THE ACCIDENT TO "K13"

By PERCY A. HILLHOUSE, D.Sc., M.I.N.A.

Being an Address
To

THE GREENOCK ASSOCIATION
OF ENGINEERS AND SHIPBUILDERS

4th March 1919

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K13 was one of two vessels of the double-hull type ordered from the Fairfield Company late in 1915. She was noticeable both on account of her size and her method of propulsion, being over 330 feet in length, of 2,600 tons displacement and having water-tube boilers and steam turbines for surface propulsion. For under water work she had the usual storage batteries and electric motors.

She was divided into the following eleven compartments from forward:-

Auxiliary Ballast Tank
Bow Torpedo Room (T)
Officers' Quarters with Fore Hatch (O)
Control Room with Conning Tower and Wheelhouse over and double Hatch (C)
Amidships Torpedo Room with Torpedo Hatch (T)
Boiler Room (B)
Turbine Room with two Hatches (T)
Motor Room with Hatch (M)
Crew Space with Hatch (C)
Steering Compartment (S & C)
Ballast Tank

See diagrams 1and 4

On the starboard side of the boiler-room was a watertight passage connecting the turbine room and the torpedo compartment. At each end of this passage was a watertight door and mid-way a bulls eye looking into the boiler room. There were in all, nine watertight doors.

The vessel had two periscopes, two wireless masts, two 10-ton drop keels, two funnels with covers worked by motors and clipped by hand, and four 37-inch boiler room ventilators having mushroom covers.

Her normal crew numbered 52, including officers.

She carried out preliminary trials on the 29th of December 1916, official speed trials on the 18th of January1917, and preliminary submergences at Fairfield on January 6th and January 7th. On Saturday 20th January she carried out a successful dive to a depth of 65 feet in the Gareloch and remained submerged for about an hour.

On Monday, the 29th January 1917 she proceeded to Gareloch to carry out her Acceptance Trials and made a successful dive to 83 feet, remaining submerged for about 2 hours. All men not required during this dive were put on board "Comet", the tender, for lunch.

The ship was duly accepted, but as the boiler room had been too hot during the dive to enable watertightness of the funnel covers and boiler room ventilators to be checked, another short dive of about a quarter of an hour's duration was asked for and decided upon.

The remainder of party had lunch, and Mr. Cleghorn and Mr. Macmillan, directors of the Company, the latter having been on board during the earlier dive, went on board "Comet", Mr. Macmillan having to go ashore to make arrangements for docking.

On board at this time were :-

Lieutenant Commander Godfrey Herbert, DSO, Captain of K13
Commander Francis H. H. Goodhart, DSO Captain of the sister vessel K14 building at Fairfield - on board to study the working of the ship
Lieutenant Singer, second in command
Engineer Lieutenant Lane, engineer to K13
Lieutenant (E) L. C. Rideal, engineer to K14
Boson H. Pratt, gunner
Petty Officer Moth, coxswain.
48 other naval ratings

55 Naval Officers and Ratings in all.

F.C. Cocks , RCNC Admiralty Representative
F.W. Searle, Admiralty Overseer.
Fred Hole, Assistant to Admiralty Overseer.
Donald Renfrew, of Kelvin, Bottomley & Baird
Sydney R. Black, of Kelvin, Bottomley & Baird
William Wallace, Director, Brown Bros, & Co.
E. Hepworth, Admiralty Boiler Overseer.
W. U. Hancock, Admiralty Electrical Overseer.
Edward Powney, Chadburn's Representative.
Robert Lake, Brotherhood's representative.
Joseph Duncan, Pilot

11 Admiralty and Sub-Contractor's men in all

Fairfield Engine Department:-
John Steel, Foreman
William Lewis. Leading Hand
William Strachan, Leading Hand
William Kirk, Leading Hand
Donald Hood, Leading Hand

6 in all.

Fairfield Shipyard Department:-
William McLean, Manager of Submarine Department.
E. J. Skinner, Manager of Electrical Department.
Frank Neate, his Assistant.
William Struthers. Assistant Manager on K13
Frank Bullen, Assistant Manager on K13
John Green, Head Foreman mechanic
Percy Hillhouse, Naval Architect

8 in all

On board at time of diving were thus:-
55 Naval Officers and ratings
11 Admiralty and Sub-Contractor's men
14 Fairfield Officials, standing by only, the ship being worked entirely by her own crew

80 Persons in total.

The day was fine and balmy, there was no wind, and the tide was high. The vessel lay near the shore, a short distance from Shandon Hydropathic, and as she began to trim for her dive, with all the crew at 'diving stations', the "Comet" was proceeding towards Shandon Pier.

The hatches were all closed and so reported and the illuminated signal "*Engine Room Closed*" signified that hatches, funnels and ventilators had been closed down, was seen to be so set by those in the Control Room.

Captain Herbert, after a last look round, closed down the conning tower hatch and ordered half speed ahead on both motors. When a suitable position had been reached, opposite Shandon Hydro, he gave the order to submerge, the hydroplanes were set to diving angles and the vessel gradually sank below the surface.

Almost immediately, we in the control room became aware that something was wrong as the depth gauges showed that the vessel was sinking much more rapidly than was intended. Our ears became oppressed and deafened, showing that the air was becoming compressed.

Orders were at once given to blow all tanks and come to the surface. In spite of this the vessel continued to sink rapidly.

Things now began to happen in quick succession.

Orders were given to close all watertight doors and to let go drop keels, this being the first thing that made us realise that the matter was a very serious one.

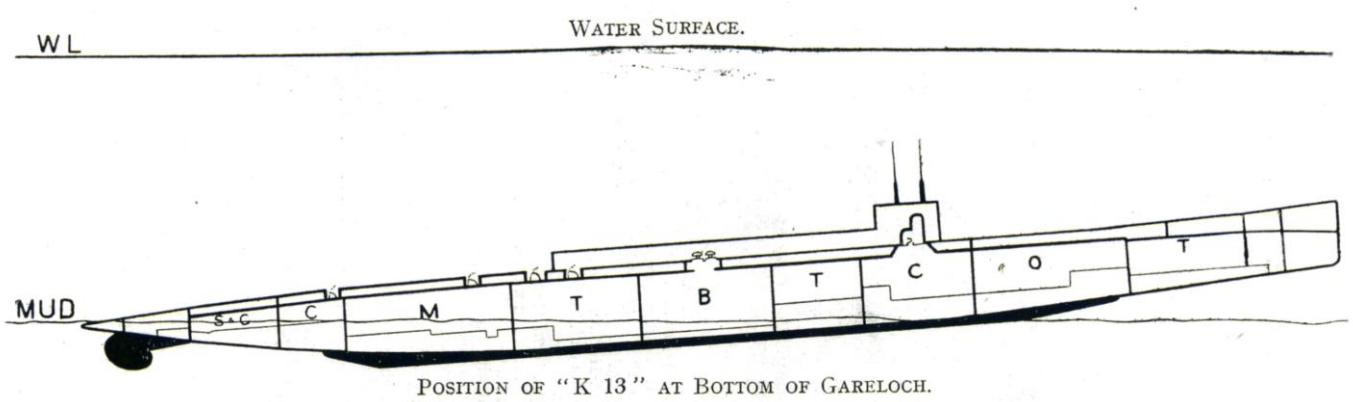
Mr. Hepworth was in the boiler room passage when submergence began, and through the bulls eye in the side of the passage saw water pouring into the boiler room. He rushed first to the engine room and then back through the passage towards the control room to report this, and was one of the last men to get through the watertight door between the passage and the amidships torpedo room.

Mr. Struthers was actually the last man to pass through before the door was shut; in fact the closing of the door was delayed a few seconds to give him passage. Two men were shut off in the amidships Torpedo Room.

Three voice pipes led from the control room to the after portions of the ship and the valves on these were closed as quickly as possible, but before this could be done a jet of water came through one of the pipes and discharging on to the switchboard caused short circuiting, bursting of fuses and ignition of cables. The control room became filled with white choking smoke. A sack was hurriedly pushed into the voice pipe to stop the rush of water until the valve was closed.

Meantime, the depth gauges showed in quick succession 20 feet, 30 feet, 40 feet, 50 feet and finally 55 feet, when the vessel came gently to rest on the bottom with a slight list to port and an inclination of about 4^{o} up by the bow.

DIAGRAM 1



POSITION OF "K 13" AT BOTTOM OF GARELOCH.

The pungent smoke from the burning cables was rapidly filling the control room irritating eyes and throat; we were all half deaf owing to the high air pressure and it was with difficulty that orders could be heard.

The burning cables were at the back of the switchboard and any attempt to smother the flames by means of wet sacks applied by hand were frustrated by the electric shocks received from the highly charged switchboard. A chart table drawer was hurriedly smashed and some time was spent extinguishing fires by poking wet sacking on to the burning cables by means of splinters of the drawer bottom.

Stock could now be taken of our position.

Repeated telephone calls to the engine room met with no response and we feared the worst for our comrades in that portion of the ship.

A considerable quantity of compressed air was expended in blowing water from the forward tanks, but no effect was produced on the air bubble indication of trim, and as our reserve of compressed air, already largely used up by the earlier dive, was running low, these efforts were stopped.

Luckily our batteries were fully charged and we were able to use "juice" freely for lighting, pumping and air compressing.

The compressors were run for a short time to reduce the pressure in the hull and to relieve our ears. This, no doubt, threw additional strain upon the after bulkhead of the space free of water, but it successfully bore the extra load.

We were unable to blow any water or oil out of the after tanks as the valves controlling these were all in the engine room out of our reach. Nor could the after drop keel be released, though the forward weight was free.

Our position appeared to be desperate, and I do not think there were any on board who had more than the very faintest hope of ever seeing blue sky again.

Mr. Hepworth came to me and said "This looks like the end," and I could only answer, "I am afraid it is."

Quartermaster Moth, who had been through the Dardanelles in an 'E' boat to the Sea of Marmora, said he wouldn't have minded losing his life in a fair fight with the enemy, but considered this a "rotten" way to die.

There was absolutely no panic at any time, only serious faces and subdued conversation.

We discussed our chances at great length.

We had submerged at 3 o'clock and we considered that those on the surface would not become seriously alarmed till about 3. 30, and that darkness would set in about four o'clock. No contact with our friends outside could be expected until daybreak on Tuesday morning, and so we set

ourselves to await the passing of some 17 or 18 hours, if we could hold out so long, and nothing else of a serious nature occurred.

As it happened, the Captain of "E50" which was also in the Gareloch on diving trials, had been watching our dive, and "did not like the look of it." He dropped a buoy to mark the spot and came over to meet "Comet" which was now returning to stand by and discussed the matter with Mr. Cleghorn, who had also become alarmed on account of the large quantity of air which had come up. Mr. Cleghorn immediately proceeded ashore to communicate by telephone with Fairfield, and at once things were set going.

Luckily it had been nearly high water when we sank so that we had not to go far from the shore to obtain sufficient depth for diving. The fact that we sank at once was also in our favour, as we had not had time to run into deeper water. Pilot Duncan expressed his opinion that we lay upon clean hard gravel. The weather was calm and the loch smooth and sheltered. We were near to the greatest shipbuilding and engineering centre in the world, and we knew that all resources of the Clyde would be exerted towards our rescue. Though short of compressed air, we had plenty of electrical current and lighting was reduced to a minimum to husband this as much as possible.

On Monday evening, the Chairman of the Fairfield Company (Sir Alexander Gracie, KBE MVO) had been called by telephone, both from the yard and by Captain Morris, Glasgow Harbourmaster, and informed, "something" was wrong with "K13" but from neither source could he learn exactly what that something was. He at once communicated with Captain Bartelott (Captain Superintendent Clyde) who, however, had as yet heard nothing. He then got into touch with Shandon Hydropathic and learned from the Fairfield Directors there that the matter was a very serious one, so serious indeed that his presence was urgently required. The yard car was sent for and Captain Bartelott informed of what was being done. Unfortunately, Macdonald the firm's driver, was not at his home and had to be hunted up, so that it was about eleven o'clock before Sir Alexander and Captain Corbett, assistant to Captain Bartelott, were able to get away, and midnight when Shandon, 27 miles away was reached. Here it was found that the Gunboat "Gossamer" and the Submarine "E50" were standing by the scene of the accident and that the crew of the "Gossamer" were grappling for the sunken vessel. It was a clear calm night and K13 was located by the grappling party about 2am. The Gunboat had a diving suit, but no one who could use it, and so Macdonald was dispatched back to Fairfield for the firm's diver, a telephone message being previously sent so that he might have time to get ready. About four o'clock the diver arrived, not the firm's chief, but a strong young understudy. He had, however, barely commenced his descent than the suit, which had not been in use for several years, burst, and it was only with considerable difficulty that the diver was rescued from drowning. The car was thereupon dispatched upon its third trip to bring the Fairfield diving suit, and in this contact with the sunken vessel was finally obtained.

During the rescue operations, the firm's car traversed the distance between Shandon and Fairfield no fewer than 14 times, and covered altogether about 400 miles.

Shortly after settling down we began to open the watertight doors again to obtain more room and more air. The watertight door leading to the amidships torpedo room was cautiously opened, releasing the two men who had been shut in. The compartment was found to be practically free of water, though its after bulkhead, constructed to withstand a pressure of 15lbs. per square inch and now enduring nearly25lbs. was leaking freely and a considerable quantity of water was coming through the voice pipe, and the glands for cables, telegraph shafting etc. Forward, we met an unlooked for difficulty. One of the clips on the far away side of the door forward of the officers quarters had accidentally fallen down when the door was shut, and as there was no one beyond the door, the clip could not be lifted and held the door closed. The clip, naturally, was not tight, and the door could be pushed slightly away from its seating, but not enough to enable a hand to be laid on the offending fastener. For about two hours Messrs. McLean, Struthers, Green and Bullen worked on the puzzle, and at last, after stripping all the rubber packing off to allow a little

more play on the hinge side, the clip was raised by a bent wire. The accomplishment of this successful piece of burglary was greeted by a ringing cheer.

Meantime water was gaining at about 2 feet per hour in the amidships torpedo compartment, and at intervals the electric bilge pump had to be run for short periods to eject this.

Those in the forward portion of the ship were:-

Captains Herbert and Goodhart.

Lieutenants Singer and Rideal.

Messrs. Searle, Cocks, Renfrew, Black, Wallace, Hepworth, Hancock, Duncan, Hood, Maclean, Skinner, Struthers, Bullen, Green, Kerr, Hillhouse, Lake, Powney, and 26 Naval Ratings.

For these 48 persons the available air space was about 12,000 cubic feet, giving about 250 cubic feet of air per person.

Air contains about 20% of Oxygen and if this is reduced to 16%, human life is extinguished. Each of us had, therefore, an allowance of Oxygen equal to 4% of our air ration or 10 cubic feet of Oxygen per head.

Now, a human being at rest consumes about 2/3 of a cubic foot of Oxygen per hour, and at this rate we should have been able to live for 10 ÷2/3 = 15 hours. If we had to work, the rate of consumption of Oxygen would be very much greater, hard work involving a consumption 9 times as great, or 6 cubic feet per hour. Most of us had nothing to do, and I assume that we were using Oxygen at an average rate of 1 ¼ cubic feet per man per hour. At this rate, unless the air could be renewed our allowance of Oxygen would last only 8 hours.

We actually carried on for about 42 hours on what air we had. This we were able to do by drawing upon our compressed air supply, and at intervals Mr. McLean allowed a small quantity to escape into the torpedo room and at the same time forced some of the vitiated air back into other bottles by means of the air compressor. On Tuesday the air was so bad that a match when struck produced only a slight smoke but no flame.

As the Oxygen was used, its place was taken by the carbon dioxide exhaled. 1% of CO_2 is distinctly smellable. and produces dyspnoea (which is what medical men call panting); at 3% the panting becomes painful, and at 5% all exertion becomes impossible.

As the air in our submerged prison became more and more impregnated with carbonic acid, so did our breathing become more and more difficult, and we had to inhale and exhale with painful rapidity. For some the process was carried on only under great pain and difficulty. Many found standing the easiest posture, while our good pilot, Captain Duncan, during almost the whole course of our imprisonment, walked to and fro in the control room as though still in command on the bridge of a surface craft. The great majority, however, were rendered more or less inert and apathetic, and lay down anywhere and everywhere, half asleep, half awake and breathing stertorously. There were a few berths, and each of these usually had two or three occupants, the armchair was in great demand, while a few cautious souls soon discovered that when on the deck under the officer's dining table they were less often trodden upon than in places more exposed to traffic.

And so the long night passed away.

When day broke about 8 o'clock on Tuesday morning, we could see a greenish light through the periscope. Some specks on the glass gave the illusion of a light green sunlit sea with a man rowing in a small boat, and it was only the immobility and constancy of the picture that assured us of its unreality. Through the bulls eyes in the sides of the conning tower we could distinctly see the wire guard rail which ran around the topsides.

At the time of the accident the hydraulic system, which worked the periscopes and the wireless masts, was running on the after pump in the engine room. This was disconnected, someone kindly advancing half-a-crown to be used as a blank flange, and changed over to the forward pump. (I understand that the lender, being a Scotsman, ultimately got his money back, upon the plea that he wanted to keep it as a souvenir).

We raised the masts to indicate our position, but afterwards learned that they had not broken surface, though the top of the foremast was bent well over, due to its having fouled one of the salvage vessels.

We were eagerly expecting some sign that our position had been located.

About 8 o'clock, we heard heavy footsteps and tappings on the outside of the hull. But so drugged were we by the bad air that we had become almost indifferent, and the knowledge that help was at hand roused no enthusiasm, not even a cheer. We tapped back again and tried to establish communication by means of the Morse Code. But for some reason this did not go very well and no messages were conveyed beyond knowledge to us that we had been found, and news to the surface that someone within the vessel was still alive.

The diver departed, and we had another long spell of waiting, with occasional starting of the pump to clear water from the amidships torpedo room. This was necessary both to reduce the weight in the boat and to prevent the water from ultimately reaching the batteries under the control room.

And now our two brave Commanders, Herbert and Goodhart, who had been earnestly conferring with each other over our desperate situation, made up their minds that one of them should endeavour to reach the surface by way of the conning tower, and as the Captain of a ship is supposed in all cases of abandonment to be the last to leave, Commander Goodhart undertook to make an attempt.

The conning tower was a heavy brass casting, elliptical in horizontal section, 5 feet 6 inches long by 3 feet 6 inches wide and 4 feet 6 inches high. It was reached from the interior of the vessel by way of a hatch having a watertight hinging cover opening upwards into the tower. The after portion of the roof was occupied by the exit hatch with a balanced watertight cover opening upwards into the chart room. The forward portion rose to a further height of 3 feet 6 inches in the form of a dome 2 feet 6 inches by 2 feet, designed to carry the projector compass at a sufficient distance from the steelwork of the main hull.

Each hatch could be opened and closed only from its underside.

On either side was a glass bulls eye, fitted with prisms which enabled an observer to see ahead, as well as on the beam.

There were fittings of many descriptions in the tower, but those of direct importance to the Captain's plan were as follows:-

An electric lamp, suspended from the top of the dome

A fuel vent pipe one inch in diameter, leading from below and out through the after side of the tower, with a valve on the inside

The projector compass tube leading down to the control room and fitted with a valve inside the main hull

An HP air pipe leading up to the whistle and fitted with valves inside the main hull and within the conning tower.

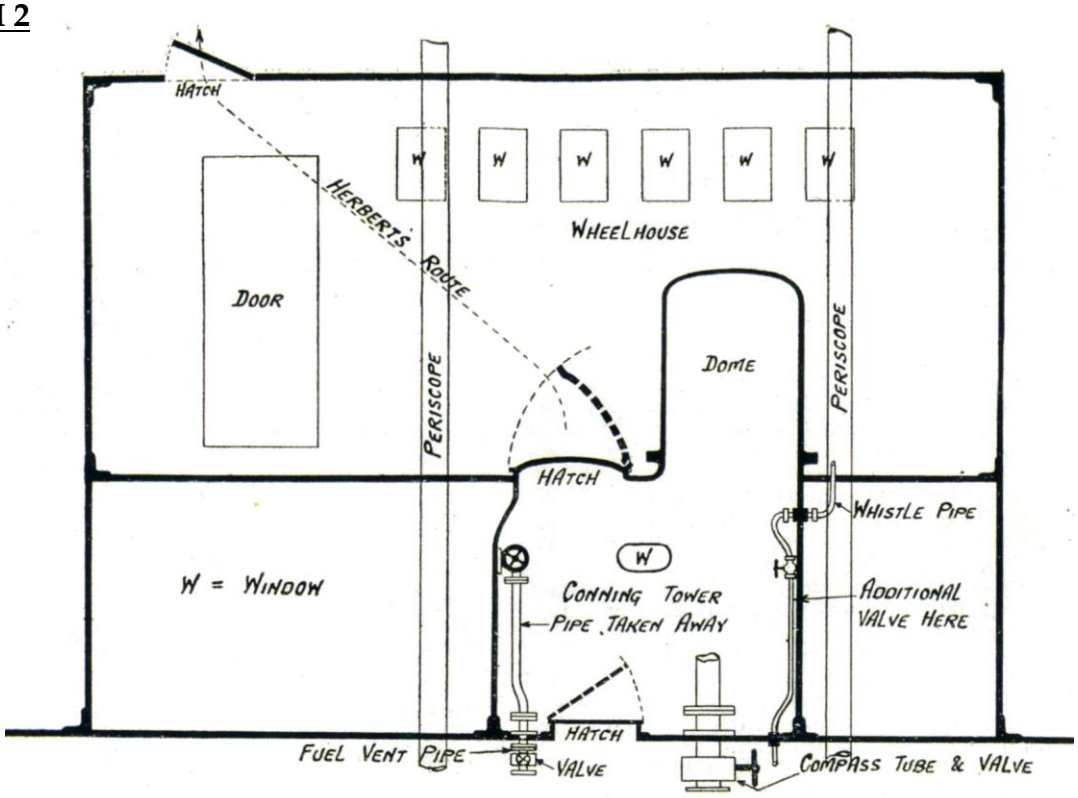
In preperation for the proposed escape, the vent pipe was removed below the valve, so that by opening the latter, sea water could be admitted to the conning tower.

The projector compass and its tube were removed so as to leave more room in the tower and dome, and so that the lower portion of the pipe within the control room could be used as a drain pipe to carry away water from the conning tower. A flexible hose was attached to the lower end of the pipe and led into the amidships torpedo room.

The whistle pipe was broken at a joint and a valve taken from an inboard portion was fitted on the upper end of the pipe leading from the HP air system. By this arrangement compressed air

could be admitted to the conning tower by opening both the valves described - the new valve specially fitted within the tower and the original valve in the control room. The air could be shut off by either valve.

DIAGRAM 2



One of Captain Herbert's most vivid recollections is that of the prawn who lodged himself against one of the bulls eyes while the above preparations were in progress. Captain Herbert writes:- "I can see him still with his little black eyes pressed against the glass; he must have been attracted by the light."

The Commanders' intentions were that both should enter the tower and close the lower hatch, which would be clipped from below. They would then unclip the upper hatch, open the sea valve and gradually flood the conning tower, squeezing up the air in it until its pressure became equal to that due to the head of sea water upon the upper hatch. This, being balanced, could then be easily opened, the two occupants of the tower standing with their heads in the dome, from which the air could not escape. The water in the conning tower at this time would be about three feet deep, but as soon as the hatch was raised, the air above this level and below the dome would of course, escape and be replaced by an inrush of sea water.

HP air was then to be turned on and, aided by its outflow, Commander Goodhart was to pass through the upper hatch and endeavour to find his way through the chart room door and swim to the surface.

As soon as he was gone, Herbert was to shut off the air supply, close and clip the outer door and knock loudly on the inner hull with an iron rod placed within reach for that purpose.

This was to be the signal for those within board to open the drain valve and as soon as this was done Herbert could let a small amount of compressed air in to the tower to take the place of the outflowing water and even accelerate its going.

Those within board were to watch the water flowing from the drain pipe, and when it ceased to flow unclip and open the lower hatch and receive Herbert, who would meantime have closed the air valve, back into the vessel.

While these preparations were going forward, a small tin cylinder, which I had brought with me to hold a hydrometer, was prepared to carry a message to the surface in case Commander Goodhart himself failed in his attempt. The cylinder was decked out in red bunting and Goodhart was to carry it in his hand and release it as soon as he could, clear of the wheelhouse. It was

hoped that it would float up to the surface, be seen, and carry a definite description of our condition and instructions as to our needs to our would-be rescuers.Many of the prisoners took advantage of this opportunity to write fairwell messages to their ain folk, and these were all given harbour in the cylinder. A list of the then survivors was also enclosed.

It was a weel-laid scheme, but, like many such, it went agley.

The two heroic Commanders divested themselves of most of their clothing, entered the conning tower and closed the lower door.

Inboard we clipped the door, opened the air valve and waited. Presently we heard a rumbling, gurgling sound by which we knew that the outer hatch had been opened and air admitted.

For what appeared to be a very long time, we anxiously waited for the noise of the air to be replaced by the pre-arranged thumping on our roof, our signal to open the drain valve. But gurgling continued and no signal came.

Reluctantly, and hoping almost against hope that Herbert, as well as Goodhart, had escaped, we closed the air valve.

We afterwards learned that the two Commanders had opened the sea cock and had stood till the ice-cold water had reached their middles. Their ears were drumming and deafened by the high pressure of the air, a thick fog filled the upper space and rendered the electric light useless. Then the door was lifted, air turned on, Goodhart said, "Well, I'm off," and with Herbert's "Good Luck" in his ears, dipped under the water level in the tower and passed up through the hatch.

Herbert stepped forward to close the hatch, but the rush of the expanding air was so great that in spite of himself he was forced upwards through the opening and into the wheelhouse, and then by pure good luck, was carried by the escaping air aft and upthrough the hatch in the after-end of the wheelhouse roof. He partly swam, and was partly carried by the ascending air, to the surface, breathing most of the time and brushing aside the "wireless" wires as he passed.

He came up close to the diver's boat, and the diver, who was standing with helmet off on his ladder, grabbed him and helped him onboard.

Herberts first words were, "Where's Goodhart?" and we can imagine his horror when he was told that he had not appeared.

Nor had the tin cylinder reached the surface, and long afterwards, the brave Commander, who truly gave his life for all of us, was found in the forward part of the wheelhouse. It is supposed that he was shot violently upwards by the rush of air and was stunned by contact with the wheelhouse roof.

Of all this, of course, we knew nothing at the time, though we speculated much and settled down again to another period of waiting, broken only by periodical startings of the bilge pump and HP air compressor.

Herberts arrival on the surface was a godsend to us all, however, as he was able to give the rescue party definite details as to our condition and to advise as to the best means of assistance. For over an hour he declined to dress or attend to his own needs in any way until he had set things going properly for our succour.

Often I have been told. "It must have been a terrible time for you" and as often I have replied, "Yes, but not so bad for us as for those on the surface upon whom rested the responsibility of getting us out." The news had spread like wildfire over Glasgow and the surrounding districts, and though no word appeared in the press, was the one subject of conversation.

Our rescuers, with all the will and all the resourses of the Clyde at their disposal, were terribly handicapped by want of exact knowledge of our circumstances.

How many were alive?
Were we helpless or able to assist?
In what part of the ship were we?
What had gone wrong?
What portions of K13 were flooded?

Had salt water reached the batteries?
Had we light?
At what angle did we lie?

A hundred such questions were asked, but until the diver reached us on Tuesday morning no answers could be hoped for. All that was known was that K13 had gone down and had not come up again, and that she was probably not at the bottom of the Gareloch from choice!

Meantime something must be done. The directors and staff at Fairfield had little sleep that night; the Captain Superintendent and his staff were hard at work; the wires were kept busy, and when morning dawned divers and craft of all kinds were on the scene, and Captain Young, giant among salvors, and his famous salvage vessel "Ranger" were en route from Holyhead.

From the commencement of the war, Captain (now Commodore Young RNR) was appointed HM Naval Salvage Advisor, and severed his connection with Liverpool for the duration of the war.

The Salvage ship "Ranger" was demised to the Crown, and became one of the HM Salvage ships.

It so happened that HM Salvage ship "Thrush" was at Greenock at the time of the accident, having just completed the salvage of the "Mavisbrook" at Loch Maddie, and this vessel proceeded at 6am the following morning for the scene of the accident, together with a number of other vessels, including two Clude hopper barges and a trawler - the operations being then in charge of Admiralty Salvage Officer Kay RNR, until relieved by Captain Young, who arrived shortly after Commander Herbert came to the surface.

Wire ropes were placed under the bows of the submarine and attached to the two Clyde hoppers, and also from the Salvage vessel "Thrush" to the trawler on the opposire side.

Many schemes were projected and discussed. The first object was to save life, and thereafter to salvage the vessel herself. If, as appeared probable, the submarine was too heavy to be lifted by main force so as to bring her crew to the surface with herself, then the crew must be brought up without the ship. A rescue tube was suggested and the necessary instructions reached Fairfield just after stopping time on Tueasday evening, when staffs and workers were homeward bound. Hasty recalls were issued, and in a short time Mr. Hendin, Chief Draughtsman at Fairfield, and his drawing office staff were at work. At 8pm on Tuesday night they had issued to the yard working drawings for a steel tube 27 inches in diameter and 60 feet in length, with a box at one end arranged to be fitted over the outer hull in way of the 'midship torpedo hatch and caulked watertight. This was to be fixed in place by divers and guyed to the hull. A discharge pipe was attached to its lower end and carried up to the surface on the outside. The top was to be temporarily closed by a bolted plate, and the water in the tube blown up the discharge pipe. (See Diagram 4)

The cover could then be removed so that someone - and preferably someone small - could be lowered and get us to open the torpedo hatch, when one by one we could be hoisted to freedom.

But it was not known if we were even able to open the hatch, much less lift it, and so it was thought that it might become necessary to cut a hole in the cover, This would have to be done by means of the oxy-acetylene flame and would be by no means a pleasant, but in every way a risky, job.

Our foreman caulker went to the man who he hoped would take the hazard and said to him casually, "Someone will be wanted to go down that tube and cut a hole in the hatch; who do you think would be the likeliest man for the job?"

"What's that you say?"

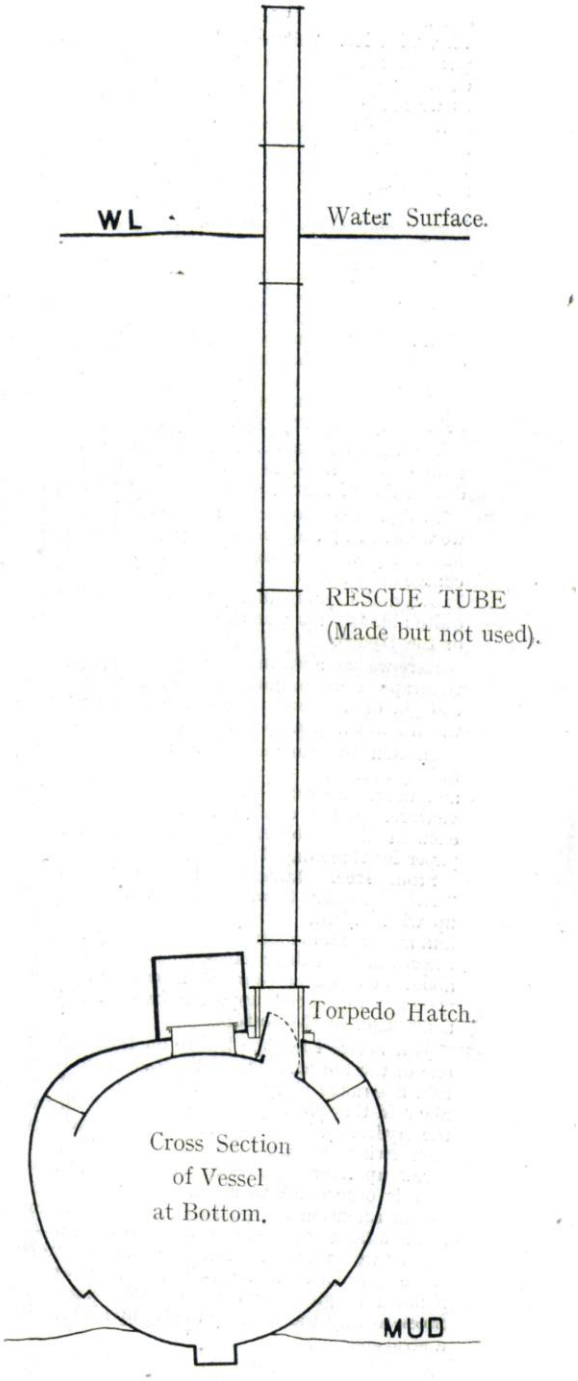
"I'm saying do you know any man likely to be game to go down the tube with a flame and cut a hole in the torpedo hatch?"

And the aswer came, "I'll do it; but you've an awful funny way of asking."

All night the ironworkers and carpenters wrought at the tube, box, and pipe; never perhaps had men worked so eagerly and so strenuously, and by eleven o'clock on Wednesday morning the whole was complete, and by two o'clock it was at Shandon.

The tube was never used, but none the less it was a noble effort and might have been of vital importance.

DIAGRAM 3



On Tuesday morning, it was arranged that Mr. John Lipton, of the Fairfield drawing office staff, who was in charge of the piping arrangements of the submerged vessel, and therefore conversant with the various air and other connections on the outside of the submarine, should go to the Gareloch. He rapidly collected the relevant plans and motored to Shandon where he was met by rescue party. Mr. Lipton had an idea which turned out to be an exceedingly valuable one and which, without doubt, proved to be the main factor in the final success of the rescue operation. His proposal was that an armoured hose should be fitted to the existing high pressure air connection forward and another to the forward ammunition hand-up. His reason for selecting these positions was that both openings were protected by valves or watertight covers, both outside and inside, and it was decided that Mr. Lipton should hasten back to the yard to obtain the necessary adaptors and hoses. The cover for the hand-up was taken from K14, the sister vessel, building at Fairfield, hose fittings and adaptors made by the engine department and the HP air hose supplied by E50. A diving bell was also sent from Fairfield, but was not used.

To illustrate the wide-spread interest taken in the operation at Shandon, and the eager desire of all who could possibly do so to render assistance, I may mention that on Tuesday afternoon, Mr. James Brown, Managing Director of Messrs. Scotts' Shipbuilding and Engineering Co. Lt., Greenock, thinking that it was possible that all who had exact knowledge of the details of K13 might be imprisoned within her, sent Mr. Hugh Leitch, one of his staff familiar with the K Class, and Mr. West, overseer on K15 then building at Scotts' by tug boat to the scene of the accident.

These two gentlemen took with them a roll of plans and various tools, hoses, and gear, and arrived at Shandon about 6 o'clock. They were informed, however, that everything that was required was already on the spot, and much to their regret they had to return without having been able to render any assistance. Before leaving, they were asked not to move the engines of the tug boats for some time, as messages were being tapped to and from the survivors within the submerged vessel.

About 6 o'clock on Tuesday evening we were made aware by tapping on the hull that an HP connection had been made to our air system. There was a branch from the air system led outboard

for gunnery purposes, and to enable air for recharging the air bottles to be received from the shore or from another vessel, and to this a flexible air pipe had been connected.

We slightly opened one of the joints in the system and cautiously opened the inboard valve. To our disappointment we obtained, not the air we so much needed, but salt water mixed with a few bubbles. We caught this water in buckets and removed bucketful after bucketful, hoping that we would soon come to an end of the water and get to the air. But at last we had to close the valve and try to tap out a message to say what was happening.

Then following another long wait while the diver disconnected and overhauled his air pipe, to find the cause of the trouble in a blank flange where, " nae blank flange sud be"

This was put right; followed by more tapping; another cautious opening of the valve, and this time we were gladdened by a fine hissing rush of pure dry air.

A little of this was allowed to escape into the hull and then the joint was made tight and we proceeded to charge our exhausted air bottles. This was about 4am on Wednesday morning when we had been below for about 37 hours.

About this time the diver hung an electric lamp in front of the eye of the periscope. This Morsed messages to us - if we happened to be looking - but of course we had no means of winking back.

About 5am, as soon as we had charged up several groups of bottles to their full pressure of 2500lbs., we began to blow out all the forward tanks within our control, namely the seven foremost external tanks and the internal tanks forward of the boiler room. As we had no means of knowing when these were emptied we had to guess how long to keep the air on each, but as our supply was now ample we made reasonably sure that each was completely blown before passing to the next.

Anxiously we watched the bubbles of our fore and aft spirit levels for some sign that the bow was lifting, but for a long time nothing happened. Tank after tank was given its quantum of air, but the bubble remained motionless at 4^{o} up by the bow.

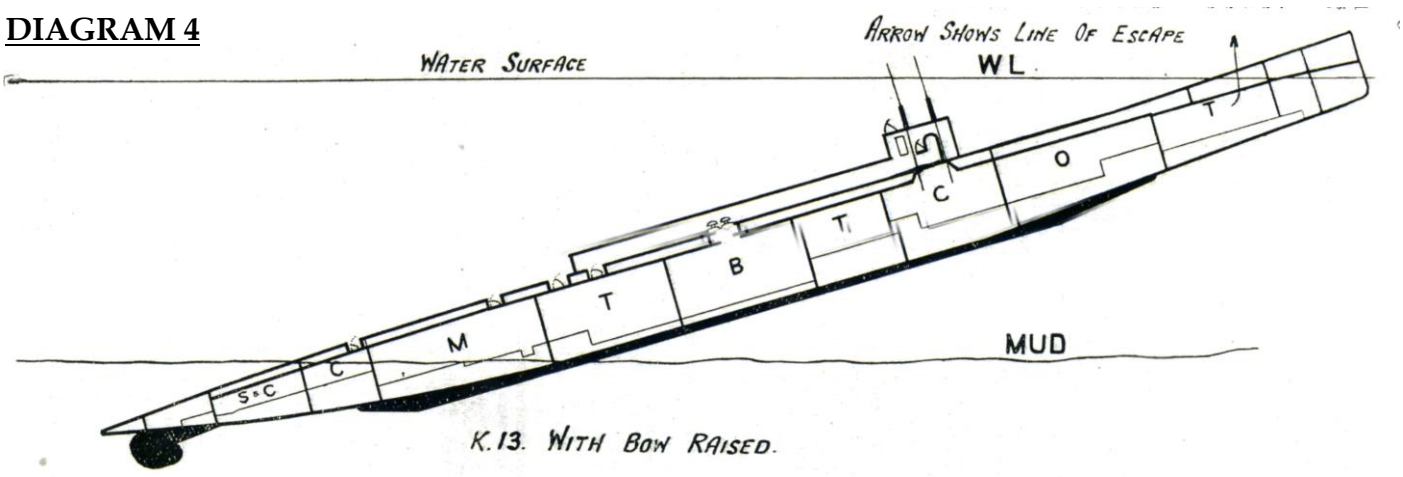
We had almost given up hope when we began to blow into almost the last remaining tank.

And then the bubble moved!

We gave a shout of delight and watched the cheering indicator as it slowly moved to 5^{0}, 6^{0}, 7^{0}, 8^{0}, 9^{0}, 10^{0}, and that was as far as it was made to go, it could indicate no further. Wire cables had been passed under our bows from the salvage vessel, and an attempt made to raise the submarine by this means, but without success; as our fore end lifted these cables were observed to slacken and were at once pulled taut so as to hold what had been gained.

But the vessel continued to rise forward, the decks became steeper and steeper, until at last those on the surface saw our bow rise out of the water and presently signalled to us that we were high enough and had better not blow any more, as the escaping air was endangering the diver.

DIAGRAM 4



K.13. WITH BOW RAISED.

At this time the vessel lay with her stern some 12 feet deep in the mud, and her stem head about 10feet above water, the angle of longitudinal inclination being about 16^{0}. Sixteen degrees

does not sound very much, but I can assure you that a deck inclined at this angle becomes very uncomfortable for pedestrians, especially if it is covered by more or less greasy linoleum. Many unpleasant falls were experienced and the unfortunate who came down usually made a non-stop trip to the end of the compartment, accompanied by as many of his friend as he could conveniently gather into his arms on the way! I remember standing near the forward end of the officer's quarters holding a chain which hung from above when my feet were knocked from beneath me by someone involuntarily going aft in a sitting position, and I was left swinging on the chain.

When the bow was raised we could see clearly through the periscope, which was now above water, and watch the work of rescue, and we were able to recognise those aboard the surface vessels.

The great inclination brought another trouble. The bilge pump was now raised so high above the after end of the torpedo room that it could no longer function. As we were in constant fear of the incoming water rising so high as to enter the control room and reach the batteries, we started to carry it in buckets to one of the forward bilges.

This was a slow and wearisome process, as we had but two buckets - one of which leaked - and the steep and slippery deck made our footing very insecure. We formed a queue, each member of which held himself in place by one hand and passed the bucket along with the other.

This work continued for some time until Mr. McLean and Mr. Bullen hit upon a better plan. They took off the cover to the manhole to the tank under the torpedo room and allowed the bilge water to run into the tank. When the tank was nearly full, the manhole was closed, HP air admitted to the tank, and all the water blown out. The manhole was then re-opened and the process repeated as before.

Incidentally this operation helped to renew our air, as each time the manhole was opened some of the compressed air in the tank expanded in to our living spaces.

By this means the water was kept well under, and it never came near to the batteries, although at one time our rescuers by some misunderstanding were led to believe that we were in imminent danger of chlorination.

Another rumour which gained considerable currency and credence may be here disposed of. It was said that we passed away the long hours by playing cards. I can assure you, and I have no doubt you will readily believe, that no one felt the least desire for such an occupation. There were cards on board, but they were never used. I still have two much-discoloured packs which were taken from the vessel in a very sodden condition, after she was raised. The story probably arose from the fact that after we had got fresh air, food, and liquid, and as we began to nurse a faint hope of ultimate rescue, our spirits revived wonderfully, and in reply to a question from above as to whether we would like anything else to be passed down the tube some joker replied, "Nothing but a pack of cards" It was also rumoured, and by some believed, that the Captain had been shot out of the torpedo tube with such force that he landed in Row!

Meantime, another connection was made to the hull. There was a seven inch ventilator and hand-up which passed though both inner and outer hulls from the officer's quarters. This had a screwed cover on top and a hinged cover below.

The top cover was removed by the diver, a hole cut in it, and a four inch flexible armoured hose securely attached. The cover was then replaced and most of the water sucked out of the pipe by means of a smaller suction hose. Word was then tapped to us to open the hinged cover. This we did very cautiously, and found that after a considerable quantity of water had come down, air began to rush strongly out of our prison, showing that the pressure was still considerably above that of the atmosphere. So strong was the outrush that small quantities of water draining down the sides of the hose, did not enter the ship but were carried back up the hose pipe. The escaping air was so black and foul that our salvors marvelled that anyone could still be alive.

The boiler room bulkhead responded to the reduction of pressure by leaking more rapidly, but luckily did not give way under the additional load caused by the reduction of air pressure on its forward side.

We could now talk freely with those on the surface, and our first enquiry was for Herbert, as our impression was that Goodhart had reached the surface, but that Herbert was still in the conning tower. He replied himself, and great was our joy to hear his cheery voice and his words of encouragement. It was not till much later that we learned that Goodhart had been lost.

The diver had found explanation of the disaster by discovering that the four air inlets to the boiler room were fully open. These should, of course, have been closed before the signal, "Engine room closed" was set in the control room, but by some oversight this had not been done. The accident was thus due to no defect in the design or construction of the vessel, but to a momentary forgetfullness on the part of someone who paid for his error with his life. When the vessel was ultimately examined, the lever controlling the air inlet covers was found to be standing at "open"

The four inch tube, besides making communications as easy as they had previously been difficult, was large enough for the passage of small articles, and presently a small bottle of brandy was seen to be dangling on the end of a string. This was served round sparingly, the dish used being the brass cover of an electric switch. One member of the crew declared that it was the first time he had ever touched spirit. I think that even the most rabid teetotaller would agree that the occasion was ample justification for so tremendous a lapse. Next came milk and chocolate, liquid and solid. No one was anxious to eat; we had onboard at the time of the accident a supply of sandwiches enough to afford about 1 ½ per person; these were passed around about 6 o'clock on Wednesday morning, but very few were eaten. Thirst was our principal trouble, our throats and mouths being parched and dry, doubtless as a result of the foulness of the air and our difficulty in breathing.

At intervals throughout our imprisonment we were alarmed at the sudden burning out of fuses, one of which would flash and spit and jump out of the switchboard every now and again, and the lights it had been serving would go out.

A high pressure air pipe was passed down the four inch flexible hose and as its hissing end entered the hull we all gathered round it and whiffed it over our faces, breathing in lungfuls of invigoration. Never had we so fully appreciated the value of fresh air.

But so soon do we take our ordinary blessings for granted that a little later we all wanted that hissing air pipe removed as far as possible from whatever part of the ship we were in, as its noise was insupportable. "Take that beastly pipe away up forward"; "shove the damned thing aft" - anywhere except where it was.

As the hull became filled of fresh air and the foul air was expelled through the friendly flexible, we all revived wonderfully, and hope began to speak again in a timid manner, though no one voiced his hope as it was felt that at any moment and in any of many forms disaster might come.

All along we had in our minds the possibility that we might have to retreat from the control room if the boiler room bulkhead showed signs of giving way and a good deal of work was done by Mr. Skinner and others in altering electric leads so that we might be independent of the switchboard and of the after battery under the control room. But the bulkhead held and these arrangements did not have to be put into operation. While connecting a wandering lead to the starter of the air compressor one of the men accidentally made a short circuit which blew the main fuse and suddenly plunged the whole interior in to darkness. The last six hours or thereabouts of our imprisonment were spent in total darkness, relieved only by one wandering lead from the switchboard, two magazine hand lamps and one electric torch.

Meantime, the problem of getting us out was exercising the minds of those on the surface. It was thought that we might possibly utilise one of the bow tubes as an exit, but when we cautiously eased the inner cover we found that the tube was fully flooded and so had to screw the cover tight again.

It was then decided to pump away the water lying between the main hull and the superstructure forward, to cut a hole in the forecastle deck and another directly below it in the main hull. We were told that the water would be removed in about 20 minutes and that the holes would then be cut by the oxy-acetylene flame in a few minutes more. We were to gather forward and prepare the way from below. At first the spot selected was above the forward ballast tank, and we spent a long time in removing the nuts from the tightly screwed manhole cover on the tank bulkhead. But it was presently decided that this would make a difficult passage as each man would have to wriggle through the manhole and would then have to stand on nothing at all while getting through the hole in the main hull. Finally, a space just aft of the tank bulkhead was chosen. The hull was more deeply immersed at this point, but the route from below was much easier. We tore away all the wood lining at this place and then clustered in a bunch on top of the torpedo tubes, eagerly awaiting the cutting of the hole through which our safety lay.

But the minutes crawled along and still no news came that the cutting had commenced. The promised 20 minutes had become an hour.

"When are going to start cutting?" we called up the voice pipe.

"In about a quarter of an hour," came the cheering reply. "We are pumping hard and there's not much water left."

The quarter dragged slowly along.

"Have you started cutting yet?"

"No, not yet, but we will be ready in a few minutes more; there's only about six inches of water left and we've sent for a larger pump."

Never had minutes seemed so long. We sat in total darkness, talked in low tones, and passing the hissing air pipe along to those of our friends who were furthest away, each one secretly confident now of seeing sky again, but afraid to count his chicken before it was hatched.

I cannot remember how often I traversed the slope between the group forward and the voice pipe to put the query, "When are going to begin cutting?" nor how often I carried back the "Quarter-of-an-hour" reply.

And then someone had a brain wave and asked me, "Have you closed the flap valves?" I should explain that as the superstructure was of light construction it was pierced by four square openings just above its attachment to the main hull, so that it would readily flood and drain when the vessel submerged and emerged. To prevent these holes admitting unwelcome water when in the surface-steaming condition, flap valves were fitted and geared to hand wheels within the vessel. These had been opened for the diving trials, but had been closed by one of the crew before pumping began. I passed the query forward, however, and Mr. McLean, on proceeding to tighten the hand wheels with a wheel spanner found that one wheel went round easily. The valve had been left partly open. The result was, of course, that as fast as the hand-pump removed water from the interspace the Gareloch flowed in through the flooding hole to take its place. In fact the valiant pumpers were busily passing portions of the Gareloch out of the interspace, over the side and back again into the place where it came from. They had just decided that, "There must be a devil of a lot of water in there" when the momentous question about the condition of the flap valve was put by Captain Herbert.

He had suspected that the flaps were leaking but had never dreamed that they could be open. He had actually in preparation a plaster of some kind to be applied to the outside of the holes to assist the flaps when he more or less casually asked his question.

The water level now responded quickly to renewed efforts at the pumps and in a few minutes the inner hull lay bare to the rescue party. The oxy-acetylene flame was set to work and soon the anxious watchers below saw its point burst through the roof of their prison. Its ghostly blue light played weirdly over the eager faces of the prisoners. A hole about 18 inches square was quickly cut, Lieut. Singer gave the order "Civilians first" and amid resounding cheers from the men crowding the decks of the rescue vessel we began to appear one by one out of the depths and on to the deck of K13. 48 men came out, each one being greeted by a tremendous ovation which we

could hear away back in the control room, and the last man was cheered as vociferously as the first. The last man to come out was, as it should have been, Lieutenant Singer, who, with Mr. Wallace and myself, had gradually passed forward from compartment to compartment, carefully closing the watertight doors behind us as we made our way forward. It was with very strange feelings that we glanced for the last time into the control room, the scene of so much tragedy, withdrew the wandering leads from the switchboard, and closed the door. Another wandering lead, passed from above through the escape opening, gave us light to enable us to finish up below.

It was a weird scene which met my eyes as I emerged from the superstructure. It was about 10pm on Wednesday night - 55 hours after our dive - the moon was full and amid a bunch of vessels of all kinds illuminated by cluster lamps and crowded with staring faces rose the snout of K13 set at an absurd angle, with a black square hole on its surface from which the last survivor was being helped to freedom and life.

We were carefully assisted onboard attendant motor boats, raced ashore and escorted through a double line of watchers to Shandon Hydropathic.

I think the crowds were a little disappointed that we were so fit; they would have dearly liked to have had the pleasure of carrying us up. I was taken charge of by two good folk, whose names I will never know, and in spite of my protestations that I was quite able to walk was carefully guided to the door of the Hydro.

Here we had a warm welcome; the telephone and telegraph were in great demand, since the first thought of each was to send the good news home; warm baths and supper were ready for all.

Captain Duncan amused us all by settling down quietly in front of the fire, immersed in a newspaper, and taking no share in the discussions of our adventure. When chaffed about his calmness, he excused himself by saying he hadn't seen a paper for three days!

Stout steel hawsers had been passed under K13 to help to raise her bow and to hold her up when raised. As water slowly leaked into her hull and was no longer kept in check by the pumps, the strain upon these hawsers became so great that about 6 o'clock on Thursday afternoon the bollards were torn out of the supporting barge and K13 again sank to the bottom.

Just before I left the Hydro on Friday afternoon, one of the housemaids, Annie MacIntyre by name, told a strange story to Mr. Cleghorn and myself. She said that she had been on the shore in front of the Hydro on Monday afternoon and had seen two men swimming who shouted "Oh!" and then threw up their hands and disappeared. She told of this occurrence to several people but no particular attention was paid to her story; it appears to have been assumed that she had been mistaken. But as we had learned that the diver had reported the engine hatch to be unfastened, we were more inclined to give her credence. We guessed that Steele at least was unlikely to give up his life without a struggle.

The salvage party closed up all openings in the inner hull and fitted to each compartment two pipes - an air supply pipe led from the surface and just through the crown and a water discharge pipe led from the surface, passed through the top of each space and pushed downwards as near to the bottom as possible. The water was thus gradually driven out of the vessel and about six weeks later she bobbed up as suddenly and as unexpectedly as she had gone down.

Upon examination of the vessel startling confirmation was given to the housemaid's story. Two men were missing - John Steele, our foreman engineer and Engineer Lieutenant Lane, engineer of K13. These two courageous men had evidently opened the engine hatch, the pressure on each side of which would of course be equal, and had managed to reach the surface, only to be overcome by the sudden reduction of pressure and to become unconscious and sink again into the Gareloch. Lane's body was found about two months' later, poor Steele still lies in his watery grave.

K13 returned to Fairfield to be completely gutted out and renewed and was before very long again passed as "fit for service."

In conclusion, I desire to give expression to my admiration for the untiring services rendered within K13 by Messrs McLean, Skinner, Bullen, Struthers, Green and Searle, who were

indefatigable in doing all that had to be done, and who knew every pipe and valve and switch in the vessel; to the lively gratitude of all the survivors to the two brave Commanders who met such great risk on our behalf, and to all those of Admiralty, Salvage, Hydro, and Fairfield who worked so hard towards our rescue and recovery.

In April, the following letter was received by the Fairfield Company:-

Admiralty, S.W.1
22nd April, 1917

Gentlemen,

My Lords Commissioners of the Admiralty have had under their consideration the minutes of proceedings of a Court of Enquiry held on the 19th ident. to investigate the circumstances attending the accident to and subsequent foundering of H M Submarine K13. I am commanded by their Lordships to request that you will convey to Mr. Wm. McLean, Mr. E. J. Skinner, Mr. F. Bullen, an expression of their appreciation of their services on this occasion, which undoubtedly contributed materially towards the saving of the survivors.

I am, Gentlemen,

Your obedient servant;

(Signed) O. MURRAY.

Commander Goodhart received posthumous award of the Albert Medal for gallantry in saving life at sea.
