being the coast of Ireland, and on the 17th the Savannah was boarded by the King's cutter Kite, Lieut. John Bowie.

The log book here, as elsewhere, is sternly brief, but fortunately we have in Stephen Rogers' own handwriting a fuller account of the amusing circumstances connected with the boarding by the king's cutter. He said, in a communication to the *New London Gazette*:

"The steamer was seen from the telegraph station at Cape Clear, and reported as a ship on fire. The admiral, who lay in the Cove of Cork, dispatched one of the king's cutters to her relief. But great was their wonder at their inability, with all sail in a fast vessel, to come up with a ship under bare poles. After several shots were fired from the cutter the engine of the Savannah was stopped, and the surprise of the crew of the cutter at the mistake they had made, as well as their curiosity to see the singular Yankee craft, can well be imagined. They asked permission to go aboard, and

were much gratified by their inspection of this naval novelty."

Two days later (June 20) they shipped the wheels and furlled the sails and run into the river Mersey, and at 6 P. M. came to anchor off Liverpool.

The simple words in the log recording the successful termination of a daring adventure is hardly worth writing. There is not a word of boasting, of congratulation, nor even of thankfulness recorded. Fortunately, Moses Rogers has left offspring who are proud of him and are not in the least backward in giving that praise which is his due without a doubt.

Then, again, in the account of Stephen Rogers, already alluded to, he says:

"On approaching Liverpool, hundreds of people in boats came off to see her. She was compelled to lay outside the bar till the tide should rise sufficient for her to cross. During this time she had her colors all flying, when a boat from a British sloop of war came alongside and hailed the sailing master, Stephen Rogers, who was on deck at the time, and answered. The officer of the boat asked him, 'Where is your master?' to which Stephen gave the laconic reply, 'I have no master.' 'Where's your captain, then?' asked J. B. 'He's below; do you wish to see him?' asked Stephen. 'I do, sir.' Stephen called up the 'Old Man,' who asked the officer what he wanted, to which the officer answered: 'Why do you wear that pennant, sir?' 'Because my country allows me to,' 'My commander thinks it was done to insult him, and if you do not take it down, he will send a force that will do it.' Captain Rogers then gave the order: 'Get the hot water pumps ready!' although there was no such pump aboard, and from what I know of steam engineering I doubt very much whether hot water pumps were used anyhow at that time. Nevertheless, the order had the desired effect on J. B., who was glad to paddle off as fast as possible, to avoid the expected scolding.

On approaching the city, the shipping, piers, and roofs of houses were thronged with persons cheering the adventurous craft. Several naval officers, noblemen, and merchants from London came down to visit her, and were very curious to ascertain her speed, destination, and other particulars.

During the stay of the Savannah at Liverpool, the British public regarded her with suspicion, and the newspapers of the day suggested the idea that "this steam operation may in some manner be connected with the ambitious views of the United States." One journal, recalling the fact that Jerome Bonaparte had offered a large reward to any one who would succeed in rescuing his brother Napoleon from St. Helena, surmised that the Savannah had this undertaking in view.

The steamer remained at Liverpool twenty-five days. Meanwhile the following tragic event is recorded in the log:

"July 19, 1819. These 24 hours begin with fresh breezes and rain. Captain Rogers told Mr. Blackman (the mate) to go ashore after James Bruce and John Smith and get them aboard. They would not come. The watchman put them in the boat, and John Smith tried to knock Mr. Blackman overboard; struck him several times and swore he would take Mr. Blackman's life; but Mr. Blackman got him aboard and he refused duty, and was then put in irons. Middle and latter part, fresh gales at S. W. and rain."

The peculiar way in which this tragedy is ushered in by breezes and rain, and concluded with gales at S. W. and rain, is somewhat amusing. Next day we read, "John Smith still in irons;" but the next day after this we read, "At 5 A. M. took the irons off John Smith and he went to duty." Stephen was bound to leave us in no doubt as to the termination of this effort to compel an obstreperous man to perform his duties.

The Savannah sailed for St. Petersburg on July 23, getting under way with steam, and a large fleet of vessels in company. Captain Rogers touched en route at Copenhagen, where his vessel excited great curiosity, and also at Stockholm, where she was visited by the royal family, or, in the homely language of the log book, "Oscar, Prince of Sweden and Norway, came on board." Here is another entry which is worth while studying:

"Mr. Huse (Christopher Hughes), the American Minister and Ladye, and all Furran Minister and their Ladyes at Stockholm come on board," and at Mr. Hughes' invitation made an excursion among the neighboring islands.

On the 5th of September the steamer left Stockholm, with Lord Lynedock, of England, who was then on a tour through the north of Europe, as a distinguished passenger.

On the 9th she reached Cronstadt, having used steam the whole passage, and a few days later she arrived at St. Petersburg. Here she was visited, by the invitation of our ambassador at that court, by the Russian High Admiral, Marcus de Travys, and other distinguished military and naval officers, who also tested her superior qualities by a trip to Cronstadt.

The daughter of Moses Rogers (who still lives, a hale, hearty old lady of eighty-four years) has a silver teapot, a guitar, and a gold snuffbox, which were presented to Moses Rogers as follows: the teapot by Lord Lynedock; the snuffbox by the King of Sweden; and the guitar by the Czar of Russia.

The Savannah lingered at St. Petersburg until October 18, and then set sail on her homeward voyage "in company with 80 sail of shipping." She arrived at Savannah Tuesday, November 30. Shortly after, the steamer was taken to the navy yard at Washington. The object of this visit to the national capital was "to fix her name and exploits in the minds of prominent men from all parts of the United States, in order to lay a foundation for the defense and maintenance of our claim to that distinction which her craft and her daring commander had unitedly wrought out for our nation upon the mighty deep."

There is one more amusing entry in the log book which I had nearly forgotten. It is as follows:

"Dec. 16, 1819. Frank Smith damned and swore at the captain. We put Smith in irons."

It appears by the log that the Smith family gave considerable trouble.

The last entry in the log book is:

"Remarks on board, Friday, December 17, 1819. These 24 hours begin with light breezes and clouds; sundry jobs on hand."

This abrupt termination of the log book is unaccountable.

The subsequent history of the Savannah can be told in a few words: On account of a great fire in Savannah, her owners were compelled to sell her, and she was purchased to run as a packet between that city and New York, whither she was bound in charge of Captain Nathaniel Holdredge, and she was lost on the south side of Long Island.

The sailing master, Stephen Rogers, was no relation to the captain, notwithstanding the similarity of names, though their descendants have become related since through marriage.

If any one of your readers wishes to establish beyond a doubt that the Savannah was or was not the first Atlantic steamship, they can find the log book at Washington, as before stated. The dates are there, which is proof enough; or let them get the *Encyclopædia Britannica*, and under the head of "Steamships" they will find a short article in regard to the Savannah.

America deserves the credit, notwithstanding that the honor has been often accorded to England. Many articles on steam navigation have been written which ignore the claims of the Savannah and her enterprising captain. In fact, when the steamers Sirius and Great Western arrived in New York harbor, April 23, 1838, twenty years after the exploit of the Savannah, they were received with extravagant manifestations of delight, it being universally considered as the beginning of a new era in the history of Atlantic navigation.

The achievement of the Savannah was forgotten; her skillful captain no longer lived to claim his rights, but patriotic citizens protested in the public press against losing sight of the just claims of America.—*Amer. Steam Engineer.*

DYNAMITE SHELLS FIRED FROM ORDINARY GUNS.

The discoveries of Lieut. James W. Graydon, late of the United States navy, have proved beyond a doubt, and by severe and satisfactory tests, the adaptability of high explosives to the practical uses of war, and that dynamite and its kindred substances may be utilized with phenomenal effectiveness, even in the firing of ordnance as at present constructed.

Lieutenant Graydon's invention consists in firing dynamite shells from modern guns or cannon, with the full service charge of powder and with no danger from heat or shock, at the same time securing the entire range desired and the complete penetration of the target by the shell before the dynamite is exploded, the penetration being absolutely necessary in order to obtain the full destructive power of the explosive.

It has been shown by different experiments, both in the United States and abroad, that the projectile must effect a penetration before explosion, to insure its perfect work, and herein consists one of the chief and distinguishing merits of this invention.

The havoc and wrecking power of Lieutenant Graydon's projectile are of course intensified by the velocity with which it travels, and the tamping or solidifying thus imparted to the explosive, augmenting its force whether in the penetration of armor or other obstruction.

Three demonstrations of the invention have been made by order of Lieutenant-General Sheridan, commanding the army of the United States. Two of the three were conducted under the immediate direction or supervision of Major-Gen. O. O. Howard, at the Presidio of San Francisco. The first was made August 1, 1886, with a 29 inch field piece before a board of army officers appointed by the War Department, the results of which were so successful that orders were forthwith issued for a second series of experiments before a new board of artillery officers at San Francisco, August 10 and August 13, 1886. These experiments were with heavy siege cannon of 4½ inch diameter, from which fifty-two (52) shells loaded with dynamite were fired.

The detail of officers for this board consisted of Capt. John W. Dillenback, First Lieut. Henry L. Harris, and First Lieut. Adam Slaker, all of the 1st Artillery, and the experiments were made at Fort Winfield Scott.

The board in its report refers to Lieutenant Graydon's invention as being "a process of so charging a shell with dynamite that it can safely be fired from a gun in service, with the service charge of powder for that gun, and without impairing in any degree the efficiency of the charge in the shell when it reaches the point where its work is desired."

The opinion expressed was that Lieutenant Graydon's claim was fully demonstrated, and that the two principal causes of apprehensions of danger—"heat and shock"—had been completely guarded against.

The board also recommended unanimously that further experiments be made with the 8 inch rifle (converted), the 15 inch smooth bore, and with mortars; in accordance with which recommendations the War Department ordered the next demonstrations to be made before the permanent ordnance board at Sandy Hook, N. J., composed of A. Mordecai, Lieutenant-Colonel of Ordnance, J. P. Farley, Major of Ordnance, and John E. Greer, Captain of Ordnance.

The gun used on this occasion was a 7 inch Ames wrought iron, muzzle loading rifle, weighing 23,000 pounds, and the weight of the charge of powder was twenty-three (23) pounds. The projectile was of steel, open at the rear and closed by a bronze plug, the same general form as used in the service; its weight being one hundred and twenty-two (122) pounds, and the charge of dynamite exploded being two and two thirds (2⅔) pounds.

The effect of the three shots is noted upon the accompanying diagrams.

The first shell struck the target twenty-four (24) inches above the horizontal joint and thirty-three (33) inches to the left of the embrasure; and although it was a glancing shot, and not a "point-on" shot, as was desired to test the penetration, it made an indentation three inches deep, exploding with great violence. In the language of the report made by the ordnance board:

"The roof (of the turret) was lifted off, breaking seven bolts each one and three-fourths (1¾) inches in diameter used to assemble the same, and five bolts three and three fourths (3¾) inches in diameter used to bolt the front and rear plates together. It also made a crack ten inches long in the front plate and about eighteen inches long in the rear plate."

The wreckage was very marked, in fact almost complete, the roof alluded to above, which weighed 30,900 pounds, being torn off and blown twenty-five