HYDROGEN LEAK SUSPECTED

Workmen Making Repairs Mangled, and Interior of E-2 Wrecked.

FUMES DELAY RESCUERS

Outer Plates Removed to Give Access to Victims Suffocating Within.

DANIELS ORDERS INQUIRY

No Hint of Crime—Theory of Oil Volatilization Dismissed—E-2 an Unlucky Boat.

Four men were killed and ten were injured by an explosion inside the United States Navy submarine E-2 at 1:20 o'clock yesterday afternoon, in the drydock of the Brooklyn Navy Yard. Up to midnight the Yard officials had been unable definitely to ascertain the cause of the explosion, although Rear Admiral Usher, Yard Commandant, appointed a special Board of Inquiry early in the afternoon to make an immediate examination.

Of several theories advanced as to the cause of the explosion the one most generally accepted by Navy officials, including Rear Admiral Usher, yesterday put the blame squarely on the new Edison storage batteries that were being tested on the boat. It was the only submarine in the Navy that had been equipped with the new Edison batteries thus far, though if the tests proved their worth it was expected that they would be adopted for use in all United States submarines.

The Edison battery generates hydrogen gas, but, it was supposed, not in quantities sufficient to cause, if ignited, more than a small explosion. Hydrogen in large volume, mixed with the oxygen of the air, explodes with much force if ignited. The product of the explosion of this mixture of gases is water—in the form of steam, of course, under the influence of the intense heat of the explosion. The fact that witnesses saw a flame of "gray-colored smoke" shoot up out of the hatch and almost instantly vanish in the cold air—the exact behavior of a column of steam—tends strongly to corroborate the theory of a hydrogen explosion.

The force of the explosion was so great that it wrecked completely the whole interior of the big undersea boat. The mechanism, some of it as delicate as watch works, was a mass of débris when rescuers in oxygen helmets went to the aid of the suffering men inside.

Efforts at rescue were almost impossible immediately after the accident because of the dense and pungent fumes that filled the boat. It was not until five electric fume blowers had been at work for some time that the workers were able to dig into the débris and take out the dead and wounded. Most of the injured had been held under wrecked machinery and overcome by gases.

The Dead.

SEABER, ROY B.; electrician, third-class; member of the crew of the E 2, enlisted at Cleveland, O.

(Yardmen of the Brooklyn Navy Yard.)

LOGAN, JOSEPH; plumber, of 417 Forty-second Street, Brooklyn, who leaves a wife and a daughter, Mrs. Rita Littlefield of New Rochelle.

PECK, JAMES H.; plumber, of 291 Ainslie Street, Brooklyn.

SCHULTZ, JOHN P.; yard workman, 176 Fourth Street, Long Island City.

The Injured.

(Members of the crew of the E 2.)

CLARK, G. H., JR.; machinist's mate, enlisted at Frankfort, N. Y.; face, neck, back, and both legs badly burned; in the Naval Hospital in a serious condition.

HOLSEY, JOHN; gunner's mate, third-class, enlisted at Halthorp, Md.; at the Naval Hospital in a serious condition, with face, eyes, and head burned.

MILES, H. L.; chief electrician of the E 2, enlisted at Newport, R. I., where his wife, Sophie, lives; in Naval Hospital with serious flame and acid burns.

OTTO, RAYMOND; electrician, second-class, of Middleborough, Md.; in Naval Hospital with both legs burned.

(Yardmen of the Brooklyn Navy Yard.)

HASERT, OTTO; plumber, of 319 Twentieth Street, Brooklyn; in the Cumberland Street Hospital, suffering from severe burns.

HEYNE, RICHARD; plumber, of 1,030 East Second Street, Brooklyn; in Cumberland Street Hospital in a critical condition from burns.

KAPLIN, AUGUST; yard foreman; in Cumberland Street Hospital suffering from burns about the face.

LYONS, JAMES; general helper, of 739 Fulton Street, Brooklyn, in the Cumberland Street Hospital, severely burned.

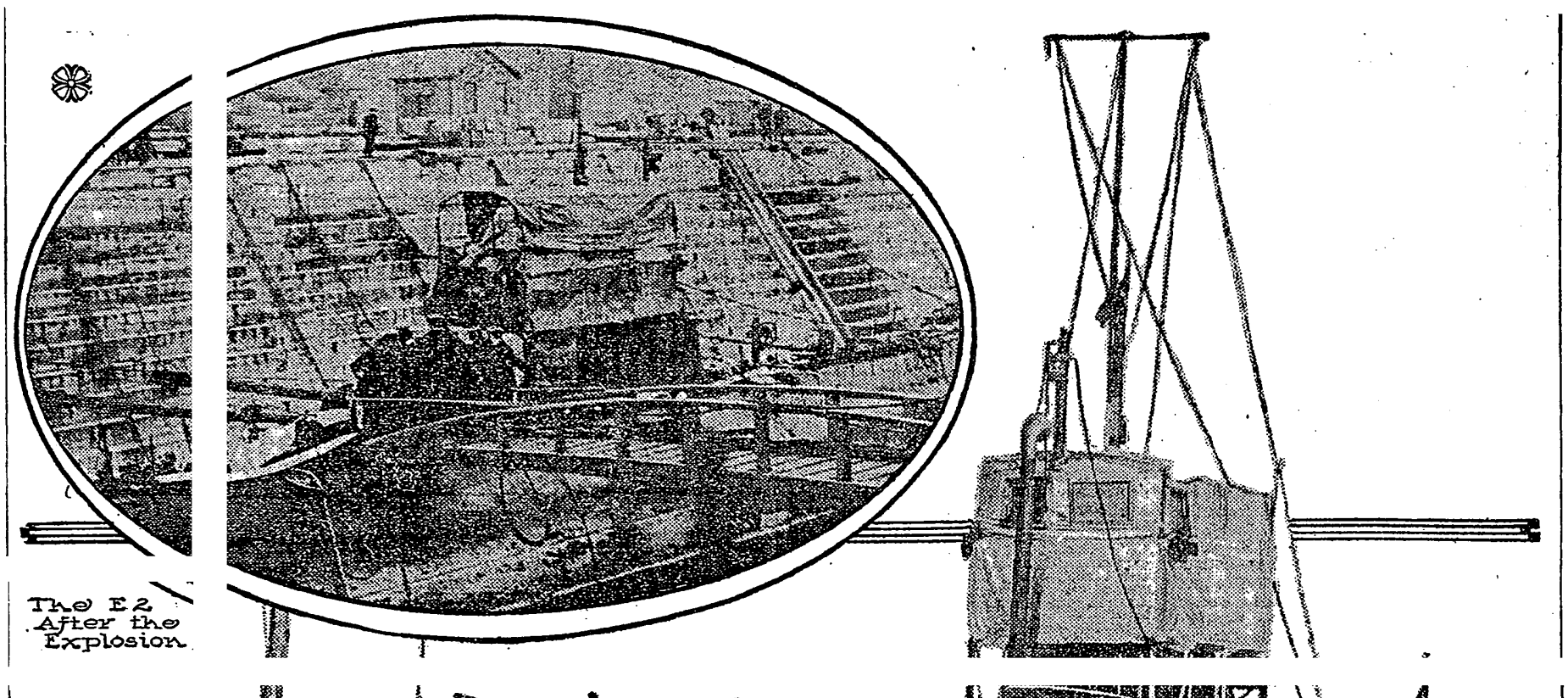
PEYSER, MICHAEL; plumber, of 218 Penn Street, Brooklyn; in Cumberland Street Hospital in a serious condition.

ZOLL, HENRY; plumber, of Huntington, L. I.; in Cumberland Street Hospital in a serious condition.

The bodies of the dead were so badly mangled as to be almost unrecognizable, and it was not until late in the evening that the officers were able to identify an enlisted man among them. A civilian workman, the last man to be found in the débris, had been dismembered by the explosion and the torso and lower limbs were found in different parts of the boat. The officers investigating the accident hoped to discover just where the explosion originated by learning from workmen in what part of the boat this man was, but the ones who might have given the information were in hospitals last night, too seriously injured to be questioned.

Secretary of the Navy Josephus Daniels was in New York at the time of the explosion, having come from Washington to speak on preparedness before the National Democratic Club, and was notified at once by telephone by Rear Admiral Usher. Secretary Daniels was then at the club, and was scheduled to begin speaking in a few minutes. He gathered what information he could, and delegated his Naval Aid, Commander David W. Wurtsbaugh, to keep in touch with Rear Admiral Usher for

Wrecked Submarine E-2 Afloat, and After Explosion.



The E2 After the Explosion

~ The E2. Before the Explosion. ~

further information, but he made no reference to the accident in his talk to the diners.

Meant to be a Lifesaver.

The explosion occurred just after the workmen, who were overhauling and repairing the boat, returned fom lunch, and it was said by some in the yard that ducts of the new Edison batteries had been opened shortly before the men went to lunch. Naval experts said the new Edison battery gave off about twice as much hydrogen as the batteries in general use in the navy, and it was believed that hydrogen, which had escaped through the ducts during the lunch hour, had been ignited.

The new batteries were being tested as a lifesaving device. Mr. Edison devoted long labor to them in an effort to eliminate chlorine gas. The chlorine gas of the old batteries has resulted in a number of fatalities in submerged submarines, but never before, according to the navy records, has there been a fatality in the American undersea fleet due to exploding hydrogen from batteries. The workmen in the boat yesterday, it was said, were installing a new ventilating system to carry off excessive hydrogen, this measure having been decided upon when the test boat made a few trial runs near the Navy Yard a few weeks ago and the officers discovered the excessive amount of hydrogen that was being created.

Another theory advanced as a possible cause of the explosion was that it was due to volatilized crude oil becoming ignited by a spark or other means. The E-2 was propelled by a Deisel engine consuming heavy oil.

"In the case of the boats using gasoline, all tanks are emptied as soon as the boats are brought into the drydock," Rear Admiral Usher said yesterday evening. "The E-2 had been in the drydock only two weeks and as the heavy oil is not nearly as volatile as gasoline, a quantity of it may have been left on board. I don't know that this was the case—it is one of the things that must be determined by a searching examination. The fumes from this oil might have exploded if it had been caused to volatilize."

Other Theories of Explosion.

A third theory was that an acetylene tank brought into the submarine for the use of the plumbers might have exploded, but until today's minute examination of debris reveals that there was such a tank aboard it will be impossible to tell whether there is foundation for this theory.

A fourth was that one of the compressed air compartments of the submarine, used for the discharge of torpedoes, had exploded, but the extent of the damage seemed to make that improbable.

Admiral Usher said that it would not have been possible for an outsider to cause the explosion, as none but persons working on the boats in the drydocks were allowed anywhere near them.

He also considered the possibility of the explosion having been caused by a torpedo in the boat as negligible, and said that if one had been left aboard the boat by accident its explosion would have destroyed the shell as well as the interior of the boat.

Despite the havoc caused inside the steel shell, the shell itself was practically uninjured as far as could be seen. From the outside the boat looked as if nothing had happened to it until, in their efforts to get out the bodies and survivors, the rescuers unfastened four plates in the hull on either side of the boat. These plates can be taken off only from the exterior, the submarine constructors having foreseen no occasion for their removal from the inside because the boats were intended for use beneath the water and the removal of the plates there would only allow the boat to fill. But the rescuers, handicapped already by the fumes, were further handicapped in their relief work yesterday by the lack of space through which to remove the injured men rapidly. They had to be brought out one by one through the hatch and the small rear manholes, and it was suggested that one of the results of the explosion should be an improvement in the building of other submersibles to enable the men inside to open the side plates in similar emergencies in the future.

Explosion Like Bursting Auto Tire.

There were not many eye-witnesses of yesterday's accident. A few of the navy yard employes who were busy on other boats in the vicinity saw it, however, and the accounts that these gave were graphic. Others, who were unable to see the boat but within hearing distance, said the explosion was little louder than the sound of a bursting automobile tire, and that until they heard the shouts of men running to the scene they did not know that anything serious had taken place.

"I heard the explosion and looked over in the direction of the boat just in time to see a dark object and a great cloud of gray smoke shoot out of the hatch," an eye-witness told a TIMES reporter while the rescue work was in progress. "The dark object fell on the deck of the boat and we could see that it was the body of Chief Electrician Miles. He must have just started up the steel ladder of the hatch to get out of the boat, when the explosion occurred.

"The smoke shot high up into the air and vanished at once. Then the men from other ships and from the buildings ran to the scene and tried to climb down into the boat, but were nearly overcome by the fumes and sent for oxygen helmets. There was some delay, but I didn't see any of the men who had been in the boat come out without aid."

Lieut. Charles M. Cooke was in charge of the submarine and was near the boat at the time of the accident. He was not injured, and afterward he headed the rescue party and worked with the investigators all afternoon. The E-2, which is about 150 feet long, had a crew of twenty-five men and officers, but their presence aboard was not required while it was in drydock and few of them were in the vicinity.

Blew Up Under Battery Deck.

Through his investigation, after the fumes had been cleared from the boat, Lieut. Cooke ascertained that the explosion had occurred beneath the battery deck of the boat. This strengthened the belief that it was caused by the explosion of hydrogen from the batteries. The batteries were being tested for strength with a rheostat during the day, and it was said that the passage of current through them for that purpose probably caused the accumulation of hydrogen.

Lieutenant Cooke, the Commander of the E-2, continued his examination of the interior of the submarine until 11 o'clock last night. Then he sent a radiogram to the Navy Department in which he reported:

"Battery explosion on E-2 probably in both batteries. Interior of boat considerably damaged."

The board designated by Admiral Usher to investigate this and other phases of the explosion, consisted of Lieut. Commander Polk Washington, who is in charge of the receiving ship Maine at the yard, senior member; Lieutenant L. M. Stewart of the U. S. S. McCall, and Lieutenant (junior grade) Rush S. Fay, who is in charge of the submarine flotilla at the Navy Yard.

After the board has rendered its findings in the case Admiral Usher probably will request Secretary Daniels to appoint a Court of Inquiry to go into the case. This court would have greater authority than the original investigating board, and could take whatever official action the result of the joint investigations made advisable.

A third investigation is to be made by Coroner Ernest C. Wagner of Brooklyn. Although the navy yard is on Government property and beyond the jurisdiction of the Brooklyn Coroner as far as navy men are concerned, he has concurrent jurisdiction where civilians are concerned. He was summoned to the yard when it was found that three of the dead were civilian workmen, and the Coroner later went to the hospitals where the injured had been taken. He said last night that all of the injured at the hospitals were in such serious condition that it was impossible to get any statement from them. An assistant from the United States District Attorney's office also hurried to the yard after the accident had been reported, but it was later said that the Federal District Attorney probably would leave the matter entirely in the hands of the naval authorities.

Calls Cause Still a Mystery.

During the afternoon Admiral Usher made a long report to the naval authorities in Washington by telephone, after which he sent a dispatch containing what fragmentary information was available at that time. An official statement was later given out at the Navy Department in Washington stating that the explosion occurred while the storage battery was being slowly discharged, and that "so far it has been impossible to determine what caused the explosion."

"The damage to the submarine cannot be estimated at this time," the statement read in part, "but while there is little apparent damage to the exterior the interior seems to be badly wrecked. A searching investigation is being made, and all new facts discovered will be given out as soon as verified."

This policy of making all the facts in the case available to the public as early as possible was decided upon by Secretary Daniels as soon as he heard of the accident. Speaking to Admiral Usher by telephone Secretary Daniels requested the Commandant to make public all of the facts obtainable. The gates of the Navy Yard were closed to the public when the accident occurred, but reporters were admitted.

The E-2 was a part of the Second Division of the Atlantic submarine flotilla, and was the largest of four submarines on which workmen were making repairs in drydock No. 2, an old wooden dock. The other three boats, all in the D series, were not injured by the explosion, and the drydock itself escaped injury.

Test Showed Little Hydrogen.

After receiving late reports from Admiral Usher last evening, Assistant Secretary of the Navy Franklin D. Roosevelt gave out a statement in Washington in which he said that, while the location of the explosion beneath the battery deck would indicate hydrogen, the Navy Department had had tests for this gas made by an expert analyst of air, A. E. Davidson, during the recent six-hour testerun of the E-2, and that Mr. Davidson had reported that the hydrogen given off was infinitesimal. "In view of this," he said, "it is difficult to see how a gas explosion could have been the cause, and we must wait further investigation." Mr. Roosevelt said that the special tests by Mr. Davidson, however, were prompted by experiments that had been made by the Bureau of Steam Engineering.

Rear Admiral A. W. Grant, Commander of the Atlantic submarine flotilla, was at the Philadelphia Navy Yard when he heard of the accident. He said that he was not surprised that it had happened while the batteries were being used, but declined to make any further etatement until he had further information.

There have been half a dozen hydrogen explosions on navy submarines in the last three years, but all have been of minor character and no serious injuries have been reported. An Italian submarine, however, was destroyed some years ago, and her entire crew killed by a hydrogen explosion.

The E-2 has been considered a trustworthy submarine, but it was one of those damaged in a storm during the war game last May while with the Atlantic fleet off Block Island. It was sent to Narragansett Bay until the storm subsided, but it was not thought that any serious damage had been done.

Pending the outcome of the investigation into yesterday's accident, officers of the navy were unable to say last night what steps would be taken to prevent a repetition of such an explosion, but it was said that a plan has been under consideration lately to operate submarines by compressed air, and some of Secretary Daniels's advisers are said to have urged him to ask Congress for an appropriation of $300,000 for a conclusive test of that plan.

Both Mr. Edison and Secretary Daniels were guests last night of the Ohio Society at its dinner at the Waldorf. Mr. Edison had heard about the explosion and what was generally believed to be its cause before he left his home at Llewellyn Park, in Orange, and his representative, Miller Reese Hutchison, had been sent to the Brooklyn Navy Yard. When asked at the Waldorf about the explosion, Mr. Edison said:

"There are many possible causes that might have led to the explosion. As I have not yet received any specific data concerning it, I do not want to make any statement at the present time."

Edison Wanted Laboratory Tests.

Thomas A. Edison began work on the new Edison submarine battery after July 10, 1910, when a delegation of four officers from the submarine branch of the United States Navy—Lieutenant Frederick C. McNair, Lieutenant T. G. Ellyson, Lieutenant Alfred G. Miles, and Lieutenant Lee Pettit Warren, according to their titles at that time—called upon him at his laboratory at West Orange, pointed out the peril of chlorine gas, which had cost many lives in submarines, and asked him in the name of humanity to invent a submarine battery which would be free from the danger of chlorine gas generated by the existing type.

Mr. Edison has been working on his battery for five years and a half. He was notified on Aug. 27 of last year that after a thirteen months' test of his new battery it had proved itself satisfactory and would be accepted. It had been noted that the Edison battery produced more hydrogen gas than the other types. This was not generally looked upon as a serious danger, but at the very time that the explosion occurred yesterday experiments were being made on the batteries of the E-2 to obtain a new ventilating system which would expel the hydrogen gas rapidly.

Whether the explosion is shown to have been due to hydrogen from the batteries or not, the case is one of the kind pointed out by Mr. Edison in his recent address to the Naval Consulting Board, of which he is Chairman, in which he advocated the building of a physical laboratory for the navy so that naval inventions of every kind could be thoroughly tested in the laboratory and their defects developed there instead of their defects being developed in actual trial on ships at a great cost of life and money.

European Nations Sought to Buy It.

The type of submarine battery which the Edison battery is intended to supplant consists of rubber jars containing sulphuric acid incased in lead-lined receptacles. The chlorine gas has been generated from salt water finding its way into the submarines and coming into contact with sulphuric acid which has eaten its way out of the lead-lined cases.

The Edison battery contains a potash solution in nickel steel boxes. The potash solution does not act upon steel and, if it should leak, the solution, which is itself alkaline, would not react on sea water, which is also an alkaline solution, so that the dangers of chlorine gas would be averted. It was also contended on behalf of the Edison batteries that they would give the submarine an under-sea cruising radius of 150 miles—longer than that obtained by the present type; that they were in less danger of getting out of order and that, in case of the sinking of a submarine the air could be purified by being passed through the potash solution, which would take up the carbon continuously for 100 days.

Before and since the outbreak of the war, Mr. Edison received large offers for the secret of the battery from Germany and other countries.

United States naval observers found on the trials of the E-2 that the new batteries generated more than twice the amount of hydrogen gas that the other batteries generated, but the amount was not considered great enough to cause an explosion. Between 3 and 8 per cent. of hydrogen added to the air makes it explosive.

The E-2 an Unlucky Boat.

When the E-2 was selected for the test of the Edison battery some objection was made because the boat was comparatively old, and had small engine power, so that the recharging of the batteries had to be done from electric power ashore, not with the vessel's engines, as is the rule with more modern craft. Some time ago the electric fan capacity of the E-2 was doubled to provide better ventilation. Shortly before the F-4 went down off Honolulu, it suffered from a hydrogen explosion, but that had nothing to do with the loss of the boat later.

Another recent hydrogen gas explosion occurred on the G-4. In one case a member of the crew of a submarine dropped a tool across the two battery connections, forming a short-circuit and an arc, which ignited the accumulated gas.

The E-2 has had many accidents since it was built by the Electric Boat Company of New York in the yards of the Fore River Shipbuilding Company and delivered to the Government on Feb. 12, 1912, under its former name of the Sturgeon. It was the first vessel of the navy to be equipped with Diesel oil burning engines. Both her engines and her former type of batteries were said to have been the source of trouble since the vessel was first commissioned.

In September, 1911, Ensign Edward J. Gillam, who was in command of the E-2 in maneuvres off the Brenton Reef Lightship, found chlorine gas gathering in the boat when it was fifty feet below the surface. The submarine was hurried to the surface by using the pumps instead of blowing out the tanks. The conning tower was quickly opened to give the crew fresh air, but every one of the nineten members of the crew was more or less affected, some bleeding from the nose and mouth. Ensign Gillam's lungs were affected by the experience and several months later he was sent to the Naval Hospital at Los Animas, Colo.

Gardner's Condemnation Recalled.

The E-2 started out with the Atlantic fleet from this harbor to engage in the naval war games of last May, but had to return to port after the first day. It was announced at Washington that the E-2 had broken her crank-shaft.

The D-1, D-2, and D-3, which lay in the same dry dock with the E-2, were included by Congressman Gardner in his charges of inefficiency of the submarines of the United States Navy last May, when he said that at the November manoeuvres of 1914 the following was the condition of the submarines of the Second Division:

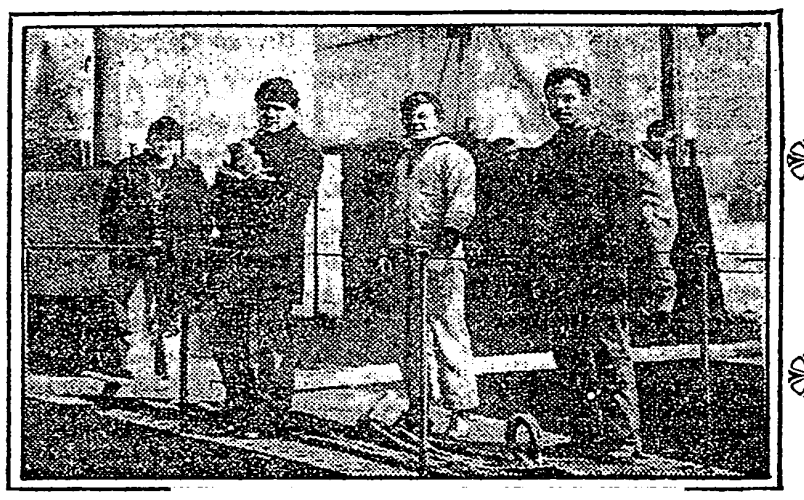
"D-1—Air compressors completely worn out. Storage battery, one-third capacity. Possible to submerge for a limited period.

"D-2—Battery capacity negligible. Possible to submerge for a limited period.

"D-3—Available for submerged work.

"E-1—One engine completely disabled, broken crank shaft, and the motor bearing on the other shaft in an unserviceable condition.

"E-2—At the New York Navy Yard, where she was towed with a cracked battery tank, which permitted the leakage of salt water into the forward battery and resulted in the escape of chlorine gas, which severely affected the crew with fumes."



Some of the Crew.
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